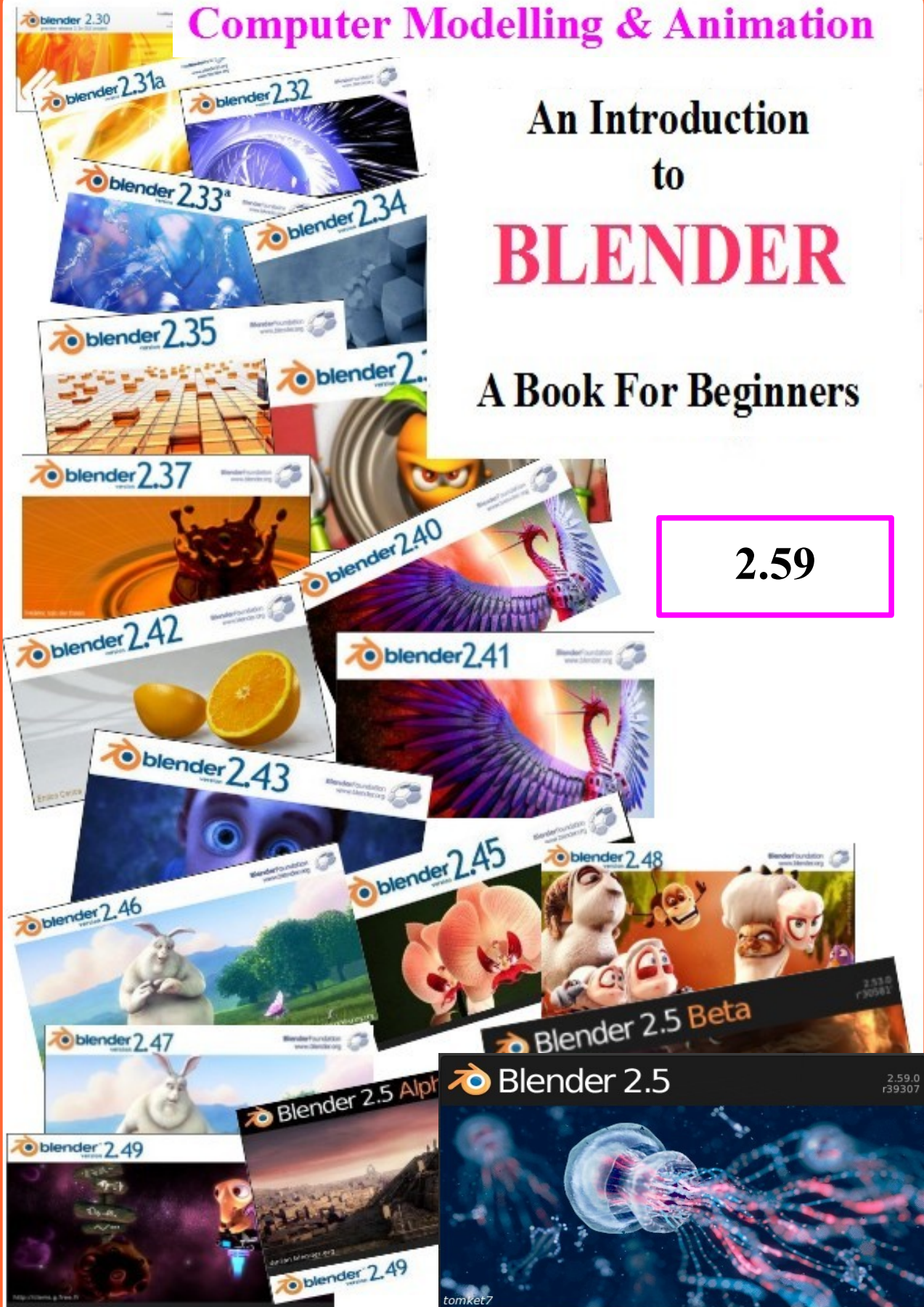# Computer Modelling & Animation

An Introduction to
BLENDER

A Book For Beginners

2.59

Author: John M Blain

Blender

Computer Modeling and Animation

Blender is a open source freeware program maintained by the Blender Foundation. The program can be downloaded, free of charge, from www.blender.org

Blender is not an easy program to learn but it has limitless possibilities and will give you an understanding of computer animation. Due to the complexity of the subject it is not possible to cover everything. This manual is designed for beginners to help with the very basics of computer animation using Blender. The subject matter in this publication is aimed at removing some of the frustration from the learning process. Blender is a wonderful application but one major drawbacks has been the lack of up to date basic instruction. Documentation has always lagged behind development. There is a multitude of free information available on the INTERNET from various sites in the form of tutorials. Much of the information is relevant to earlier versions of the program and since there has been a dramatic change to the interface, with the introduction of version 2.50+, I believes that a new student would find learning Blender difficult without a current written instruction. This manual is an attempt to remove some of the pain and relieve frustration by setting out the basics.

The manual has been written by trial and error in finding the way between Blender 2.49 and Blender 2.50+. I trust you will find the information informative and useful.

This Manual Is Written Using Blender 2.50+

Blender Versions

Blender has been around for a considerable time. On starting the program the Graphical User Interface (GUI) shows a panel with the version number in the center of the screen. On each release this panel has been changed to identify the version. The cover of this manual shows the historical array of version number panels. Blender has developed over time and as that development has evolved new releases (versions) of the program have been made available. The program reached the stage where the developers considered that a complete overhaul of the Graphical User Interface (GUI) was called for. Version 2.49 was the last of the old and at the time of writing version **2.59** is the current version. The GUI of **2.5**+ is completely different to 2.49 and the frustration of learning the new interface without documentation has prompted the writing of this manual.

Graphical User Interface

The Graphical User Interface (GUI) is the arrangement of Windows, Panels and Buttons which allow you, the user, to interact with the program. The interaction takes place through inputs via the computer keyboard and mouse.

In giving instructions in the use of the program with reference to keyboard and mouse actions a series of commands has evolved. The list of commands is extensive and it is not recommended that a new user attempts to memorise the list without understanding of the meaning. As you progress through this manual many of the commands are repeated over and over and you soon find that it becomes second nature. Of course you will forget the obscure commands therefore a listing is provided in the Appendix to this manual.

Omissions and Errors

You are invited to participate in the creation of this document by advising the author of omissions and errors that you discover. Please email your comment to:

silverjb12@gmail.com

Good Luck
and
Enjoy the Experience.

John M Blain

How to Get Blender

Installation instructions

To install Blender, download the appropriate package for your platform to your computer. The Windows version comes with an optional self-extracting installer, for other operating systems you can unpack the compressed file to the location of your choice.

Provided the Blender binary is in the original extracted directory, Blender will run straight out of the box. No system libraries or system preferences are altered.

Blender can be downloaded from www.blender.org

Blender 2.59 (stable)

Blender 2.59 is the third stable 2.5x release from the Blender Foundation. To download it, please selec your platform and location. **Blender is Free & Open Source Software.**

Blender 2.59 was released on Saturday, August 13th 2011

Windows 32 bits

Blender 2.59 Installer (20 MB)

Requires Windows XP/Vista/7, built with Python 3.2

USA | Germany | NL 1 | NL 2

Blender 2.59 Zip Archive (27 MB)

Requires Windows XP/Vista/7, built with Python 3.2

USA | Germany | NL 1 | NL 2

If you have downloaded the 2.5x installer, please don't use the uninstaller, as in some cases you might lose more files than intended (i.e. when using %HOME% for installation, or a directory that already contained other files – these directories get recursively deleted upon uninstall. Safest is to just remove the blender files by hand).

Windows 64 bits

Blender 2.59 Installer (23 MB)

Requires Windows XP/Vista/7 64bit

USA | Germany | NL 1 | NL 2

Blender 2.59 Zip Archive (31 MB)

Requires Windows XP/Vista/7 64bit

USA | Germany | NL 1 | NL 2

If you have downloaded the 2.5x installer, please don't use the uninstaller, as in some cases you might lose more files than intended (i.e. when using %HOME% for installation, or a directory that already contained other files – these directories get recursively deleted upon uninstall. Safest is to just remove the blender files by hand).

Linux x86-32

Blender 2.59 (34 MB)

Requires glibc 2.7, includes Python 3.2,
FFmpeg
Suits most recent Linux distributions

USA | Germany | NL 1 | NL 2

Linux x86-64

Blender 2.59 (35 MB)

Requires glibc 2.7, includes Python 3.2,
FFmpeg
Suits most recent Linux distributions

USA | Germany | NL 1 | NL 2

Mac OS X

Blender 2.59, PowerPC (39 MB)

Requires Mac OS X 10.5+
Suits PowerMac G5, Powerbook G4, iMac
G5

USA | Germany | NL 1| NL 2

Blender 2.59, Intel 32 or 64 bits
(39 MB)

Suits Mac Pro, MacBook, MacBook Pro,
iMac (intel)

Mac OS X 10.5+ 32 bits

USA | Germany | NL 1 | NL 2

Mac OS X 10.5+ 64 bits

USA | Germany | NL 1 | NL 2

FreeBSD

Blender 2.59 i386 (15 MB)

USA | NL

Blender 2.59 amd64 (16 MB)

USA | NL

Note: The above download information is referring to version number 2.59 of the
Blender program. During the course of writing this document the program has been
amended and the current version is 2.59. The Blender download site will reflect the
most current version release and it is expected that the download procedure and
installation will remain unchanged.

Recommended Viewing

Blender 3D Design Course
Tufts University

http://www.gryllus.net

The Blender 3D Design Course provided by Neil Hirsig of Tufts University is a self paced on line educational facility providing a comprehensive series of video tutorials, PDF tutorials and learning exercises.

The video tutorials are short and to the point providing the student with a concise introduction to the many facets of the Blender program. The tutorials are presented in an ordered structure which lead the student gently into the complex and fascinating world of computer modelling and animation using the Blender program.

Where you see this logo thought the manual gives an approximate reference to the relevant Learning Unit and Video Tutorial provided on the Blender 3D Course website.

LEARNING UNIT Number
Video Tutorial File name

To access the 3D Design Course video tutorials go to the web site address shown at the top of this page. Click on the 'Learning Units' heading to open a selection menu for Learning Units 1 to 5 and Learning Units 6 to 10.

Clicking on the Learning Unit headings will in turn open a selection menu for the individual Unit which then provides access to the video tutorials.

Contents

Note: The contents pages reflect the electronic bookmarks provided with the PDF files of the individual Chapters. The Chapter Titles are links to the separate Chapter Pages.

G- Day Mate

Chapter 14 Modifiers

- Modifiers
- Modifier Stack
- Array Modifier
- Bevel Modifier
- Boolean Modifier
- Build Modifier
- Decimate Modifier
- Edge Split Modifier
- Mask Modifier
- Mirror Modifier
- Multiresolution Modifier
- Screw Modifier
- Solidify Modifier
- Subdivision Surface Modifier
- UV Project Modifier
- Armature Modifier
- Cast Modifier
- Curve Modifier
- Displace Modifier
- Hook Modifier
- Lattice Modifier
- Mesh Deform Modifier
- Shrinkwrap Modifier
- Simple Deform Modifier
- Smooth Modifier
- Wave Modifier
- Cloth and Collision Modifier
- Explode Modifier
- Fluid Simulation Modifier
- Particle System Modifier
- Particle Instance Modifier
- Smoke Modifier
- Soft Body Modifier

Chapter 15 Particle System

- Particle Systems and Interactions
- Nomenclature
- Setting up a Particle System
- Particle Settings and Material
- Particles Buttons
- The Particle Buttons Panel
- Velocity tab
- Physics
- Display
- Starting a Particle System
- Material Influence
- Particle Interaction
- Wind
- Snow Effect
- Fire
- Simple Fireworks
- Keyed Particle
- Boids Particle
- A Flock of Birds
- Directing Movement
- Prey Predator Relationship
- Follow Terrain
- Hair Particles
- Assignment Tab

Chapter 16 Child Parent Relationship

- Child Parent
- Child of Constraint

Gooey

Have you heard about Blender?

Blender

Computer Graphics
Modelling and Animation

CH01- The Blender Interface

The Blender Screen

When Blender first opens the screen displays as shown below. The screen shows the **Graphical User Interface** (GUI) fore Blender.

Expansion Button

On some operating systems the screen may not display full size on start up. Left click on the expansion button in the upper RH corner of the screen.

The Blender screen opens with the Version Panel in the middle . Left click anywhere in the screen to remove this panel
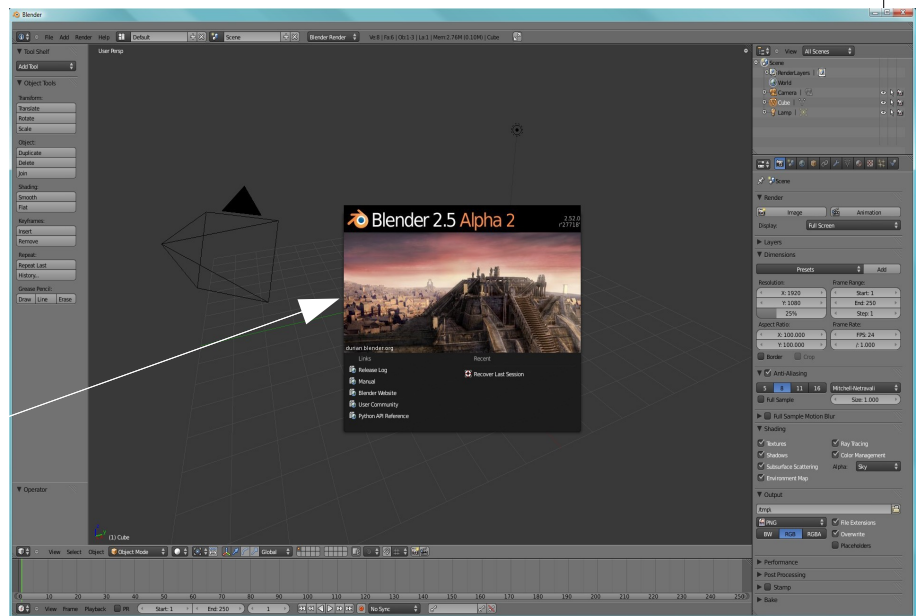
The Default Blender Screen displays with five windows opened.

Info Window

Outliner Window

Note: Window background colors have been changed to make them distinct

3D Window

Timeline Window

Properties Window
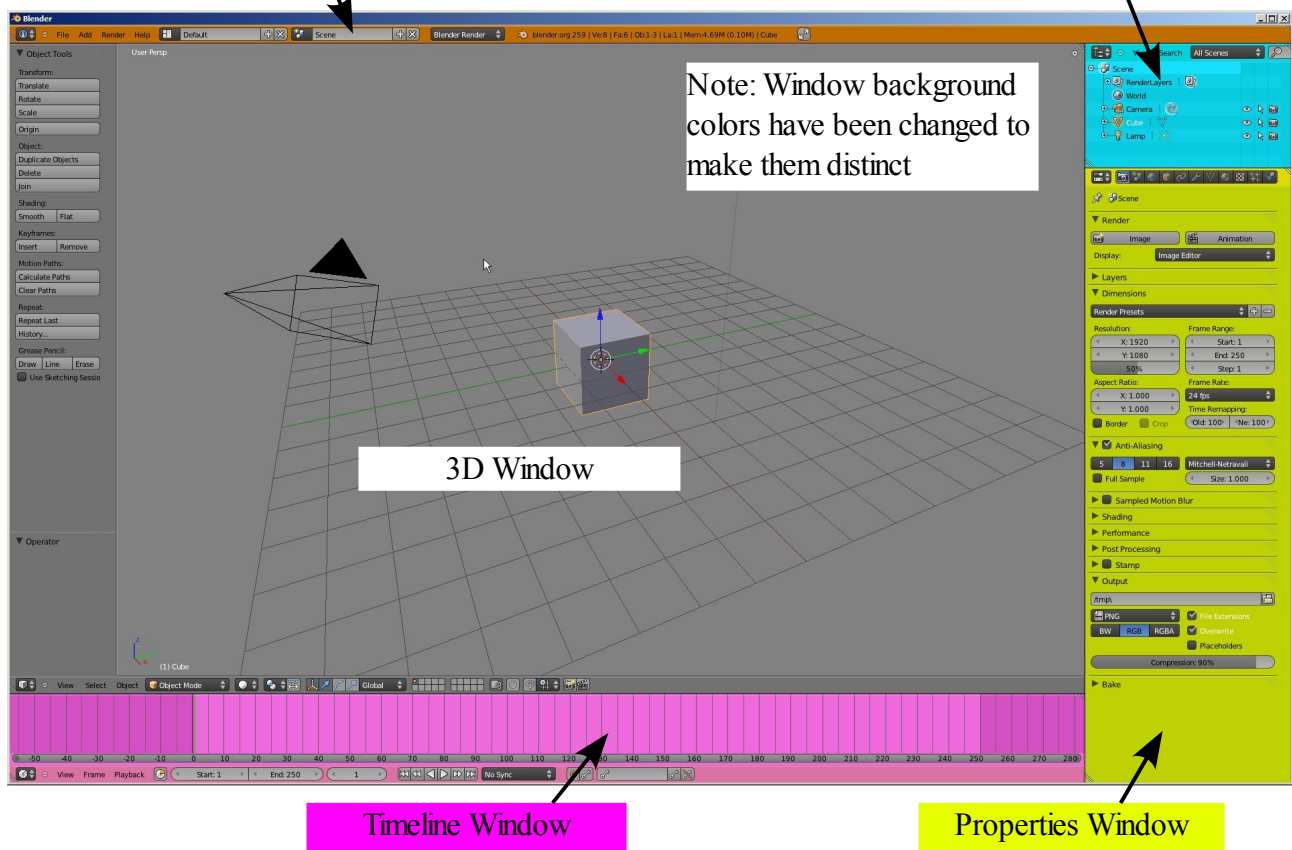
Besides the windows displayed there are fifteen other window types available for selection. Look at the lower LH corner of the 3D Window and note the Icon .

This is the Icon representing the 3D Window. Each window has an Icon displayed in the upper or lower LH corner of the window representing the window type.

Window Type Selection
Menue

Clicking on a window type icon displays a drop down selection menu for selecting a different type of window. Selecting (Clicking LMB) a different window from the menu changes the current window into the type selected.

Interface Input

Through this manual the user input to the program is described using a standard keyboard and a three button or wheel mouse. Blender is designed to be operated by enlarge with one hand on the mouse and the other on the keyboard. Laptop users will require to adapt to the instructions provided as notes in the manual.

Example: In the lower LH corner of the 3D Window click on the icon with the mouse cursor Select (click) 'Graph Editor'. The window changes to the Graph Editor window. Click on the Graph Editor icon – select '3D View'. The window reverts to the 3D Window.
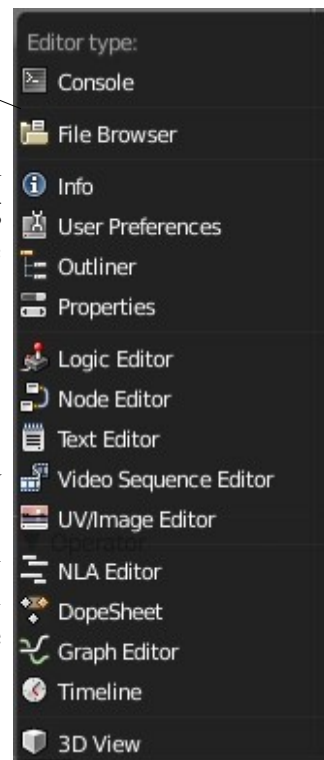
Any window may be changed to a different window type in this way.

Every window and panel within a window may be resized. Place the mouse cursor on a window or panel border and it changes to a double headed arrow.   ⟸⟹
Click and hold with the LH mouse button (Clk LMB for future) and drag the arrow to resize the panel or window. This works on both horizontal and vertical borders.

Every window may be divided to form a new window. In opposite corners of each window there is a small cross hatched triangle which is a Splitter Widget.

Learning Unit 1
Splitting Joining/Extending Windows

Mouse cursor on
Splitter Widget

New Window

(1) Cube
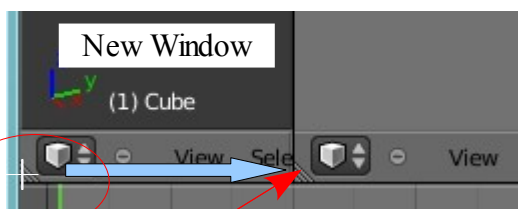
Click Hold and Drag to make new window

Editor type:
Console
File Browser
Info
User Preferences
Outliner
Properties
Logic Editor
Node Editor
Text Editor
Video Sequence Editor
UV/Image Editor
NLA Editor
DopeSheet
Graph Editor
Timeline
3D View

When the mouse cursor is placed on the cross hatching it changes to a white cross. Click, hold and drag the cross into the window and the window divides in two forming identical copies of the original window. One copy may then be changed to another window type as previously described.

To cancel a window place the mouse cursor on the cross hatching (changes to cross) and drag it out of the window into the window to be canceled. A large arrow appears pointing into the window to be canceled. Release LMB and the window cancels. Before releasing you can move the cursor from one window to the other. The arrow changes direction accordingly. Releasing LMB cancels the window into which the arrow is pointing.

The individual windows will be explained as we progress through the document but first we need to understand the components of a window in general terms.

Window Type Icon (Info Window)

Panel (Tool Panel)

Window (3D Window)

Window Type Icon

Header

(3D Window)
Drop Down Selection Menu

Buttons
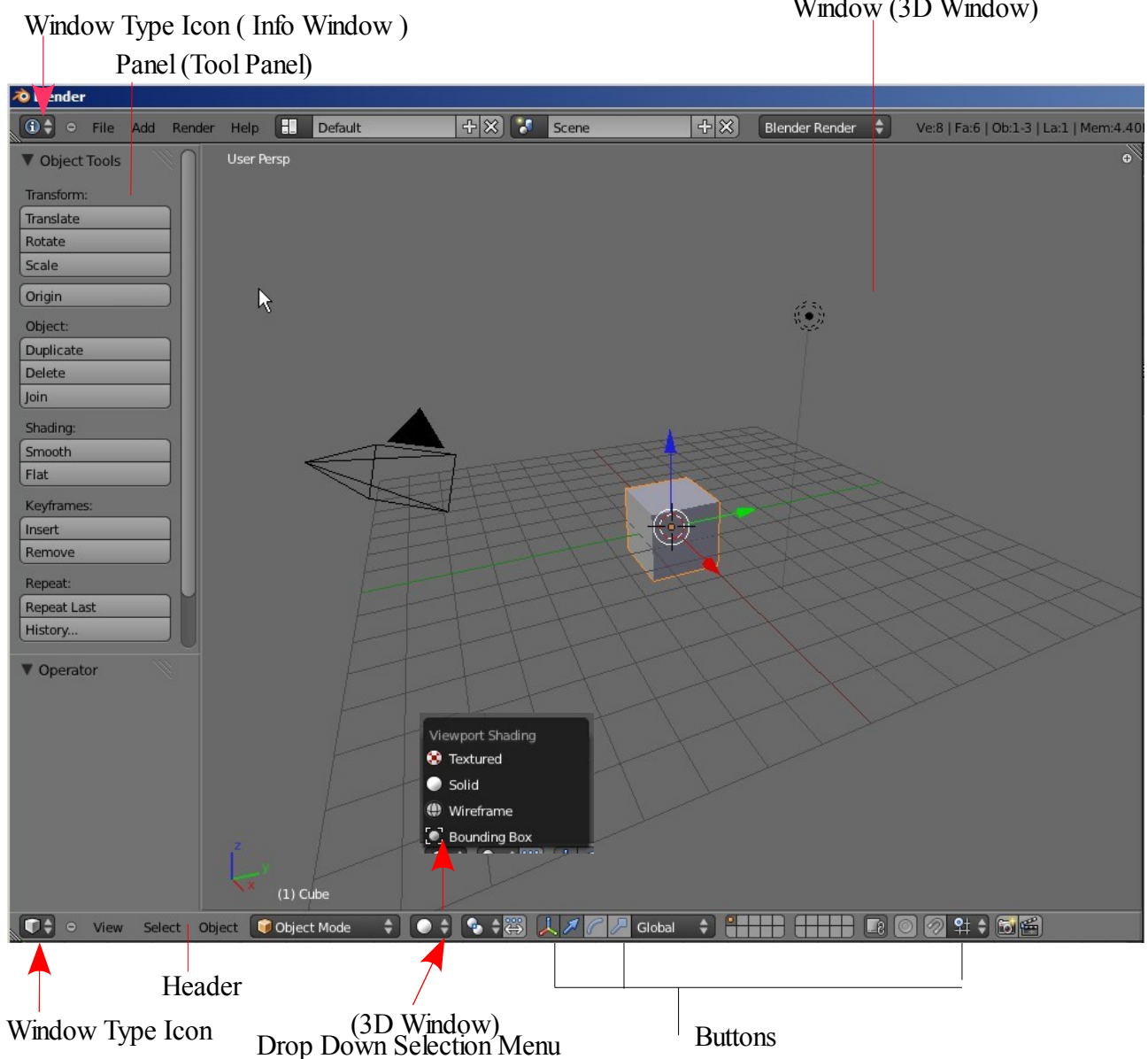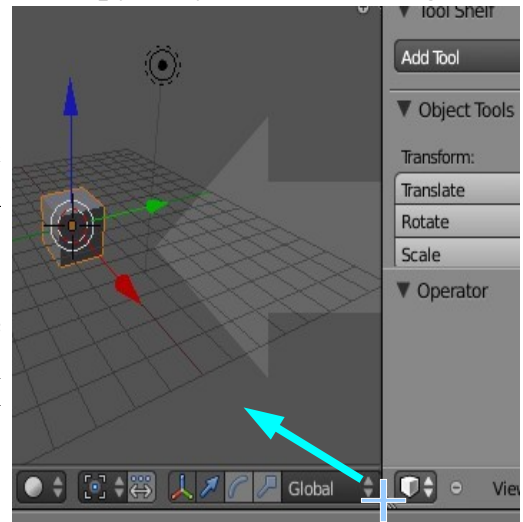
One of the great features of Blender is that the GUI (**Graphical User Interface)** may be modified to suit the preference of individual user. We have mentioned how to resize windows and panels and how to split and cancel windows. There are many other features which can be changed. At this stage we will demonstrate an example just to show how this is done. The possibilities are endless so like many things in blender you will have to experiment and try options for yourself. The following example will introduce you to the **User Preference Window.**

User Preference Windows

If you are like me and sometimes find it difficult to see things on the screen especially against Blender's sexy sultry dark 3D Window background then you can fix it.

Divide the 3D Window in two (See the section on that) and make one part the User Preference Window or go to the Info Window header, click on 'File' then click on 'User Preference Window'. In the later scenario Blender opens an overlapping version of the User Preference Window. This is the only time that Blender opens one window over another.
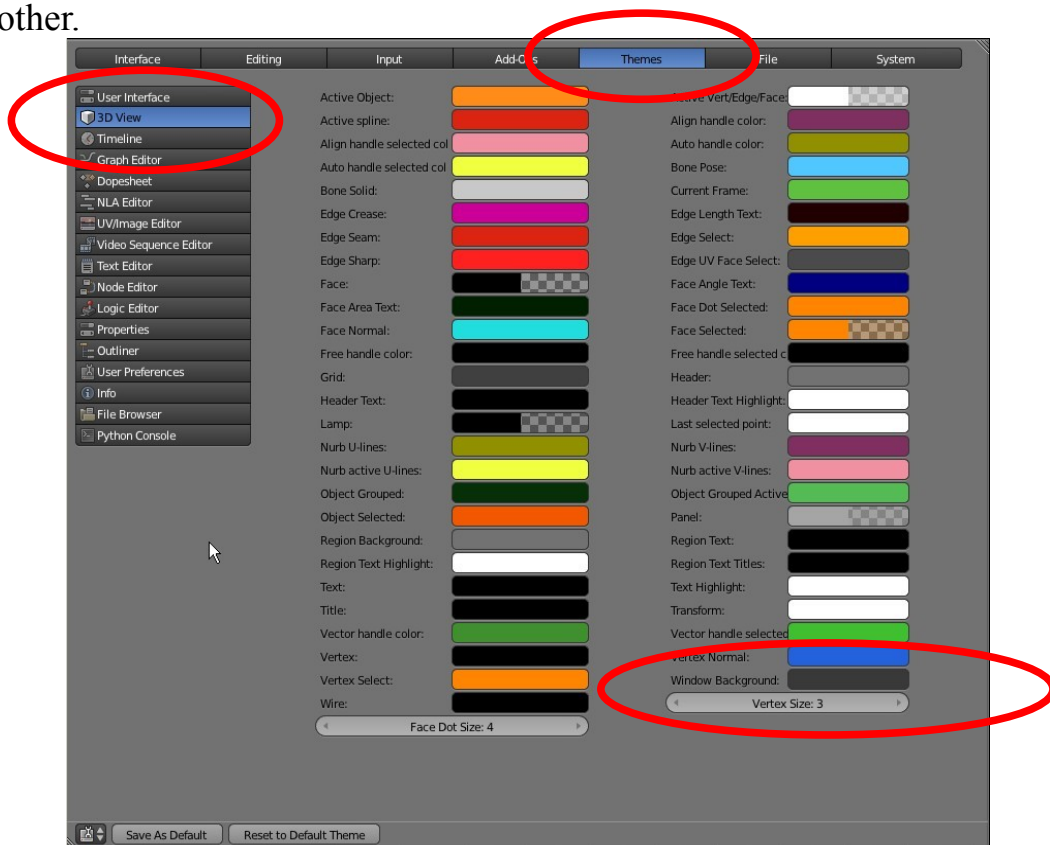
Go to the top of the window and click on 'Themes'. At the LHS of the window you see a list of the different windows. Click on '3D View'. You will see a series of colored panels with headings next to them. At the bottom of the second column you

will see 'Window Background'. This is the grey colored panel which is the color of the 3D Window background.
Click on the panel and a color picker will display.
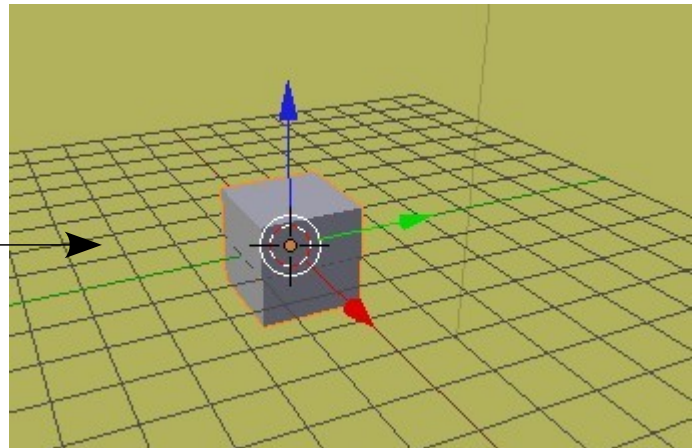
3D Window with Color Selected

At the RHS of the picker is a vertical bar showing a color gradient from white at the top to black at the bottom with a white dot in the middle. Click LMB on the dot and drag, while holding the button. Move it upwards. See the background color of the 3D Window lighten up. The color picker also lightens up. You can click LMB anywhere in the colored circle to change the 3D Window background to any color you like. You can also change the color by altering the RGB values (Click LMB on either the R, G or B value and the text changes to white indicating that it is editable). Press delete to delete the value and retype a new value. A second click before deleting will place a blue text cursor which allow individual numbers to be edited. You may also click and drag the slider. The background color will remain set for the remainder of the session. You can now close the User Preference Window. If you want to set the background color permanently click on 'Save As default' at the bottom of the User Preference Window. This will change the background color for the next time you start Blender.

Note: When you press 'Save As Default' in the User Preference Window you obviously have the User Preference Window open. Blender takes the command literally and assumes that you want the User Preference Window displayed the next time you open Blender. If you don't want this to happen, close the User Preference Window, without clicking 'Save As Default,' by clicking and dragging on the cross hatch in the corner as previously described. In the **Info Window Header** click on 'File' – 'Save User Settings'.

If you click around the User Preference Window you will see that there are many many options. Feel free to experiment. If you goof up when changing **Themes** just press 'Reset to Default Theme' at the bottom of the window. This puts everything back to square one. Remember close the User Preference Window and click 'Save User Settings' in the Info Window Header. **If you change settings in other panels of**

the User Preference Window make sure you record the changes you have made. The other panels do not have a reset button.
Preset Interface Arrangements

While still on the subject of 'Graphical User Interfaces' we will point out that Blender has some preset arrangements for working on different aspects in the program.

In the 'Info Window' header at the top of the default screen arrangement to the RH of the 'Help' button there is a little window button with a panel with 'Default' in it. Default is referring to the default Blender screen arrangement or GUI. Placing the mouse cursor over the window button displays 'Choose screen layout'. Clicking on the button displays a drop down selection menu with a choice of screen arrangement options.

You will see that 'Default' is highlighted in blue. Clicking on any of the options changes the screen arrangement with window types appropriate for the named aspect of the program.

Window Button

Search Bar – Type in a Word to Search
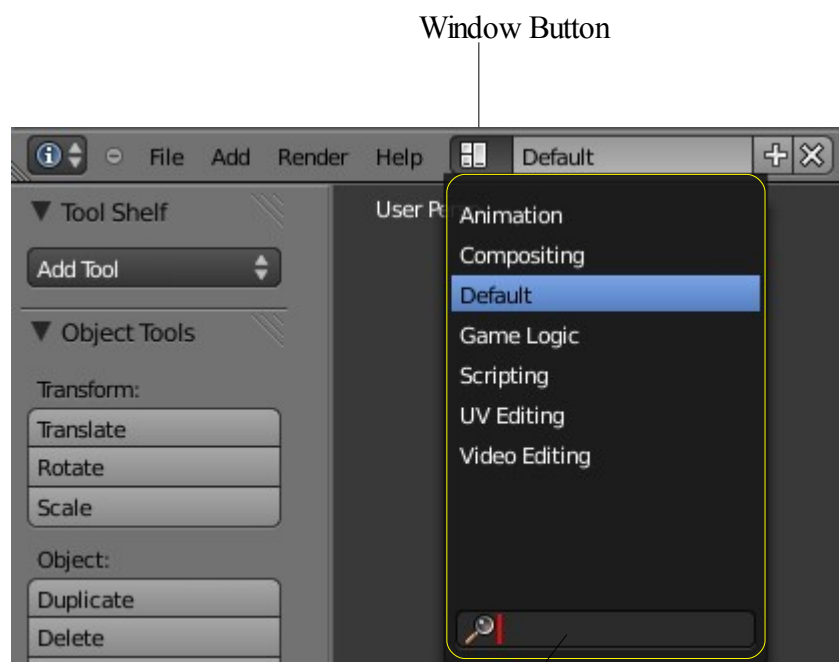
The 3D Window

Before we can actually create anything in Blender we should understand the 3D Window.

In the first place we should understand the basic concept of creating something with computer graphics. A scene is created. The scene may be static or animated. In either case the scene is rendered. The render produces a computer image in the case of a static scene or a computer animation in the case of an animated scene. Images are rendered to a number of file formats such as JPEG or PNG while animations are rendered into video files. The scene is set up in the 3D Window.

The default 3D Window in Blender is shown below.

The Widow panels have been colored to distinguish them. We will show how to do this later in the manual.

Object Tools Panel   Main Window

Note: This is the 3D Window only, not the Blender Screen which has the Info Window, Properties Window, Outliner Window and Timeline.
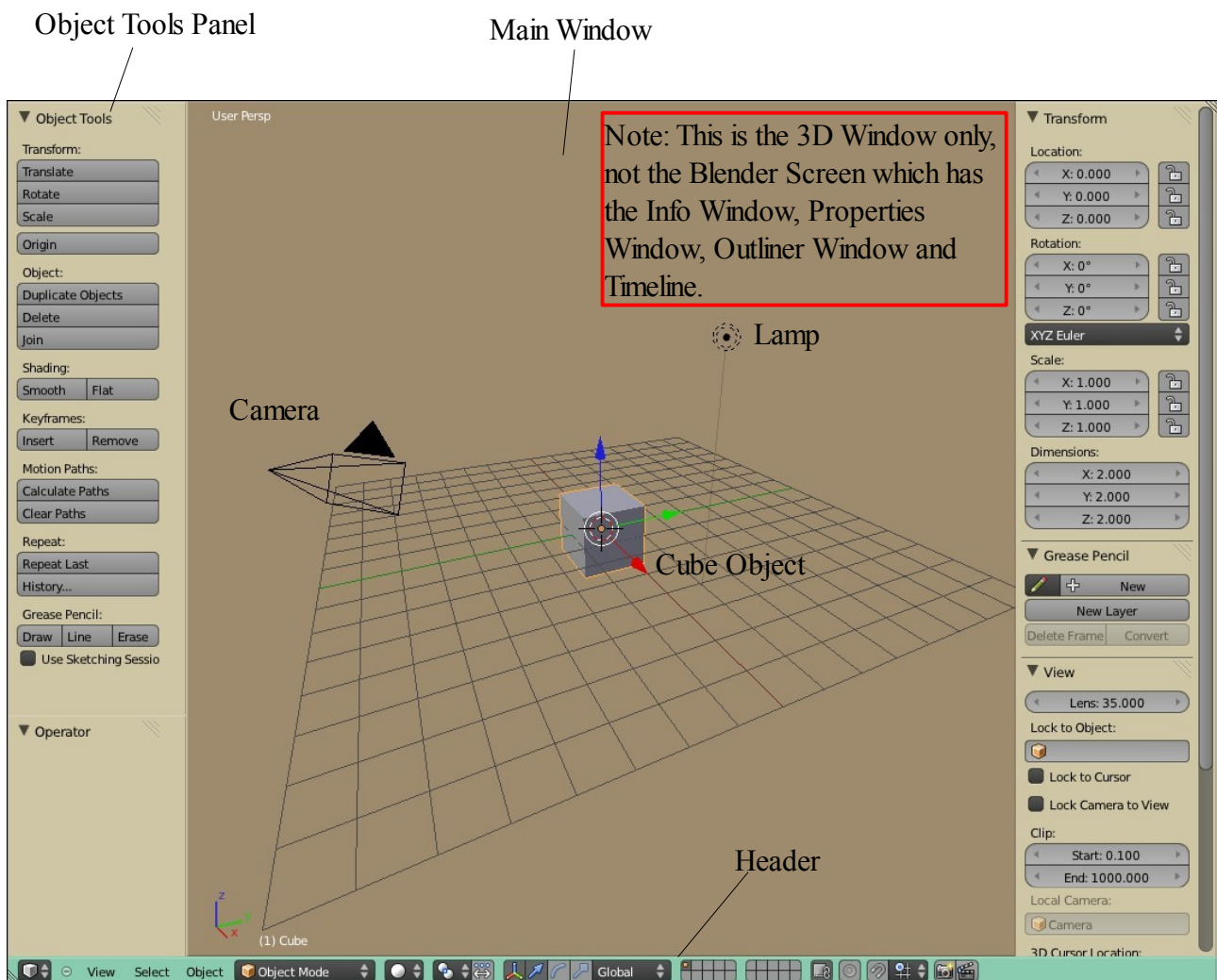
The 3D Window comprises a Main Window panel and a side Object Tools panel. The 3D Window Header is the strip across the bottom of the window with all the buttons.

The default 3D Window contains a Cube object, a Lamp and a Camera. Without the lamp or camera nothing will render.

The Object Tools panel can be hidden from view by pressing the T Key on the keyboard. Press T Key again to show the Object Tool panel . This process is referred to as 'Toggling'. You can also drag the edge of the panel to close it

Besides the Object Tools panel there is another panel, the Object Properties panel, which by default is hidden. Press the N Key or the expansion icon, to show the panel. Here you see values pertaining to the Object that is selected in the 3D Window.

Place cursor over edge of pane.
Click LMB hold and drag to move panel edge

Object Properties Panel

Values pertaining to Cube Object
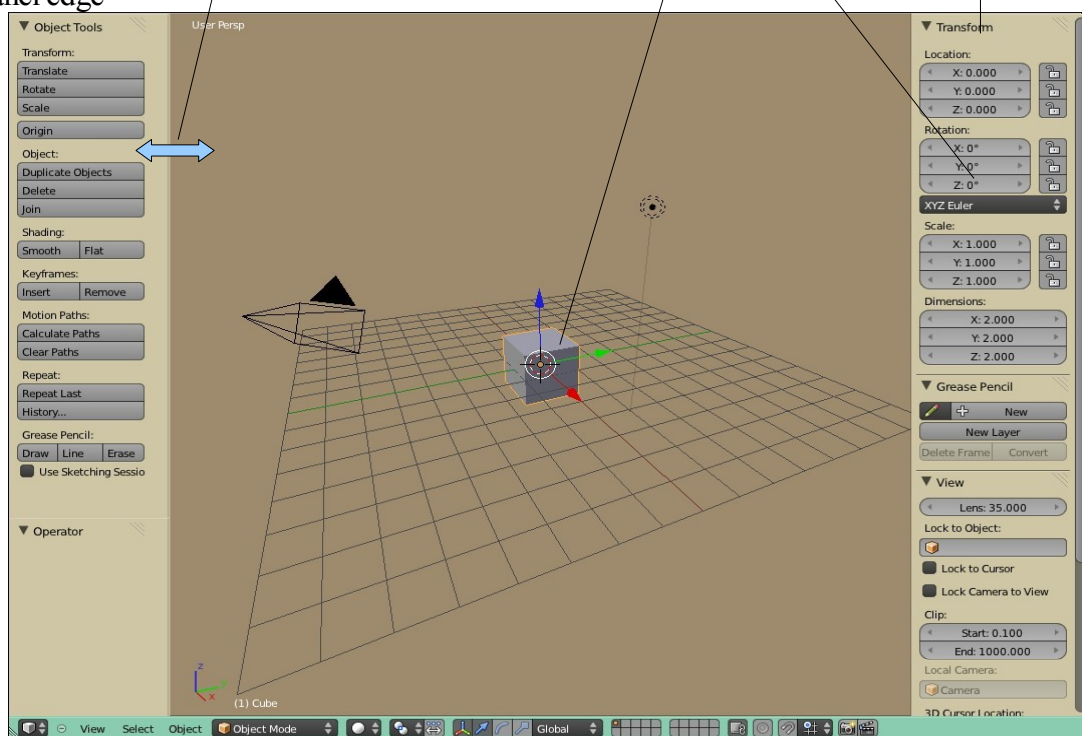
Note: With the Objects Tool Panel and the Objects Properties Panel hidden a small white circle with a cross is displayed in the upper corners of the 3D Window. Clicking LMB on these will also display the panels.

By default the Cube is selected as shown by the orange outline around the cube. An Object is deselected by pressing the A Key and selected by clicking on it with the right mouse button (Clk RMB).

Try it out: A Key(deselect) – Click RMB on the Camera (select Camera) -A Key (deselect) – Cube, Clk RMB (selects the Cube again). I'm trying you out with my abbreviations for later.

Note that if you A Key (deselect) an object then A Key a second time you will select everything in the 3D Window.

Note also that with the Object Properties panel displayed the values change according to which object you have selected. At this stage do not be concerned with the values we are just getting the broad outline of the interface.

Remember that in the 3D Window we are seeing a three dimensional representation of a World. The squared grid in the scene represents the horizontal mid plane of the world on the X and Y axis. The green line on the grid is the Y axis and the red line is the X axis. The vertical axis is the Z axis. If you look at the lower LH corner of the window you see these axes displayed. You also see in white the name of the Object selected.
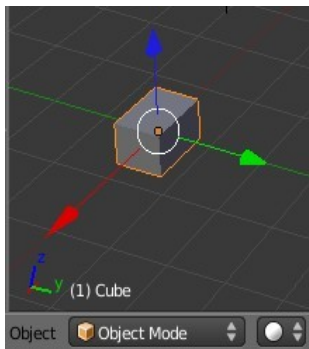
The red green and blue arrows on the Cube object are a 3D manipulator which is a device for moving the object about in the scene. This will be discussed in detail later but for now we will use it to move the cube. Click on the green arrow and holding the mouse button down drag the mouse to the right. The Cube outline turns white in the process indicating that it is in 'Grab' mode. Release LMB (left mouse button) and the Cube stays where it is placed.

3D Curser
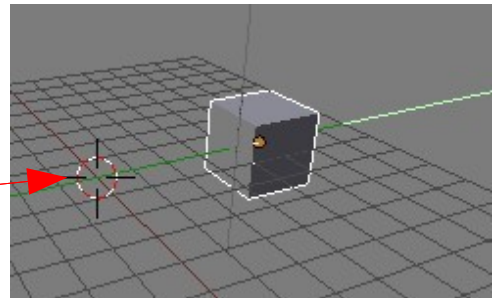
We moved the Cube so that you can see the small circle with the cross hairs at the center of the world. This is the 3D Cursor (Not the Mouse Cursor). If you click LMB anywhere in the scene with the mouse the 3D Cursor relocates to wherever you clicked. If you were to add another Object into the scene that object would be located at the location of the 3D Cursor.

The Cube Object is called a 'Primitive' which is one of ten basic shapes available in Blender from which to commence modeling. Click on 'Add' in the Info Window header then in the drop down place the mouse cursor on 'Mesh' to see the list of Primitives. You can click on one to add it to the scene. Another way to do this is to Press Shift + A Key on the keyboard to display the same list.

Learning Unit 1
Primitive Mesh Objects

Blender Primitives

Manipulator shown on Circle

Plane
Cube
Circle
UV Sphere
Icosphere
Tube
Cone
Grid
Monkey
Torus

Blender Primitives

Window Modes

Mode:
Weight Paint
Texture Paint
Vertex Paint
Sculpt Mode
Edit Mode
Object Mode

(1) Cube

Object Object Mode

Click for Drop Down
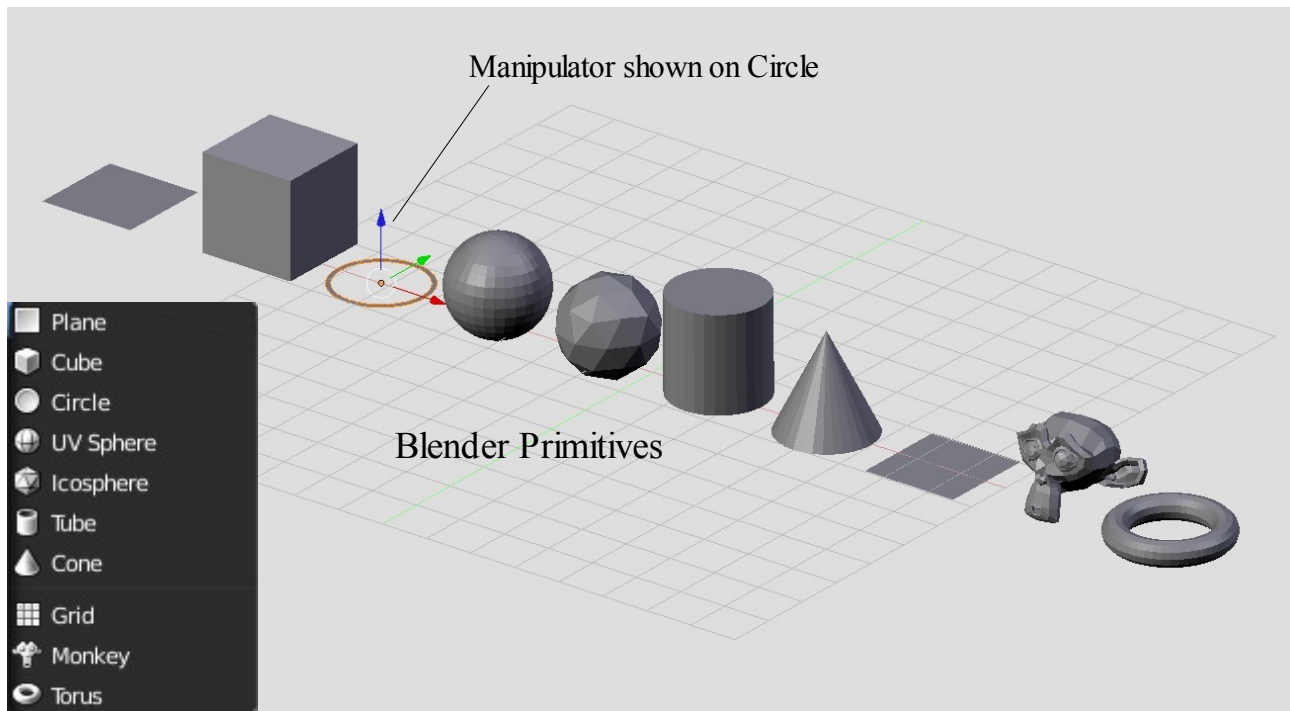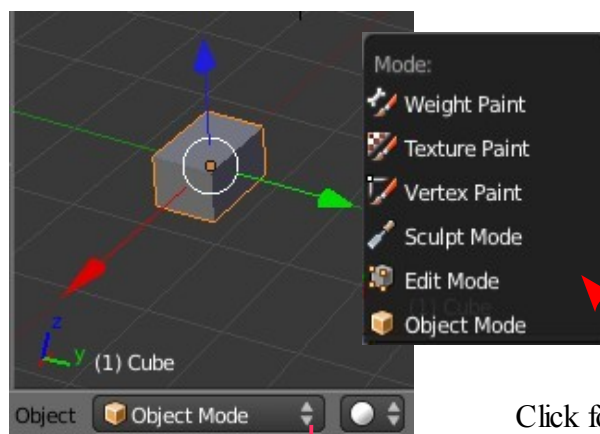
The 3D Widow, by default is opened in Object Mode. You will see this in the window header. By clicking on the drop down selection menu it is able to select one of the other modes.

At this stage we only need be concerned with the Edit Mode option. Object mode allows us to move, rotate and scale an object in the scene while Edit mode allows us to change the shape of the object.

To change between the two modes you can select the mode from the drop down in the header but since it is common to switch between Object and Edit mode pressing the Tab Key toggles between modes.

With the Cube selected in the 3D Window and the mouse cursor positioned in the window press 'Tab'. You will see the object shown with its edges drawn in orange with dots at each corner. The significance of this will be discussed in detail later. For now toggle back to Object Mode.

(1) Cube

Mesh Edit Mode
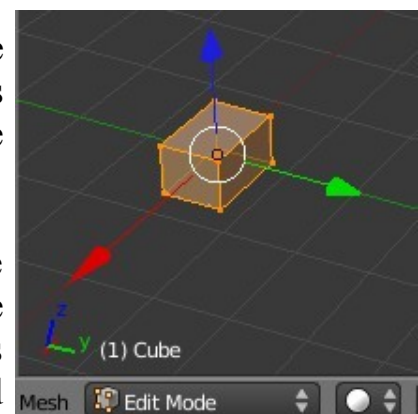
Layers

Like many other graphics programs Blender uses layers to aid in constructing complex scenes. Note the display in the 3D Window header. This represents 20 separate layers. Imagine sheets of transparent drawing paper with different items on each sheet being placed one on top the other. Each square represents one sheet. The orange dot in the first square indicates that the selected object is on the first layer. The fact that the first square is shaded tells us that we are looking at the first layer.

Orange dot indicates
Object selected in first
layer

20 Layers
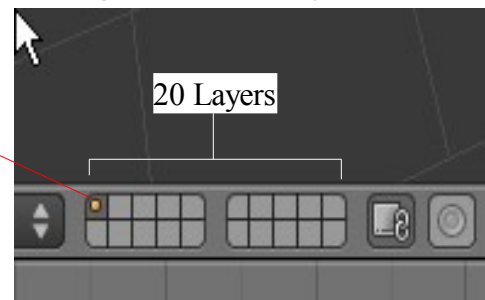
To move to another layer click on one of the squares. It becomes shaded indicating the layer is being seen in the window. If you click on square 2 the screen shows an empty layer. The orange dot remains in square 1 indicating that there is an object selected in layer 1 (Not necessarily selected). Go back to square 1.

To move the Cube object to layer 2 first select the Cube in the 3D Window. Press M Key and the 'Move To Layer' window appears. Click on square 2 and the Cube is moved to layer 2 as indicated by the orange dot displayed in square 2 in the window header.
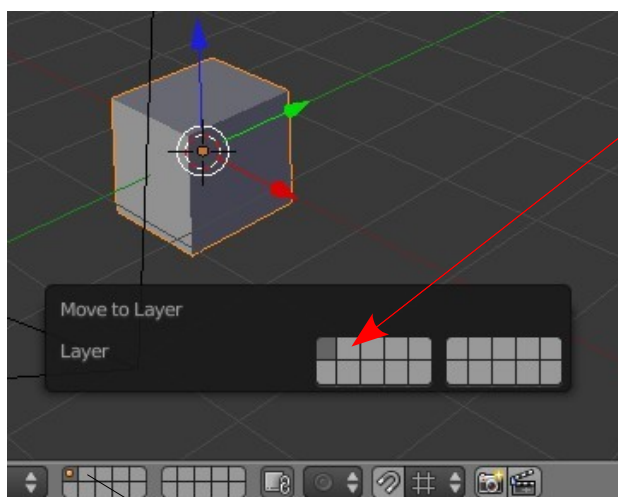
Move to Layer

Layer

Click on square 2 to move the
Cube to layer 2

Orange dot shows Object on layer 1
Shaded square indicates Layer 1 being
viewed.

Orange dot will display here when Cube moved to layer 2

Note there is still a dot in square 1. This shows that there are objects on layer 1 (the Camera and the Lamp).

To replace the Cube in layer 1 click on square 2 in the header, press M Key with the cursor in the window and click on square 1 in the 'Move To Layer Window'.

Object Tools Tab (Tool Shelf Panel)

The Object Tools Tab contains tools for manipulating objects in the 3D Window. What tools are displayed depends on which window Mode you are in (ie. Object Mode or Edit Mode). Not all tools are displayed. This is simply to save screen space. In earlier versions of Blender 2.5 there is a search bar at the top of the Tool Shelf where you enter the name of a tool and it is added to the Shelf. In later versions the Tool Shelf has become the Object Tools Tab and the search bar has disappeared.

Enter Tool Name in Search Bar

Duplicate Window	Ctrl Alt W
Reload Start-Up File	Ctrl N
Load Factory Settings	
Save User Settings	Ctrl U
Toggle Fullscreen	Alt F11
Quit Blender	Ctrl Q
Open Blender File	Ctrl O
Link/Append from Librar	Ctrl Alt O
Recover Last Session	
Recover Auto Save	

The Search Bar is now accessed by pressing the Space Bar with the cursor in the 3D Window. This displays a drop down menu with the search bar at the top.
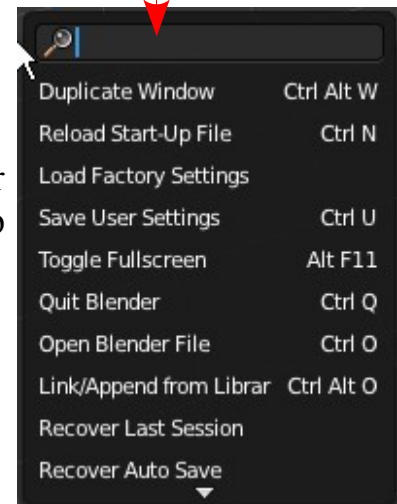
Moving in 3D Space

In a 3D program, not only do you have to worry about where you are in 2 dimensions (height and width), but you also need to consider depth (how close or far away). Before you can work in 3D space, it would be good if you had some skills in 2D drawing and layout. Moving around in the 3D window is controlled by the mouse and the keyboard number pad.

The Blender default scene opens in what is termed 'User Perspective View' which allows you to move objects about in the 3D window. Sometimes it is more convenient and easier to see how far objects are separated by using separate orthographic views. Think of a standard 3-view orthographic drawing - top, front and right side views. These views match up with the N**umber Pad** 7,1 and 3 keys (look at their arrangement on the keyboard- just like the views). Put your cursor in the 3D window and try pressing those numbers keys.

Note: Laptop users – Some laptops do not have Number Pad keys. In the **User Preference Window** click on 'Input' at the top of the window and then, at the LHS of the window tick 'Emulate Num Pad'. You can now use the number keys on your laptop to emulate the Num Pad on a standard keyboard.
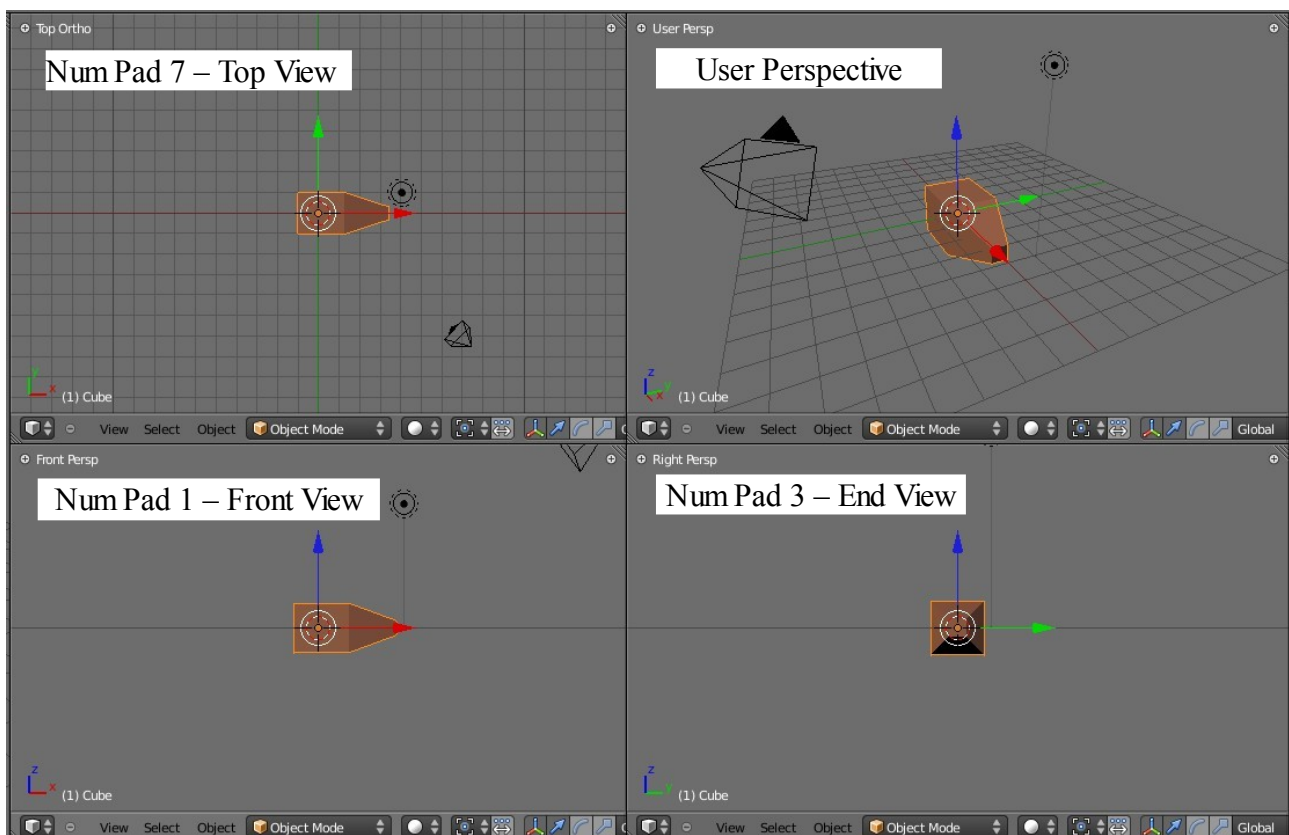
When moving from the User Perspective View to either of the orthographic views, at first you get a Top, Front or End **perspective** view. Look at the Lamp and you see a

line pointing towards the Cube. Press on Num Pad 5 to get the true orthographic view. Pressing Num Pad 5 again toggles back to the perspective view. Pressing Num Pad 0 will put you into camera view (what the camera sees). To get back to the User Perspective view press Num Pad 5 twice. One press gets a User Orthographic view the second press gets the User Perspective view. But hey! Its not quite the same as we had in the default scene. We need to rotate the view a bit. Click and hold the middle mouse button and wiggle it around a bit. **NOT TOO MUCH!** You will see the scene rotating in the window. Wiggle and practice is the best way to learn. This all sounds a bit complicated but you will soon get used to it.

When you go to Camera View (Num Pad 0) most of the window becomes shaded leaving a small <u>window in the middle with a dotted line around it.</u>

Clk RMB to select Camera
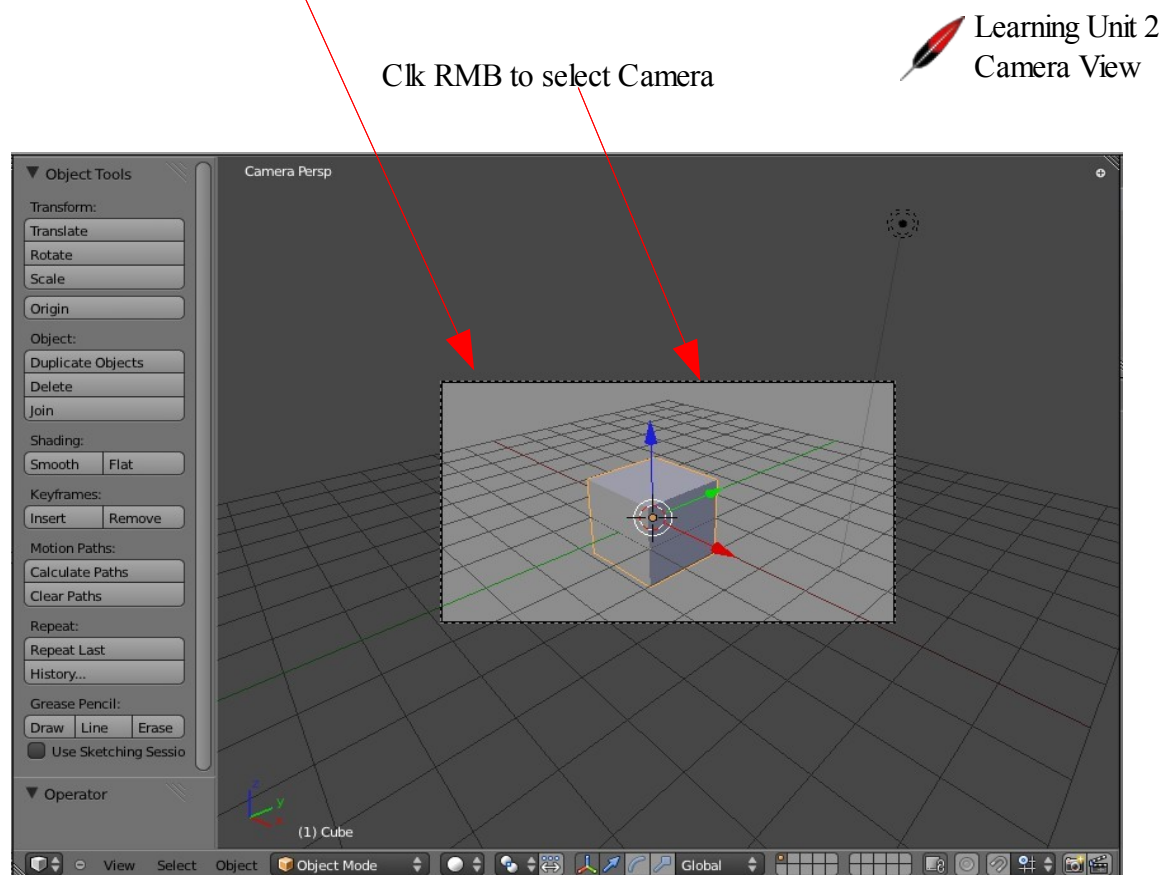
This is the part that will actually render to an image. Right click on the outer line and it turns orange. You have the camera selected. You can now move and rotate the camera like any object in any view. We haven't actually covered that yet so hold fire for while. The shading in the camera view is called 'Passepartout' and can be removed to let you have a clear view of everything in the scene. We will show you how later.

The Number Pad Arrow Keys (2,4,6,8) will rotate you around in 3D space (**Not in Camera View**). The "+" and "-" keys on the number pad will zoom in and out. The number pad "." (period) key will center your view on the selected object on your screen.

The Mouse serves a number of functions. Clicking the Left Mouse Button (LMB) in the 3D Window repositions the 3D Cursor in the scene. Wherever the 3D Cursor is positioned is where the next object you add to the scene is located. Clicking the Right Mouse Button (RMB) on an object selects that object. Similarly in Edit mode clicking RMB on a vertice will select that vertice. Pressing the B Key on the keyboard then clicking LMB (Cross Hair Lines Display) and drag a rectangle over an object will select that object. Klick LMB to cancel. Pressing the 'C' Key on the keyboard changes the mouse cursor in the 3D Window to a circle. Scroll the mouse wheel to change the size of the circle. Position the circle over an object and click LMB to select the object. Press the 'Esc' Key to cancel the circle selection. Click and hold the middle mouse button or mouse wheel and drag rotates the 3D View. Scroll the mouse wheel zooms in and out on the scene.

Don't attempt to memorise all the combinations they will become second nature with practice since they are used over and over.

Blender View Menu
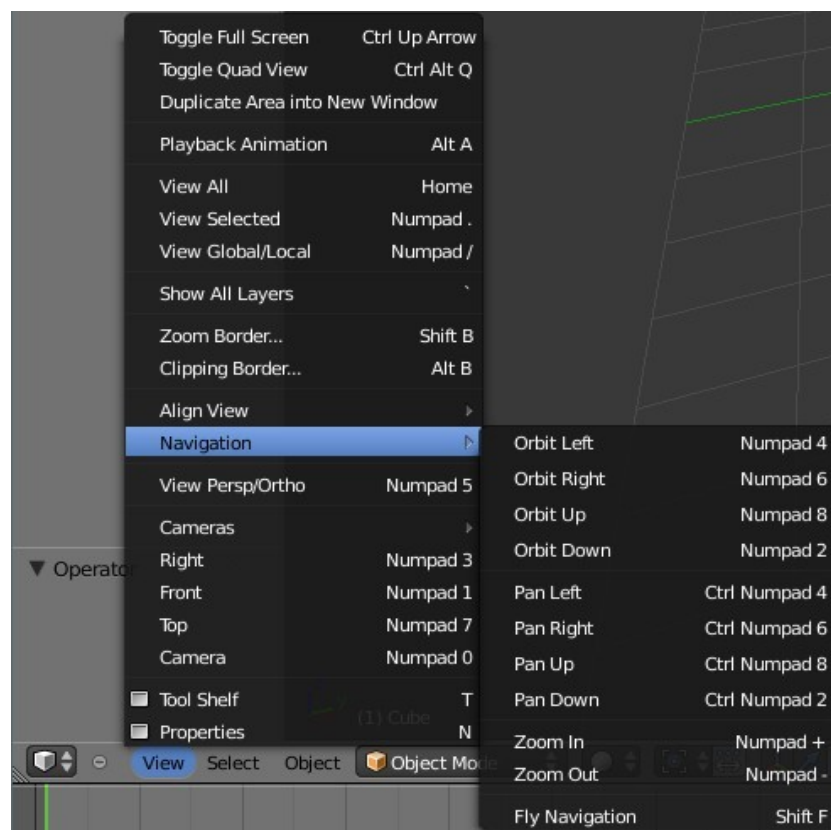
The View Menu showing the full range of options to manipulate view ports.

Note: Clicking on the 'Toggle Quad View' option displays all four orthographic views, in separate windows as shown in a previous page. The keyboard shortcut to select this option is to press Ctrl + Alt + Q Key. Pressing this combination a second time toggles 'Front Orthographic View'. To return to 'User Perspective View' press Num Pad 0 (Camera View) then press Num Pad 5 twice and rotate the view.

The View Menu also shows the shortcut keys for the Right, Front and Top orthographic views. These are Numpad 1,3 and 7 keys previously mentioned. Besides these views the following are also available:
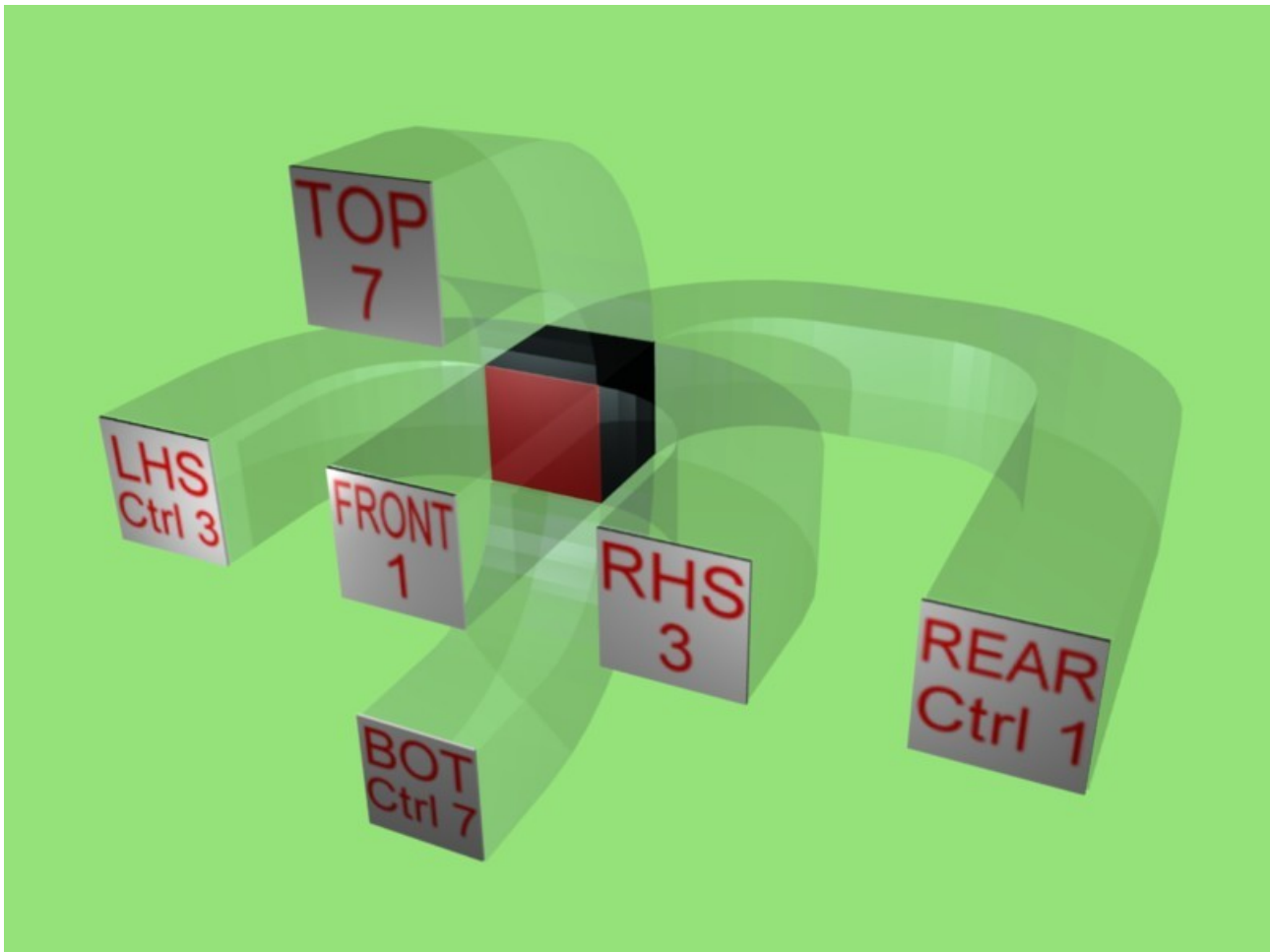
Numpad 7 – Top   Ctrl + 7 – Bottom
Numpad 1 – Front   Ctrl + 1 – Rear
Numpad 3 – Right Hand side   Ctrl + 3 – Left hand Side
Numpad 0 – Camera View

Note: Click Numpad 5 toggles User Orthographic View – User Perspective View.

Note : The numeric keys at the top of the keyboard change the active layers not the viewports, unless the emulate Numpad function has been set for a laptop computer.

The Numpad 2 and 8 keys rotate the view about the X axis.
The Numpad 4 and 6 keys rotate the view about the Z axis
The Numpad . Del key and the / Forward Slash key centers and zooms in on the selected object.

Hold Shift + F Key and move the cursor to fly about the scene. Clik LMB to stop

The Properties Window

The 3D Window is the place where you set up your scene and see what you are creating and where you are going. The Properties Window on the other hand is the engine room with all the controls that drive everything.

The Properties Window is the main part of the vertical panel at the RH of the default screen.

The Properties Window controls what you see in the 3D Window, how objects move and behave and finally how the scene renders. It controls how your artificial world is configured, how everything in the scene appears, moves and interacts with everything else.

To get an insight into the Properties Window in practical terms look at the row of buttons displayed in the window header. These buttons are the starting point for everything that happens.
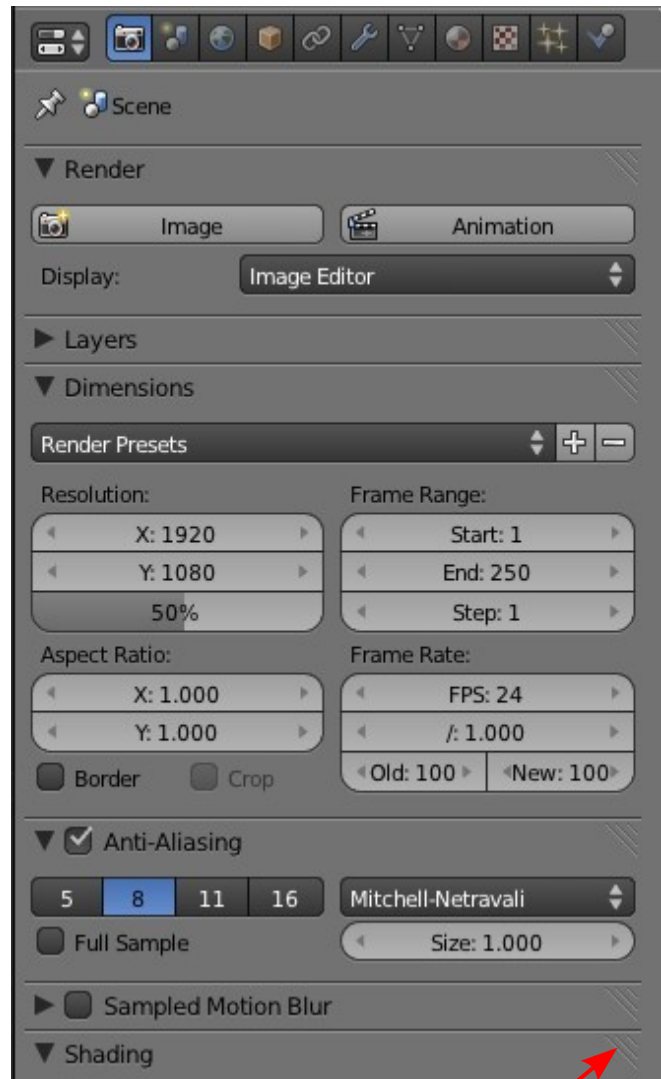
Click hold and drag crosshatching up or down to reposition tabs

Note: In the 3D Window the default Cube object is selected as seen by the orange outline. Buttons available in the Properties window header vary depending on what is selected in the 3D Window. Try clicking RMB on the Camera then the Lamp and back on the Cube. You will see the buttons in the header change.

By default Blender opens the Properties Window in the default screen arrangement with the Render button active and with the window containing all the render buttons and values. The Render button is seen highlighted in blue.

It is not the intention to describe the function of every button and value in the Properties window. The specific operation of buttons and controls will be demonstrated as you progress through this document and even then it will be up to you to experiment and record as you go.

The following diagram shows the default Properties Window Header.

Render: How the screen renders. ─────────────

Scene: Basic scene functions. ─────────────

World: Controls for scene background. ─────────

Object: Controls for the selected object. ───────

Object Constraint: Interaction with other objects. ──────

Modifiers: Effect the selected object. ─────────

Object data: Data effecting the selected object. ──────

Materials: How the object appears (color).──────

Textures: How the objects surface looks. ───────

Particles: Object can emit particle effects. ────────

Physics: How the object behaves. ──────────

Clicking on each of the buttons in the header changes the display of buttons and controls in the main window. The buttons and controls are separated into panels called Tabs. Some tabs are open and some are closed. Clicking on the little triangle in front of the tab name toggles the tab open or closed. With some buttons selected there are too many tabs to fit in the window. When this happens a scroll bar appears at the RHS of the window.

The Properties window may be resized by dragging the border and may be changed to another window type if required.

The location of the tabs in the Properties Window can be rearranged by clicking and holding the crosshatched area at the upper RHS of the tab and dragging it up or down in the stack.

Blender Controls

Up to this point it has been assumed that you are familiar with the use of the keyboard and mouse and the input of data to the computer via these devices.

Blender uses a system of controls employing the keyboard and mouse as follows:

Button Control: Activated by positioning the mouse cursor over the button and clicking LMB (Left Mouse Button). Button controls either perform a direct action or activate a secondary function. For example:

> With an object selected in the 3D Window clicking on the Delete button in the Tool Panel requires you to click on a 'Delete – OK' button to delete the object.

> Clicking on the Scale button in the Tool Panel requires you to drag the mouse cursor in the 3D Window to scale the selected object.

Most Button controls are duplicated by keyboard shortcut keys. For example:

> Press the X Key on the keyboard with an object selected prompts the 'Delete – OK' button.

> Pressing the S Key and then dragging the mouse cursor scales the object.

Check (Tick) button controls require you to click LMB in a small square to place a tick which activates a function.

Clicking a menu selection button displays a drop down menu which requires a selection by clicking LMB on an option. This activates a function.

Slider controls are activated by three separate methods:

> Click LMB with the mouse – hold – drag right or left to change a value.

> Click LMB on the arrows at either side of the slider to incrementally alter a value.

> Click LMB on the value displayed in the slider – press the 'Delete' Key – Retype a new value – Press 'Enter'.

The Blender Windows

Editor type:
- Console
- File Browser
- Info
- User Preferences
- Outliner
- Properties
- Logic Editor
- Node Editor
- Text Editor
- Video Sequence Editor
- UV/Image Editor
- NLA Editor
- DopeSheet
- Graph Editor
- Timeline
- 3D View
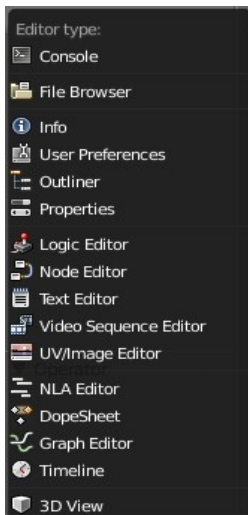
The application of the Blender Windows will be explained as you progress through the different sections of the manual. There are some windows however that require special mention since they have a more general application rather than applying to a specific topic. For that reason, when sticking to the basics, they can be overlooked.

They are worth a mention here to make you aware.

Console Windows

The console window is where you go if you want to modify the Blender program using Python Script. Python is the programing language of Blender.

Learning Unit 2
Outliner Editor
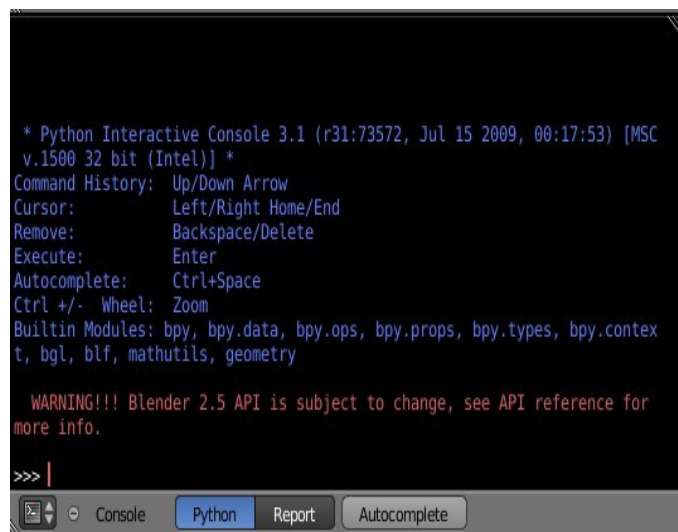
Outliner Window

The Outliner Window gives you a visual display of everything in your scene and shows how the different items are connected. For example if you click on the little cross next to 'Cube' you get 'Cube' and if you click again you see that it has a material.

See website Supplements Page for more details about the Outliner Window
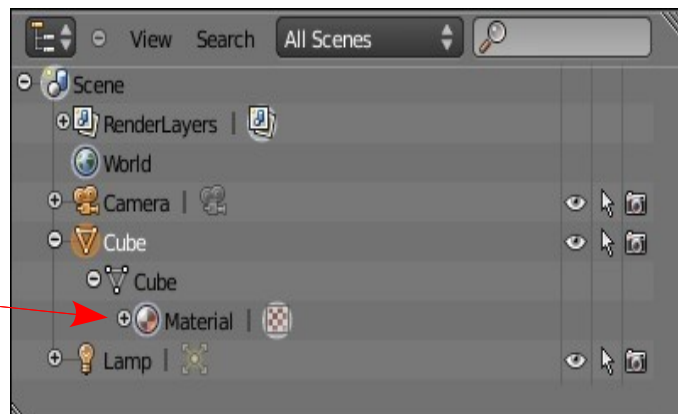
Text Editor Windows

The Text Editor is just that, a text editor. When you create something in Blender and save the .blend file to use later you can write yourself notes in the Text Editor and what you write will be saved in the .blend file. This is very handy for a bad memory.
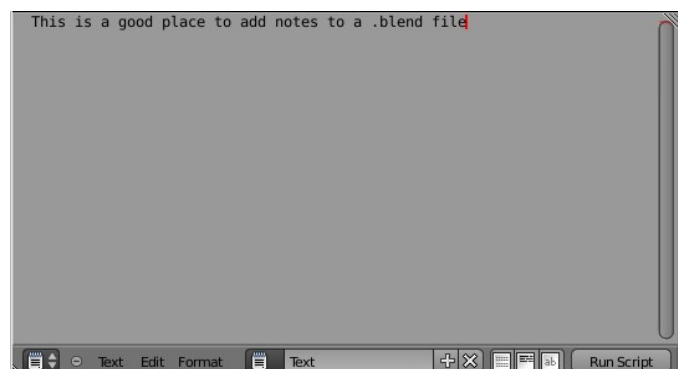
Add-Ons

In order to minimise some of the selection options in various parts of the Blender interface some features have been put aside in a repository. You could say they have been hidden away so we will tell you where to go looking if you cant find something.

These features are listed in the **Add Ons** Directory in the **User Preference Window** and may be activated and deactivated depending on what you are doing.

User Preference Window - Add-Ons
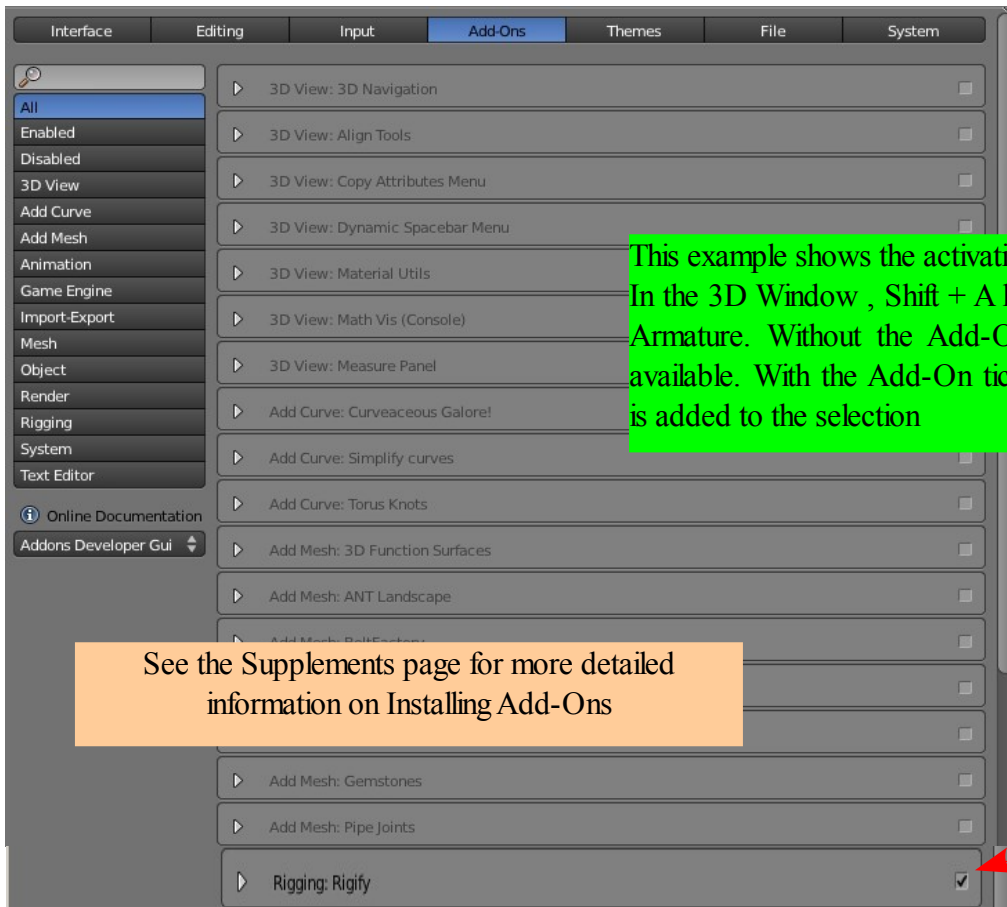
This example shows the activation of an Add-On. In the 3D Window , Shift + A key is pressed to add an Armature. Without the Add-On only 'Single Bone is available. With the Add-On ticked Human (Meta-Rig) is added to the selection

See the Supplements page for more detailed information on Installing Add-Ons

Rigging Rigify ticked to activate the Add-On
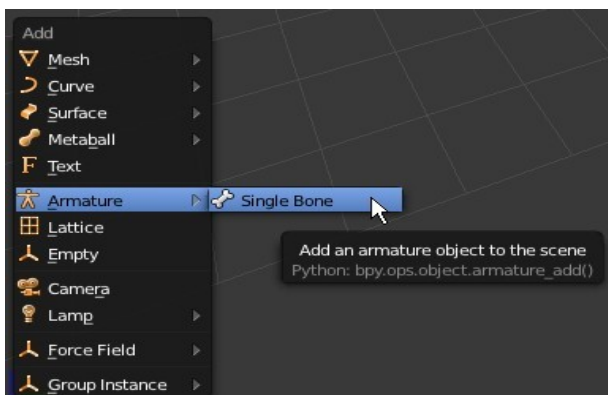
Add Armature before Add-On ticked
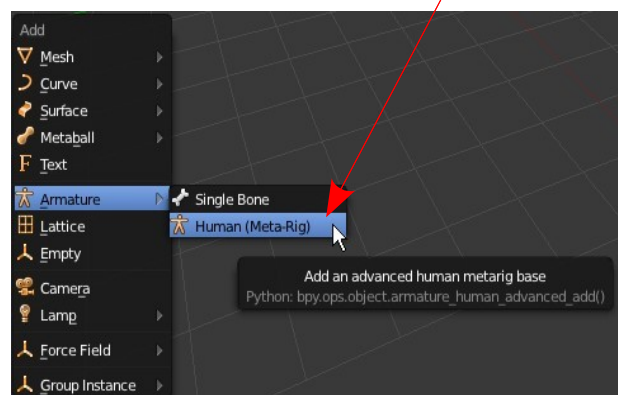
Add Armature after Add-On ticked

CH02- Navigation

01-Navigate & Save

02-Windows Explorer

03-The Append or Link Command

04-Packing Data

05-Importing Objects

Navigate and Save
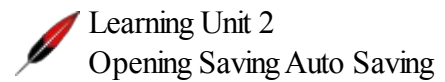
This section has been titled 'Navigate and Save' since it is most important to understand where you are saving your work. As with all computer work being organised will save you a lot of frustration down the track when you have created many files and want to find something. Blender is all about building up your own library of things that you have created or things that you have downloaded and want to use in future Blender masterpieces.

It is impossible to teach everything so we will assume that you know how to navigate around your computer system and create places where you store your stuff (If unfamiliar with this, see the section on Windows Explorer). In a Windows system 'Windows Explorer' is an invaluable tool for doing just that. It is recommended that you become familiar with your computers file system. At some stage you will want to save files, images, web pages, audio files and obviously your Blender files and movie files.

We will discuss how you navigate in the Blender File Browser and save your work to a location of your choice. The assumption is that you have created a file to save and a folder in which to save it. The creation of the folder is where Windows Explorer comes in. Sorry but I'm a Widows guy. (See the page on making a new folder in Windows Explorer)

As a demonstration we will use the default Blender scene with the Cube object, the Lamp and the Camera. I know that is not very exciting but we haven't learned to do anything at this stage.

Open Blender with the default scene. In the Info Window header click on 'File'.

In the drop down that is displayed you will see 'Save' and 'Save As':

Use 'Save' to save a new file or to save work you have added to a file.

Use 'Save As' to save a copy of a file. You will have to give this a new name if you are saving it in the same folder as the original.
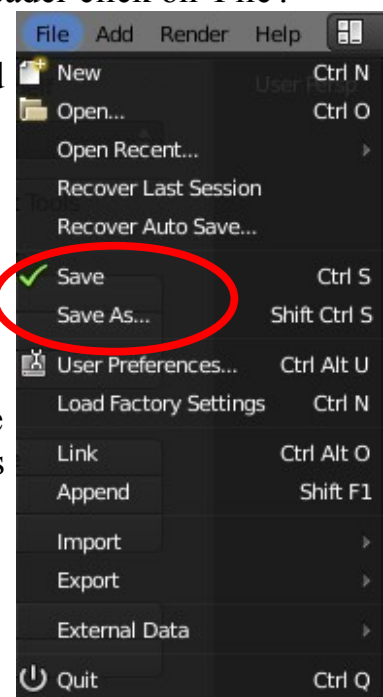
With our new default scene click on 'Save'. The Blender File Browser window opens with the option 'Save Blender File' in the top RH corner of the window.

Drives on my PC   FilePath   File Name
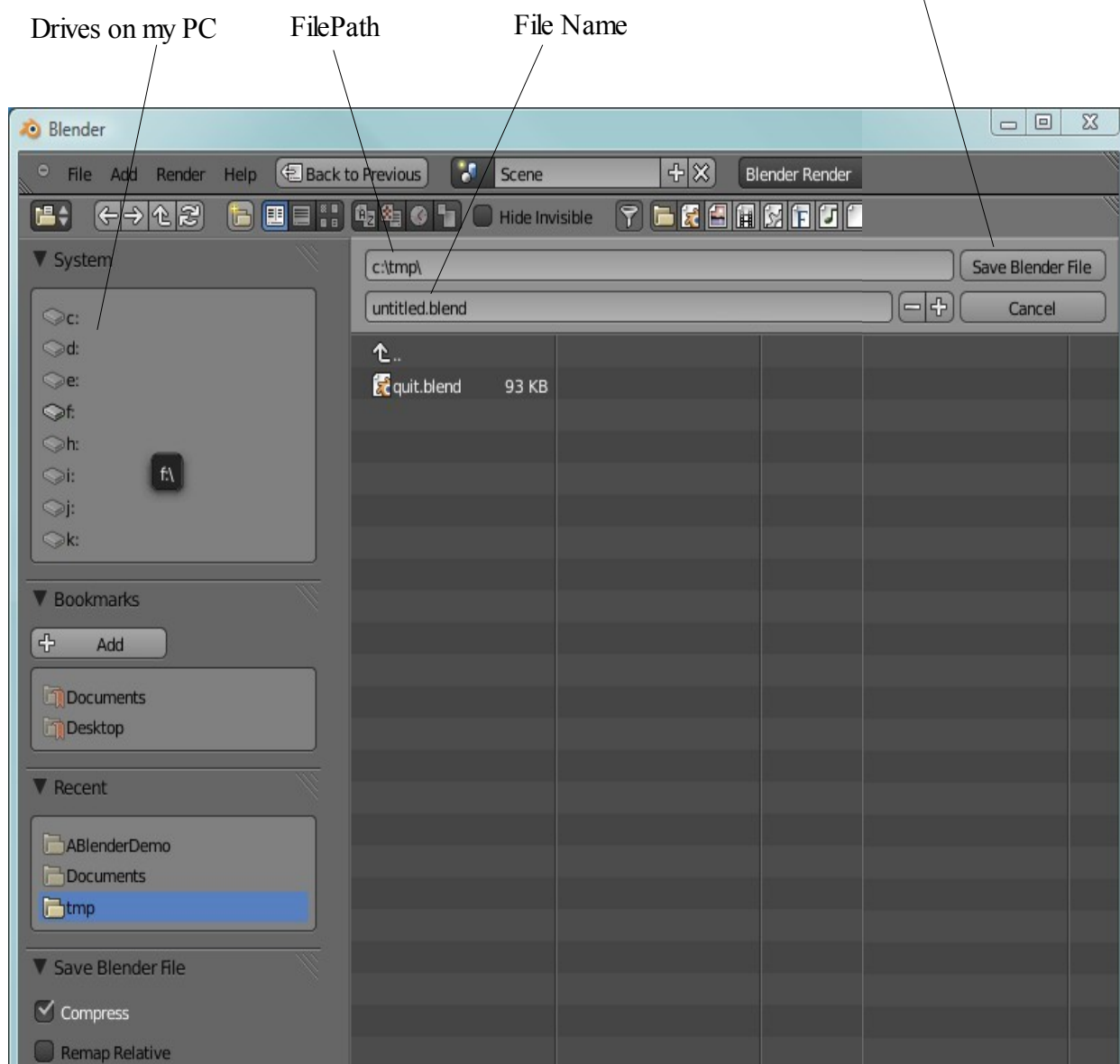
Where you see 'untitled.blend' is the name of your file. Blender automatically names the file 'untitled.blend'. Click on the name to highlight it, press delete on the keyboard then type in a new name and hit 'Enter'. I have named my file 'Demo.blend'. It is good practice to add the '.blend' suffix. Older versions of Blender did not automatically add the .blend suffix.

Just above where you have typed the name you will see the file path to where your file will be saved. On my computer this is 'c:\temp\'. Blender has automatically decided that if I do not say otherwise my file will be saved in the 'temp' folder on the 'c:' drive. You can see there is a previous '.blend' file already saved to this folder.
The 'temp' folder is not where I want my file to go.

I have made a new folder named 'ABlenderDemo' on my C: drive for this new file. To navigate to this folder I go into the System panel at the top LH side of the screen. In the panel you see all the drives on my computer listed, the top one being 'c:', the C: drive.
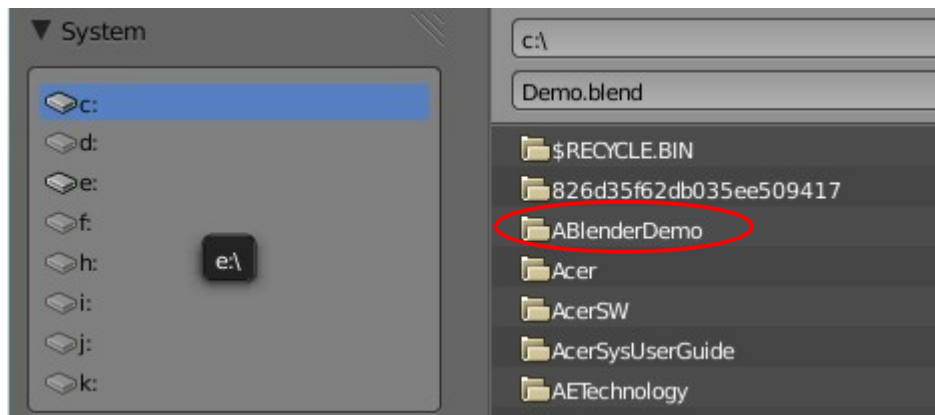
When I click on the 'c:' in the panel all the folders on my C: drive display in the main browser window. 'AblenderDemo' is third from the top of the list. Note that just above where I typed in my file name 'Demo.blend' 'c:\' is displayed. This tells me that I am looking at the 'C:' drive. To put my new file into 'AblenderDemo' I click on it in the window. The main window is now empty as it should be since I haven't put anything into it. Now I click on 'Save Blender File' at the top RH side of the screen. Blender displays the default blender scene again.

If you have followed these directions on your computer and want to prove that you have saved your file change the window type to the File Browser window. Click on the 3D Window header Icon and chose 'File Browser'. Hey! there we are 'Demo.blend' in the c:\ABlenderDemo\ folder.
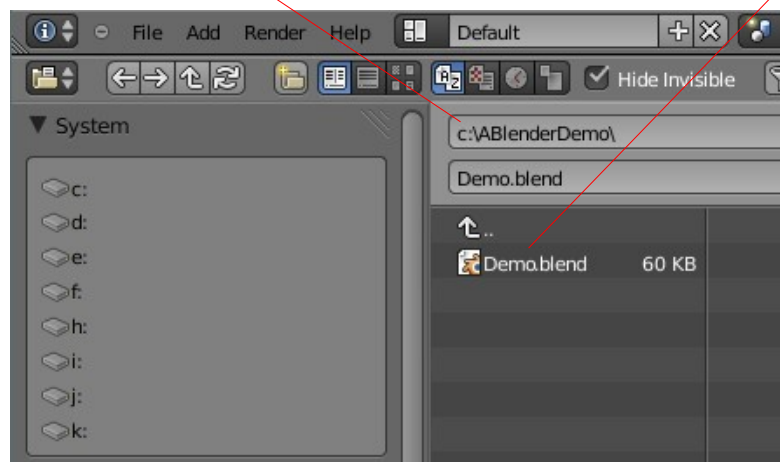
Note: In the Blender default 3D Window the 3D Window button/icon is in the lower left hand corner of the window in the window header. In the File Browser Window the button is in the header at the top of the window at the LHS.

That should keep us out of trouble for the time being as far as saving our work but it is a good idea to play around and find out what all the buttons in the File Browser window do. I know you will hit on one that says create a new directory and it does but Blender just names it 'New Folder' which isn't all that helpful. With 'New Folder' newly created press 'Delete' and retype a new name then press 'Enter'.

This has given a brief insight into navigating in the File Browser window as well as showing how to save your work. Of course you can use the File Browser to find other stuff as well. Just click on a folder in the window and it opens showing what's inside. There are some buttons at the top of the window which let you choose how the content's of folders are displayed.

Choose how files are displayed
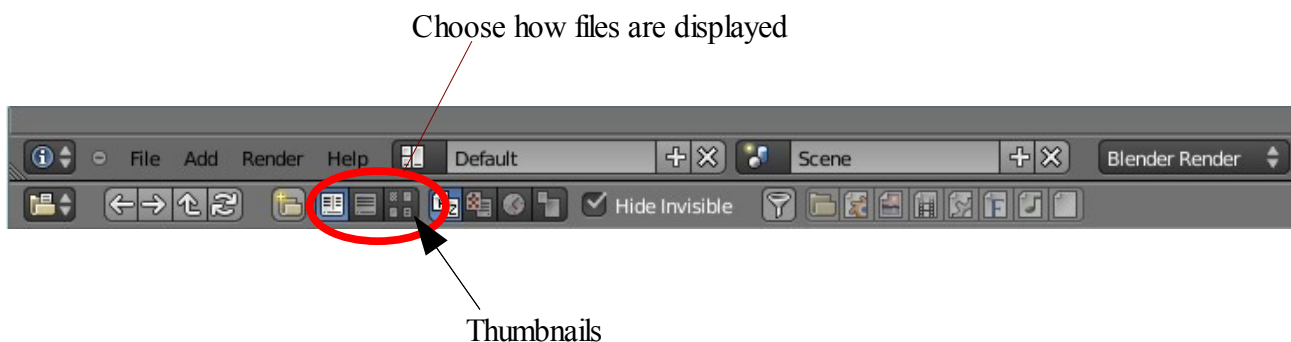
Thumbnails

One nice one lets you see files as thumbnails (pictures) so if you have photo images you can see them from within Blender.
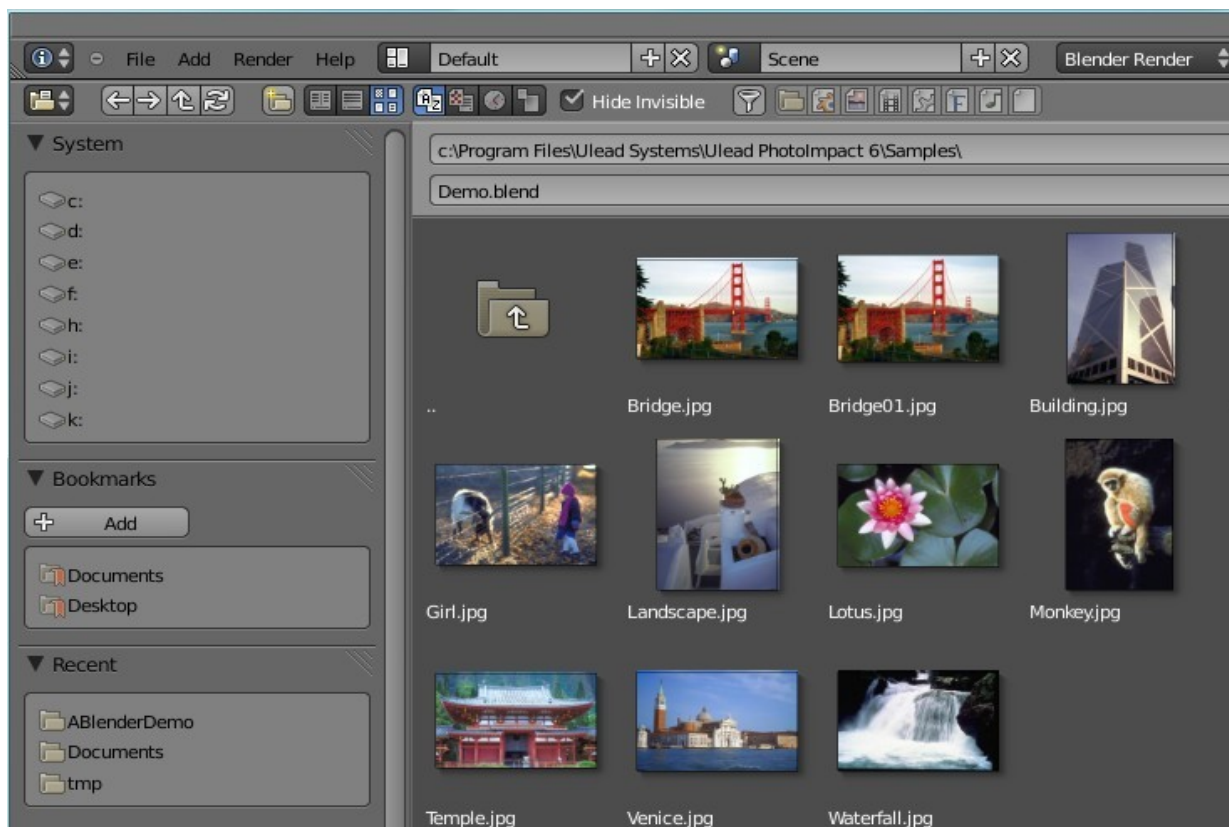
Windows Explorer

Lets make a folder where we can save our stuff.

Open Windows Explorer. There are several ways of opening Explorer depending on what version of Windows you are using. You can usually find the application by clicking the 'Start' button, clicking open 'All Programs' and going to Accessories. Windows Explorer is usually in Accessories. You could have a quick start icon somewhere else.

If your computer is like mine it persists in opening Widows Explorer showing my 'Documents' folder. You can save your stuff there but it will soon accumulate and get all mixed in with your letters to Grandma and the Tax Man. This is not a good thing.
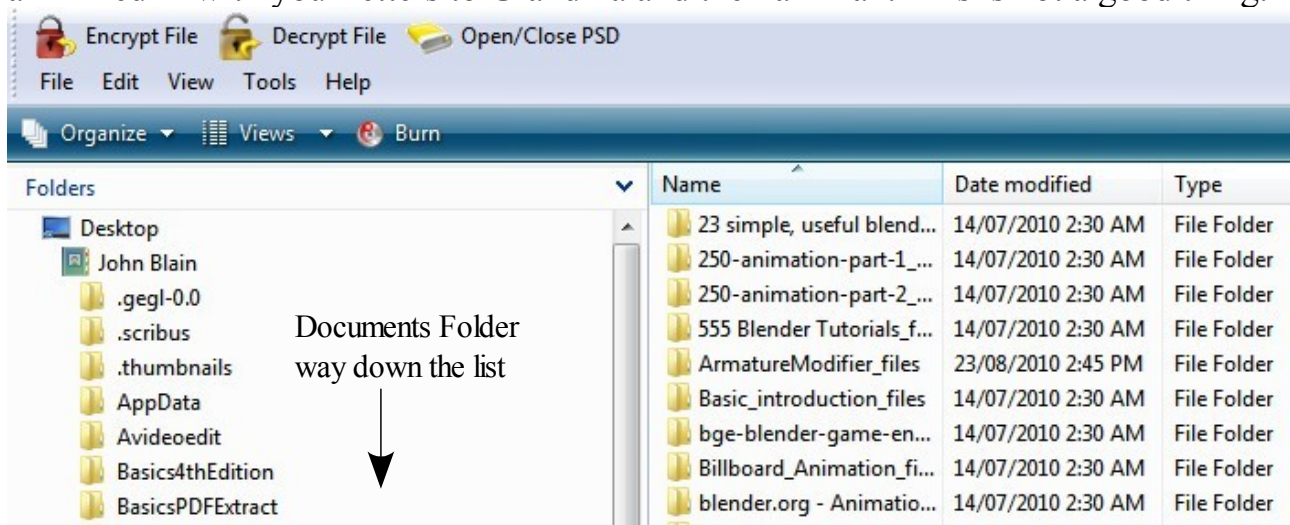
We will make a new folder in the C:\ drive. Close the folder list and get back to the basic directory.
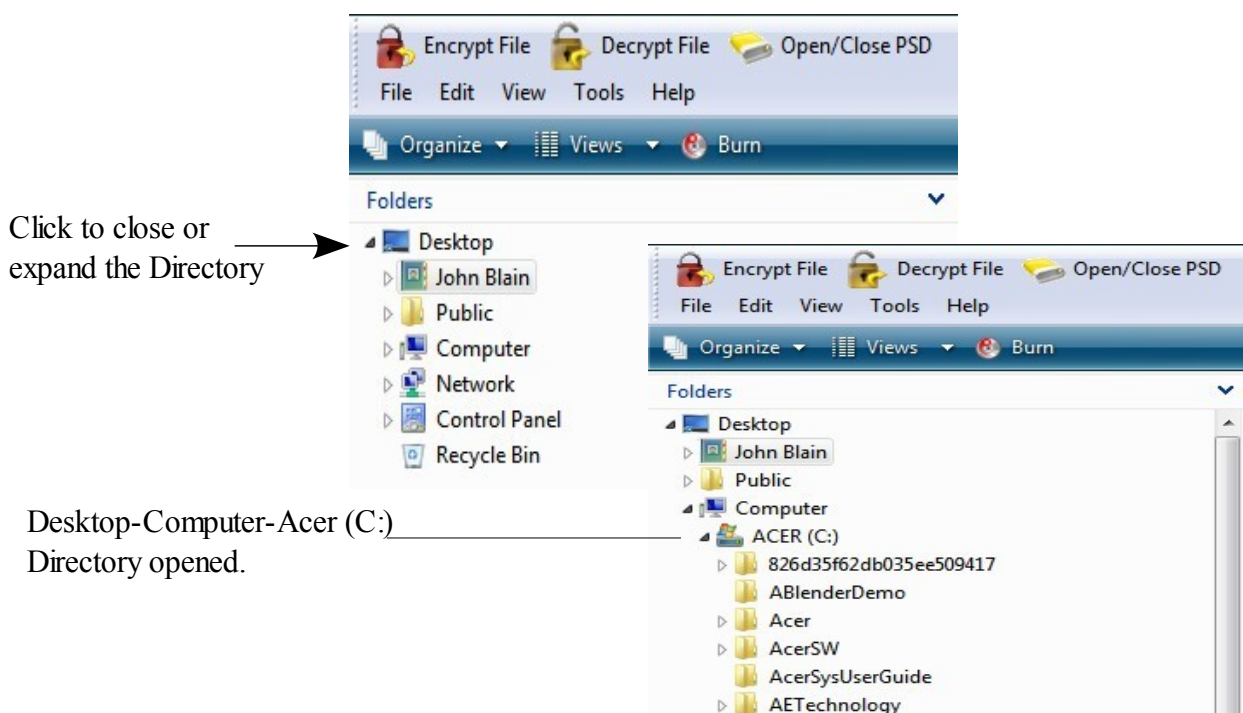
Right click on your C:\ drive and in the drop down that displays click on 'New' and then click on 'Folder'.
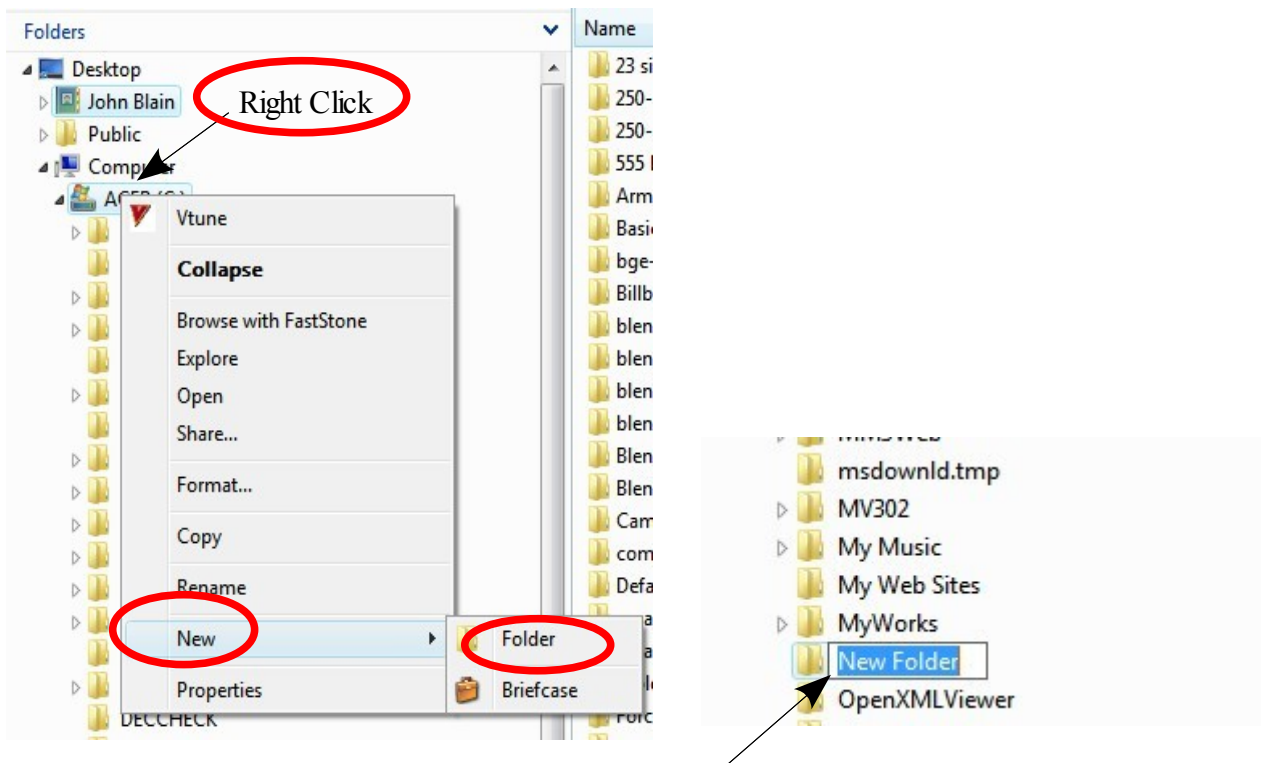
Windows enters a new folder and names it **'New Folder'**. At this stage you can edit the name. Press 'Delete' to delete 'New Folder' and type in your new name. I have named my folder 'ABlenderDemo'. I have put the 'A' at the beginning of the name so that Windows will put it at the top of the directory list. If I named it 'Xanado' it will go way down the bottom (Alphabetical Order). When you have typed in your name press 'Enter' and way you go you have a new folder.
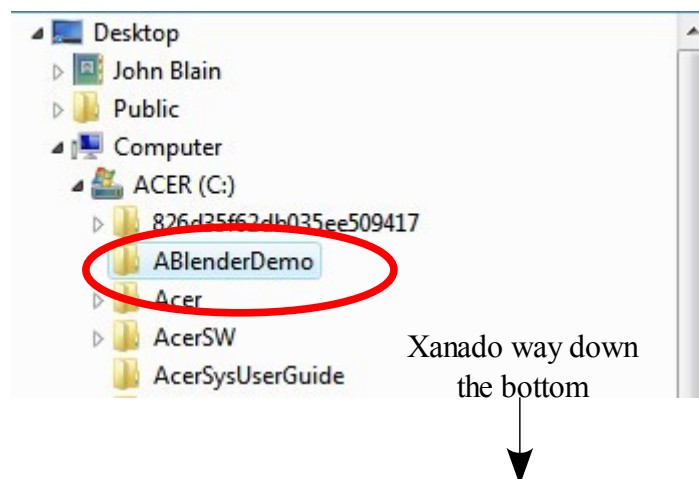
IMPORTANT: Remember your name and where it is. This makes life easier later on.

The Append or Link Command

When you want to insert elements from one Blender (.blend) file into another, you select the Append or Link command from the file pull-down menu in the Info Window header.

Append takes data from an existing file and adds it to the current file. Link allows you to use data in an existing file in the current file but the data remains in the existing file. The data can not be edited in the current file. If the data is changed in the existing file the changes show in the current file the next time it is opened.

Selecting 'Append' or 'Link' opens the File Browser Window allowing you to navigate to the Blender file you wish to select elements from. You can append anything from cameras, lights meshes, materials, textures, scenes and objects. For most purposes, use the Object option. By appending objects, any materials, textures and animations that are linked to that object will automatically come in with it. Left Mouse Button (LMB) clicking on an object will select it. Pressing A Key will deselect. After you select your objects to append, click the 'Link/Append from Librarary' button in the upper right corner of the screen.

Folders in C: drive
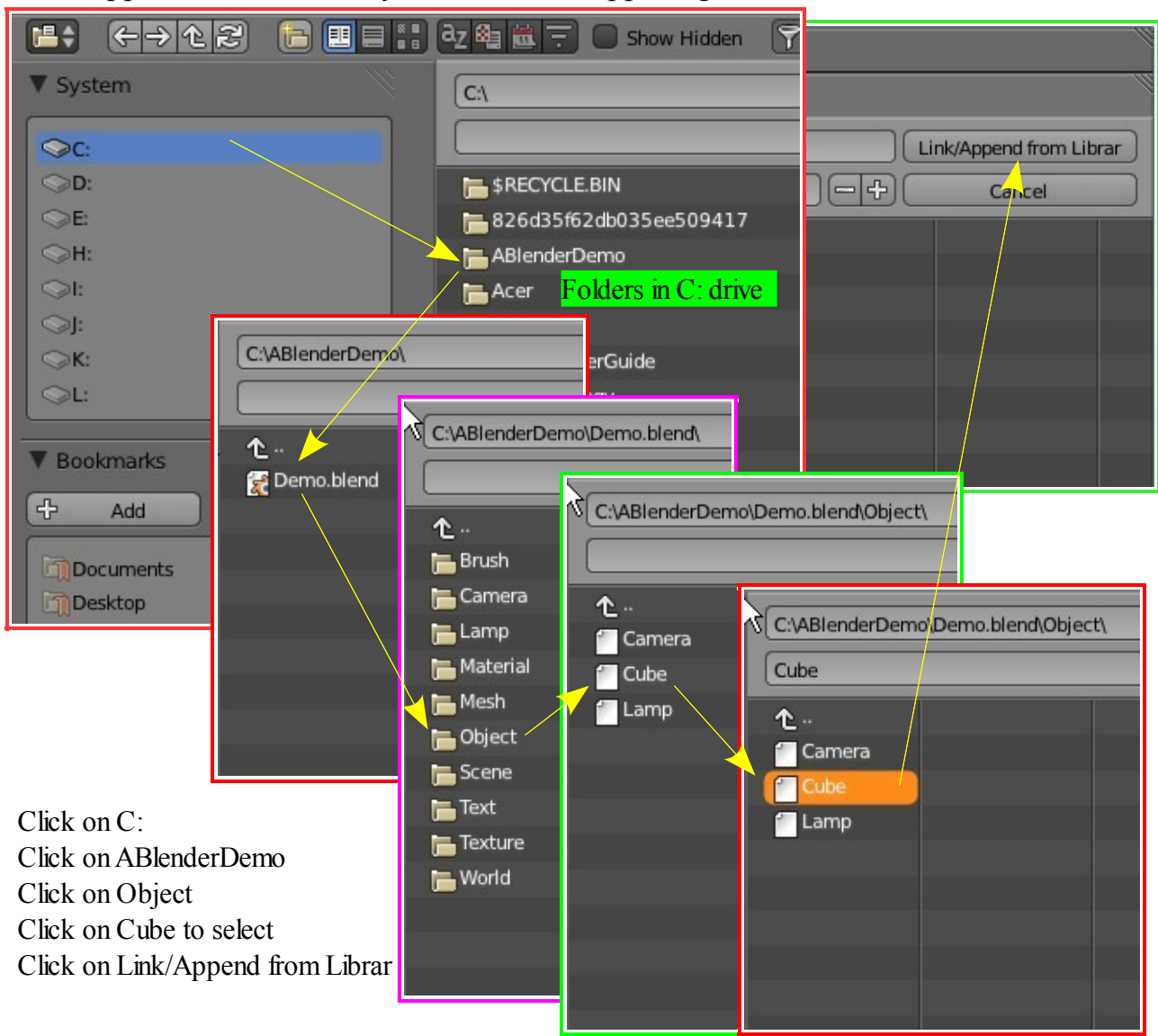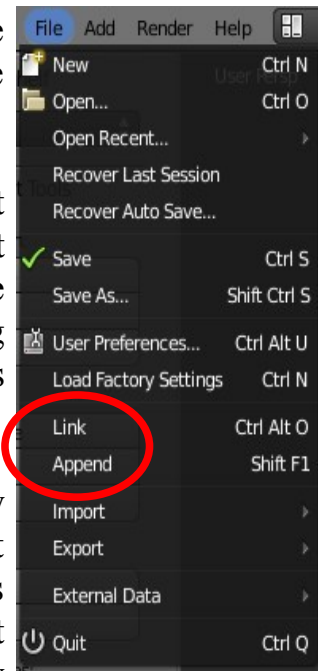
Click on C:
Click on ABlenderDemo
Click on Object
Click on Cube to select
Click on Link/Append from Librar

Packing Data

If you plan to open a Blender file on other computers, you will need to select the 'Pack into .blend file' option in the file menu under 'External Data'. Textures and sounds are not automatically included in your Blender file in order to keep the file size down. Every time your file opens, it looks for the textures and sounds and places them into your file. If it can't find the files, you won't have any textures and sounds. If you pack data, those files are included with the .blend file so they can be opened anywhere. Remember, your file size may become very large. When data is packed, a small package shows up on the top of your screen letting you know that the file is packed. You can also unpack data to bring the file size back down.
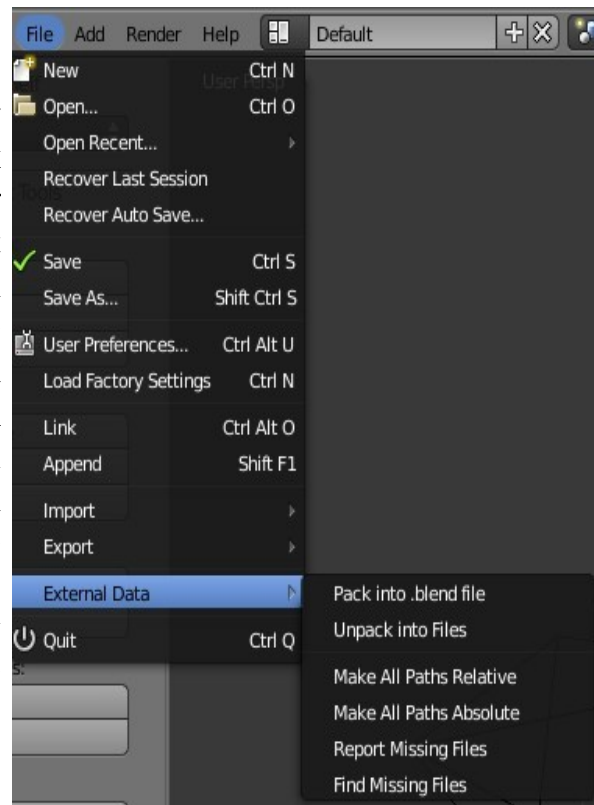
Importing Objects

One of Blender's strong points is the program's ability to accept several generic types of 3D files from other programs. Two examples are:

> The .mxh file format used by the **Make Human** program which creates models of the human figure.

> The .dxf file format used by the **Elefont** program which creates 3D solid text models.

Both the Make Human and Elefont programs are freely available.

Other programs save files in one format but also give the option to export in another format. You will have to find the 'Export' command in the program and match up the file type with one of the file types in Blender's Import Add Ons.

With every new release of Blender, the import/export format options list changes. This makes Blender compatible with a variety of other 3D modeling and animation software programs.

Note: There are only a few file type options shown in the default selection menu. MXH and DXF are not shown. To conserve space in the GUI Blender has limited the file type display. MXH and DXF as well as several other file types are available as 'Add-Ons' in the User Preference Window.

To import a MXH or DXF file into a Blender scene open the User Preference Window and click on 'Add Ons' at the top of the window. In the list at the LHS of the window select 'Import Export'. A shortlist of the Import Export file types will display. Find the file type you require and place a tick in the box at the RHS of the panel. The ticked file type will now be available in the <u>Info Window</u> – File – Import selection drop down menu.

Note: When importing Blender files into other Blender files, remember to use the Append command instead of Import. In the Append command, select the file, then select what you would like to bring into the current file. You will usually want the "Objects" option.

AddOns in User Preference Window

.dxf file format ticked

Import .dxf file format added to the Import selection menu.

CH03- Create Edit Object

Working with Basic Meshes
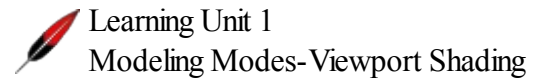
Now that we know how to move around in Blender, let's start doing some basic building and shaping. In this section we will talk about creating basic shapes and using modifiers to form them. There are a lot of different types of things to make in Blender. Right now we will only discuss Meshes.

Start a new scene in Blender and save it in your 'Documents' folder. Name it something meaningful and write down the name . You can save your work wherever you like as long as you remember what you named the file and where you saved it. In Windows the 'Documents' folder is usually accessible from the Desktop so its easy to find. Its best to be familiar with saving and creating files and folders so go back and read the section on that subject. Yes! I know I said not to mix things up with your letters to Grandma bu the Documents folder is easy to find.

Note: Blender will not prompt you to save you file when exiting the program. Remember to always save your work often! Don't forget the .blend suffix.

Placing Objects On The Screen
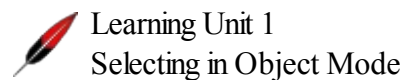
The 3D Cursor's location is used to place new objects. Click with the Left Mouse Button where you want your Object located and the 3D Cursor locates to that position. When you have it in a good location, press Shift + A Key to bring up the insert menu. Select Add, then Mesh and select UV Sphere.

Note : We previously stated that we were discussing Meshes. An Object in Blender is a Mesh Object. Think of a sphere made out of chicken wire or fishing net and you get the idea. A sphere in Blender has a mesh with vertical and horizontal divisions called segments and rings. Vertical segments like the inside of an orange and horizontal rings. The default UV Sphere has 32 segments and 32 rings. You can change these by altering the values in the panel at the bottom of the Tool Shelf which displays when you add the Sphere to the scene. You can keep it at 32.
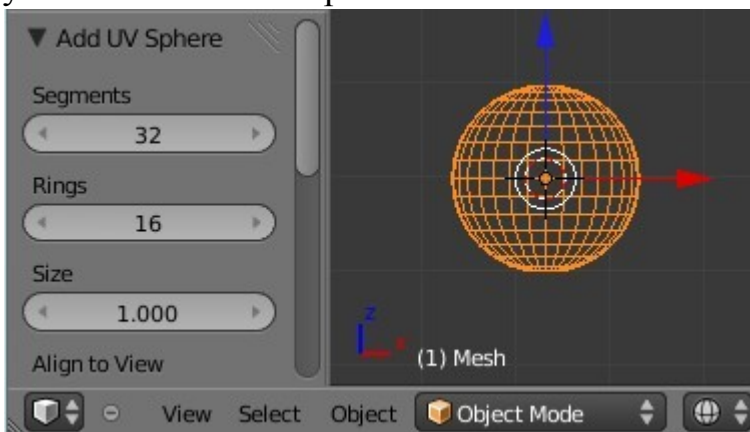
Note: Once the Sphere object is deselected in the window or translated or scaled the options to change the rings and segments in the Tool Panel is lost. Make sure you change these values before moving on.

Window Modes

Edit Mode and Object Mode

When you place an object in Blender, it comes into the scene in Object Mode and is selected as shown by its orange outline. There are basically two states in Blender, Edit Mode and Object Mode. Edit mode is intended for modifying the shape of the object by selecting vertices on the object. Vertices are the joining points of the mesh. Object mode affects the object as a whole. The Tab Key toggles you between the two modes.

Vertices
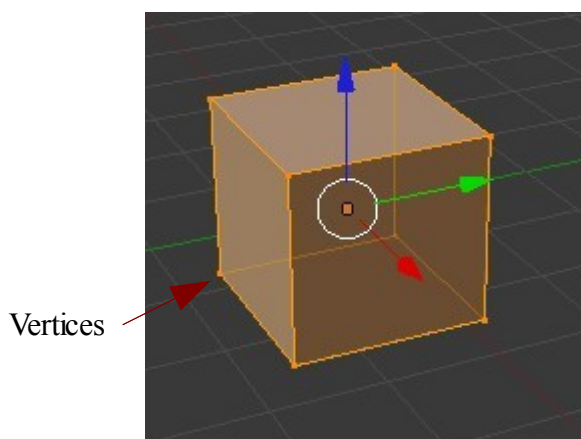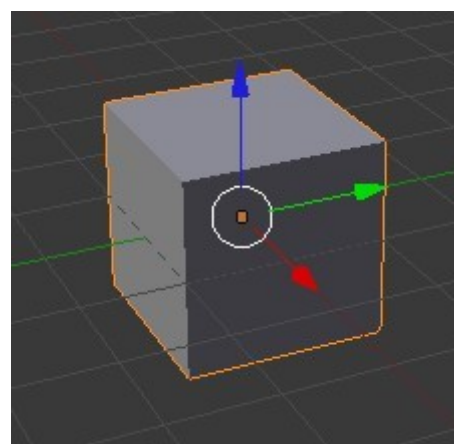
Edit Mode   Object Mode

Before entering a new object into your scene make sure any other objects are not in edit mode otherwise the objects will be joined.

Another way to switch between modes is to use the Mode selection drop down in the window header. You will see that besides Object and Edit there are other modes available.

Window Modes

In our diagram showing the UV Sphere with segments and rings the Sphere was drawn in <u>Wireframe</u> display mode (Viewport Shading).

Display Modes
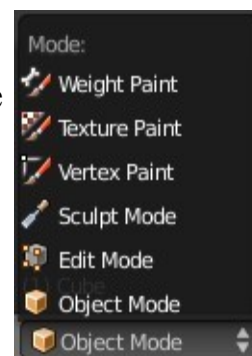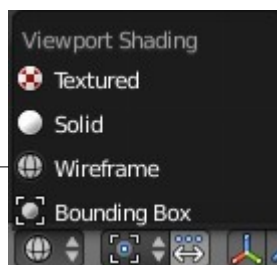
The default display mode is Solid. Other modes are accessed from the drop-down in the window header.

Mesh Types

Press Shift + A Key to reveal Mesh types selection menu. Mesh types (Primitives) available are shown below.

3D Manipulator shown on Circle Object

Plane
Cube
Circle
UV Sphere
Icosphere
Tube
Cone
Grid
Monkey
Torus

Mesh Types Venue
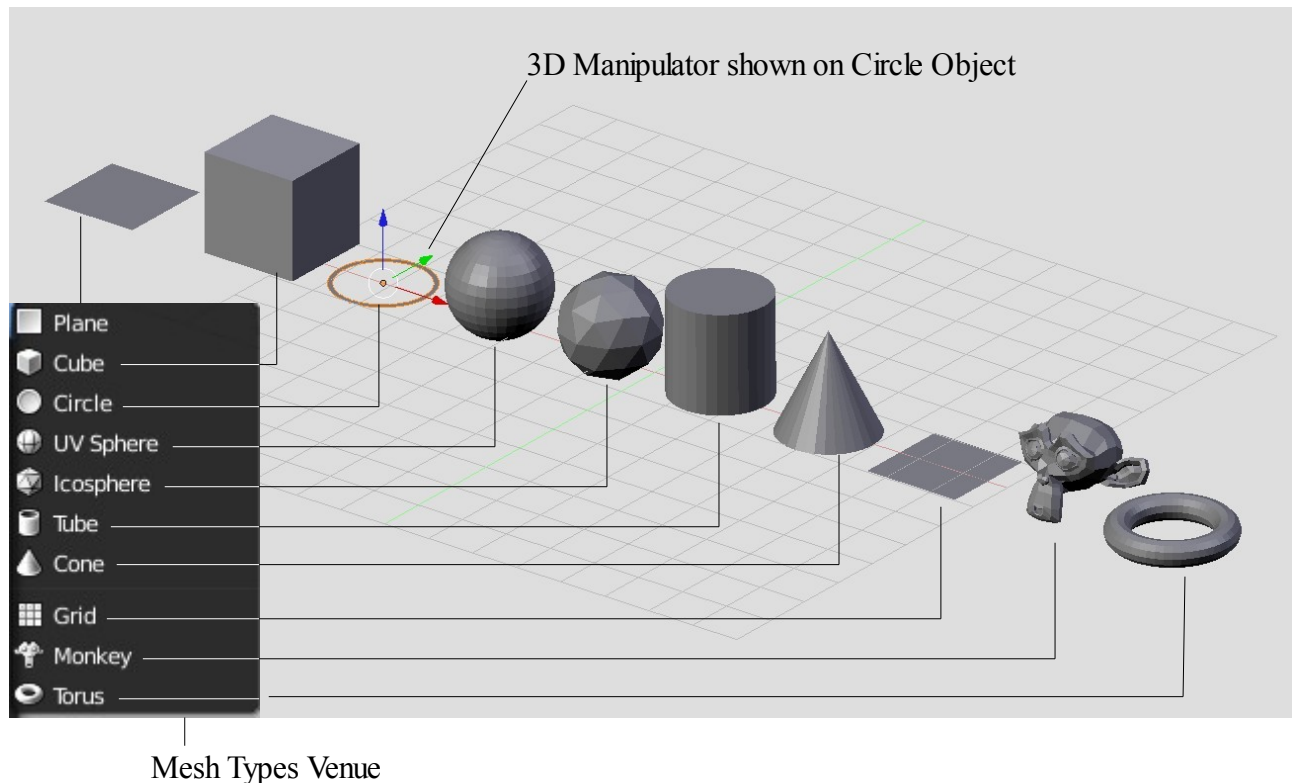
Primitives are basic shapes from which you can start modeling.

Precise 3D Cursor Placement

To precisely place the 3D cursor, use the **Shift + S Keys** for options to move the cursor to objects, grid etc.

Snap
Selection to Grid
Selection to Cursor
Selection to Origin

Cursor to Selected
Cursor to Center
Cursor to Grid
Cursor to Active

Learning Unit 2
Undo / Redo

Adding Mesh Objects in Edit Mode

Naming Objects

Deleting Objects

Learning Unit 3
Duplication
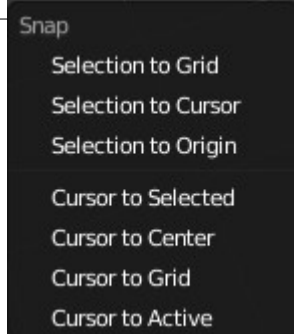
Moving a Mesh Object

The three basic controls for moving an object are: **G Key** (Grab), **S Key** (Scale), **R Key** (Rotate).

To move an object freely in the plane of the view press the **G Key** with the object selected and drag the mouse.

To lock the movement to a particular axis press
G Key + X , Y or Z

Movement locked to
the X axis
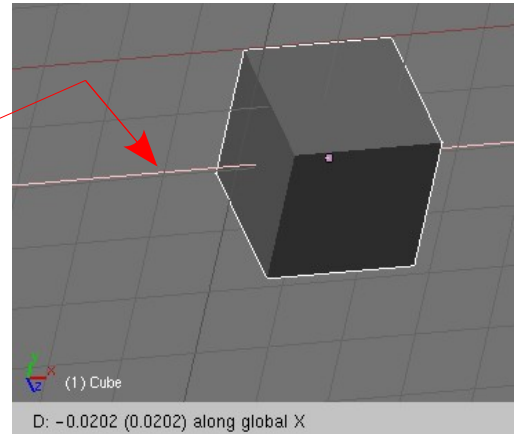
Scaling an Object

To scale an object freely press the **S Key** and drag the mouse.

To lock the scale to a particular axis press
S Key + X, Y or Z

Scale locked to
the X axis
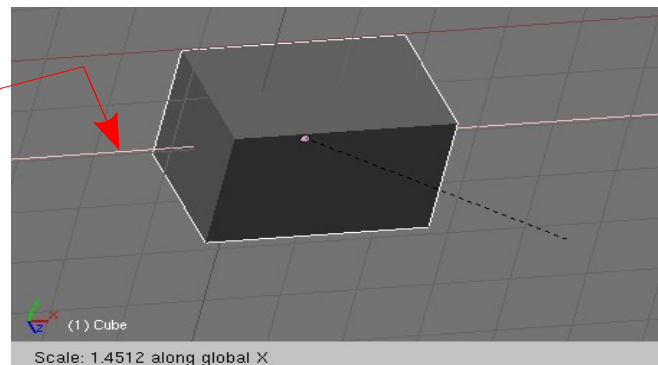
Rotating an Object

To rotate an object press the **R Key** and move the mouse about the objects center.
To lock the rotation to an axis press
R Key + X, Y or Z

To rotate a set number of degrees press **R + 30** rotates the object 30 degrees.
R + X + 30 rotates the object 30 degrees about the X axis.

Learning Unit 1
Moving Objects

Blender Grid – Units – Scale

X Y and Z Axis

Rotating Objects

Scaling Objects

Precision Manipulation of Objects

To manipulate an object in the scene to a precise location, scale or angle of rotation alter the values in the object data numeric panel. By default the panel is hidden in the 3D Window. The **N Key** toggles hide and display. The panel displays at the RH side of the 3D Window and the values therein are pertaining to the object selected in the window.

Tool Shelf - T Key toggles hide display

Numeric Panel – N Key toggles hide display

Numeric values for the Cube object
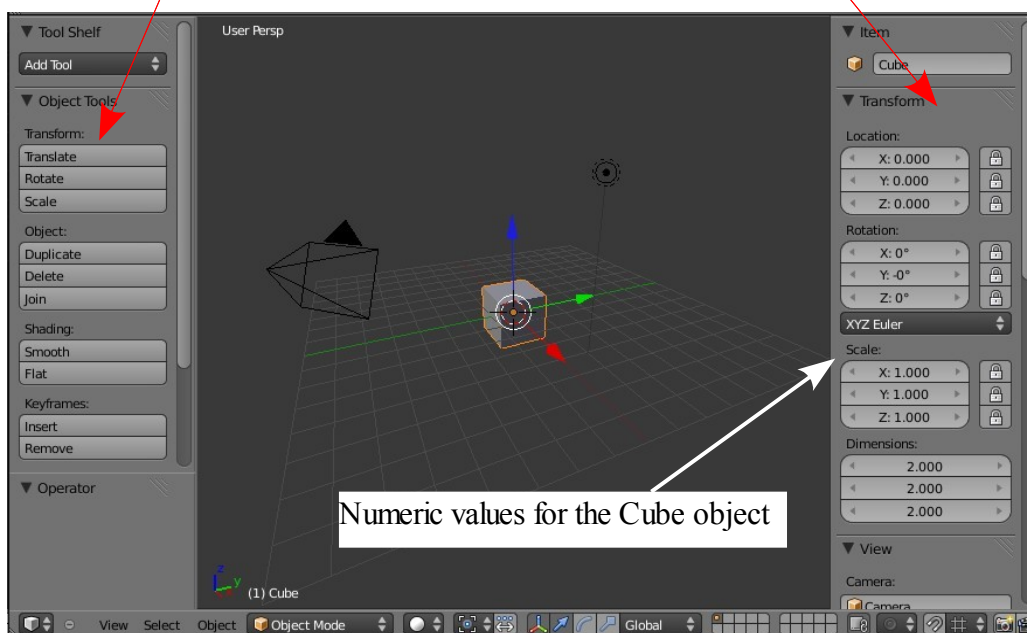
To change a value in the numeric panel:

Click on the value LMB – Press Delete – Retype Value – Press Enter
or
Repeatedly click on one of the little arrows either side of the value.
or
Click and hold LMB in the value box and drag the mouse right or left.

Snap and Align Tool

Sometimes it is desirable or essential to accurately position the object or your cursor to a center or grid location. Blender provides a quick shortcut tool for performing these operations. You can view the options from a drop down in the 3D Window header. Click on 'Object – Snap'. Alternatively you press 'Shift + S Key' to display a selection panel. The selection menu is self explanatory.
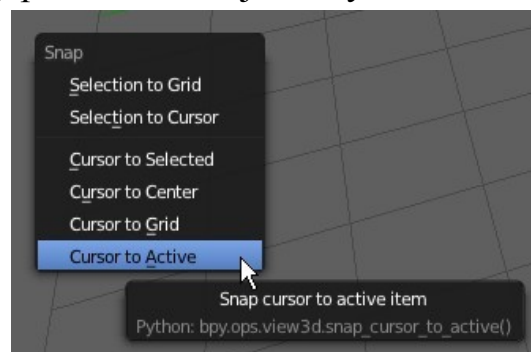
The Transformation Widget

The transformation widget is a handy way of performing the manipulation operations of the G, S and R Keys described above. By default the widget is displayed in the 3D Window in Grab mode.

Clicking on the red, green or blue handles (Arrows, Ring) with the LMB and holding while dragging the mouse moves the object in the window. The widget sometimes obstructs the view but it can be turned off in the window header. As well as turning off the widget, rotate and scale modes are accessed in the window header.
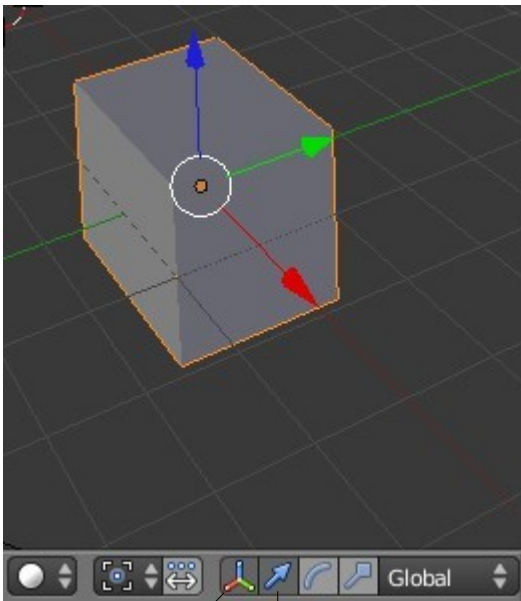
G Grab Mode

Toggle Widget On- Off
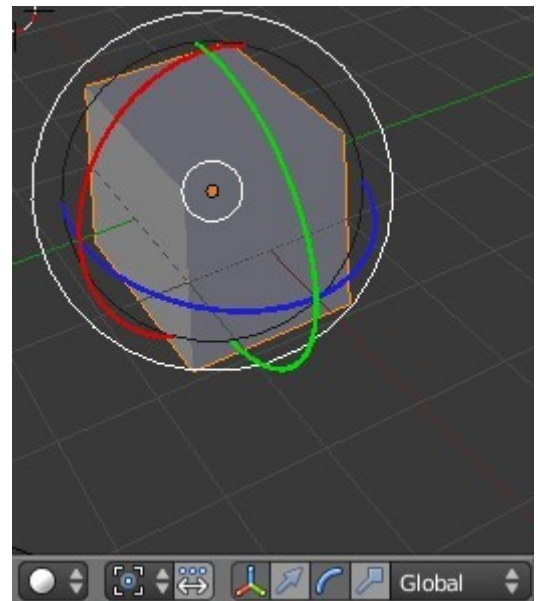
R Rotate Mode
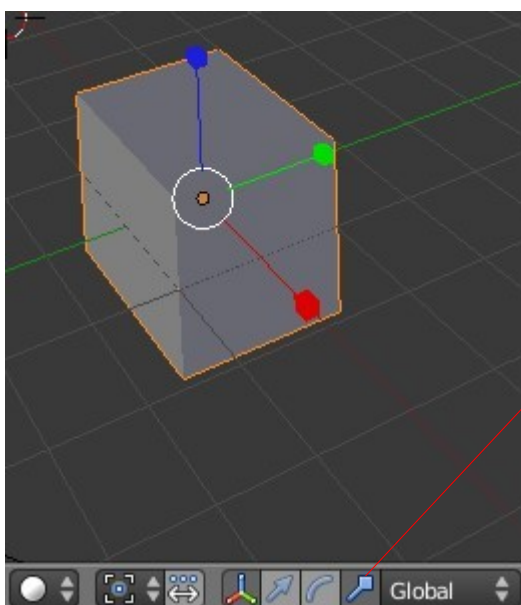
S Scale Mode

Learning Unit 2
Global & Local Orientation

Center Point (Object Origin)

Pivot Points

Mesh Vertex Editing

After you have added a mesh to your scene in Object Mode, you can go into Edit Mode (Tab key) and change its shape. In Edit Mode, you can work with the shape's individual vertices (mesh intersections) to create the shape you want. You know you're in Edit Mode when you see orange lines and dots on the selected object. When you tab into Edit Mode the whole of your selected object is in Edit Mode with all the vertices selected. By default Edit Mode is in Vertex Select Mode.
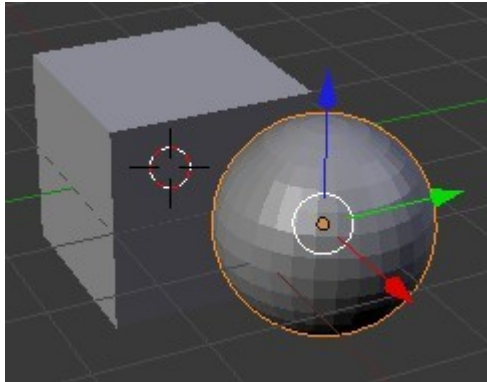
Object Mode
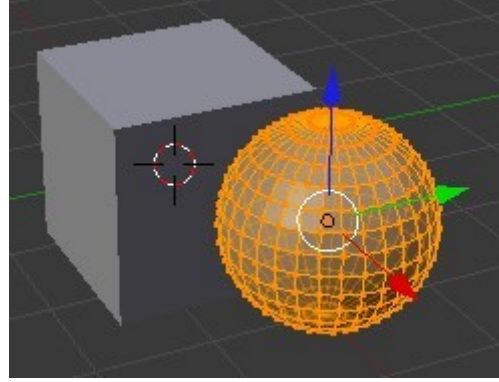
Edit Mode

Selecting Vertices:
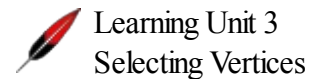
Learning Unit 3
Selecting Vertices

While in edit mode, to select a single vertex, first press A Key to deselect all the vertices. In Edit mode this does not deselect the object, only the vertices. RMB click on a vertex to select it. To select multiple vertices, hold down the Shift key while RMB clicking on them. You can also drag a window around vertices. Press B Key(Box Select) and drag a window to select a group of vertices. Pressing C Key will bring up a circular selection tool. Holding the LMB and dragging the circle selects vertices on the move. The circle can be sized by pressing the + or - Keys on the Number Pad or scrolling the center mouse wheel . Pressing Esc will get you out of the circular selection tool. In order to select all vertices or deselect currently selected ones, press the A Key (for all) once or twice.

Edit Mode Selection Options
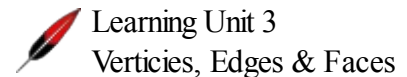
Learning Unit 3
Verticies, Edges & Faces

By default, in Edit mode, the selection mode is **Vertex**. You can also select **Edges** or **Faces**. These options are available in the window header.
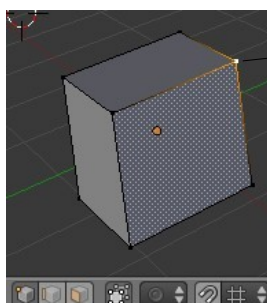
Vertices
Selected

Vertex
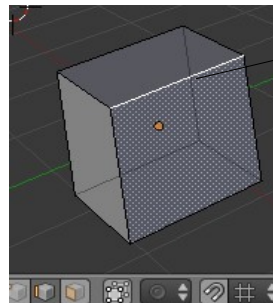
Edge
Selected

Edge
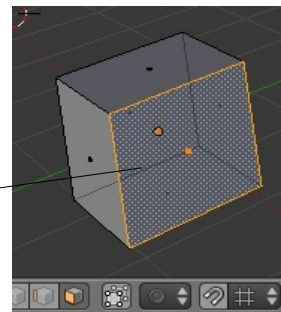
Face
Selected

Face

Also by default only visible vertices or faces are available for selection. This means that you can only select the vertices or faces on the front of an object. Blender has a **Limit Selection to Visible** function which means that with this activated you can only see the front surface and only select vertices or faces on the front. This function is toggled on off in the window header.

Background Not
Shown
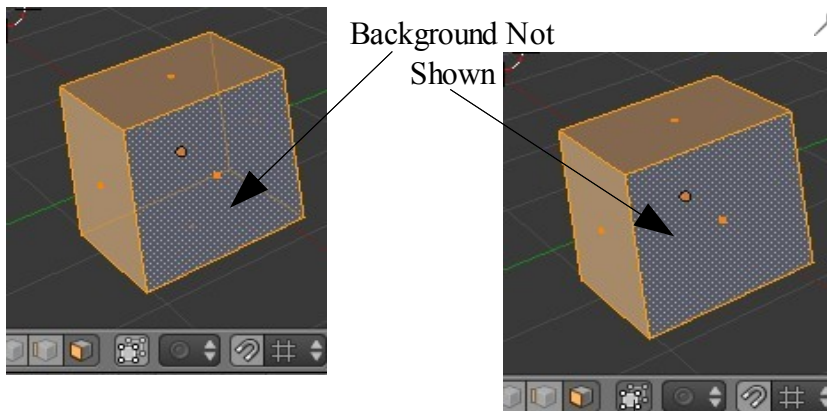
Box selecting faces with the **Limit Selection to Visible** ON will only select the front three faces of the cube.

Toggle Limit Selection to Visible On/Off

Creating More Vertices:

Add:
Extrude Region
Extrude Individual
Subdivide
Loop Cut and Slide
Duplicate
Spin
Screw

Sometimes you need to add more vertices to some or all of the mesh in order create detail. To do this, you must first select all the vertices in an area that you wish to add vertices to, then go to the Tool Shelf at the LH side of the screen (T Key toggles hide-display) and find the Subdivide button. Click it as many times as you need to divide the area selected.

Specials
Subdivide
Subdivide Smooth
Merge...   Alt M
Remove Doubles
Hide   H
Reveal   Alt H
Select Inverse   Ctrl I
Flip Normals
Smooth
Shade Smooth
Shade Flat
Blend From Shape
Shape Propagate
Select Vertex Path
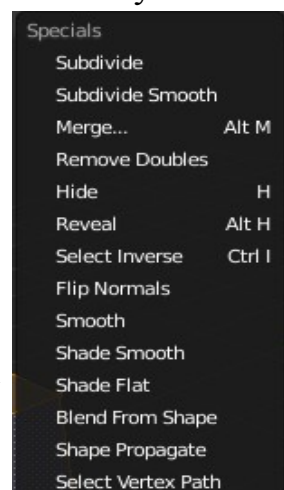
Specials Menu:

In edit mode, pressing the "W" key will bring up a shortcut menu that will give you a variety of editing options. Most of these options can also be selected in the Tool Shelf.

Center Points:

Object Center

3D Curser
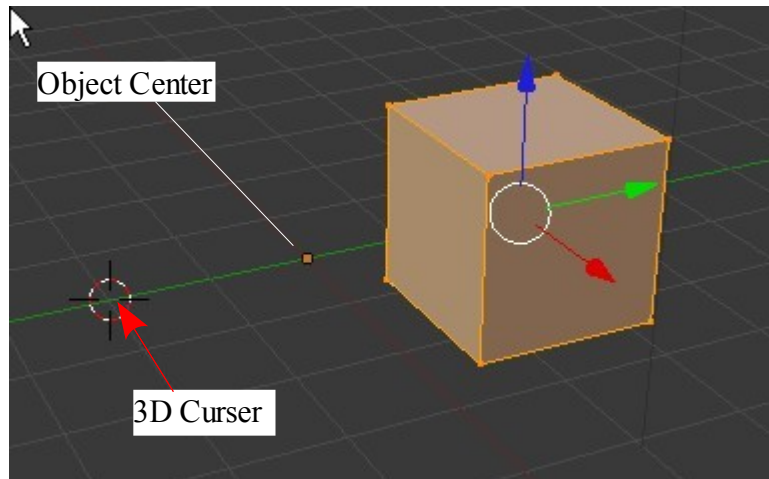
Vertices moved
away from the
objects center in
Edit mode

Learning Unit 2
Center Point (Object Origin)

Every object you create in Blender has a small dot somewhere in the center (by default, usually in the center of geometry of that object).This is the object's center, or pivot point. Beginners in Blender often get these center points moved around to locations other than where they want them. This happens because they move all the vertices of the object in Edit Mode, but the center point fails to move. If you want to move an entire object, hit tab to get out of Edit Mode and into Object Select Mode. Using the G Key to move the object in Object Mode will move the center point along with the object. If you ever need to relocate an object's center point, move the 3D cursor to the desired center location.
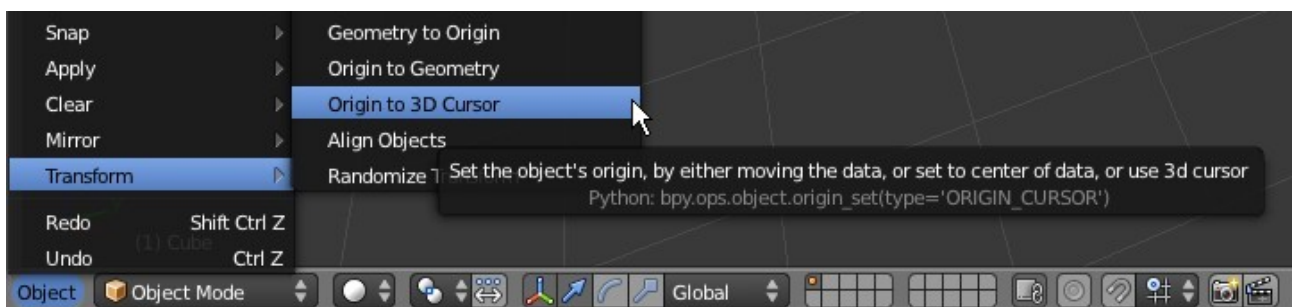
In Object mode click on 'Object' in the window header then 'Transform' then 'Origin to 3D Cursor'. This will move the center point to the cursor. Now repeat the process selecting 'Geometry to Origin' which moves the vertices to the center.

Object Display - Shading:

Viewport Shading Selection

Usually by default, the selected object in the window is set to Solid Shading. Many times, you will need to work with your objects in Wireframe Mode. All shading does is change the way you see your objects. Shading also affects the way you can select vertices in Edit Mode. In Solid Shading, only visible vertices can be selected. In Wireframe, all vertices can be selected. To change between Solid and Wire modes, press the Z Key or select the shading mode from the header toolbar. You will notice several other shading options in the menu. Experiment with the other options.
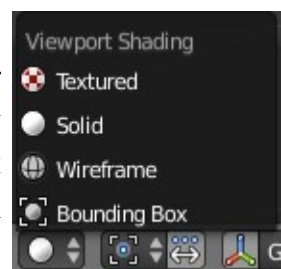
Using the Shading Smooth and Flat Options

As you add objects and view them in Solid shading, you will notice that circular objects are not being displayed smooth. In the Tool Shelf you will see two buttons under the heading **Shading**. Clicking these smooths or reverts to flat shading. These buttons not only effect the way things look on the screen, but how they will be rendered in a final image. Be aware that the appearance of objects on the screen are not displayed at the same

Smooth   Flat

quality as a final rendered image. The computer needs to conserve memory because 3D applications can be very memory intensive on your computer. There are other smoothing options available in the Tool Shelf .
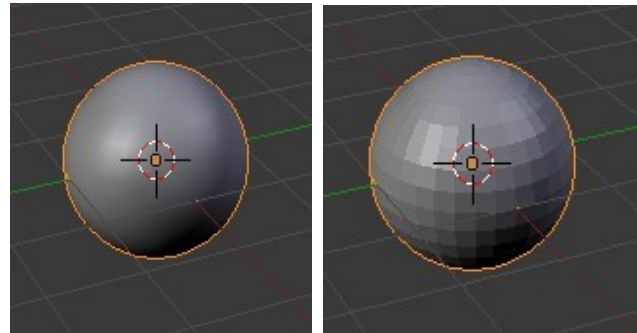
Extruding Shapes:

Shapes can be altered by selecting vertices (RMB Clk, B Key or C Key), either a single vertex or group of vertices, then G Key to move the vertices, S Key to scale or R Key rotate. Clk LMB to leave them in position. Scaling and rotating are however relative to the objects center. G Key, R Key and S Key are the basic modifiers.

A more refined method of altering a shape is by extrusion. Select the vertices as above. Press the E Key. The selected vertices are duplicated and by default placed into grab mode ready to be moved. Also by default the movement is confined to a line normal to a plane defined by the selected vertices. This line displays on the screen. Moving the mouse moves the vertices along the line. If you want to freely move the vertices Clk MMB (Middle Mouse Button) and then move the mouse. The vertices will follow wherever you go. You can constrain the extrusion to the X,Y or Z axis of the scene by pressing E Key + X, Y or Z. by Clicking LMB when you have finished moving releases the vertices from grab mode but they remain selected. You can now rotate them and scale them but in this case the rotation and scaling takes place about the mid point of the selected vertex group.

Original Cube

Extrusion Rotated
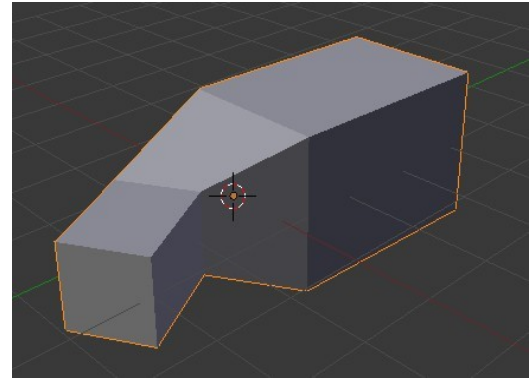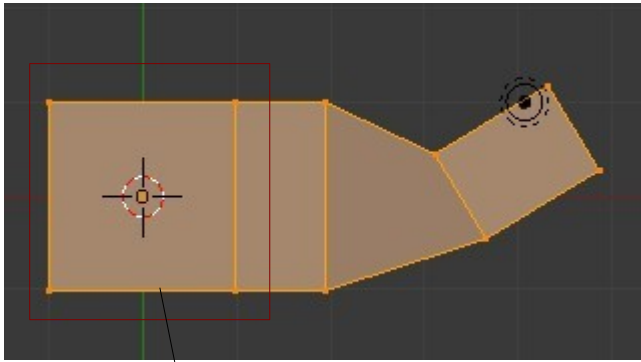
The forgoing is an example of a cube, extruded from the right side several times using scale and rotate.

Basic Extrude is a great command for making long tubes and tunnels. It is also good when you don't want to subdivide an object too much in order to add detail.

Proportional Vertex Editing:

Proportional Vertex Editing is used to create a flow in the shape when editing vertices. To turn proportional vertex editing on, press the O Key while in edit mode or by selecting the small circle button on the toolbar.

Note: you will only be able to select this option while in edit mode.

Learning Unit 8
Proportional Editing
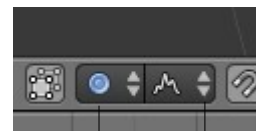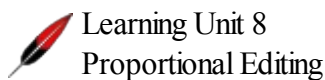
Turn Proportional Editing On / Off ————

Select type of Fall Off

You have several options for effecting vertices in proportional editing. We usually use Sharp or Smooth fall off, but feel free free to experiment with the other options.

Creating Ground

You can use proportional vertex editing to create landscape easily. The first thing you need to do is create a plane in the top view (Num Pad 7). While in Edit mode, make sure all vertices are selected (vertices are orange). You can use the A Key to select them all. Press W Key for specials menu, then select 'Subdivide' or click subdivide in the Tool Shelf. Do this a few times. Select a single vertex somewhere near center. Next, switch to a front view (Num Pad 1) and press the O Key to enter **Proportional Vertex Editing** mode. Select sharp or smooth falloff depending on what effect you want. Press G Key to grab (move) the vertex or drag the arrows on the manipulation

widget. Use the scroll mouse wheel to change the size of the proportional selection if you have used the G Key. Experiment with different size selections and different fall offs. To see your final work in a smooth display, exit Edit mode (Tab key) and with the object selected go to the Tool Shelf and find the 'Set Smooth' button. This will smooth the mesh in the display and final output.

The following diagram shows ground terrain created by subdividing a plane. Then selecting a single vertex and moving it up the Z axis with the Proportional Editing tool On with Random Fall Off

Single verticies selected

Plane subdivided

Scrole mouse wheel to vary size of influence circle
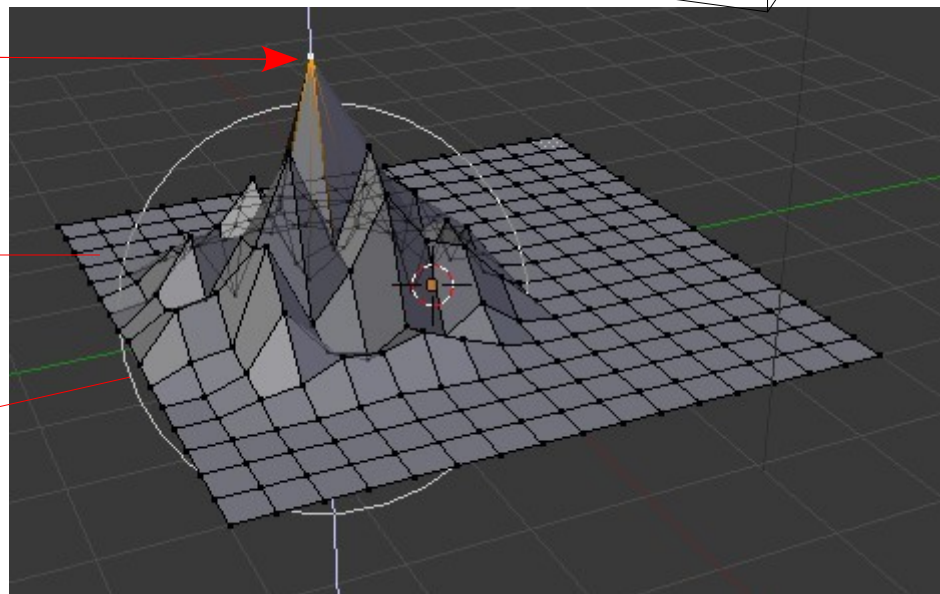
Edge Loop Selection

When working with vertices it is sometimes useful to be able to select edge loops.

To demonstrate this procedure you will have to create an object as shown in the diagram below.

Add a Circle Mesh Object to the 3D Window. Tab to Edit Mode. The mouse cursor changes to a white cross. Press the E Key to extrude but do not move the mouse cursor. Click LMB on the mouse. You have created a duplicate set of vertices. Now press S Key to scale the duplicated vertices and move the mouse cursor towards the center of the circle. This produces an inner circle. Press the A Key twice to deselect the inner circle then select all the vertices. With both circles selected press E Key (Extrude) and move the mouse cursor away from the mesh. By default the extrusion takes place normal (At right angles (90 degrees) to the plane of the selected vertices which in this case is along the Z axis. You should have a mesh object something like the one shown in the diagram

Perform the following in Edit Mode.

Click on outer ring Alt + RMB to
select the outer ring.

Shift + Alt + RMB to add the inner
circle of vertices to the selection
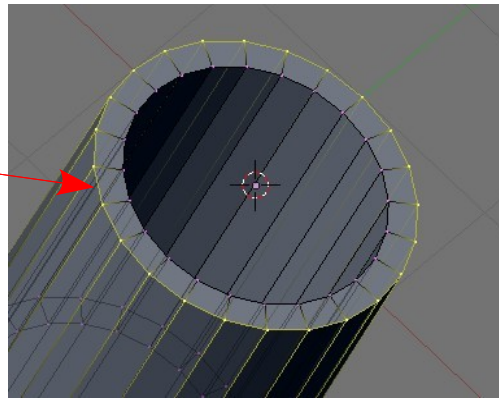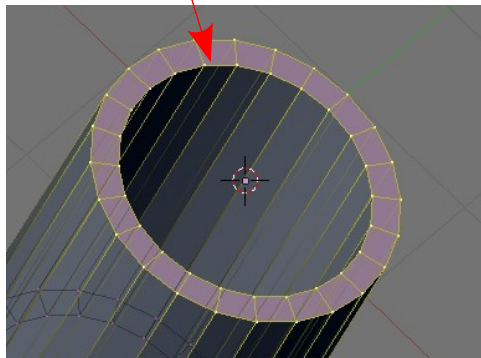
Click on the edge with Alt + RMB
to select the loop shown here
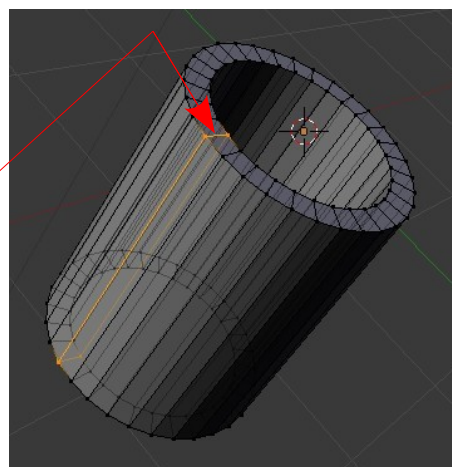
Learning Unit 4
Loop Cut and Slide

Basic Modifiers:

After selecting vertices, edges or faces you can use the basic tools we talked about
earlier ("G"-grab or move, "S"-scale, "R"-rotate).

Basic Modifier Examples

Widget Handle
Red, Green or Blue Arrow
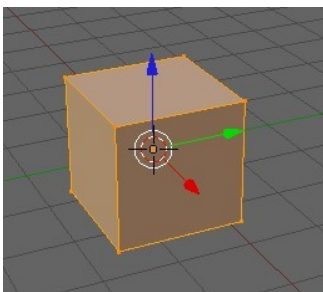
Default Cube Object
All Vertices Selected
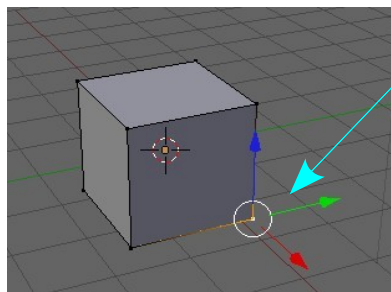
Single Vertex Selected
(RMB Click on Vertex)
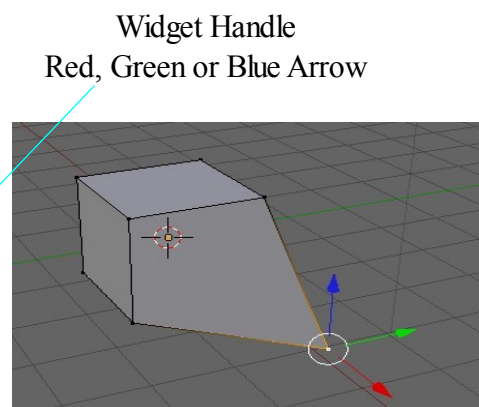
Single Vertex Translated
(G Key – Drag Mouse)

Note: An alternative to G Key- Drag Mouse is to click on one of the Transformation
Widget Handles, hold the mouse button and move the mouse
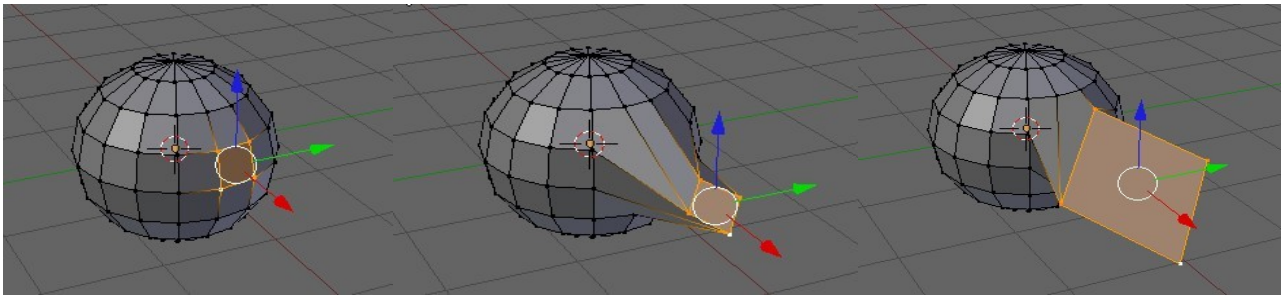
UV Sphere 4 Vertices Selected   Vertices Translated   Vertices Rotated
(Hold Shift + RMB Click   (G Key – Drag Mouse)   (R Key – Move Mouse)
Or
(Click on Translation Widget)
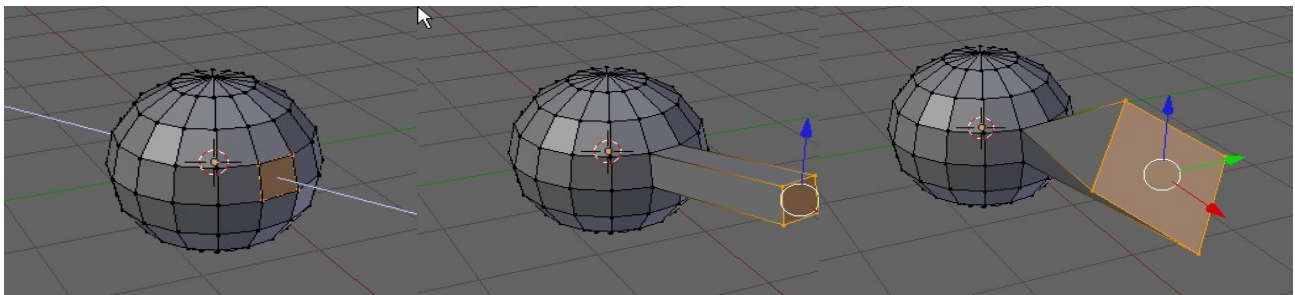
4 Vertices Selected   Vertices Rotated
(E Key to Extrude – Drag Mouse)   (R Key – Move Mouse(

Vertices are extruded along an axis normal to the plane of the selected vertex group
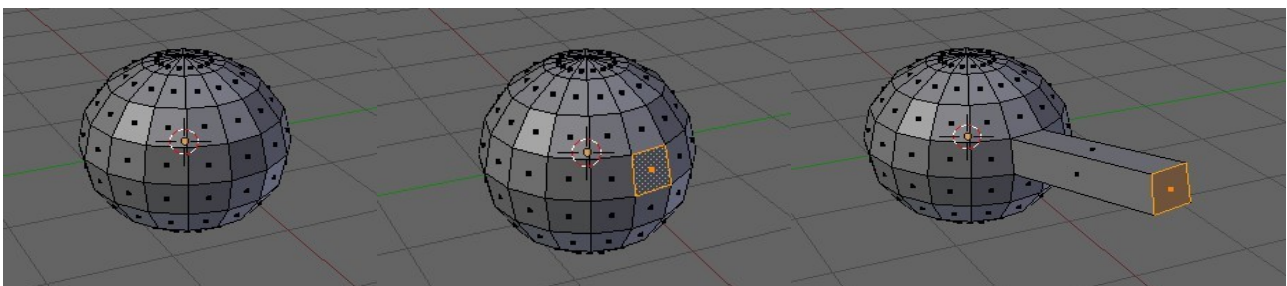
UV Sphere in Face Select Mode   Single Face Selected   Face Extruded
                        (Click RMB)   (E Key – Drag mouse)

Note: TheTransformation Widget is turned off in this example.

Joining Meshes:

To join two or more meshes together, hold down the Shift Key and click RMB to select them, then press Ctrl and J to join them. They will retain any materials you have placed on them, but will be one object.
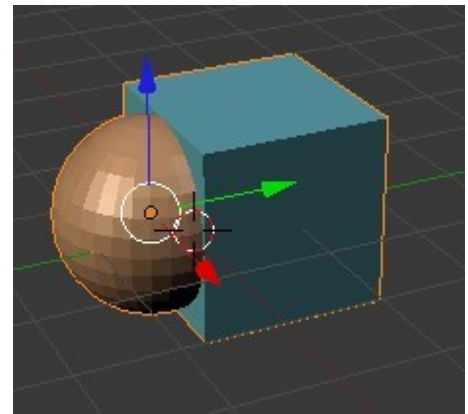
Separating Meshes:

In order to break up a mesh, you need to be in Edit mode (Tab Key) and select the vertices you wish to separate from the rest of the mesh. With the vertices selected, type the P Key (Partition) and click on 'By Selection'. You also have an option to separate 'All Loose Parts' which means separating objects that were added while an object was in Edit Mode. 'Separate By Color' separates vertex groups with different colors assigned.
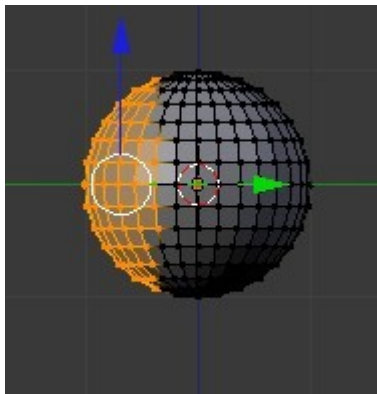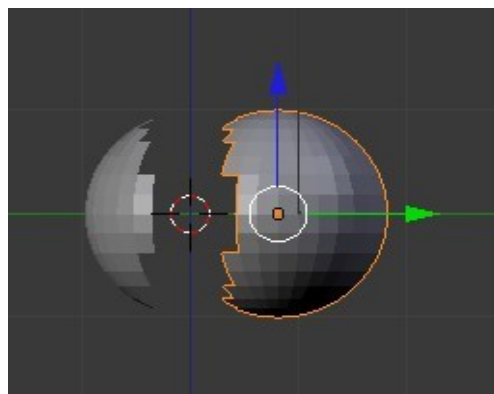
Vertices selected   Separated: P Key By Selection

Note: Pressing P Key in object mode deletes the scene background. Press Esc.

Deleting Vertices/Edges/Faces:
If you want to make a hole in a mesh, select the verticies, edges, or faces you wish to remove, then hit the Delete key.

Adding Faces: Plane
Sometimes you need to fill in holes in a mesh by creating your own faces. To do this, go into Edit Mode and select the vertices you wish to face together (you are limited to 4 vertices in a group). With vertices selected, hit the F Key. A face will be formed. Here is an example. A simple Plane object has been added to the scene. In Edit mode a single vertex is added (Ctrl + Clk LMB). Shift select or box select two vertices on the Plane and the new vertex. Press the F Key (Face).
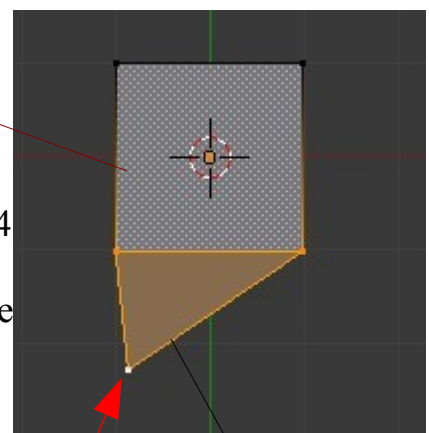
New Vertex Added

Select 3 Vertices
Press F Key

Modifiers

Mesh objects can have their shape modified by using Blenders Modifiers.

Modifiers are accessed from the Properties Window on the LH side of the screen.
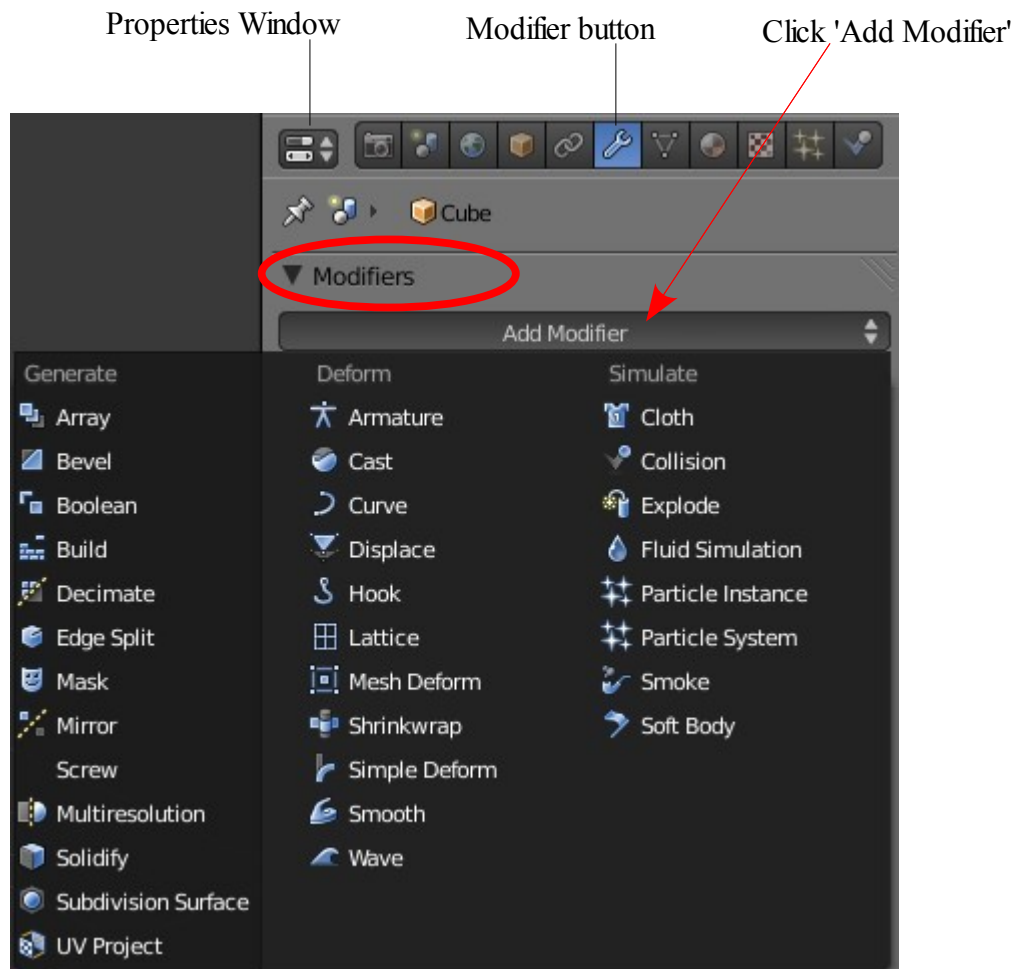
Modifier Selection Menu

With the object selected in the 3D Window go to the Properties Window – Modifier button and click on 'Add Modifier' to display the modifier Selection menu.

A modifier may be selected from the menu to change the shape of an object. As you can see there are a number of modifiers to choose from. At this stage we will demonstrate a few.

For more on Modifiers see Chapter 14

Bevel Modifier

Learning Unit 6
Bevel Modifier

Cube with Bevel Modifier Added
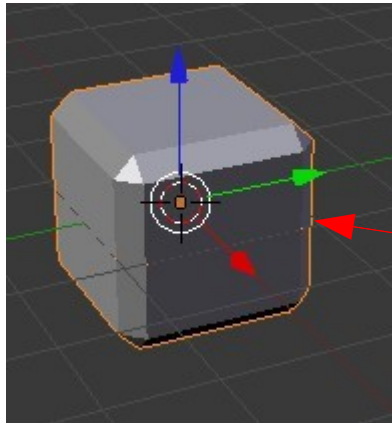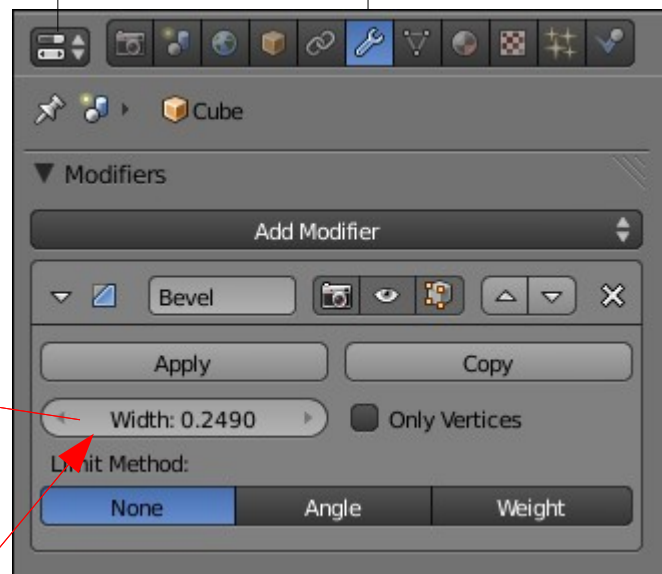
Change Width value to Increase/Decrease Bevel

Subdivision Surface Modifier

Learning Unit4
Subdivision Surface Modifier - Subserf
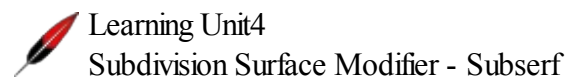
Cube with Subserf Modifier Added
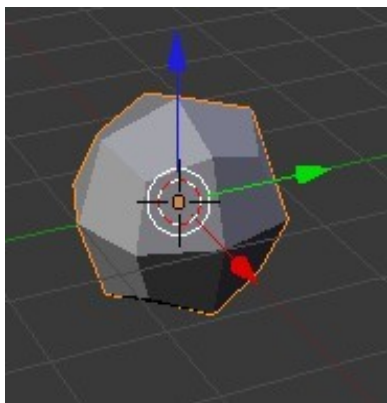
View: 1 = 4 divisions
View: 0 = Cube
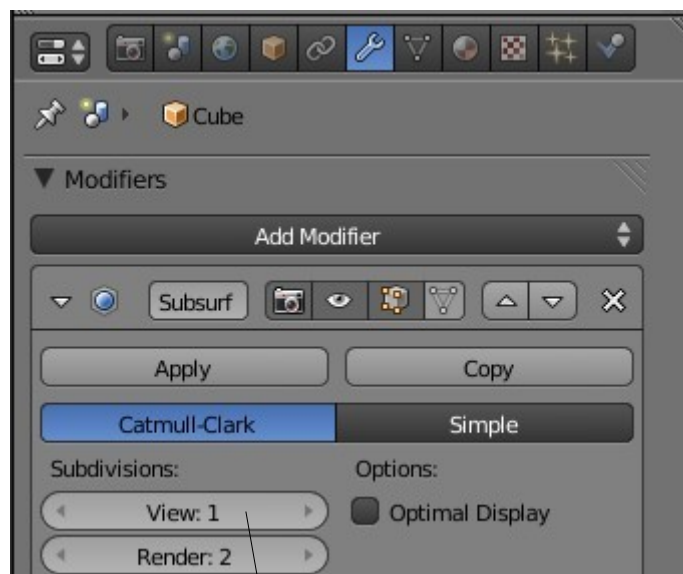
Change View value to Number of Subdivisions

Value: 3 Cube becomes a Sphere

Note: After selecting a modifier and adjusting values to produce the desired effect click on the 'Apply' button to permanently apply the modification to the object. The Modifier panel in the Properties Window cancels.

Mirror Modifier

Sometimes when creating a complex shape you want it to be symmetrical on either side of a centerline. The Mirror Modifier is a very useful tool for achieving this.

Start a new scene and place the default cube in Front Orthographic view (Num Pad 1 followed by Num Pad 5). Tab into Edit Mode and in the Tool Shelf click on Subdivide once. The surfaces of the Cube have been subdivided into four squares.
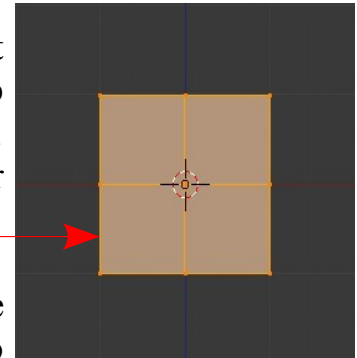
It is important to note that only the surfaces of the Cube are subdivided not the Cube itself. The cube is not divided into four cubes only the surfaces of the original cube are divided.

Still in Edit mode, deselect all vertices (A Key). Turn off 'Limit selection to Visible'. Box select (B Key – Drag a rectangle) over one side of the cube and delete the selected vertices (X Key) so that you are left with half of the cube. Tab to Object mode.

3D Window Header

Note: Deselect 'Limit Selection to Visible' Before selecting
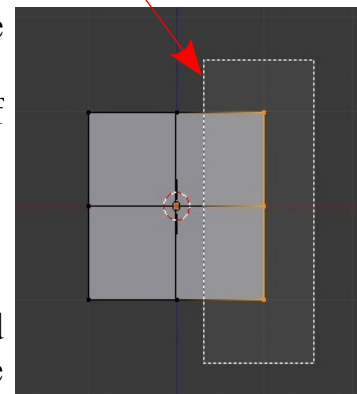
If you rotate the scene (Clk Hold Center Mouse Wheel and Drag) you will see that you have half an empty box with one side missing. Hit Num Pad 1 to get back to Front View.

Remain in Object mode and go to the Properties Window – Modifiers buttons. Click on 'Add Modifier' and select 'Mirror' in the drop down menu. Hey presto you have the solid cube back again. Any modifications you make to the one side of the Cube in Edit Mode will be duplicated on the other side.
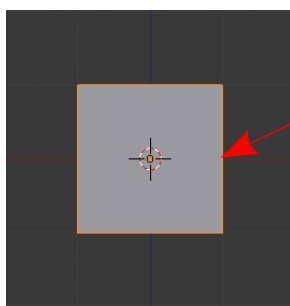
Solid Cube after applying Mirror Modifier
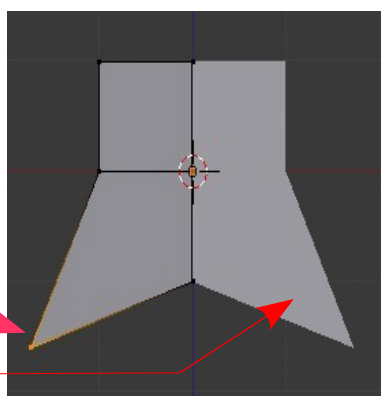
In Edit mode
Vertex selected and moved.
Mirrored on other half of Object
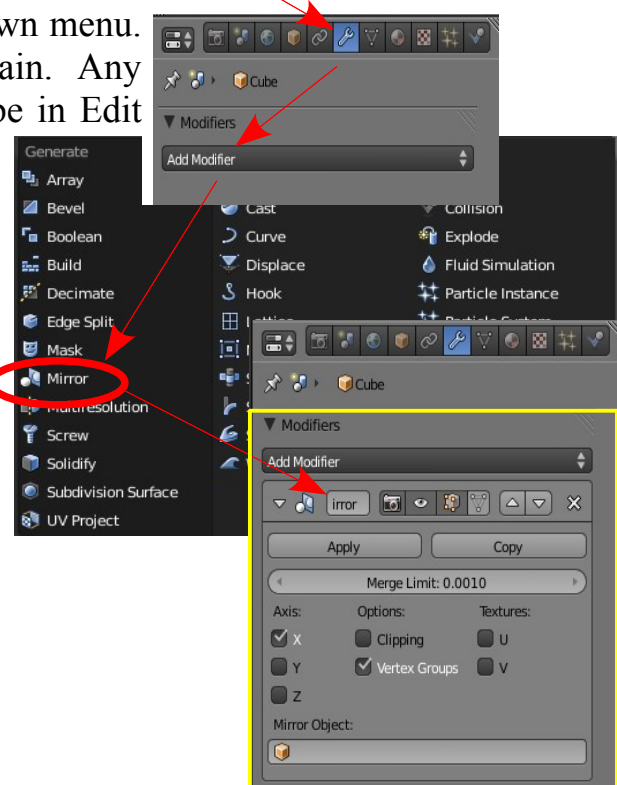
Boolean Modifier

Boolean Operations

Boolean Operations allow you to cut and join meshes by using other meshes. The operations are implemented by employing Boolean modifiers.

An Object selected in the 3D Window has a Modifier applied to it and the Modifier is given the instruction to use another Mesh to perform an operation. The operations performed are described as **Intersection, Union and Difference.** The following example demonstrates the Intersection Boolean Operation.

1. The default Cube in the 3D Window with a Cylinder object added and positioned as shown.
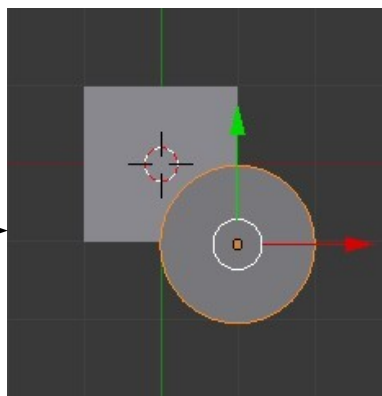
2. Default Cube selected in 3D Window
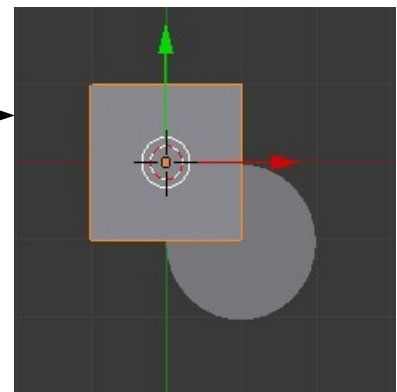
3. With the Cube selected a Boolean Modifier is added and Operation Type Intersect selected

5. Apply button clicked

4. Click on the little cube and click on 'Cylinder' in the drop down to select the modifying object.

Type Intersect selected

6. Result after applying the modifier and separating the meshes.

The original Cube has been modified to the shape of **intersection** (overlap)

Cylinder
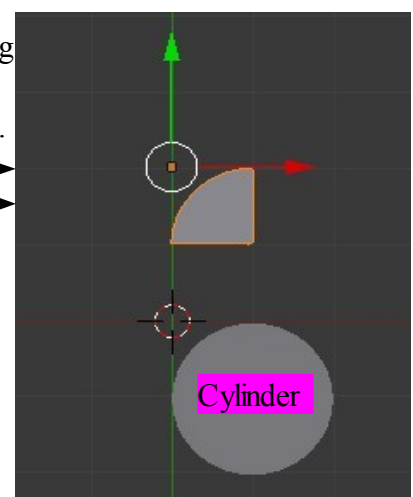
Example of the Union Boolean is shown commencing with the same setup with the Default Cube and tube object.

Boolean Union Type selected ————→

Operation:	Object:
Union	Cylinder
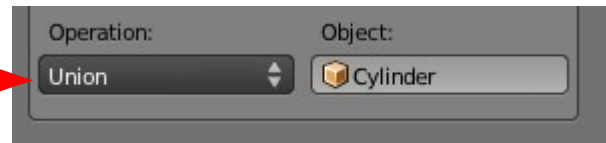
Result after applying modifier ————→
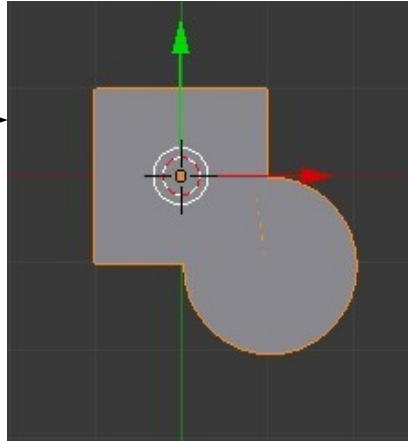
Result after applying modifier and separating meshes ————→
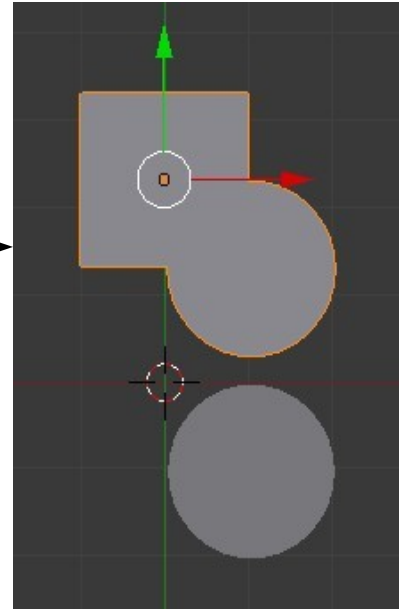
Two meshes joined together

Example of the Difference Boolean .

Result after applying modifier ————→
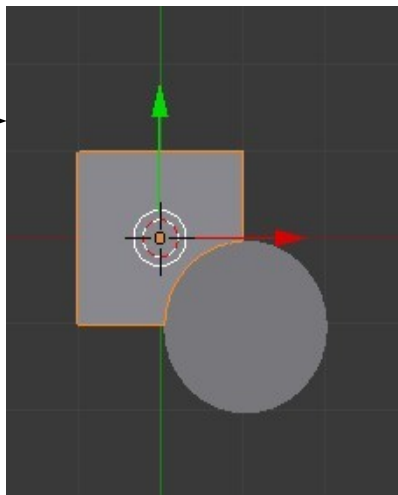
Result after separating meshes ————→
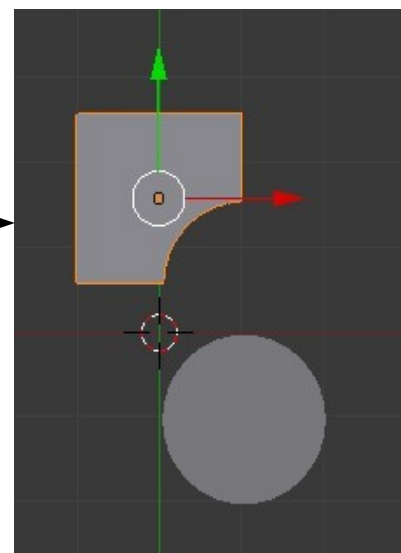
Overlap of meshes subtracted

For more on Modifiers see CH-14

The Knife Tool

As Blender is developing some things seem to disappear from the interface. One such useful tool is the Knife Tool.

The Knife Tool is used to create additional vertices on the surface of an object while in Edit mode. It allows you to add vertices by drawing a line across a series of edges much like subdividing but limiting the subdivision to a specific region.

As an example using the default Cube object tab into Edit Mode and leave all the vertices selected (Vertices and edges showing in orange).Hold down the K Key and click and hold LMB. The mouse cursor turns into a neat little knife. Drag the knife over some of the edges on the Cube. Release the mouse button and the vertices on the plane are deselected except for new vertices which have been created where your knife cut the edges. The new vertices may now be manipulated to modify the surface of the Cube object.

Drag Knife to cut edges of Cube

Knife Tool

New Vertices added at intersections
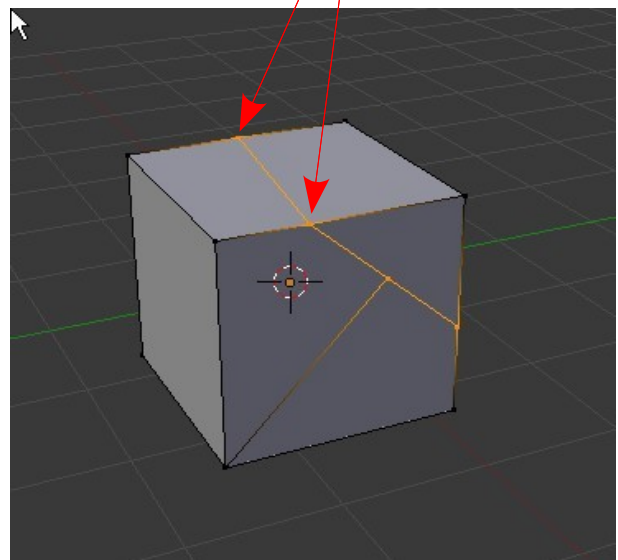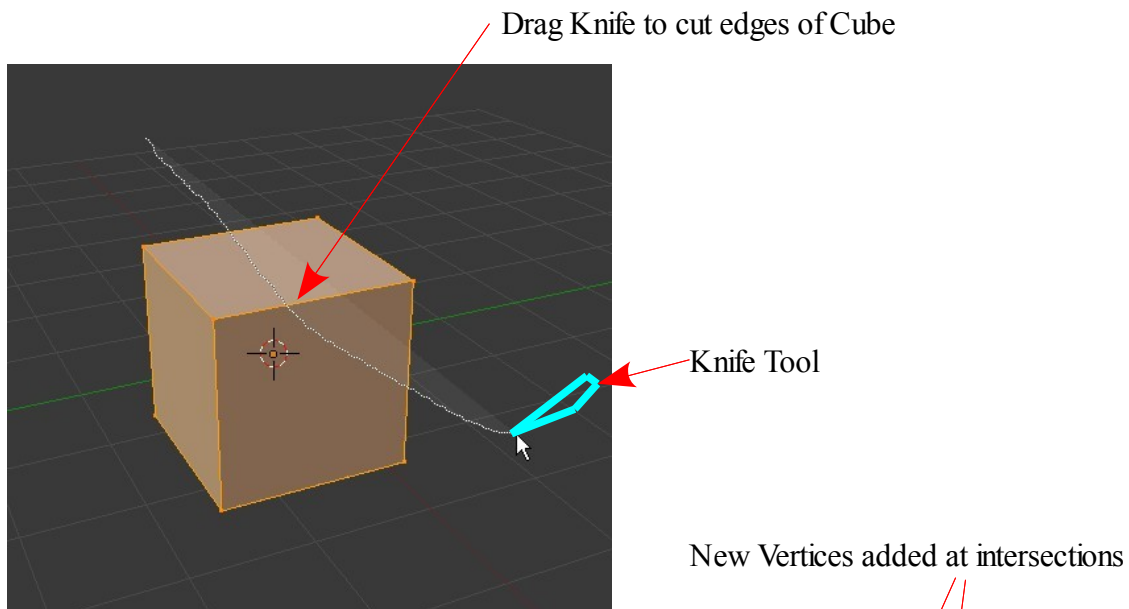
Bezier Curves and Circles

Blender uses curves, or to be precise, curve paths in a variety of ways. Objects can be made to follow a curve path in an animation or they can be extruded following the shape of a curve path or they can be duplicated in a scene and placed along a path. The speed of an object in an animation can be manipulated by altering the shape of a curve in a graph. There are many many applications for curves and in particular Bezier Curves. The Bezier Circle is simply a circular curve joined at the ends.

Curves are added to a scene by pressing 'Shift + A Key' and selecting, 'Add – Curves'.

Bezire Curves and Circles are of particular importance since they have control handles attached which facilitate the reshaping of the curve. At first the method of controlling the shape of the curve can be tricky to grasp especially without some instruction. Run through the following tutorial to get the idea.

In the default Blender scene press the 'X Key' followed by 'OK-Delete' to delete the cube object.

Change to Top Orthographic view. Press Num Pad 7 followed by Num Pad 5.

Press 'Shift + A' and select 'Add – Curve – Bezier' to add a Bezier Curve to the scene.

Bezier curves are always added to a scene drawn on the X-Y Plane, that is, in Top View. If you add a curve in front view all you will see is a straight line. As it is, being in top view, you see a curved orange line. You will have to zoom in to see it properly. Press the Num Pad Pluss sign a two or three of times.

As with any object in Blender it is entered 'selected' as shown by the orange color and the Transformation Widget is active by default. Turn the Widget off.

Click LMB to turn Widget Off
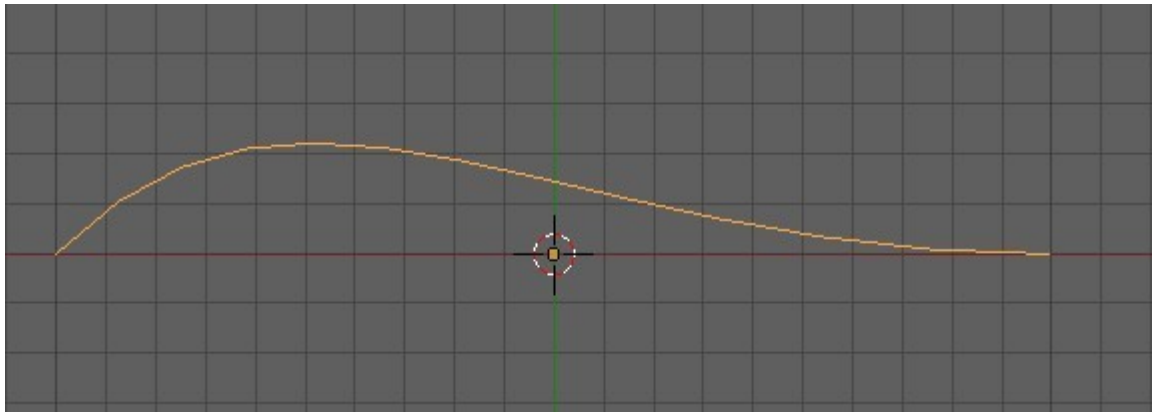
To fully appreciate the Bezier Curve we need to be in Edit Mode. Press the Tab Key.

Control Handles

Three Dots
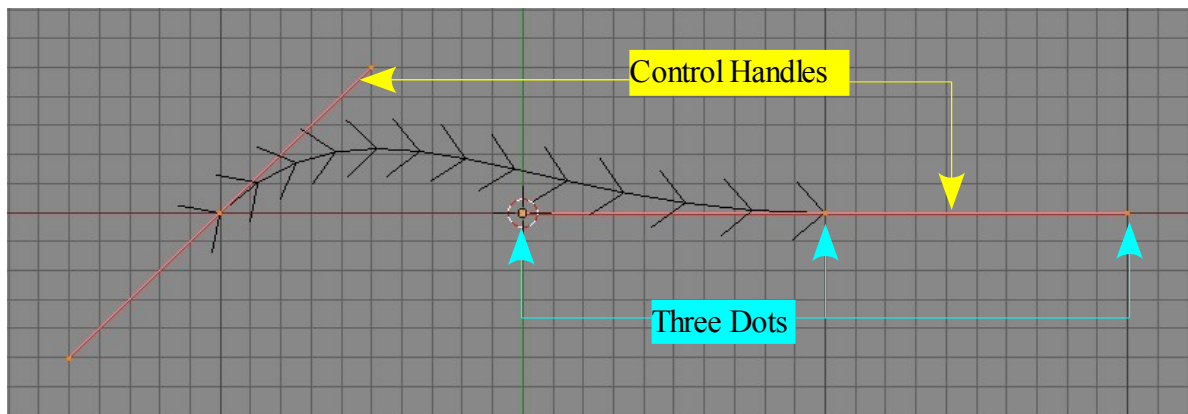
The Curve is now displayed as a black line with a series of chevrons along its length and colored straight lines located at either end. These colored lines are Control Handles and they are drawn tangential to the curve. The handles are selected as shown by the bright color. Note that each handle has three dots. One at the centre and one at either end.

Press the 'A Key' to deselect the handles then press 'A Key' again to select. In edit Mode, you are selecting and deselecting the handles only, not the curve.

Press 'A Key' to **deselect** the handles.

Right click on the centre dot of the left hand handle. The whole handle is selected as indicated by the bright color and make note of the white dots.

Press 'G Key' and drag the mouse. The handle is moved reshaping the curve. LMB click to cancel the movement.
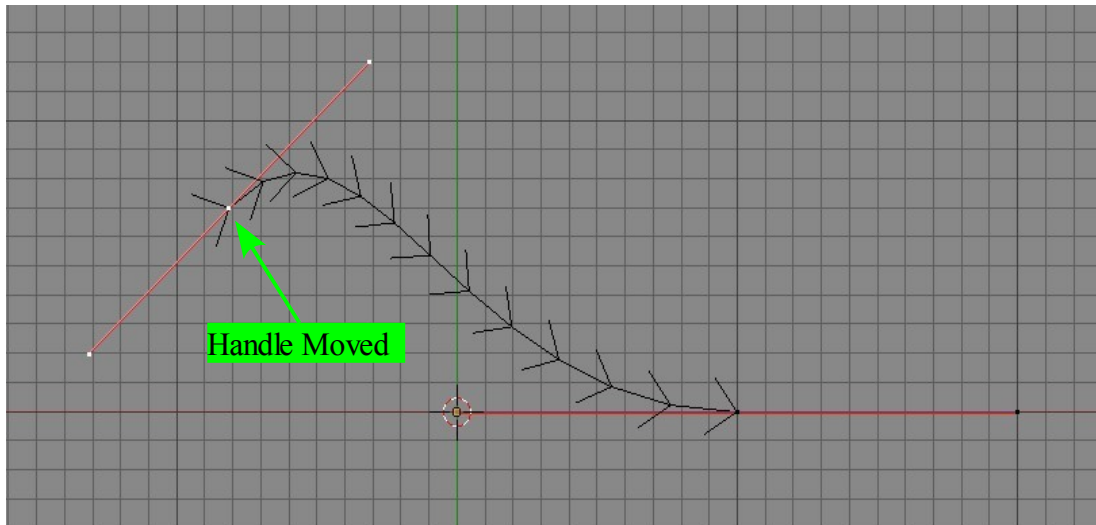
Press 'A Key' to deselect the handle.

Now **Right Click** on the dot at the end of the handle. Only one half of the handle is selected as indicated by the bright color.

Press 'G Key' – 'Drag mouse' to move the end of the handle rotating about the handle's mid point and reshaping the curve. LMB click to cancel the operation.
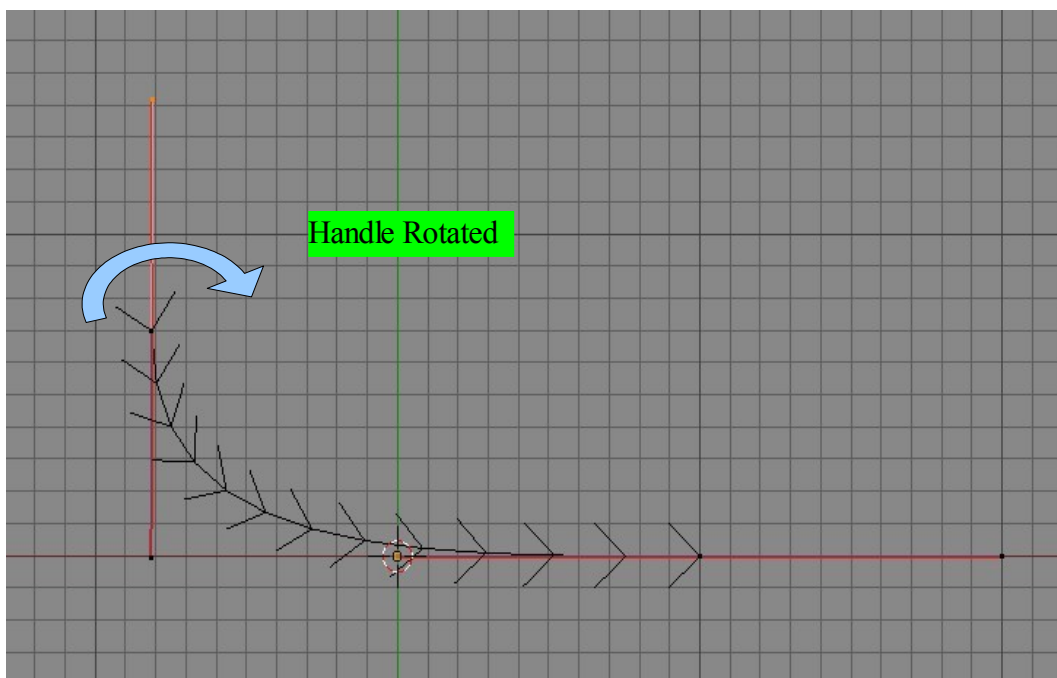
Press 'A Key' to deselect.

Right click on the handle's mid point to select. Press the 'E Key' (Extrude) and drag the mouse moving the handle away from the curve. The curve is extruded producing a curve with three control handles.
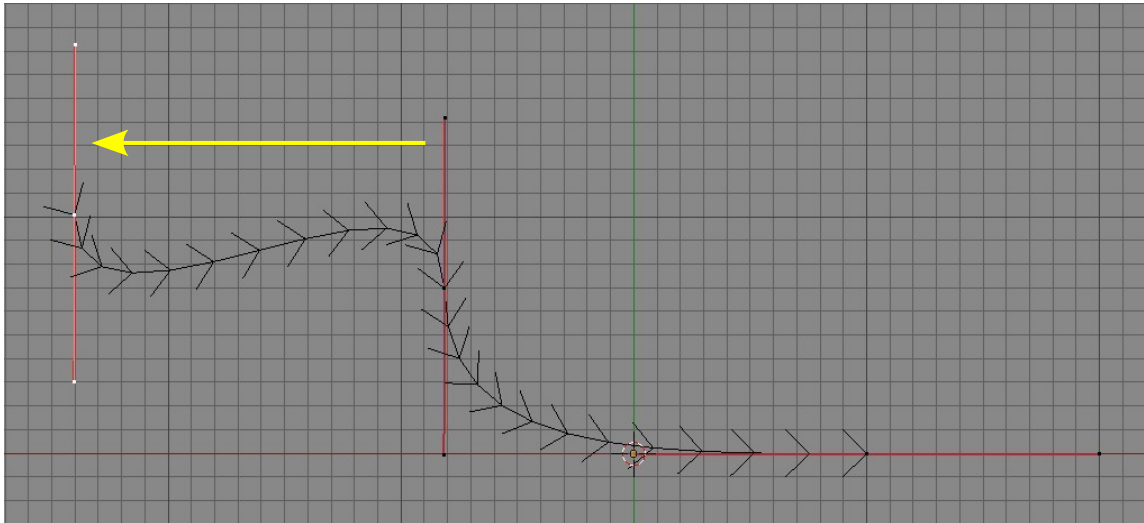
Press 'A Key' twice to select all handles (The whole curve)a. In the Tool Panel at the left hand side of the window click on 'Subdivide'. The curve is subdivided and control handles are added.
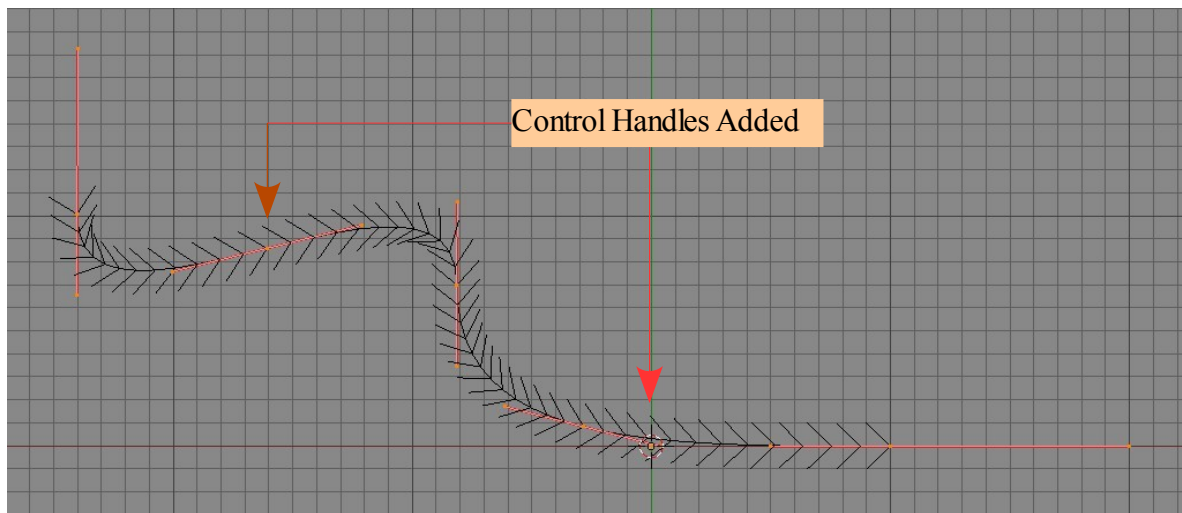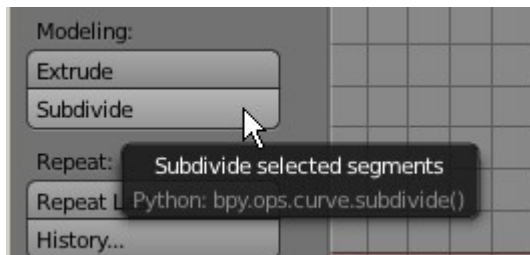
Any of the handles may be selected and manipulated to change the shape of the curve.

Tab to Object mode and the whole curve may be translated, scales and rotated in the scene.

Sculpt Mode

The 3D Window Sculpt Mode allows the manual manipulation of mesh vertices. Objects surfaces are constructed from a mesh of vertices and by pulling and pushing the mesh you modify the surface. Its a bit like modelling a piece of clay or plasticine only there is no inside to the lump.

To give you the idea and get you started we will consider a UV Sphere. Add a UV Sphere object to your scene. Tab into Edit Mode and in the Tool Panel at the LHS of the Window click 'Subdivide' three times. This will provide plenty of vertices on the surface of the mesh to manipulate. Tab back to Object Mode.

Change the 3D Window from Object Mode to Sculpt Mode and change the Viewport Shading to 'Texture'. The 'Texture' Viewport Shading just lets you see the effect of your sculpting a little better, it has nothing to do with applying a Texture. Zoom in to get a nice big view of the sphere (Num Pad Plus on the keyboard).
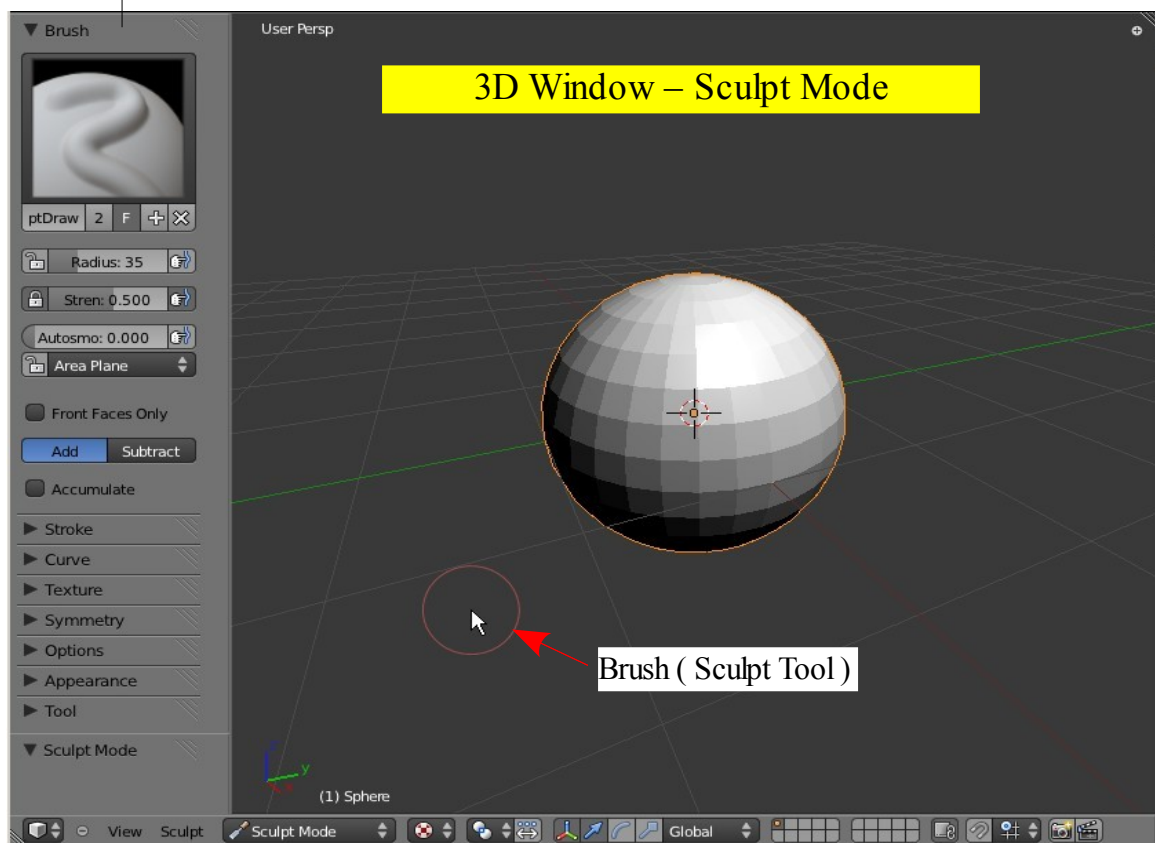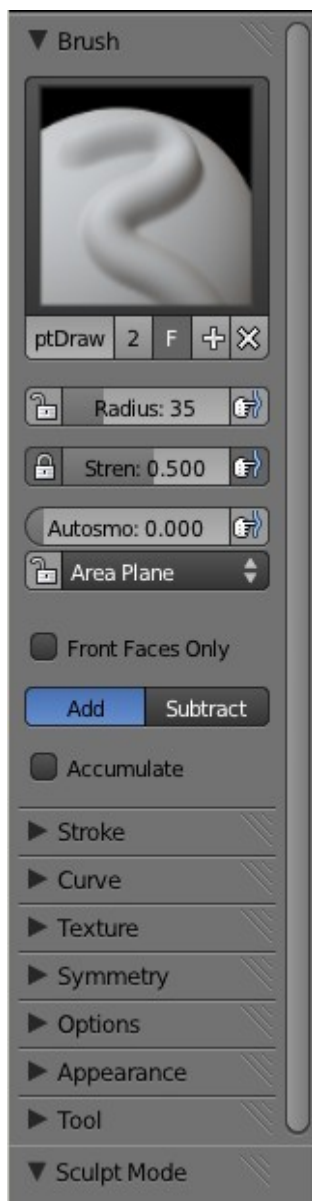
Take a look at the 3D Window in Sculpt Mode. The only difference between Object Mode and Sculpt Mode is the Tool Panel at the LHS of the Window has changed and the cursor has a circle attached to it.
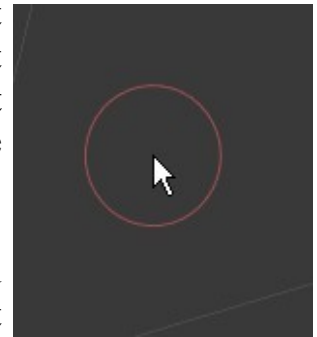
For want of a better word the circle attached to the cursor is called the 'Brush'. It is in fact a 'Sculpting Tool'.

The Tool Panel contains a series of Tabs with buttons and sliders for controlling the Brush. By default the 'Brush Tab' is open. Clicking on the little triangles adjacent to each Tab name toggles the Tab open or closed. This is purely a space saving mechanism. If there is too much information to display in a Tab a scroll bar will display at the RHS of the Tool Panel.

Tab Closed   Tab Open

Before attempting to figure out what all the Tool Panel controls are fore let's see what the Brush does. Click LMB, hold and drag the cursor circle (The brush) across the surface of the UV Sphere.
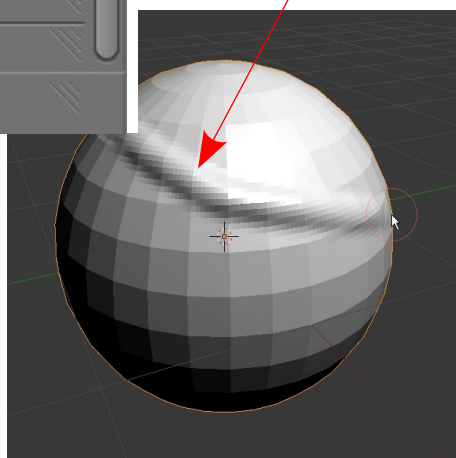
Welt on Surface   Sphere Rotated
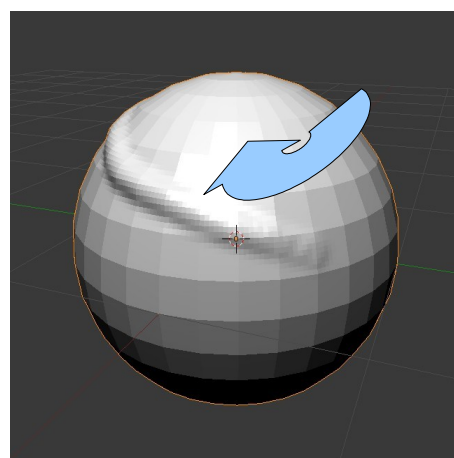
The mesh surface deforms producing a welt on the surface. If you click and hold MMB while dragging the mouse (Rotating the Scene) you will see that the welt has been produced only on what was the visible surface.

OK! That is how the Brush works but of course there is much much more to it than that.

In the Tool Panel, by default the 'Brush Tab' is open.
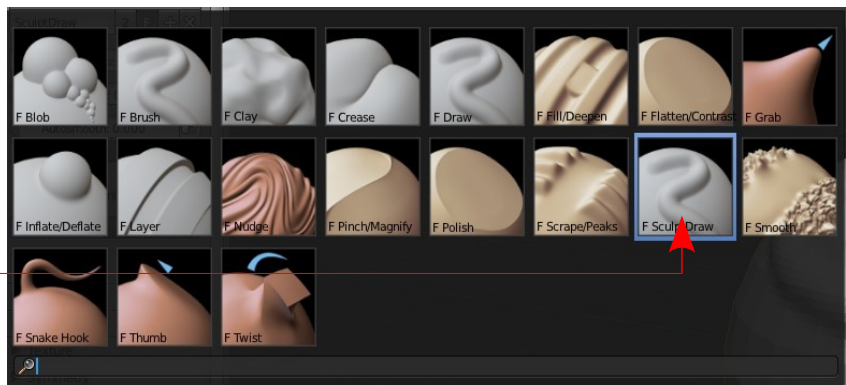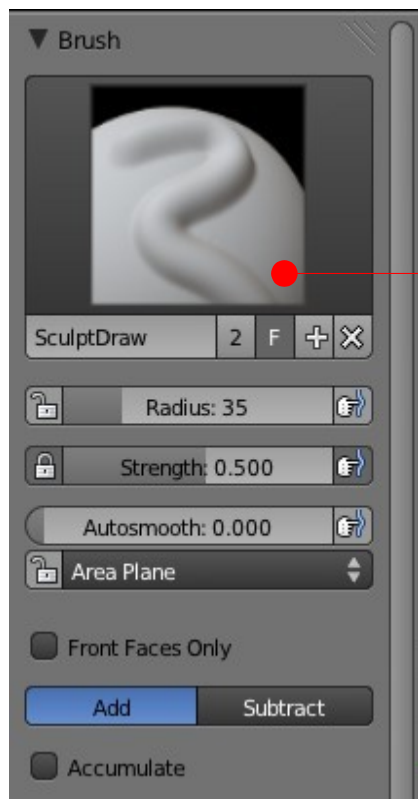
At the top of the Brush Tab there is a small window showing part of a sphere with a welt on the surface. By clicking LMB on the window a second panel displays showing nineteen Brush type options. You will see that type 'F Sculpt Draw' is highlighted in blue which is the default Brush type. Clicking on any of the different types selects that particular type making it active.
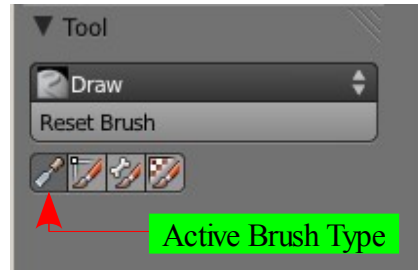
Go to the Tool Panel and open the 'Tool Tab'. Here you see tool type 'Draw' is shown as being active. Tool type 'Draw' is the same as 'F Sculpt **Draw**'. Where you see 'Draw' is a drop down menu which lists the same nineteen Brush type options as previously shown. You can select a Brush type here as well. Note below the drop down menu button there are four options for Brush selection. Since we are in Sculpt Mode the Brush for Sculpt Mode is active.
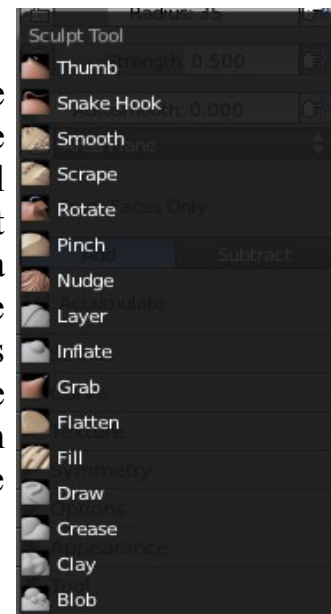
Go back to the 'Brush Tab' at the top.

Sorry about the up, down, up but the quick selection window at the top of the 'Brush Tab' is relevant to the 'Tool Tab'.

Now we will attempt to explain some of the control options for the Brush. To do this we

will use the default Tool type 'Draw'. There are many many combinations of control options for the Brush which, unless we maintain a common baseline, an explanation would be impossible. Experiment and experiment is the only way to proficiency.

The Brush Tab

Radius Slider: Controls the size of the Brush circle.

Another way to change the size of the Brush circle is to press the F Key on your keyboard and drag the mouse. LMB click when you have finished dragging.

F Key Drag Mouse
LMB Click
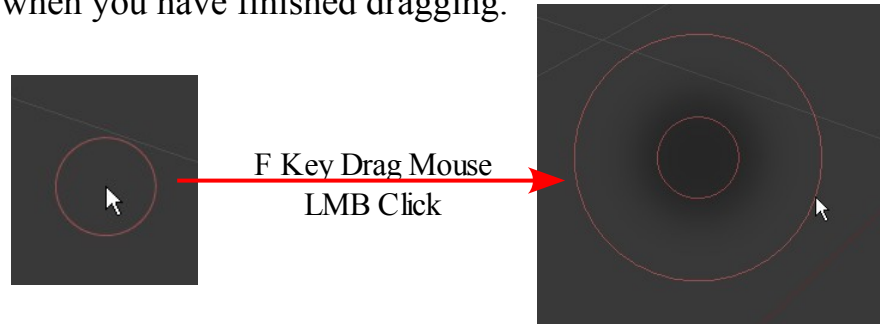
Strength Slider: The strength of the Brush influence on the vertices.

Add-Subtract: Add pulls vertices away from the surface. Subtract pushes vertices into the surface.

See Screenshot on next Page

Note: I did say explain **some** of the control options. Options not explained will require you to experiment.

The Stroke Tab
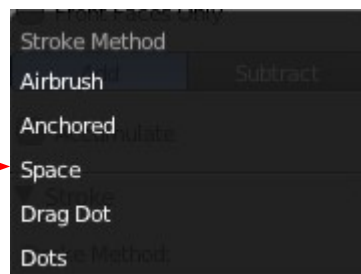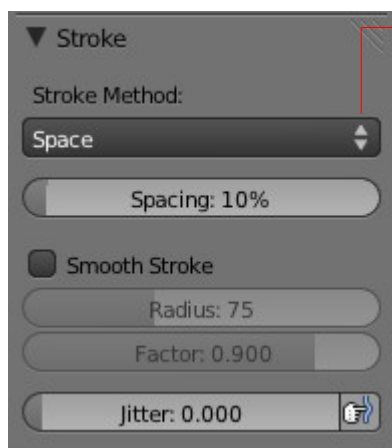
Stroke Method: The stroke Method drop down provides different options.

Remove the UV Sphere and add a Plane object to the scene. Subdivide five or six times

to produce vertices. You must be in Object mode to delete the sphere and then Tab to Edit Mode to subdivide the Plane.

After subdividing change back to Sculpt Mode. Make sure you have Viewport Shading type 'Texture' selected.
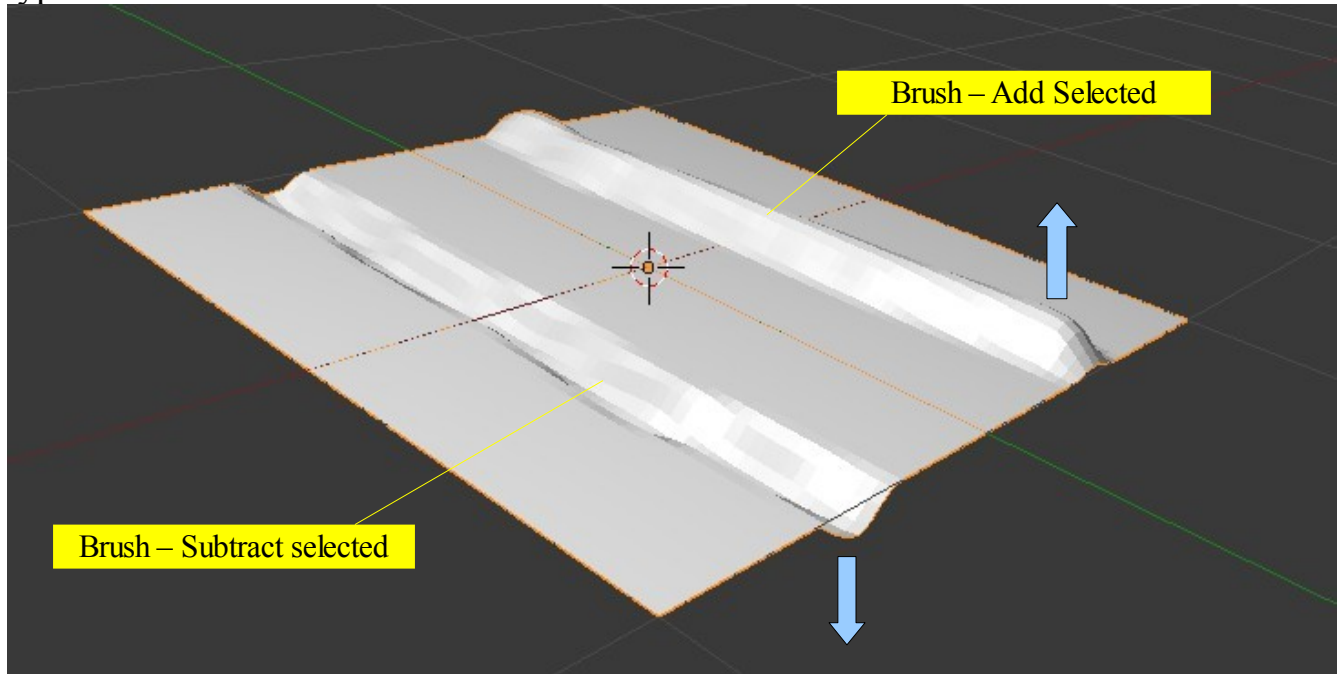
Clicking LMB and dragging the Brush across the surface of the mesh with 'Add' selected in the Brush Tab deforms the mesh in the positive direction as the Brush   is   moved. This applies to all Stroke Methods. In most cases dragging over a   deformed   area produces an accumulative effect even though the 'Accumulate' box   in the Brush Tab is not ticked. **In the screenshots the Brush 'Strength' value is 0.963**
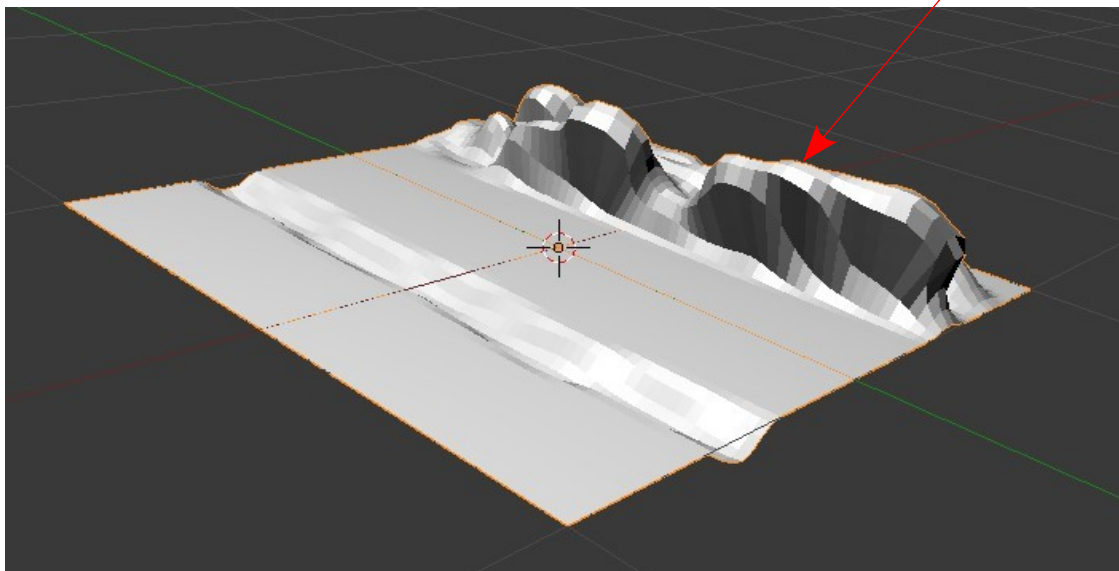
Clicking LMB and dragging with any **Stroke Method** produces a deformation with the exception of the 'Drag Dot' and 'Anchored' methods.

With 'Drag Dot' the initial deformation on clicking is duplicated and moved to a new location when the mouse is dragged.

Drag Dot
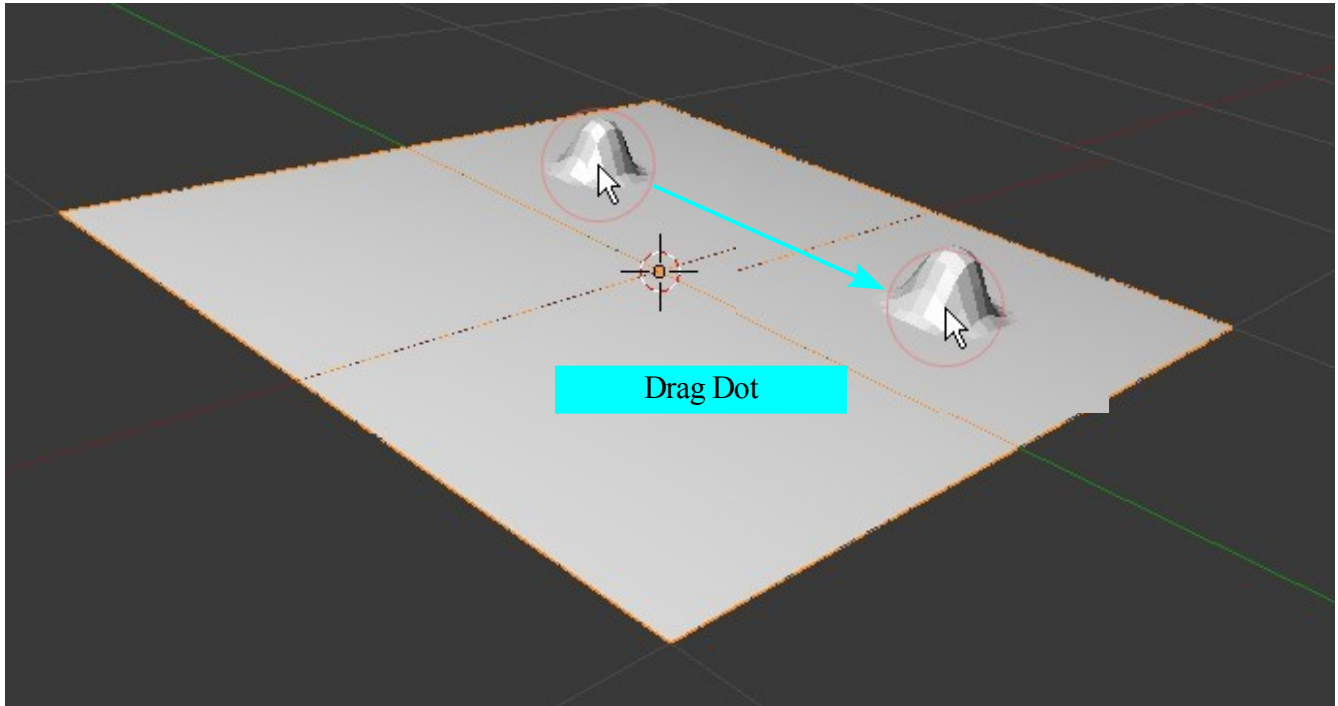
With 'Anchored' the deformation is produced (increased) on the same spot.
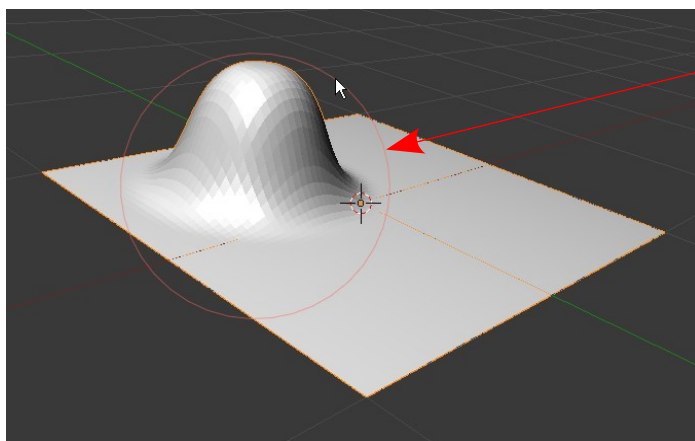
Anchored – Click and drag mouse to produce hump

Continue dragging mouse to deform the entire Plane object
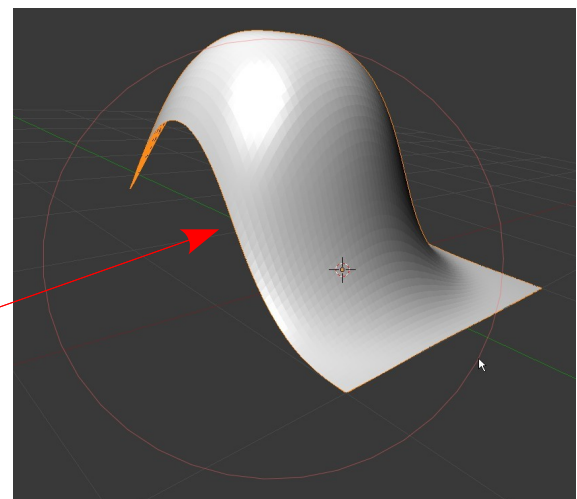
The Curve Tab
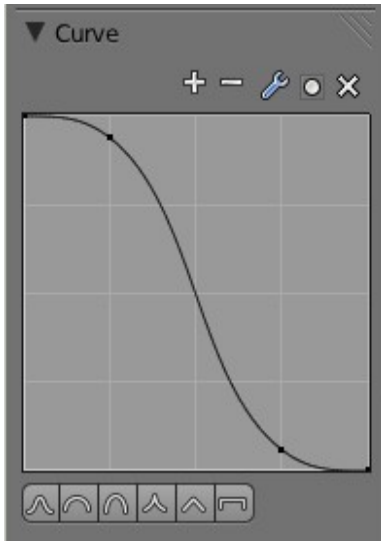
A graphical method of controlling the Brush effect. Click and drag handles (dots)   on the curve to reshape the curve or select from the array of quick select options displayed below the curve window.

The Texture Tab

I have no idea at this stage. Even the *experts* have to experiment.

The Symmetry Tab

Ticking X, Y or Z under 'Mirror' results in a deformation produced on one side   of an objects axis being reproduced on the opposite side of the axis.

Deformation Reproduced on opposite side of Axis

Drag Mouse

Axis
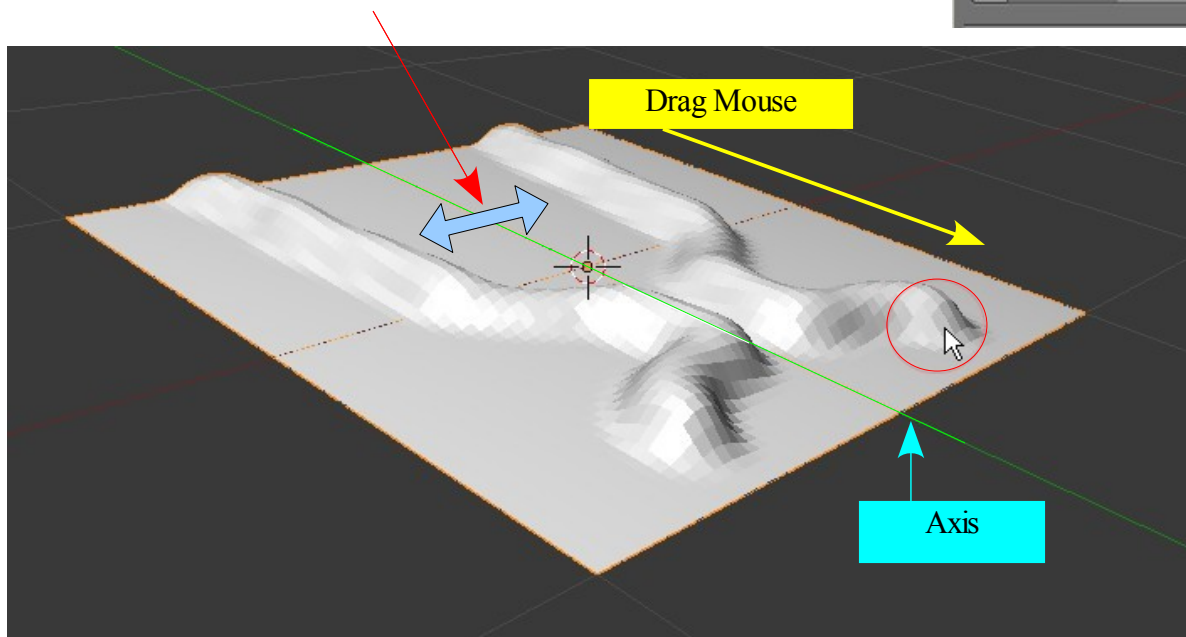
The Options Tab
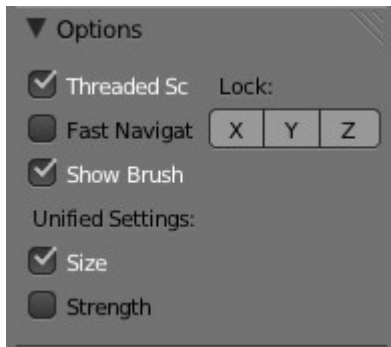
Another Tab requiring some research.

The Appearance Tab
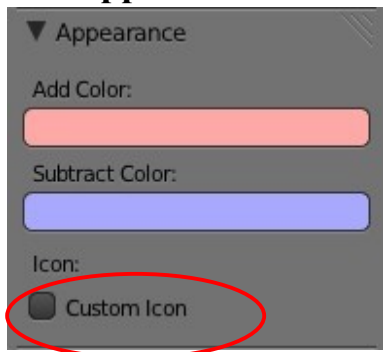
Clicking either of the two color bars displays color pickers for changing the   appearance (color) of the Brush circle in the 3D Window .

Which, depends   on   weather   you   have   Add   or   Subtract selected in the Brush Tab.

Ticking 'Custom Icon' allows you to select an image to display for the Tool Type icon instead of Blenders default icon (See the Brush Tab quick select panel).
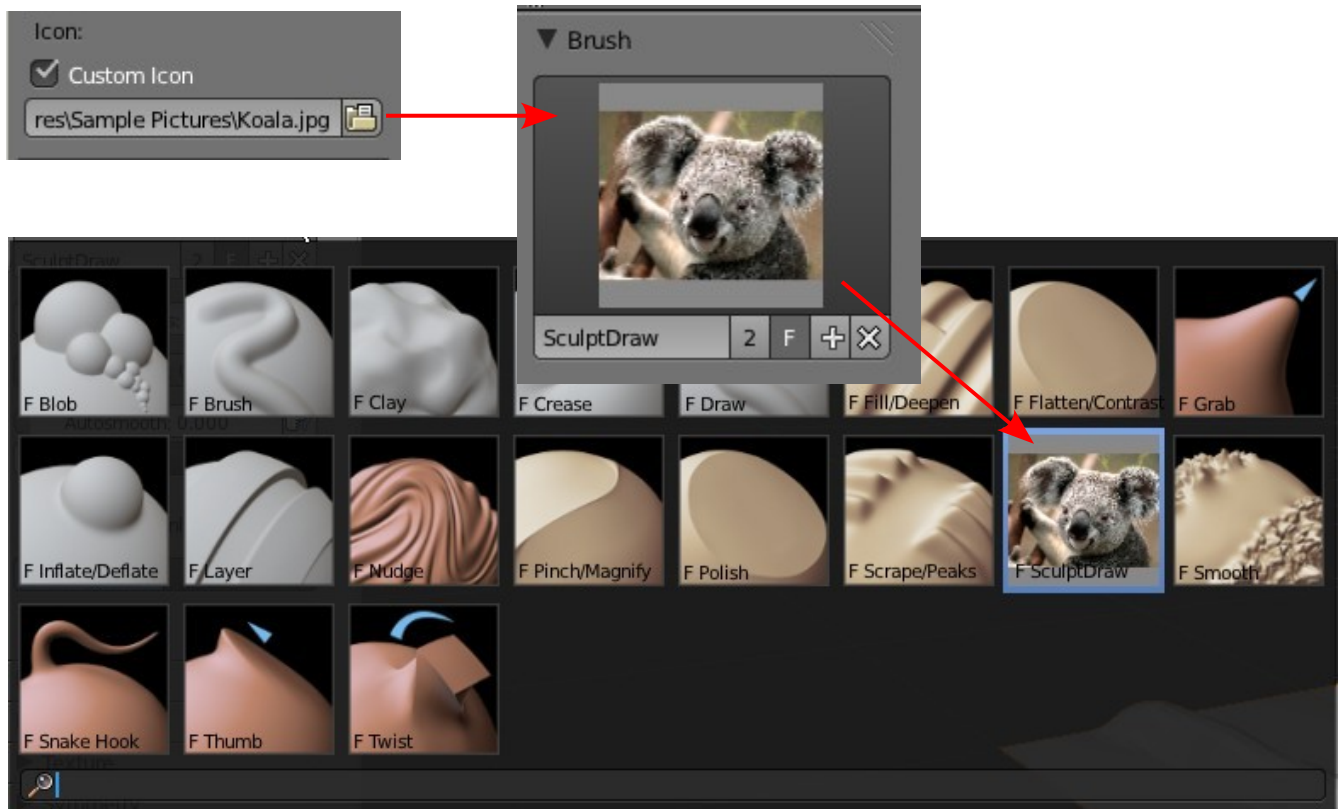
CH04- Materials

Return to Contents

Materials

What is a Material? A material is a color but it is much more than just a color. Think of the color red. It could be dark red or light red or any shade of red you could image. The color can be shiny or dull or it could be transparent or it could gradually fade from one shade to another. The possibilities are endless. That is a material.

Basic Material Settings

The default Blender scene has a Cube object which displays as a dull grey color. Color is the way your eyes interpret the reflected light from an objects surface. If there is no light you see nothing so Blender has placed a Lamp in the default scene and assigned data to the Cube which says, show the Cube as being grey with this color light. Every object added to the scene will also be given the same data as the Cube so you will see them as grey.

Adding a material is done in the Properties Window with the Material button activated

Note: In the default Blender scene the default Cube object has been given a Material as seen by the grey color of the Cube object and the fact that the Material buttons display in the Properties Window (See Next Page for Materials Buttons). Subsequent objects added to the scene also display with this same color although the Material buttons for a new object do **not** display. Clicking on 'New' will display the buttons.

For now, consider an object as **not** having a material unless the Material button displays all the tabs shown on the next page. Remember: The values in the Properties Window only apply to the object that is selected in the 3D Window.

When you click on the Material button for a new object the Properties Window only displays the following:

Material button

Properties Window

To add a material to an object, first select the object you want to work with (The default cube comes with a material added). In the Properties Window header click the Material button, then click the 'New' button. You will see the Material Properties tabs open up. The values will be the same as those for the default Cube.

Materials Buttons

Material Slot: See separate section

Material Name: Click here to delete the name 'Material.001' and type a new name for your Material

Material Stack: Click here to see all your materials

Preview Panel: Shows a preview of your Material when rendered. Click the buttons to the right for different preview options.

Color Picker: Click in the color bar to display the color picker.

Click to select color

Tabs: Click to open the tab and display buttons.

The material panel is used to change some of the physical properties of the object in the way it looks. If you plan on using just straight color and no texture, this is where you set the object's color. Here is where you set other properties such as: Shading ,Transparency, Glossy or Flat, Reflective, Halo Effect Etc.

A brief example of setting a Material will follow.
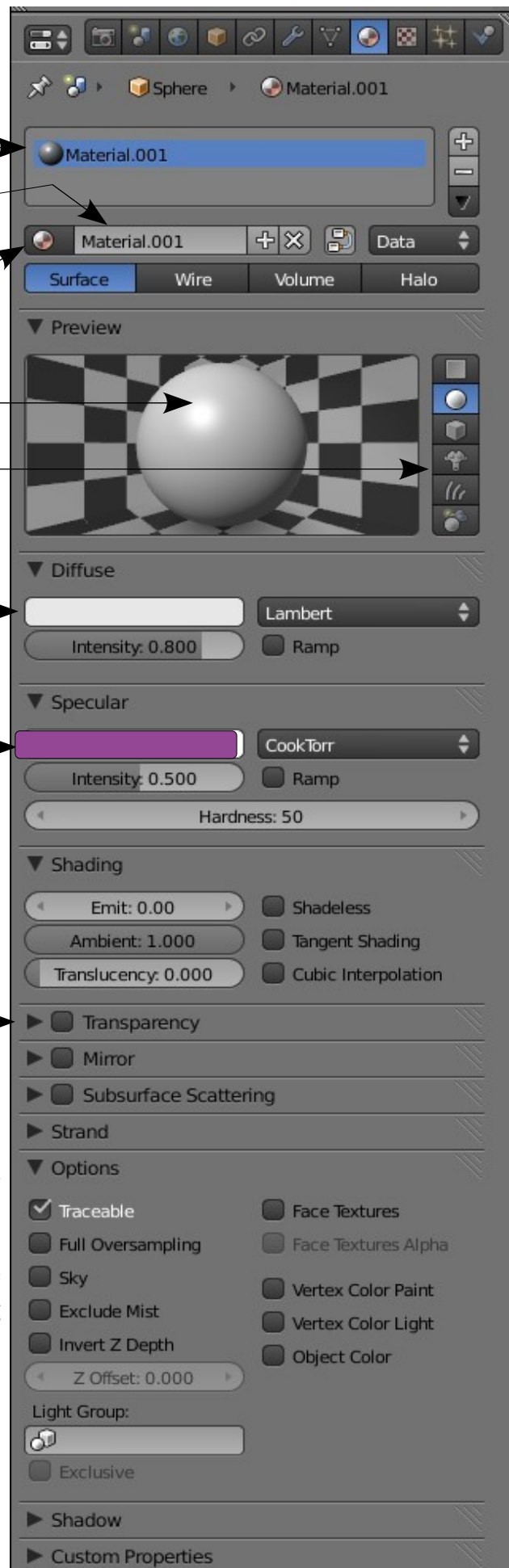
Material Colors

Each material can exhibit three colors;
      The basic Diffuse overall color which is seen when a surface reflects light..
      The Specular color which gives a surface highlights or a shiny appearance.
      The Mirror color which is color used to fake mirror reflections.

It is important to remember that the material color is only one element in the rendering process. The rendered color of an object is a product of the material color and the emitting light color. An object may have a yellow material color but put it under a blue light or a red light and you get something else altogether.

Adding a New Material

We will demonstrate the basics of adding a material by an example.

Start a new Blender scene and add a Monkey object. Monkey always comes laying on his back so with him selected press R + X +90 (Rotate about X axis 90 degrees).

Hit the Num Pad + and zoom in a bit. Go to the Tool Shelf and under 'Shading' click on 'Smooth'.

Make sure the Monkey is selected then go to the <u>Properties Window</u> – <u>Material button</u>.
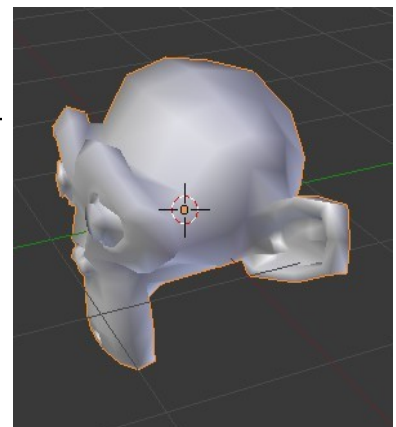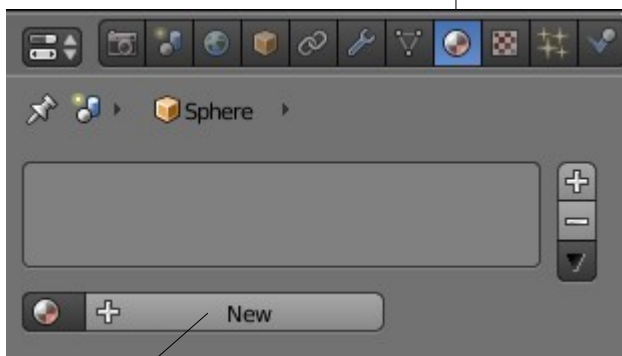
Click on the 'New' button to display the Material Properties buttons.

When the monkey is added to the scene Blender assigns it the properties for the grey color even though the Material Properties are not displayed. After clicking 'New' you can modify the properties to achieve the look you want.

Note: We selected the smooth option from the Tool Shelf to better display the modifications to the Material. Some of the effects are very subtle so a nice smooth surface is best for the demonstration.

Remember that color is the light we see reflected from a surface.

The Preview Tab

Have a look at the Preview tab in the Material Properties Window. This preview gives an indication of what you will see in a Render of the 3D Window. To save computer memory Blender does not display everything in the 3D Window. On the LH side of the Preview tab there are options for viewing the preview in different formats. One of the options is Monkey but for simplicity I have left my preview as the default Sphere.
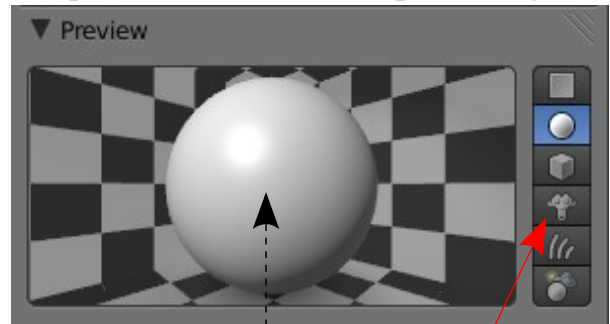
Preview Monkey Option

The Diffuse Tab

We previously stated that the Monkey object had been assigned a grey color. This is the Diffuse overall color of the Material.

Color Bar showing the Diffuse color. Click to display the Color Picker.

GreyColor
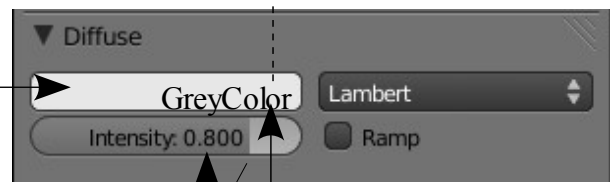
Intensity Slider

Default color

Color System Options

Note the R: 0.800, G: 0.800, B: 0.800 values. These are the numeric values which denote the Grey color in the RGB color system. RGB stands for red,green and blue primary colors. Mixing the three 0.800 values produces the grey color. There are three color system options available. RGB, HSV and Hex.

What is Intensity? Intensity of a color is the shade of the color going through a range from absolute no light to maximum light.

Intensity 0.000 No light

Rendered Images

Intensity 0.800
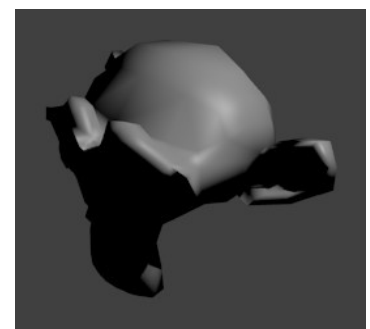
The two images demonstrating Intensity also serve to show that light has a major effect in a rendered image. When Monkey was added to the scene it was added at the center of the World and then rotated on the X axis through 90 degrees. This has meant that the position of the default lamp is above and behind Monkeys head. This explains why Monkeys face is in shadow.

OK! How come we see the Monkey when the Intensity is 0.000 no light? We will come back to that a bit later. For now let's make Monkey a bit more colorful.

Get the color picker again and select something pretty. If you want to get exactly what I will show you enter the RGB values: R:0.800, G:0.430, B:0.000
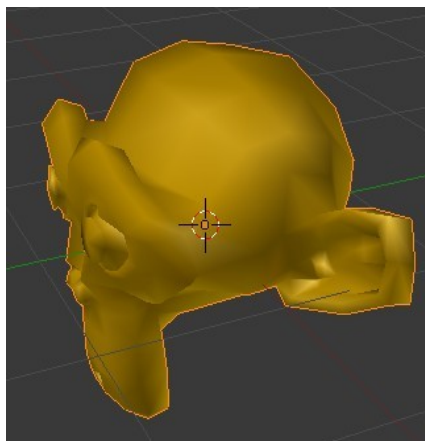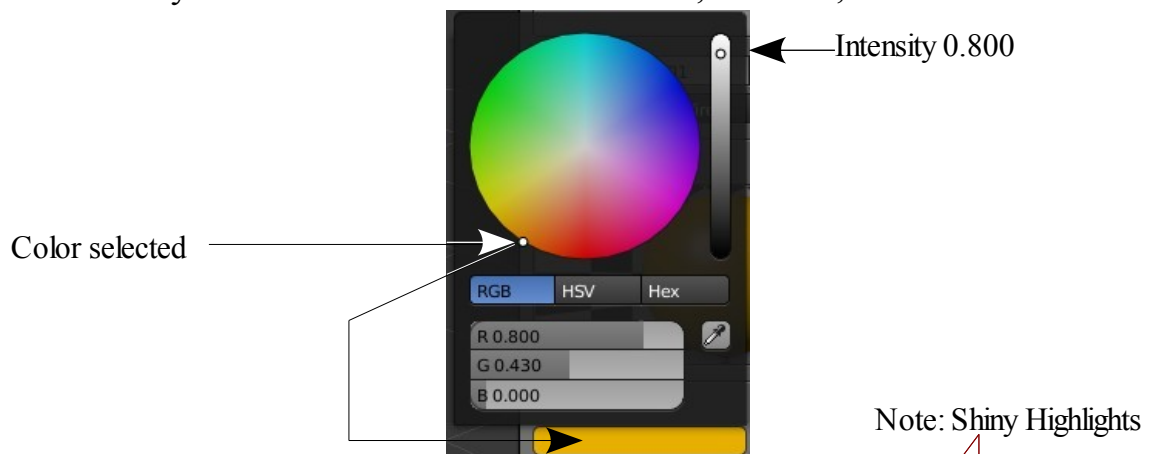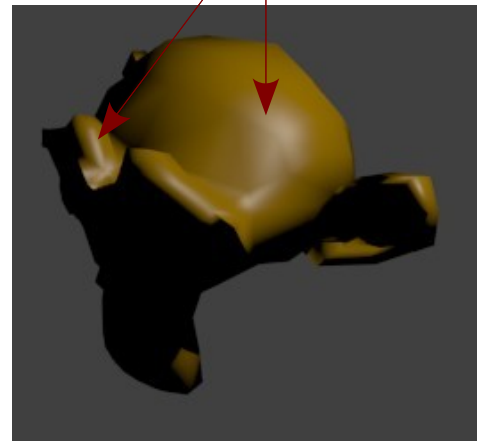
We now have a pretty golden Monkey. You can see the difference between what you see in the 3D Window and the rendered image. The 3D Window has some shadowing effect so that you can see a three dimensional image. This is also evident in the render but you can also see some shiny highlights.

The shiny highlights are there since by default Blender has added Specular color to the Monkey. That's why we could see the Monkey when we turned the Diffuse color intensity down to zero. We in effect canceled the Diffuse light reflection but there was still Specular light reflection.

Intensity Effect for Diffuse Color

3D Window Views
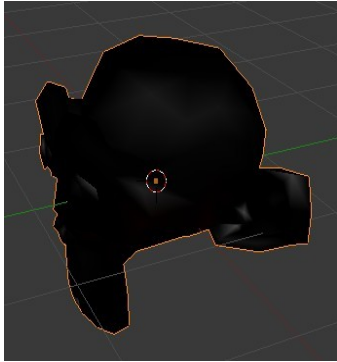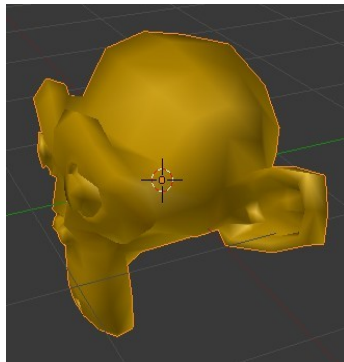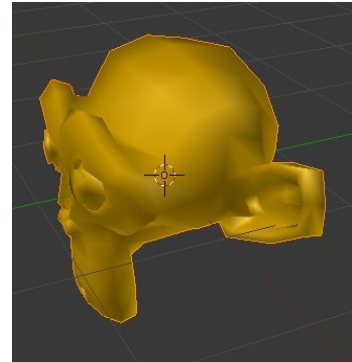
Intensity 0.000   Intensity 0.500   Intensity 1.000

Rendered Images
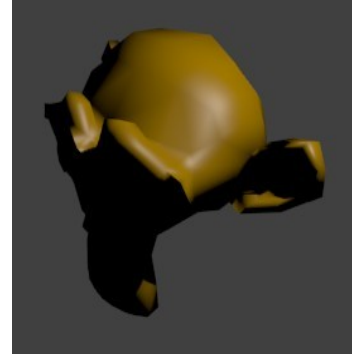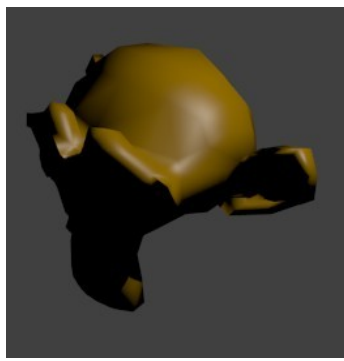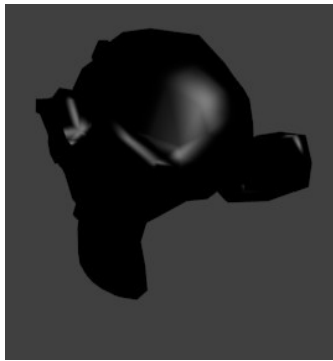
The Specular Tab

We will demonstrate the effect of Specular color which adds a highlights to a material. The Specular tab is similar to the Diffuse tab with a color bar which when clicked displays a color picker. The difference between the two tabs is that the Specular tab has a hardness value.

Selected Specular Color
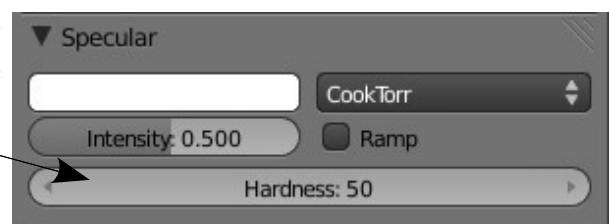
Select the green color with R:0.000, G:1.000, B:0.450

When you add a Specular color to an objects material there is no dramatic effect in the 3D Window. The difference will be the Specular Highlights. The following comparisons demonstrate the differences with varying Intensity values.

3D Window View

Specular Highlights
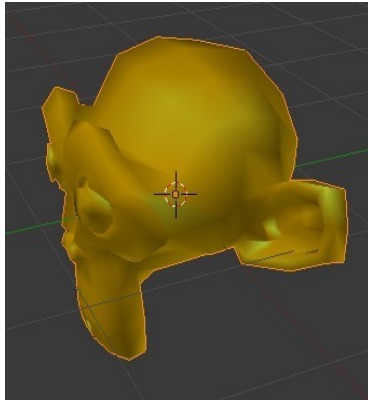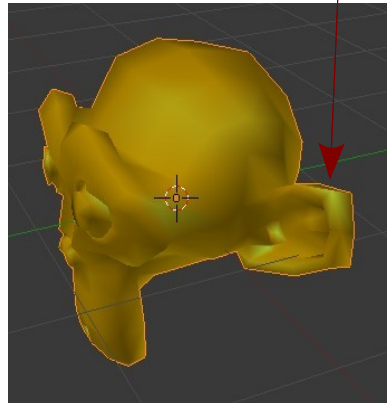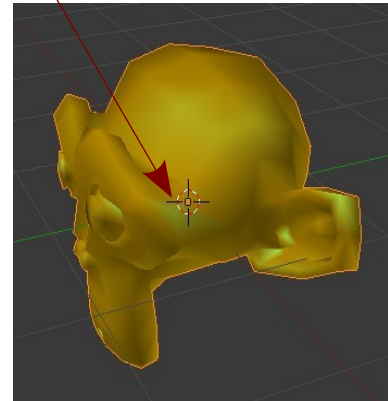
Intensity 0.000   Intensity 0.500   Intensity 1.000

Rendered Image View
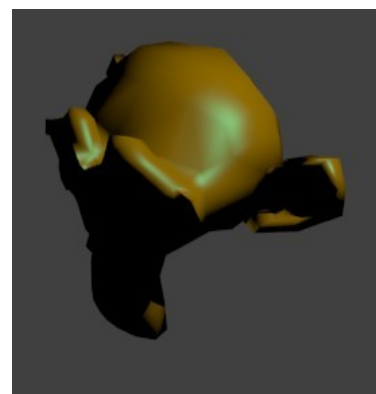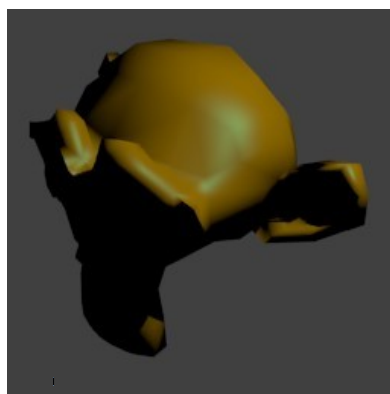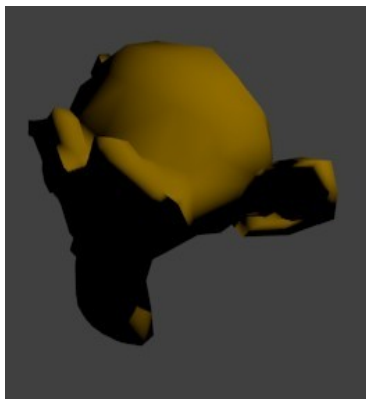
Learning Unit 5
Multiple Materials

Blender Materials - Mirror

The Hardness Value

The best way I can describe the effect of the Hardness value is to say that the effect spreads the specular color across the surface of the object. The default Hardness value is 50. The value range is 1 to 115. The most visible effect when altering the value occurs in the lower region of the range. The following examples demonstrate this effect.

Hardness Value Variation

3D Window View
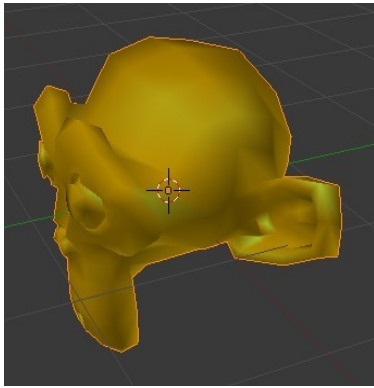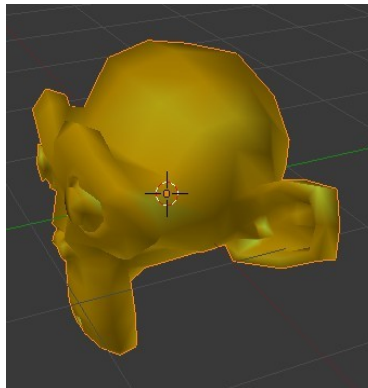
Hardness: 1   Hardness: 50   Hardness: 115
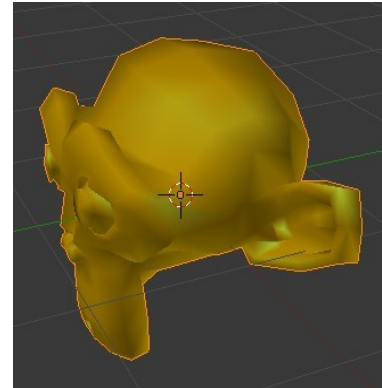
Rendered Image View
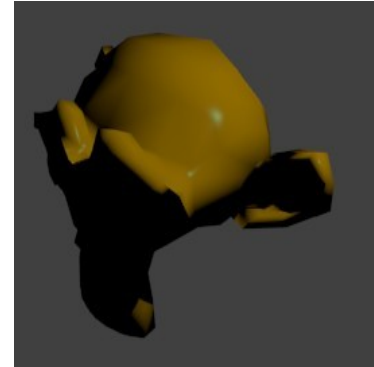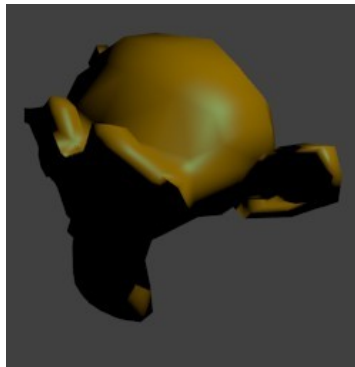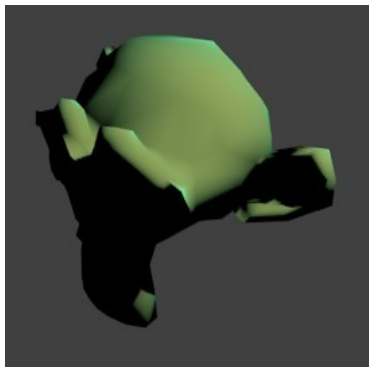
As you see in the rendered images there is a relatively small change between Hardness value 115 and 50 but a huge difference between 50 and 1. It is hard to see any difference in the 3D Window.

Ramp Shaders   Learning Unit 5
                          Blender Materials - Shaders

Besides having control over Diffuse and Specular Intensity and Specular Hardness there is Ramp Shader system to integrate color shading over a surface. We will not attempt to give instruction in its use here only to point out its existence.

Learning Unit 5
Blender Materials - Ramps

Ramp Shader produce very subtle effects of color mixing but it must be used in conjunction with lighting and lamp positioning.

Tick to turn Ramp Shader on

Transparency

To make an object transparent go to the Properties Window – Material button – transparency tab. Tick transparency to display the controls.

With the Sphere selected in the 3D Window tick Transparency and reduce the Alpha value
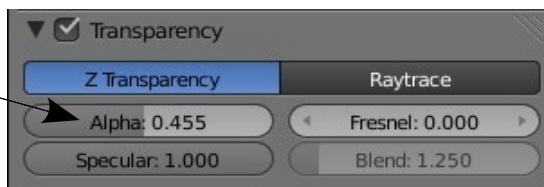
Cube placed in background
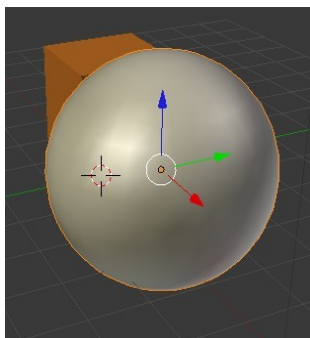
3D Window View

With the Cube selected, in the Shadow tab untick 'Receive'.
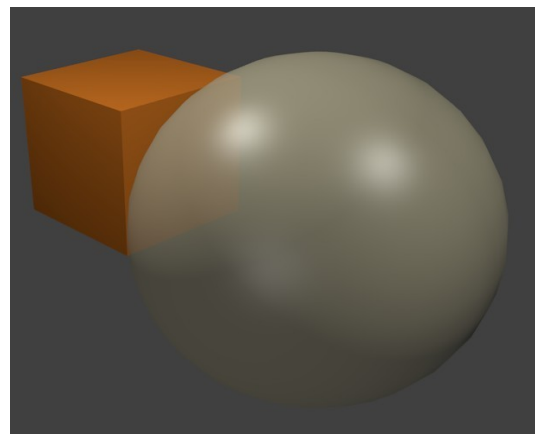
Rendered Image

Halo Settings

By using Halo settings only the Vertices of a mesh object will be visible when rendered. The vertices will display as points of light which look like rings, lines or stars or a combination.
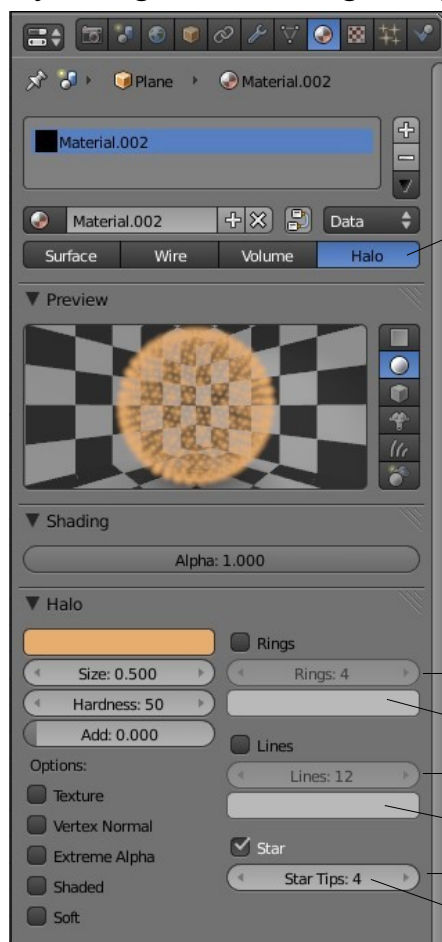
Halo Selected
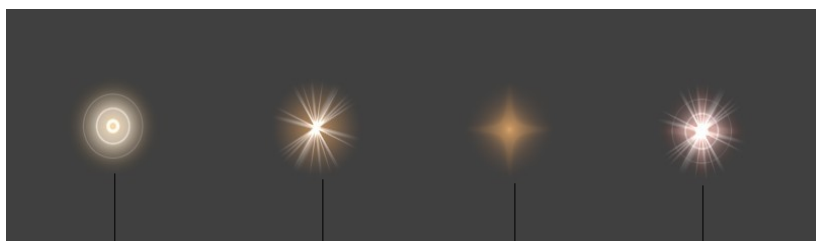
Mirror Color

Specular Color

Change values as required

Rings
Lines
Stars
Combined

Vertex Painting

In addition to adding materials to an object as described in the foregoing pages Blender also provides the Vertex Paint tool which allows you to manually paint a material on to the surface of an object

You paint by changing the 3D Window from Object Mode to Vertex Paint Mode. You will be able to paint a selected object immediately but before you can render an image with the paint showing you must have a material added. A new object added to the 3D Window displays with the default Blender grey color but as seen in the Properties Window – Material button there are no control tabs displayed. With a new object added to the 3D Window, in the Properties Window – Material button press 'Add Material'. The new object still displays in the 3D Window as the same grey color but now the Materials button contains control tabs.
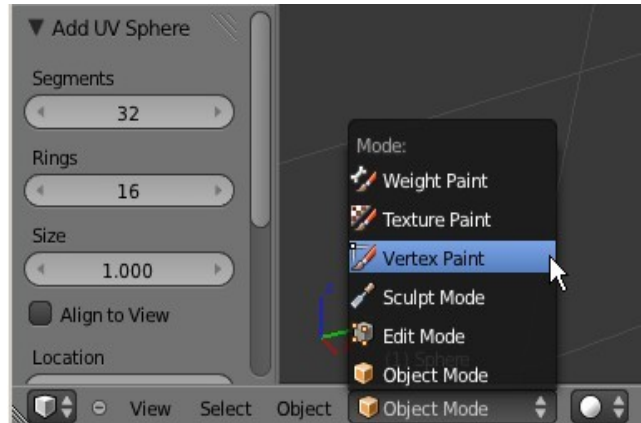
Go to the Materials button – Options tab and tick 'Vertex Color Paint'.

'Vertex Color Paint' tells Blender to use the painted material instead of base color when you render an image.

'Vertex Color Paint' must be ticked before the paint color will render.

As Vertex Paint suggests, the process involves painting vertices. The default Cube in the 3D Window only has eight vertices therefore it doesn't provide much scope for a demonstration. Delete the Cube and add a UV Sphere. The default UV Sphere has 32 Segments and 16 Rings which provides a vetex at each intersection point. If you would care to count the intersections you will find there are a lot more vertices in the sphere than the cube. Don't ask me how many. You can also subdivide in Edit Mode.

OK! Change the 3D Window to 'Vertex Paint Mode'.

UV Sphere

Paint Brush
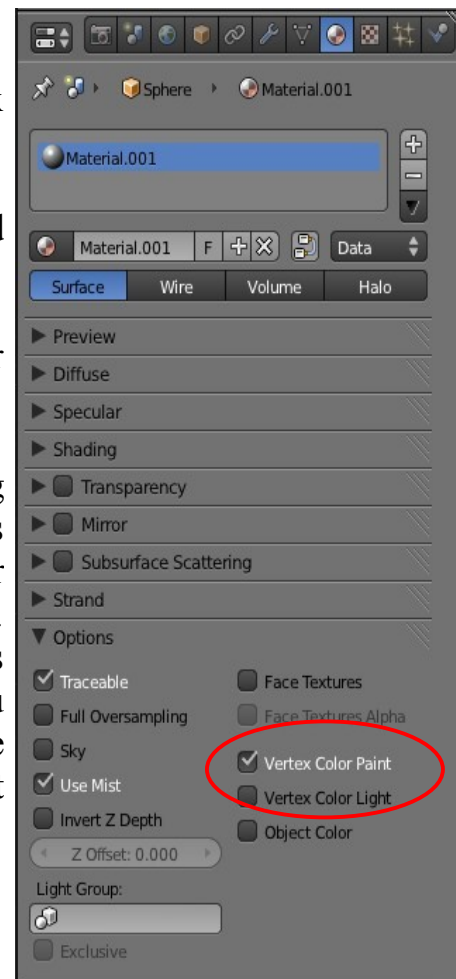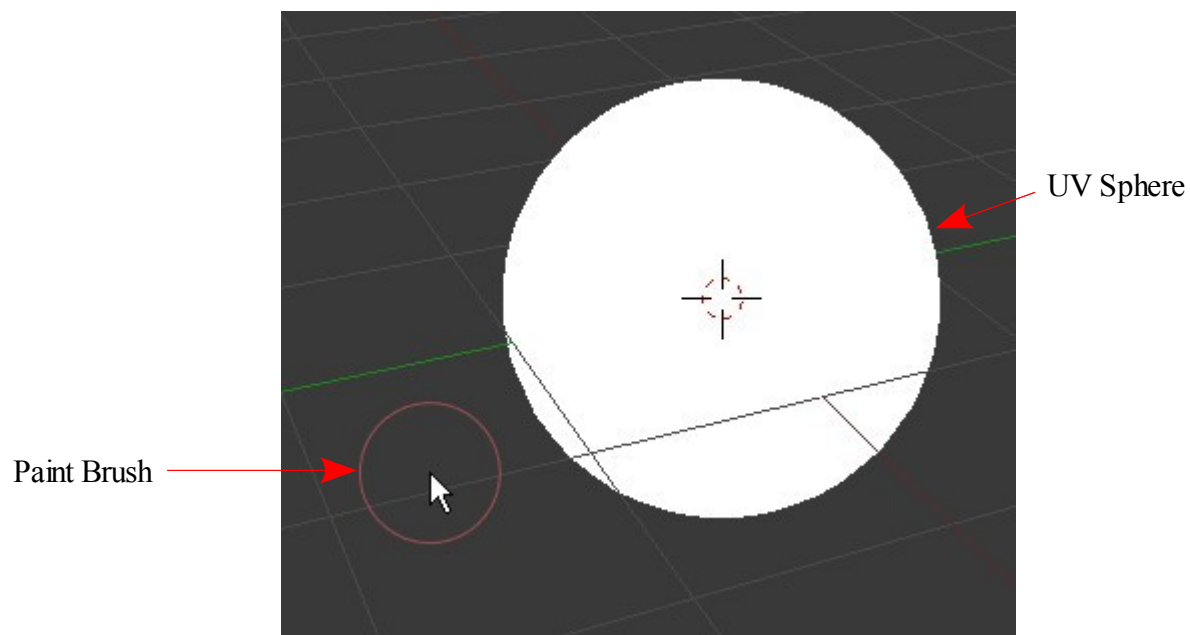
In Vertex Paint Mode the UV Sphere looks like a white disk and your 3D Cursor changes to a orange circle. The Tool Panel at the left of the window displays with the 'Brush tab' open.
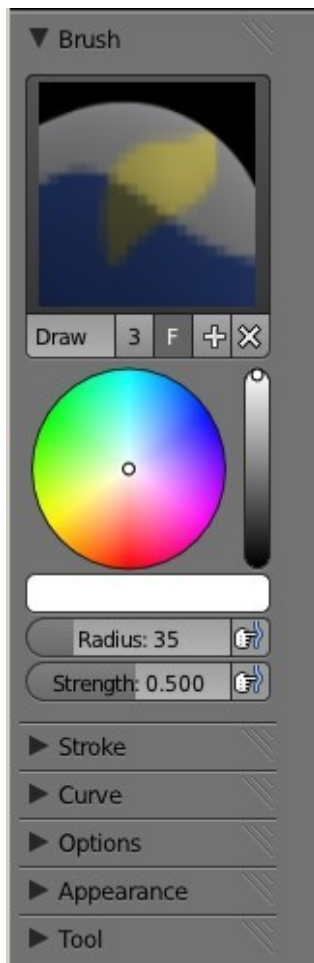
In the 'Brush tab' you have a circular color picker for selecting the paint color with a bar across the bottom showing the color selected. By default the selected color is white. To paint, click in the colored circle to select a color then in the 3D Window, click hold and drag the Brush across the UV Sphere.

Immediately below the color bar are two sliders. 'Radius' controls the size of the Brush (The circular 3D Cursor) and 'Strength' controls how much paint color is applied.

Another way of controlling the size of the Brush is to press the F Key and click and hold the LMB dragging the cursor towards or away from the centre of the Brush circle. Click LMB when finished. The size of the Brush circle changes and the slider value in the tool shelf is reset.

Drag mouse and click to change Brush size.
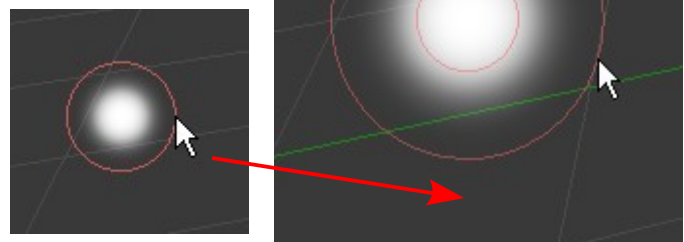
Besides the 'Brush tab' the Tool Panel contains five other tabs. Starting at the bottom:

The 'Tool Tab'. Here you select the tool specific to Vertex Paint and have a drop down menu for selecting the Brush Mode. The default Mode is 'Mix'.

Experiment with the different Modes to determine their use. The 'Add' Mode appears to act like an erasor.

Drop Down Mode Selection Menu

Select this Tool for Vertex Paint

The 'Appearance Tab' has a color bar showing the color of the Brush circle. Clicking on the bar opens a color picker for changing the color of the circle.

The 'Options Tab' provides settings for how the Brush operates. For example with 'All Faces' ticked the Brush will apply paint to all faces adjacent to the vertex being painted.

Paint applied to four faces

Cursor adjacent to Vertex

Paint applied to only one face

All Faces Ticked

All Faces Unticked
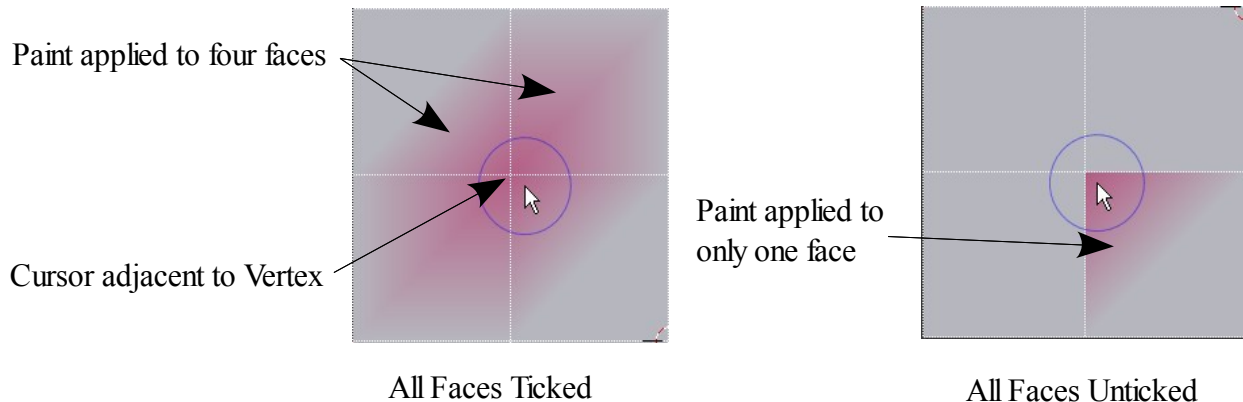
Placing the cursor over each option displays a description of the function. Unfortunately some of the descriptions are ambiguous.

The 'Curve Tab' provides a graphical method for controlling how the Brush applies paint. A small graph is displayed with a curve containing control handles. The handles may be manipulated altering the curve shape and changing the Brush paint application. There are also quick select buttons for changing the shape of the curve.
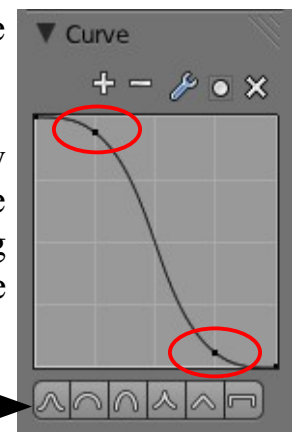
The 'Stroke Tab' provides controls for Brush application but the descriptions for use are ambiguous and it is difficult to determine the effects.

Remember that although the UV Sphere looks like a flat disc it is in fact a 3D Sphere. You can display the segments and rings and hence the vertices and faces of the sphere by activating the 'Face Selection Mask' in the 3D Window header.

Face Selection Mask activated
showing segments and rings.
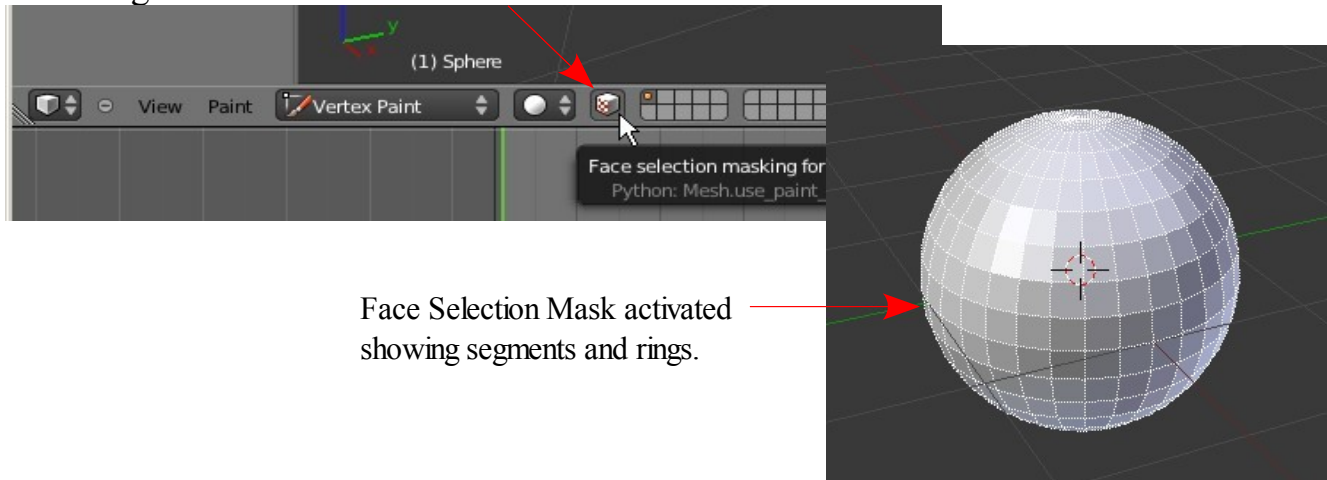
When painting you are only painting the visible surface of the object. You have to pan the 3D View or rotate the object to paint the hidden surfaces.

Visible surface painted.

3D View rotated showing
unpainted hidden surface
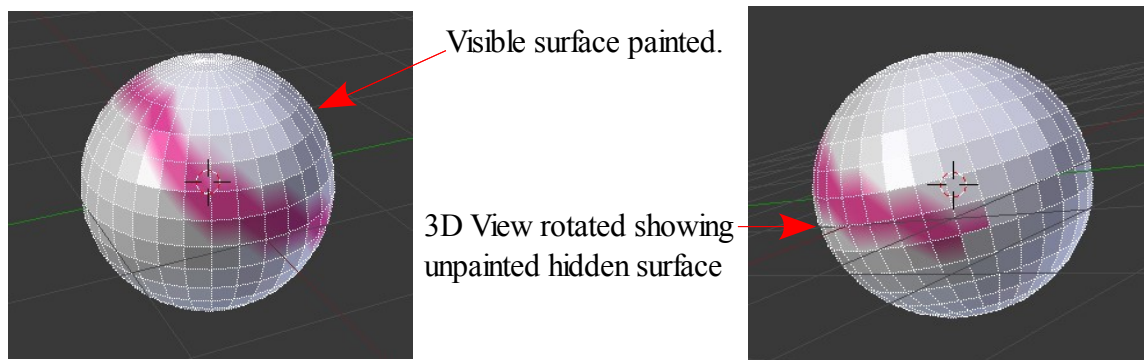
The Vertex Paint Color can only be seen in Vertex Paint Mode or in a rendered image.
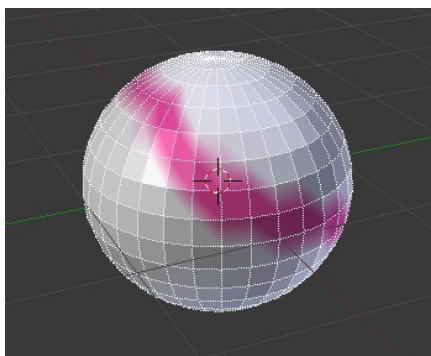
Vertex Paint Mode
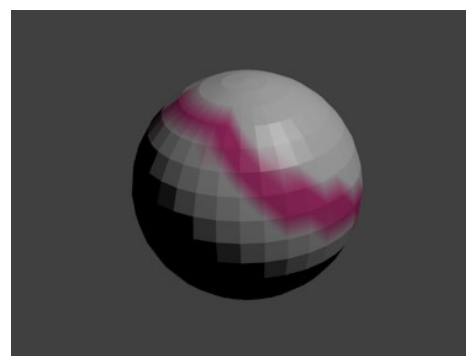
Rendered Image

There is plenty to experiment with in this topic and having grasped some of the basics a good idea is to look at some tutorials on the internet. Video tutorials pack in a lot of information and there are some good tips to be found.

Tip: In Vertex Paint the default viewing mode is 'Solid'. We have mentioned about turning on 'Face Select Mask' to see the mesh vertices but you can also switch to 'Textured Viewing' to see the actual surface of the mesh while you paint.

Tip: Click in the Brush tab for the quick set Brush options in the 'Tool Tab' .

The Option names are hard to see.
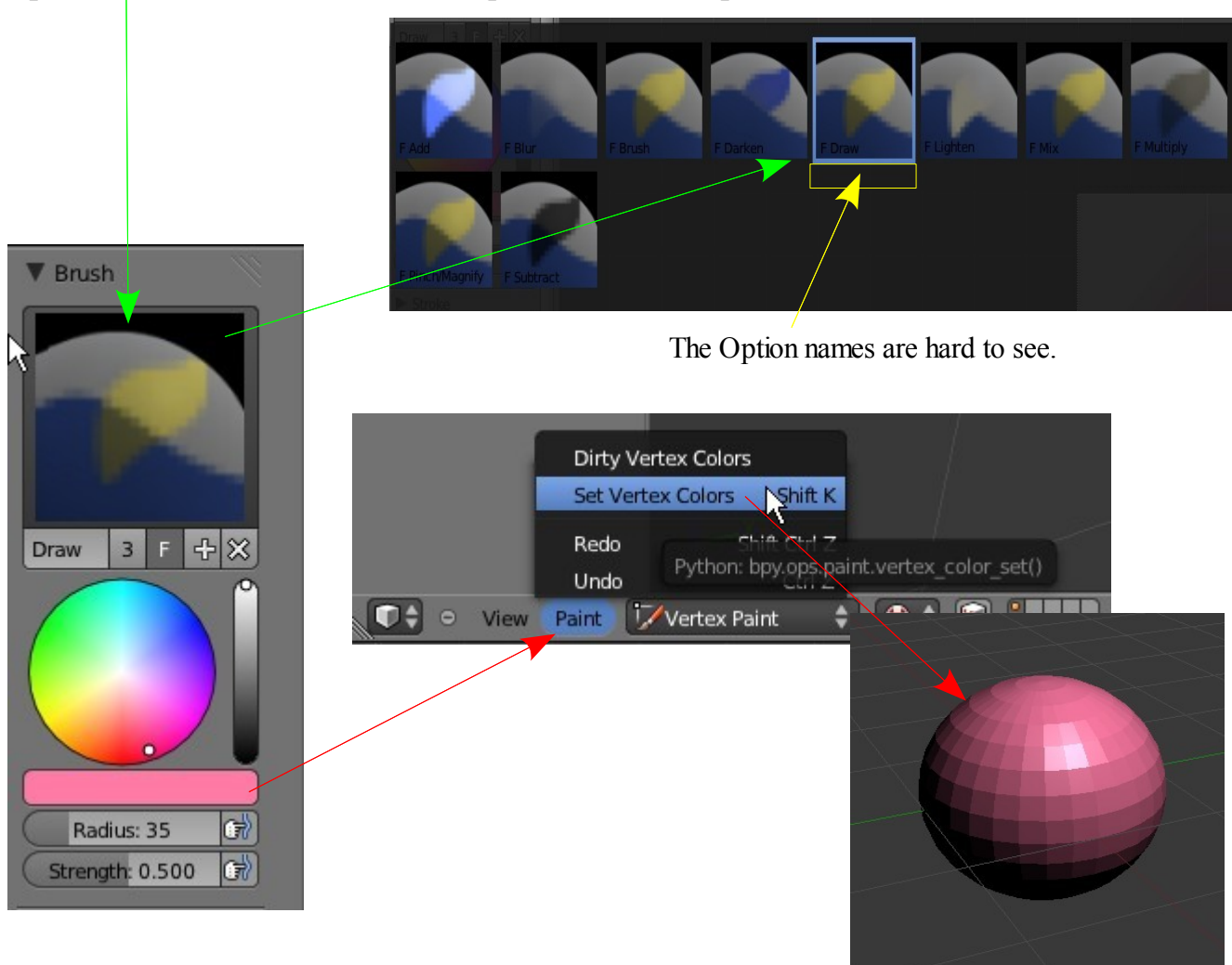
Tip: If you want to paint the entire surface of the mesh go to the 3D Window header (While in Vertex Paint Mode) ans select 'Paint' – 'Set Vertex Colors'. Whatever color has been selected in the Brush color picker will be applied to the whole mesh surface.

Tip: Sometimes it is difficult to see what is being painted in the 3D Window. Remember the default 3D Scene only has a single Point Lamp in place. You are therefore going to have shadow which obstructs the paint view. Add some more light with additional Point Lamps or Spot Lamps.

The Application of Materials and Material Slots

To simplify the understanding of the application of materials in Blender it may be easier to think of materials as colors. The color of an object in a Blender scene is set by values entered using a color picker, typing RGB values or moving sliders.

A Blender scene may have multiple materials and these materials are stored in a cache for use by any of the objects which are introduced to the scene or any object in any scene in the Blender file. A Blender file may contain multiple scenes.

To demonstrate the application of materials in Blender set the screen to include the 3D View and the Properties Window with the Materials Buttons active .

When a new Blender scene is opened the 3D View displays a cube mesh object which has a dull grey color. The Properties Window opens with Render Buttons active. Change the Properties Window to set the Materials Buttons active.
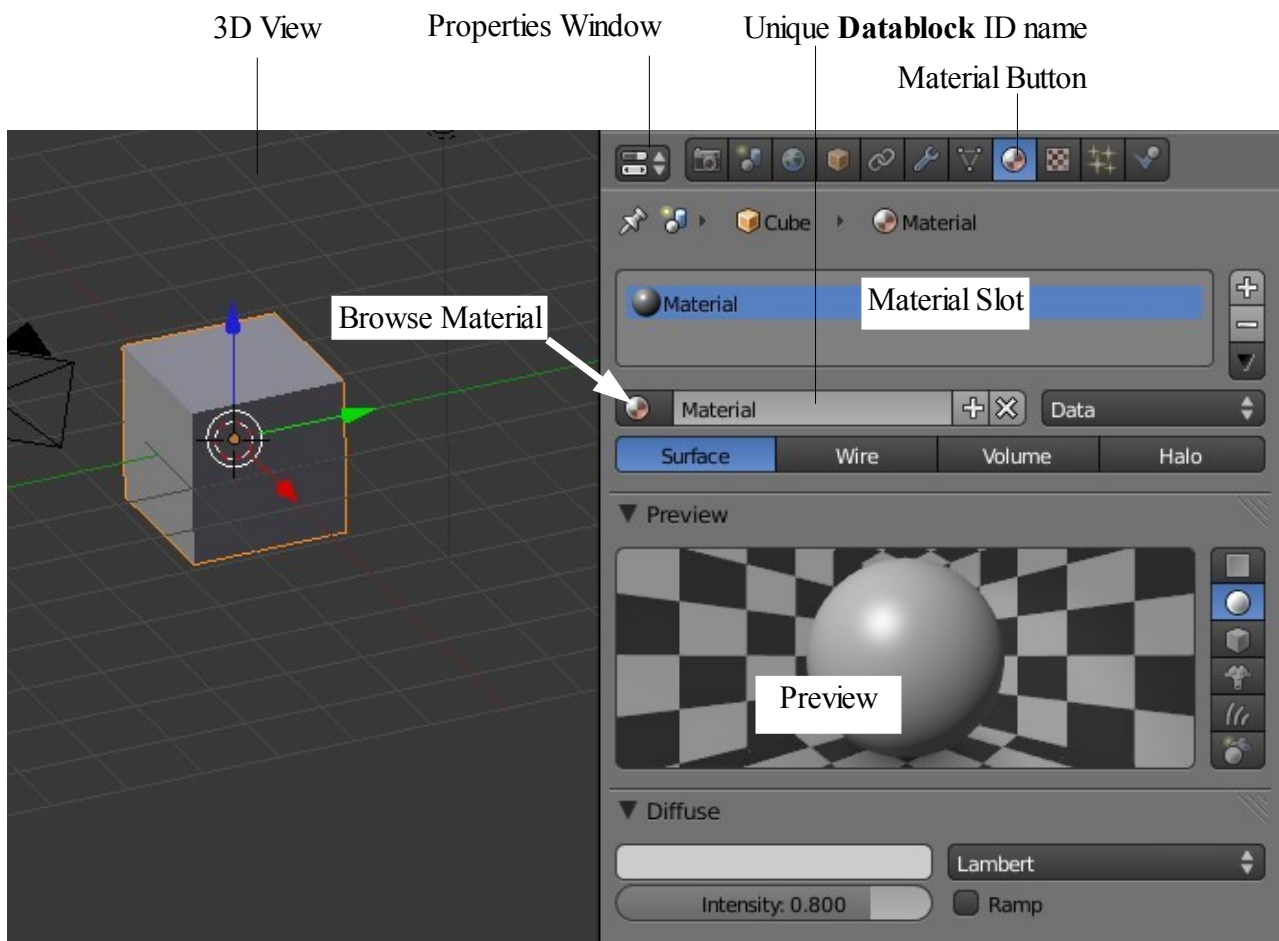
With the Materials Buttons active it is seen that:
1. A preview pane shows a dull grey color on a sphere.
2. There is a material named "Material" in the Unique Datablock ID name.
3. There is one Material Slot active showing the material named "Material".

By clicking the Browse Material data button a drop down displays, showing the Materials Cache containing the single material named 'Material'.
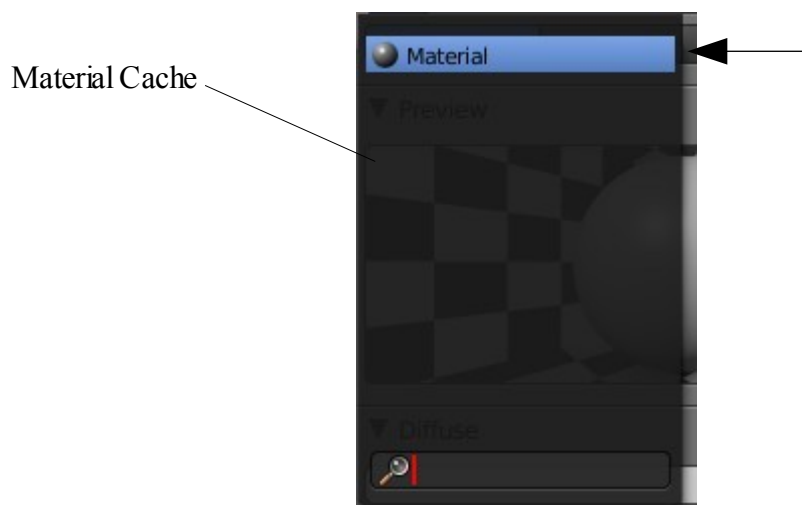
Material Cache

The relationship between the Material, the Material Slot and the Object in the 3D View may be considered as shown below.

Material data stored in the Cache is entered in the Material datablock which is linked to the Material Slot. The Slot is assigned to the object selected in the 3D View.

Object

Material Slot

Datablock

Cache
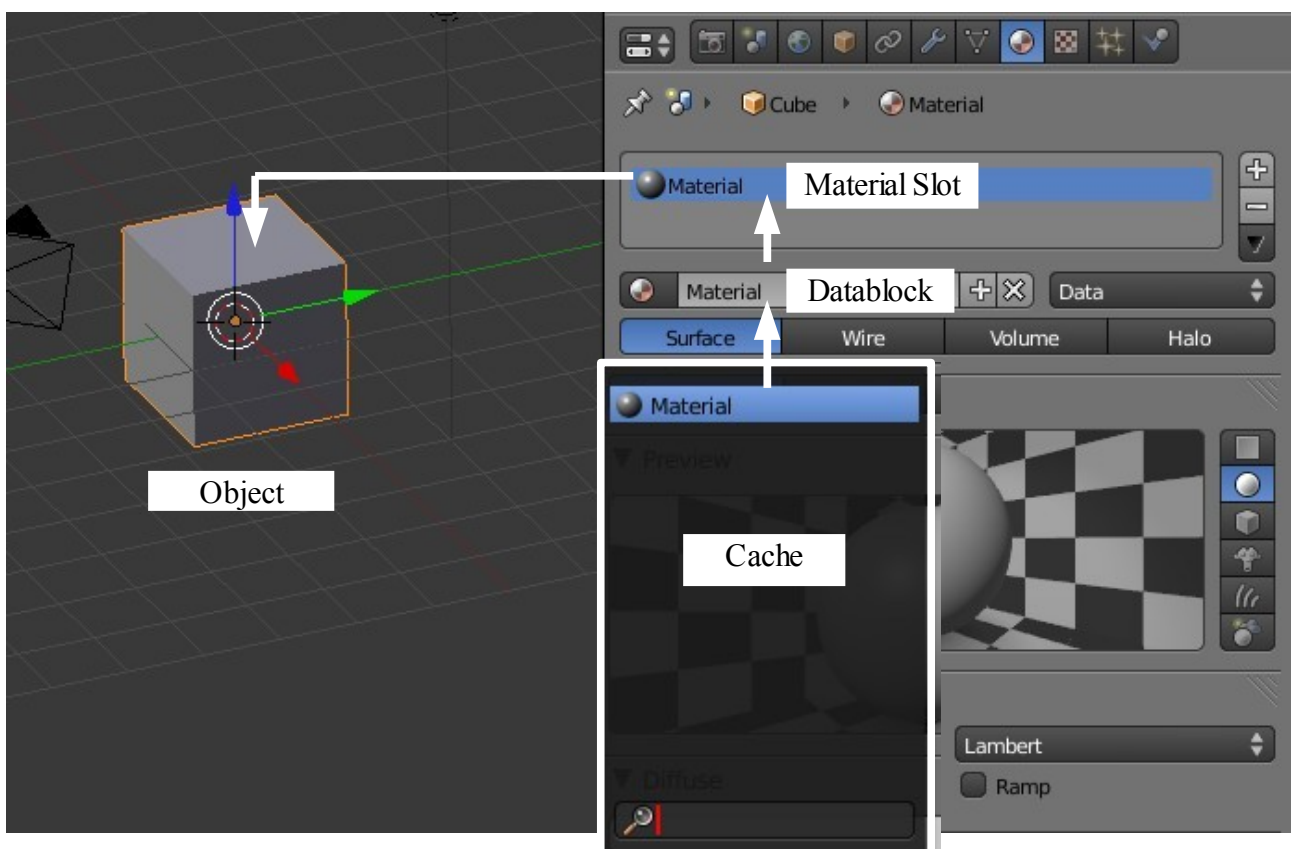
To further explain the relationship continue with the following procedure.

Delete the Cube in the 3D Window then add a new Cube Object.

Observe that the Properties Window Material buttons now show no reference to any material data. The cube in the 3D Window still displays as a dull gey color. By clicking the Browse Material data button it will be seen that 'Material' is still in the cache but it is named '0 Material'. It follows that there must be a hidden material slot with '0 Material' datablock linked to it and the slot is assigned to the cube in the 3D Window. Click on '0 Material' in the cache to display the material properties with the slot. Note: '0 Material' becomes 'Material' both in the Cache, the Datablock and Slot. The '0' prefix indicates that the Material is not entered in a Datablock.

Material Properties No material data reference

No Material data

No reference to material

Material data added

Click Browse Material data

Material Properties with material data reference

Material in Cache

Click on '0 Material'

Click on Diffuse color bar to display color picker
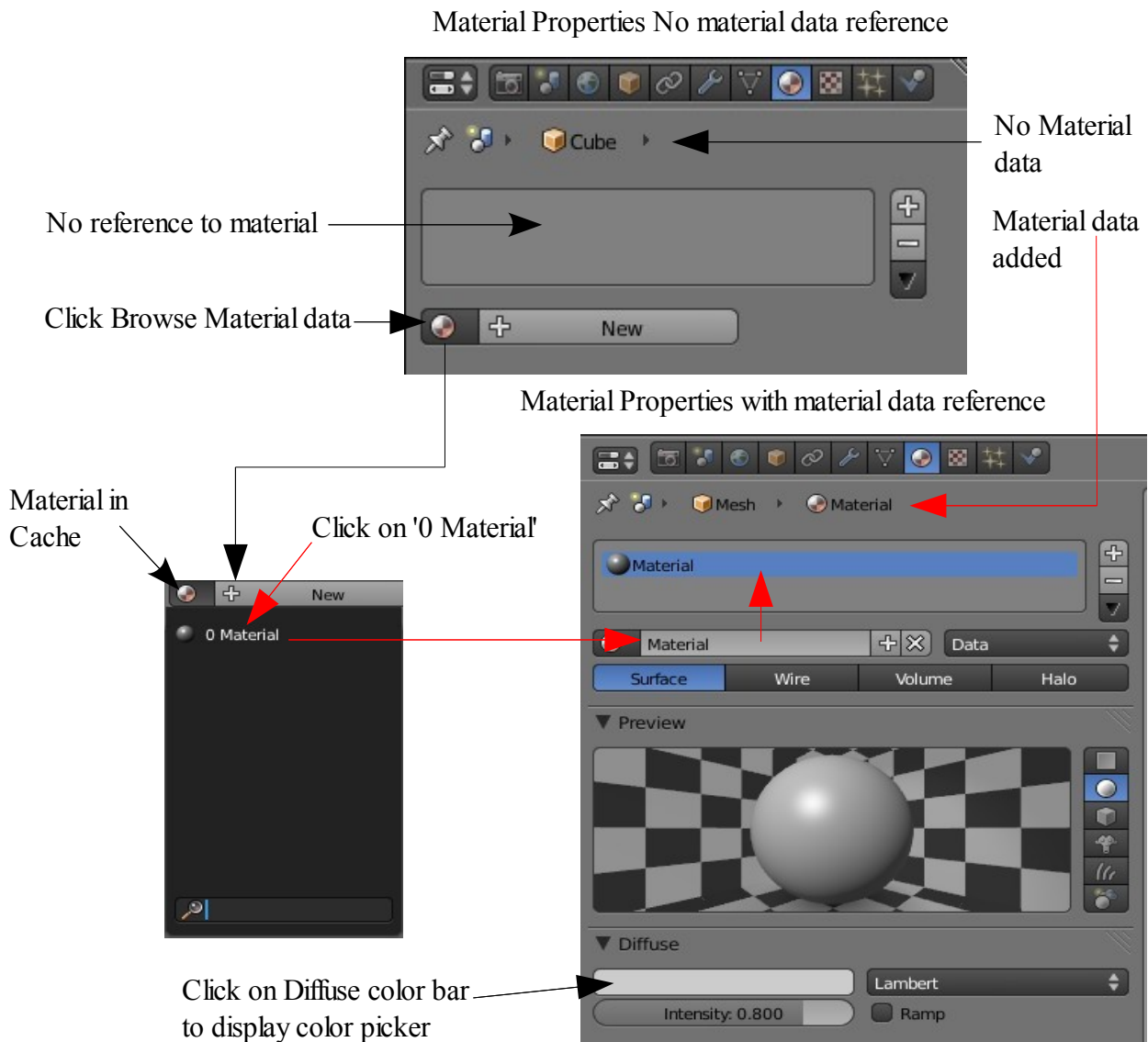
The relationship between the material and the object is applied whether the object is selected in the 3D Window or not. If there is more than one object in the window the relationship will be applied to the last object that was selected.

To demonstrate this deselect the cube in the 3D Window. Click in the Diffuse color bar to display the color picker and then click in the multi colored circle to select a new color. The color of the cube changes despite the fact that is is not selected. The material is still named "Material" but it has been given new data. The material is still linked to the slot and the slot is still assigned to the cube object.

Color Picker

Brightness Slider

Click in Circle

Type RGB values

R 0.60
G 0.60
B 0.60

RGB

Python: Material.diffuse

Drag Sliders
RGB values
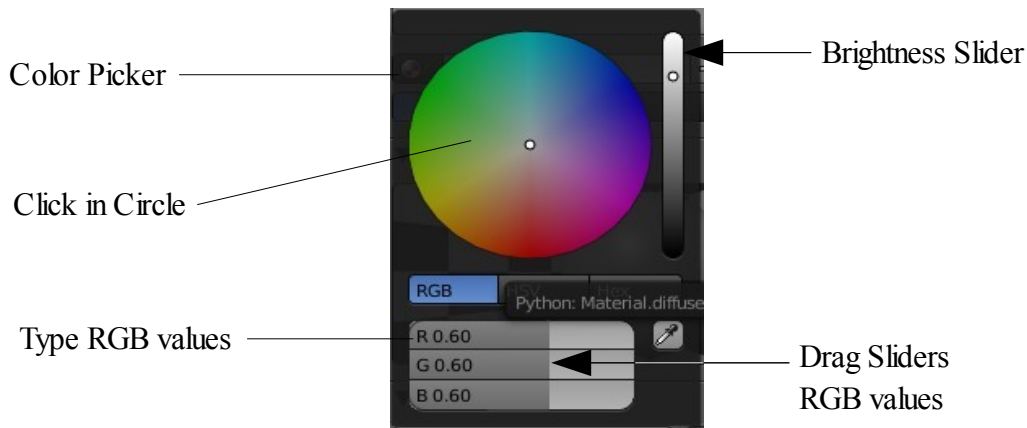
Note: To see the
results as show in
the diagram change
the slider values to:
R= 0.840
G= 0.290
B= 0.310

Color Selected
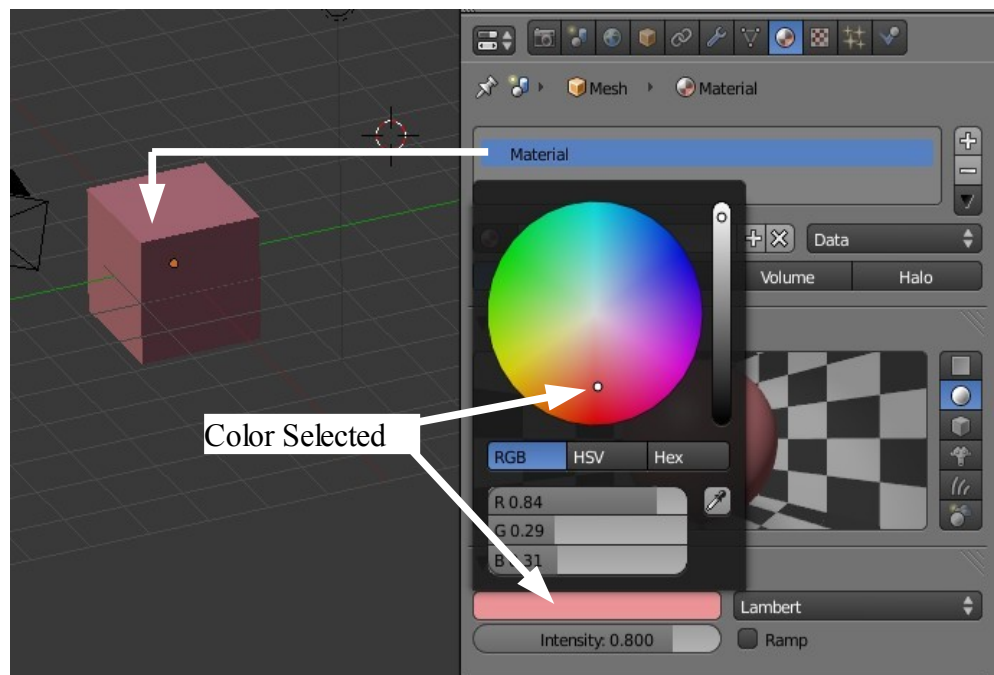
It is important to understand that with an object selected in the 3D Window the Properties Window shows the materials buttons and data that are relevant to the selected object only. Selecting a different object in the 3D Window changes the Properties Window and the data from that of the previous object to the new object selected. This may seem to be expressing the obvious but the concept must be understood.

The exception to the foregoing is that the materials cache and the materials contained therein are relevant to any object in any scene in the Blender file.

Multiple Materials may be added to the Cache.

Click on the + Add New Material button and a new material named "Material.001" will show in the 'Browse Material' datablock which is linked to the slot and therefore assigned to the cube. Blender creates a duplicate of the previous linked Material. 'Material.001' is identical to 'Material' i.e. it is the same color.

Material.001 in slot

Material.001 after
adding new material
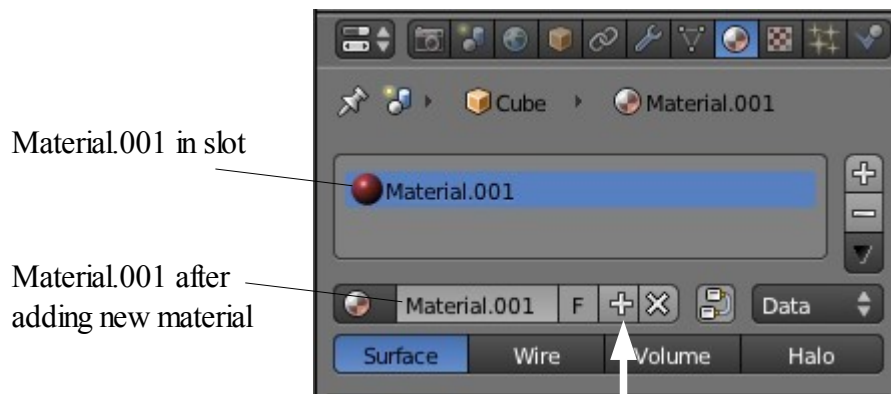
Add New Material Button

Click on the 'Browse Material' data button to reveal the cache. 'Material.001' is now stored in the cache. With the color picker, click and change the color. The color of the cube will change in the 3D Window since 'Material.001' is linked to the slot and assigned to the cube. Note that the Cube is not selected in the 3D Window.

Material.001 data linked
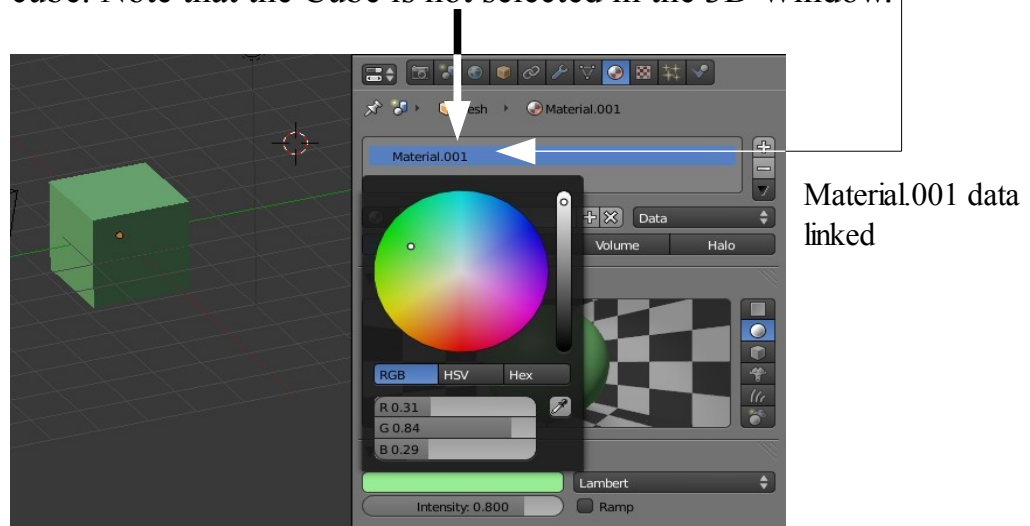
Go to the cache again and click on '0 Material'. Note: A material in the Cache which is not linked to an object has the '0' prefix.

By using the color picker and changing the color the material data is changed and therefore the color of the cube is changed. Clicking on 'Material' has linked it to the slot and with the slot assigned to the cube the color of the cube changes.

Therefore, by selecting 'Material' or 'Material.001' from the cache linking the material to the slot the color of the object cube can be changed at will.

Adding a new object to the scene creates a new material slot and by default the original material with its dull grey color is linked. As previously stated when a new object is introduced into a scene a new set of material data comes with it.

The cache retains the material colors previously used and they may be selected and linked to the new slot changing the color of the new object.

Up to this point only one material slot has been employed linked to an object.

Note: When a material from the Cache is linked to more than one object a number displays adjacent to th 'Unique User ID name' indicating the number of users.

Three (3) Users
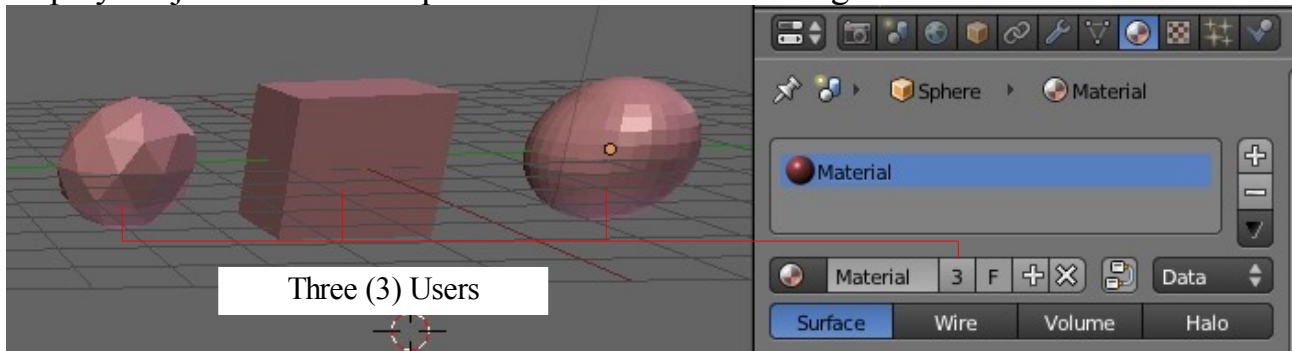
Multiple material slots may be introduced for each individual object in the scene.

The application of multiple material slots can be demonstrated by showing how a single mesh object can have multiple colors.

Follow this procedure leaving the default Cube in the scene.

Add a UV Sphere Mesh Object to the scene. The sphere will be in Object Mode and selected in the 3D View. Have the Properties Window with the Material buttons active. The sphere will be the default dull grey color and the materials properties window will be blank.

Remember the cache is still available for selecting materials if you wish.

Click on the 'New' button to create a new material. By default it is the dull grey color but note its Datablock ID name in the window 'Material.002'. Click on the 'Browse Material' button and it will be seen added to the cache. The name is 'Material.002' since 'Material' and 'Material.001 already exist.
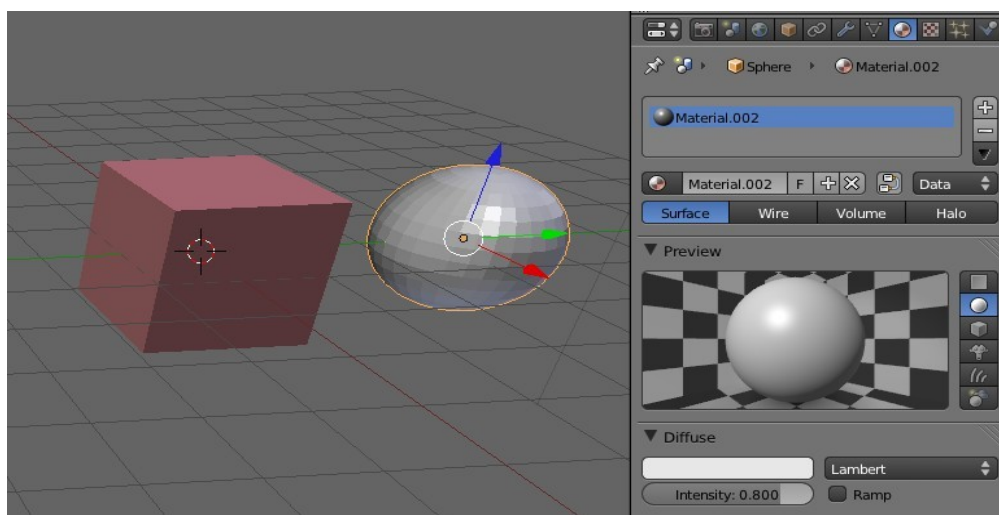
Now click on the Add Materials Slot button.
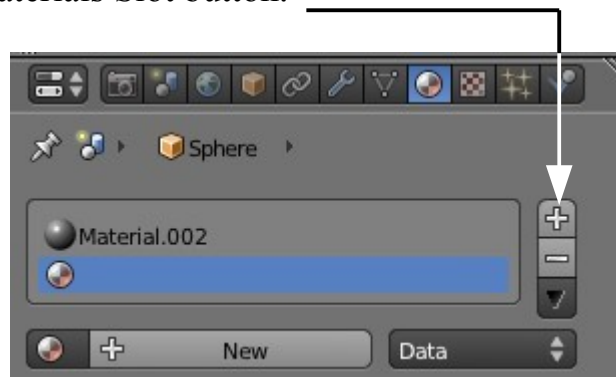
A new slot is created but note, there is no Material linked and the new slot is not assigned to the object selected in the 3D View.

At this point you can click on the 'Browse Material' button and link a material to the new slot or you may click on 'New' to create a new material datablock. Remember a new datablock will be a duplication of the last datablock selected which in this case was 'Material.002'. Click on 'New'.

Upper slot
linked to sphere

New
Material.003
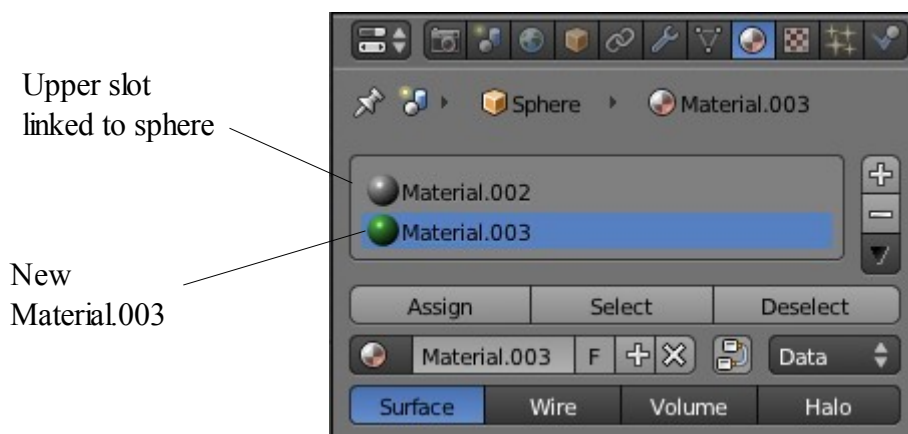
Since 'Material.002' was the last in the list Blender names the new Material datablock 'Material.003' and remember it is identical to Material.002. Change 'Material.003' color. The Sphere does not change color.

There are now two color slots, one is linked to the sphere, the other is not linked. Remember, the information in the Properties Material Window is only relevant to the object which is selected in the 3D View. If the sphere were deselected the the first slot remains assigned to the sphere since it was the last object selected.

As a demonstration of the foregoing select the Cube then the Sphere and note the change to the Properties Window.

More slots may be added and single user materials linked.

Now, the reason for the second slot.

OK! We have two slots assigned to the Sphere, one is assigned the other is not.

To change the assignment make sure the Sphere is selected in the 3D Window and Tab to Edit Mode. All the vertices will be selected. Click on the new Material Slot in this case the slot with 'Material.003' linked. Click on 'Assign'.

Tab back to Object Mode and you will see that the Sphere has changed color showing that the Material Slot with 'Material.003' linked is assigned to the Sphere object.

The Material datablock has been assigned to the Sphere since, in Edit Mode, you had all the vertices selected.

Change the 3D View to a side view (1 key or 3 key on the num pad) so the sphere is visible. Enlarge the view by + Key on the Num pad. Tab to Edit Mode (This is with the sphere selected). In Edit Mode the sphere will have all its vertices selected.

Press the A key to deselect the vertices. B key and drag a rectangle around part of the sphere selecting some of the vertices (A vertex Group).

B key Drag Rectangle

Vertex group selected
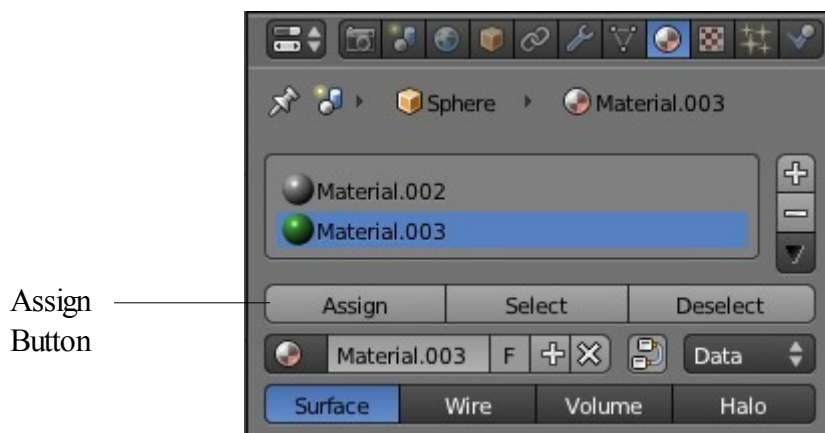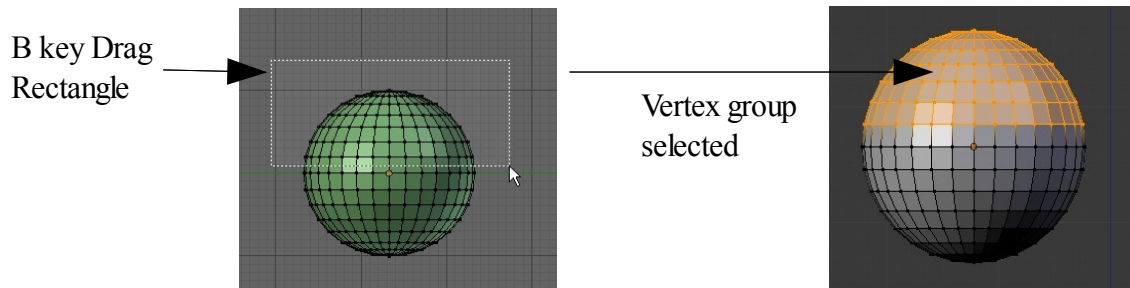
Assign Button

Select the with 'Material.002' and click on the Assign button. Blender assigns the slot and thus links the material to the selected group of vertices (Vertex Group). Make sure that the color for the material linked to the slot is something different to the material linked to the first slot or this will not be evident.
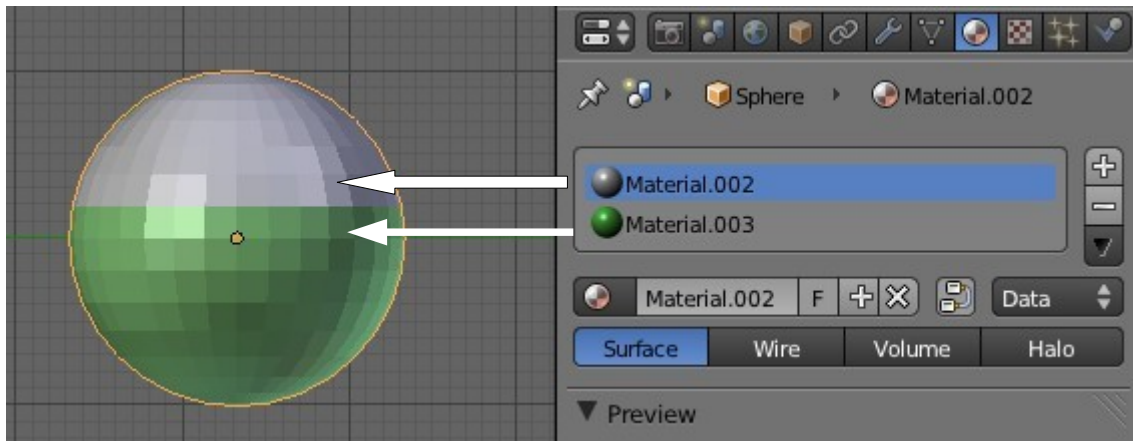
New Material.003
assigned to vertex group
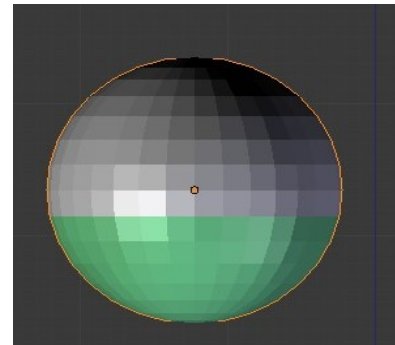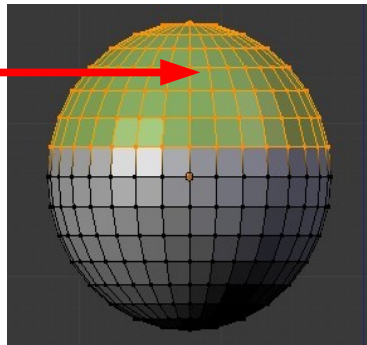
Sphere in Object Mode

Tab to Object Mode in the 3D View to see the sphere with two colors (Multiple colors).

Nothing is difficult when it is explained.

Some things are very simple.

Why is it so difficult to explain something so simple?

CH05- Textures

01-Textures

02-Texture Mapping

03-Displacement Mapping

04-UV Texture Mapping

05-Selective UV Mapping

06-Unwrapping with Seams

07-Texture Paint

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Textures

In the Materials section we considered the effect of light reflecting off a smooth surface. Textures are the physical characteristics or imperfections of a surface such as the grainy surface of bricks, the fiberous pile of carpet or wood grain etc.

In Blender the visualisation of these types of surface characteristics are created by mapping images on to the surface of a model in the 3D Window. In this case the images are called Textures.

In Blender, there are three Texture Modes. They are named Material, World Background and Brush.

Besides creating surface characteristics Textures are used to sculpt, paint and deform objects. Textures are also used by several of Blender's Modifiers.

It should be noted that Textures do not display in the 3D Window. An image of the scene must be rendered to see the Texture. This is to save computer power.

Material Textures

Before you can add a Texture to a surface you must first add a material since by default, Blender Material textures are set to influence the material. See Influence tab.

Textures are applied to an objects surface using the buttons in the Properties Window – Texture button. Clicking the Texture button displays a panel where you add a new texture. Blender comes with a series of built in Textures from which to chose or you can use any photo image stored on your computer. Blender can also place movies on a surface and you can animate the textures.

To demonstrate the placing of a Texture follow this example:

Open a new Blender scene and replace the default Cube with a Plane. Scale the Plane up by five. Add a Material R: 0.800, G: 0.767, B: 0.495.

Properties Window   Texture button

Go to the Properties Window –   Texture button and
click 'New'.

Note: By default Material Texture Mode is active.

Click 'New'
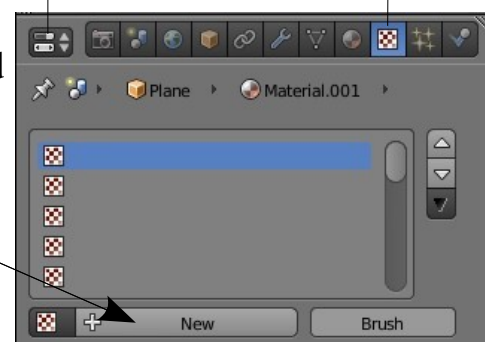
The texture buttons display with a default texture type 'Clouds' shown in the 'Preview tab' panel. With a 'Clouds' type texture a 'Cloud' tab has displayed. This tab contains settings for altering the characteristics of the texture. The tab will change depending on what texture type is selected.

Click on the texture type drop down and select type 'Magic'. Tab.

Texture Mode Buttons

Click for dropdown menu   Magic
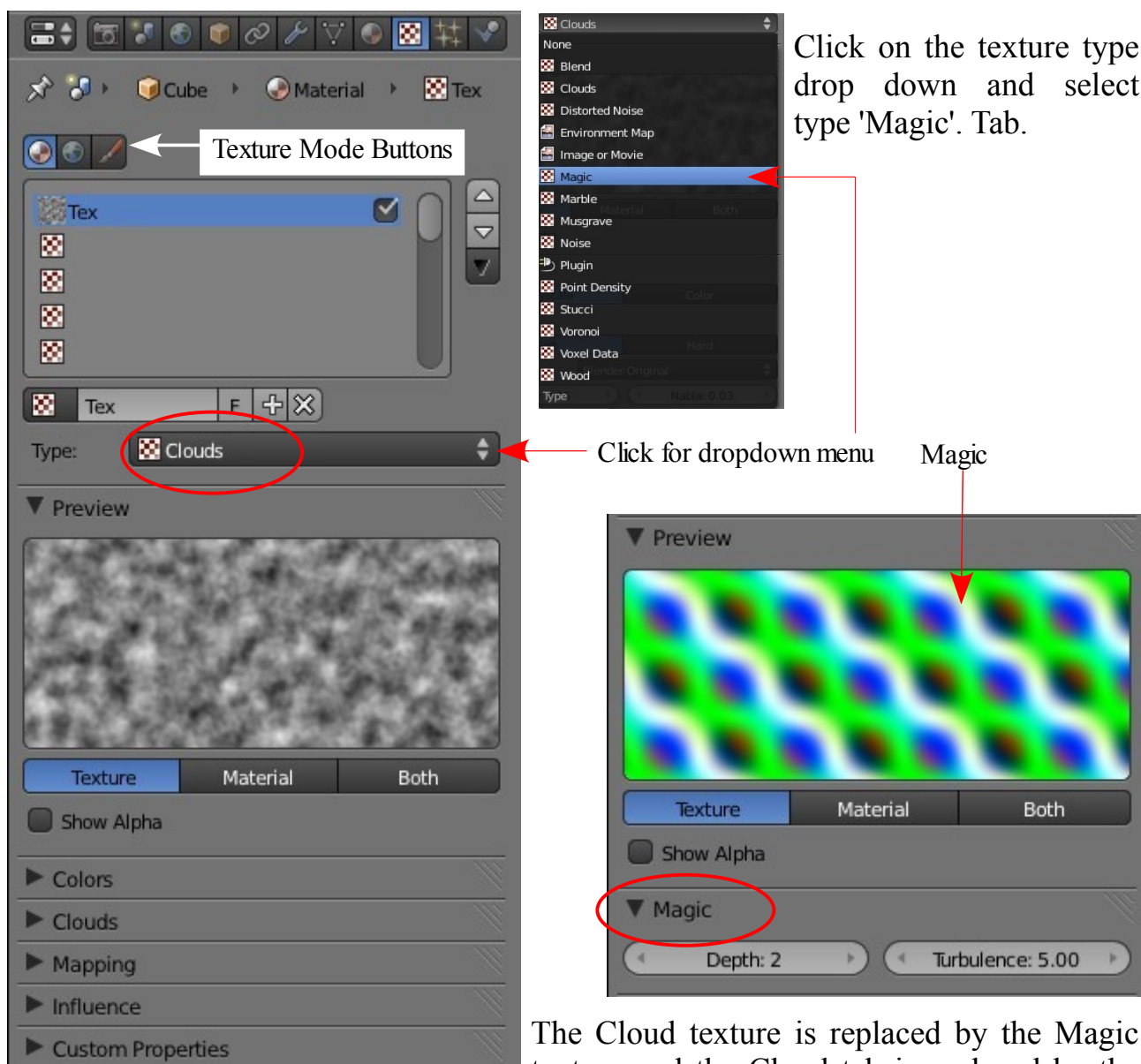
The Cloud texture is replaced by the Magic texture and the Cloud tab is replaced by the Magic tab. This tab contains only two values for altering the characteristics of the texture, Depth and Turbulence.

Note the 3D Window does not show the texture on the object. This is where Blender conserves memory. Render, press F12, to see the texture.
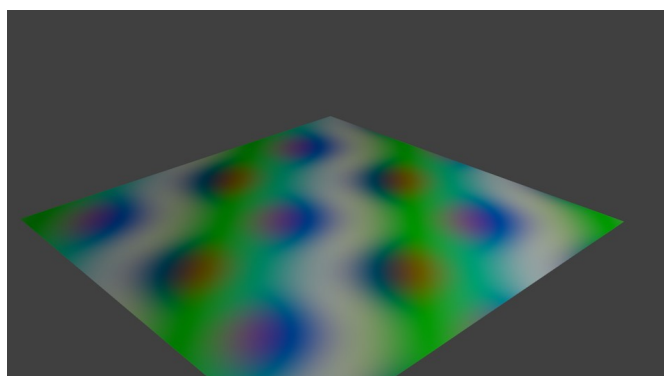
Change the Depth value to 4 and render again to see the alteration.

Go back to the texture type drop down selection and select 'Image or Movie'.

An 'Image' tab displays instead of 'Magic' and the preview shows a black window. We haven't told Blender what image to use.
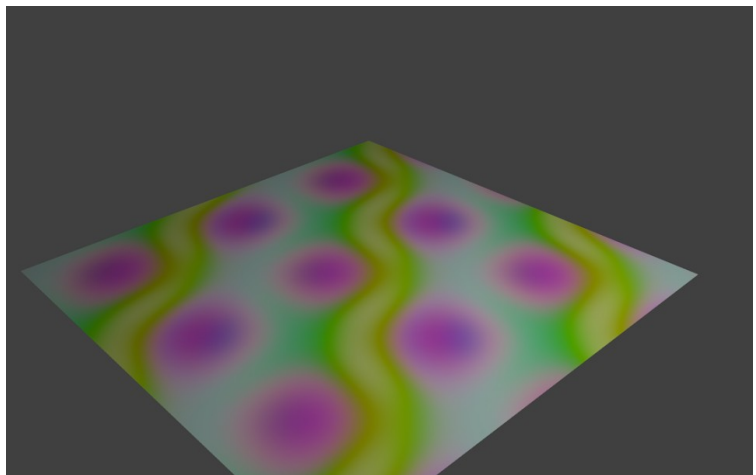
Render with Depth: 4
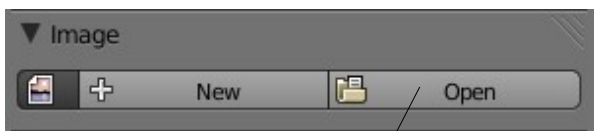
Learning Unit 5
Image Textures

In the Image tab click open. The File Browser window displays. Navigate to a file containing a picture. I have a picture named 'Street.jpg' in my Documents folder. Click on the picture file then click 'Open' (Top RHS of screen).

You will see your picture in the preview panel (probably multiple images). Render to see your picture displayed on the surface of the plane.
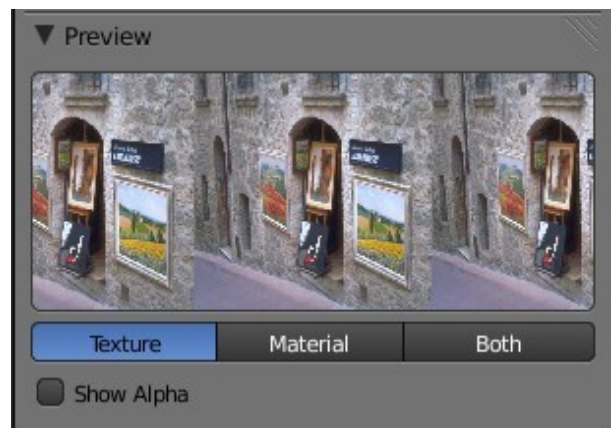
Learning Unit 5
Decal Image Texture

Mapping the Texture

Whether you use one of Blenders built in textures or an image you may want to adjust how the texture is positioned on the object. The 'Mapping' tab is the place to do this.
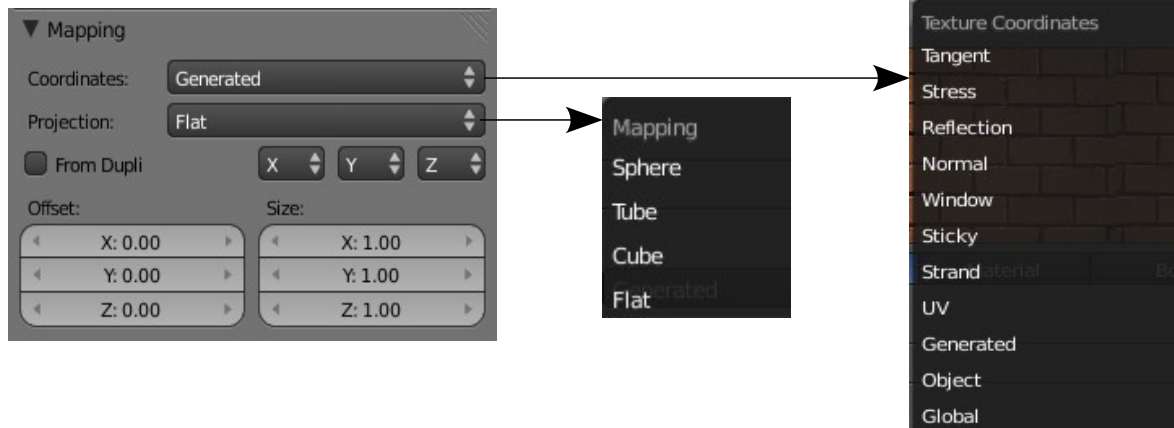
Offset and Size are self explanatory. Either can be controlled on the X, Y and Z axis. The Coordinates drop down gives you a selection of coordinate systems and the Projection drop down has a choice of mapping options to suit the shape of your object.
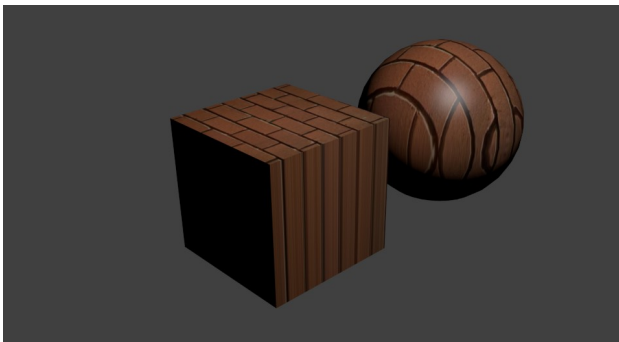
Flat
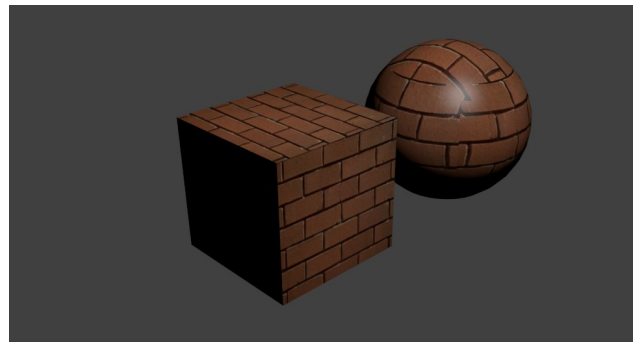
Cube
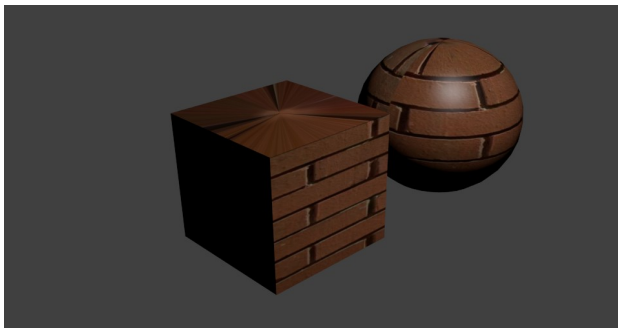
Tube
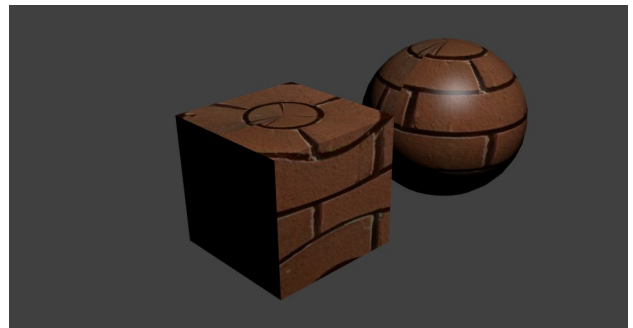
Sphere

There are a lot of buttons and settings to experiment with in the Texture buttons and the best way to find out what they do is play around and record results for future reference.

Displacement Mapping

Displacement Mapping is using a Texture to deform a mesh. You can make a Cube or a Sphere etc. look wrinkled without having to move vertices around.

Start a new Blender scene with the default cube. Make sure the Cube has a material then in Edit mode subdivide the Cube six times. The texture is going to displace vertices so you need a whole bunch of vertices to work with.

Put a Cloud Texture on the Cube then go to the Influence tab. Leave the Diffuse Color ticked and under the Geometry heading tick 'Displace' and alter the value as shown. Render to see the effect.
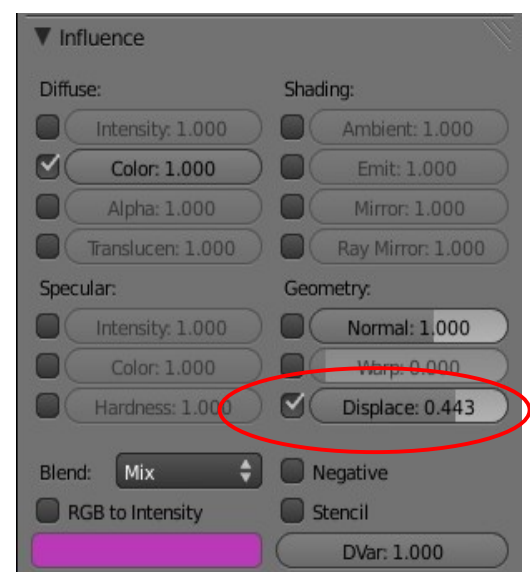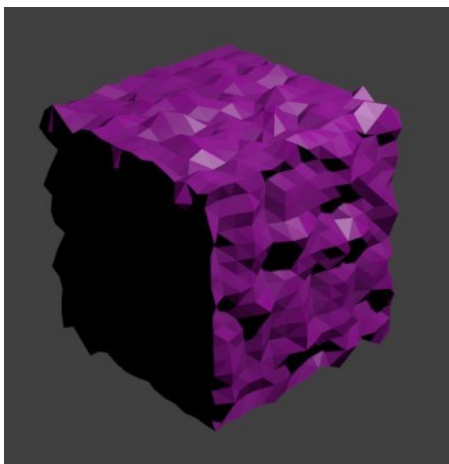
Moving the slider next to the Displacement tick varies the amount of displacement. The 'Blend' drop down displays options which influence the Material. Try 'Add' and 'Subtract' and render to see the difference. Another example is shown below. This time a black and white image texture has been used on a plane. Don't forget to subdivide the plane. Negative Displacement values raise the surface up positive values depress the surface.

Black and White Image
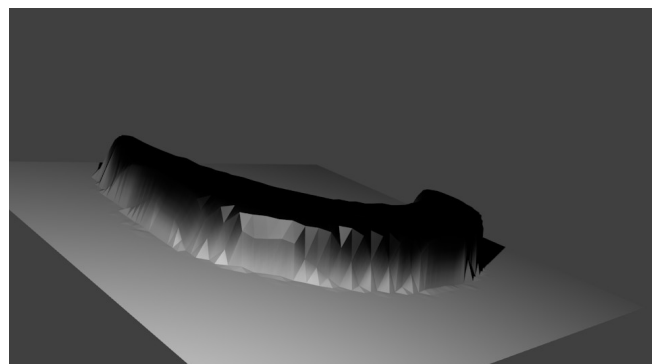
Rendered Image with Negative Displacement Value

Experiment with other features and record the outcome for future reference.

UV Texture Mapping

For complex models regular Cubic, Cylindrical or Spherical texture mapping is not sufficient to accurately place the texture on the surface . This is where UV Mapping can help.

The coordinates U and V are used simply to distinguish from the XYZ coordinates used in the 3D Window.

UV Mapping is accomplished by taking the surface of an object (Model) , peeling it off as you would a skin from an orange and laying it out flat on a 2D surface. An image is then superimposing as a texture over the flattened surface (Mapping). The surface for laying out the flattened object is the UV/Image Editor Window.

As with every basic instruction in Blender it is best to begin with something simple. Although the process we are describing is for complex surfaces anything other than simple is going to be confusing at first.

Start with a Cube object in Blenders default 3D Scene but first delete the cube that is loaded automatically and add a new cube.

The default cube comes pre loaded with a material and a texture channel. In our previous discussion on material and textures it was stated that before a texture could be applied, an object had to have a material. Adding a new cube to the scene which does not have a material or a texture will demonstrate that neither are necessary when applying UV Texture Mapping.

Properties Window – Material Button
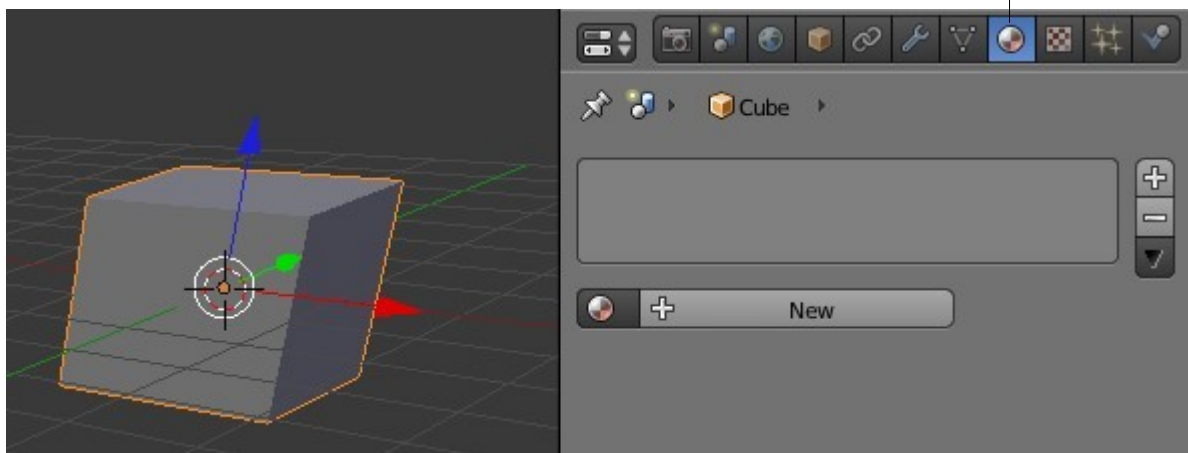
New Cube added – no material applied

With the new cube added divide the 3D Window in two and change one half to the UV/Image Editor. In the 3D Window zoom in on the cube. When you divide the window the cube is a little small to see what you are doing.

Change the 3D Window to Edit mode and select 'Textured' as the Viewport Shading Type.

Selecting 'Textured' will allow you to see the superimposed texture in the 3D Window while in Edit mode.
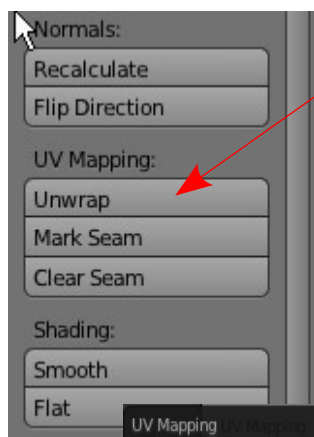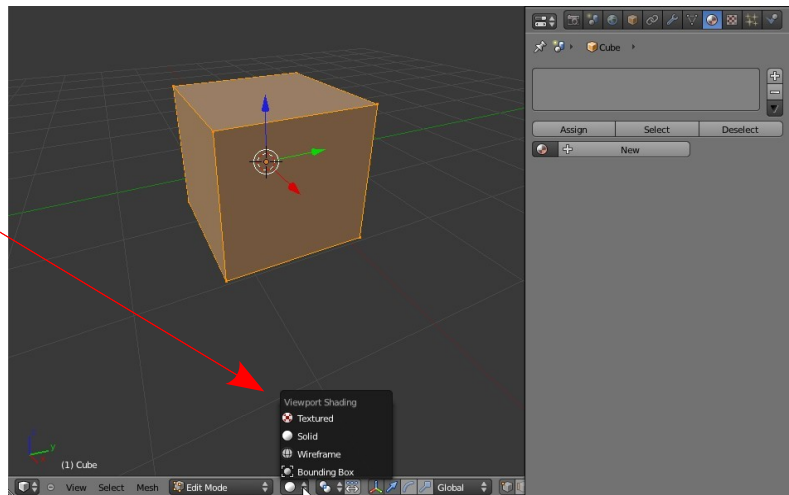
In the 3D Window Tools Panel under 'UV Mapping' click on 'Unwrap' to display a 'UV Mapping' unwrapping type selection menu. These options allow you to unwrap the surface of the selected object in a variety of ways. Some of the unwrapping methods are difficult to visualise so the only way to learn is to experiment and record your findings.
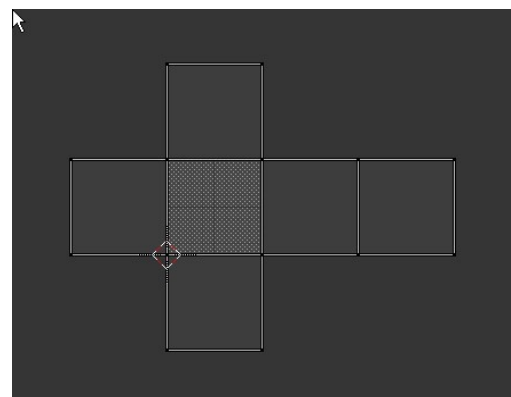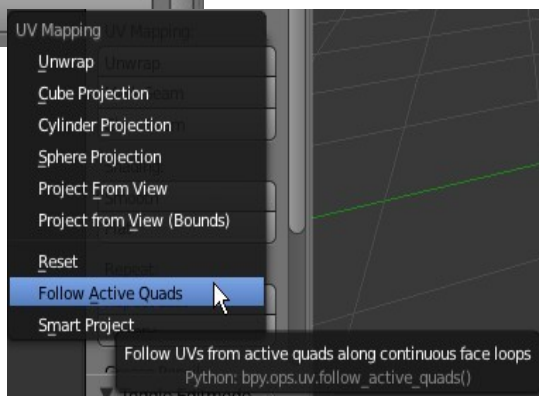
To keep things simple select the 'Follow Active Quads'- 'Edge Length Mode - 'Length' method for unwrapping the cube. This method will lay out the surface of the cube as if you had unfolded one of those post office mailing boxes. The surface will consist of six squares. The UV/Image Editor window will probably require you to zoom out to see the whole arrangement (Num Pad – Minus Key, the same as the 3D Window). Now the flattened surface is displayed it's time to load a texture image.

In the UV/Image editor Window header click on 'Image' and select 'Open Image'. This will display the File Browser Window where you can navigate and find an image to use as a texture. Once you have located your image file click on it to select and then click on 'Open Image' (Top RHS of Window).

File Browser Window

Click to display files as thumbnail images.
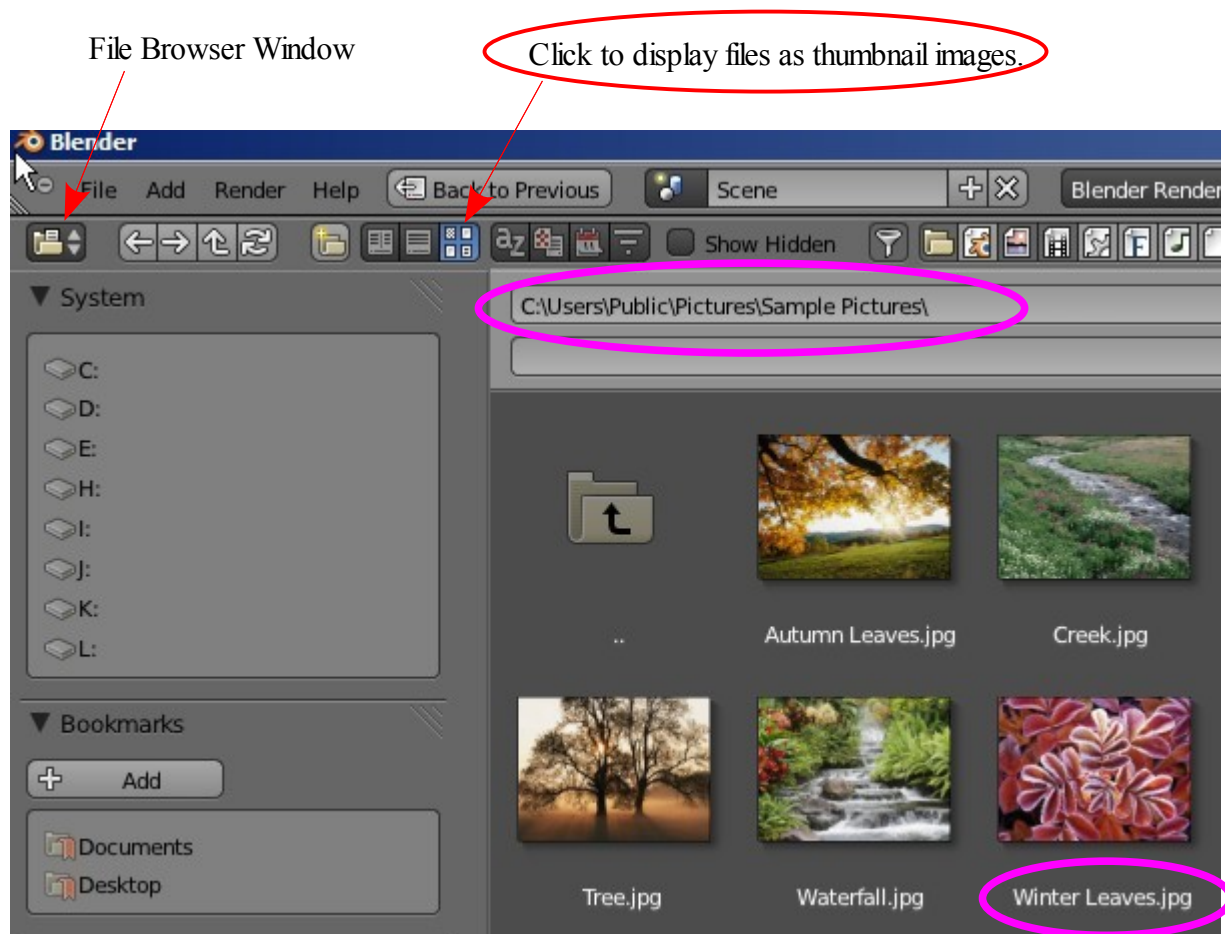
In my case I have selected a picture file named 'WinterLeaves.jpg' in my C:\Users\Public\Pictures\SamplePictures\ directory.

The image displays in the UV/Image editor window.
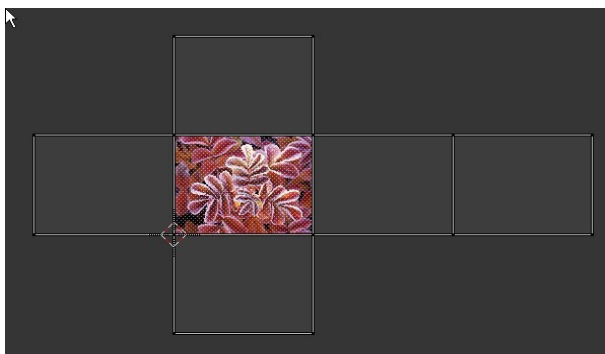
Zoom out again if the image is too large. The image shows in the centre face but you will see that it is mapped to each surface of the cube in the 3D Window. Go ahead and rotate the cube to see if I'm correct.
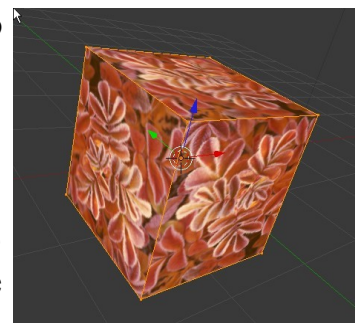
With the cursor in the UV/Image editor press the A Key to select all the surfaces then G Key (Grab) and move the selected surfaces around. As you move the surfaces you will see that the image is repositioned on the surfaces of the cube in the 3d Window.

The outline of the surfaces in the UV/Image Editor can be scaled and rotated the same as you would edit a mesh in the 3d Window. Individual vertices on the mesh may be selected then grabbed and moved also. As you see by manipulating the surface outline in the UV/Image editor you can accurately position the texture image.
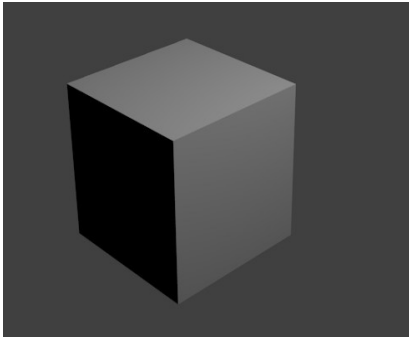
If you were to render an image of the object (F12) at this stage you would be disappoint to see that the image texture does not render.

To render the image texture you have to activate 'Face Texture' (Tick) in the 'Options tab of the Materials buttons in the Properties Window. OK, now you have to apply a material. The default dull grey color will do.

Default Grey
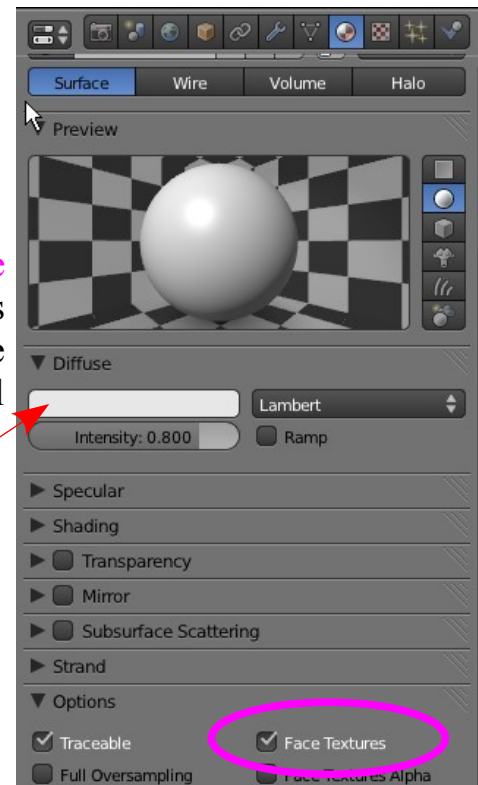
Now press F12 to see the rendered image.

Selective UV Texture Mapping

So far the image texture has been mapped to all the surfaces of the object but Suppose you wish to place the texture only on one face of the object.

Create a new scene and **leave the default cube selected**. Divide the 3D Window as before and set up the UV/Image editor. In the 3D Window tab to Edit mode and select 'Textured' Viewport Shading.

In the 3D Window change from Vertex Select mode to Face Select mode. Deselect all faces then select only one face (Right click on the face).

One face selected

Face Select Mode
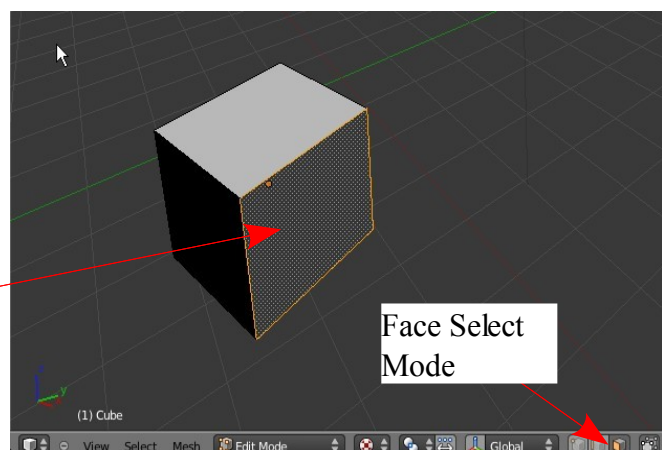
In the UV/Image Editor select and enter an image for your texture as before.

You will see the image mapped to the face you selected in the 3D Window. The other faces display a white.
In this case we didn't do any unwrapping but as soon as the image was entered in the

UV/Image Editor Blender automatically mapped the single face.

With the cursor in the UV/Image Editor pressing the A Key will select the face. The white outline turns red.

You can then manipulate the face map to position your image the way you want.

G Key - grab, R Key – rotate, S Key – scale.
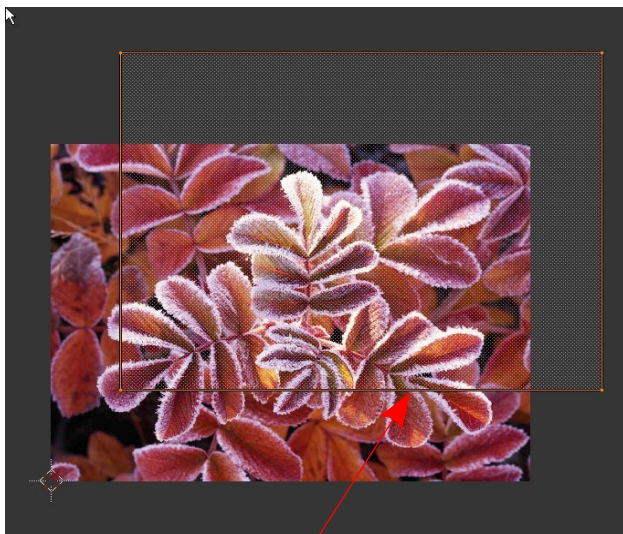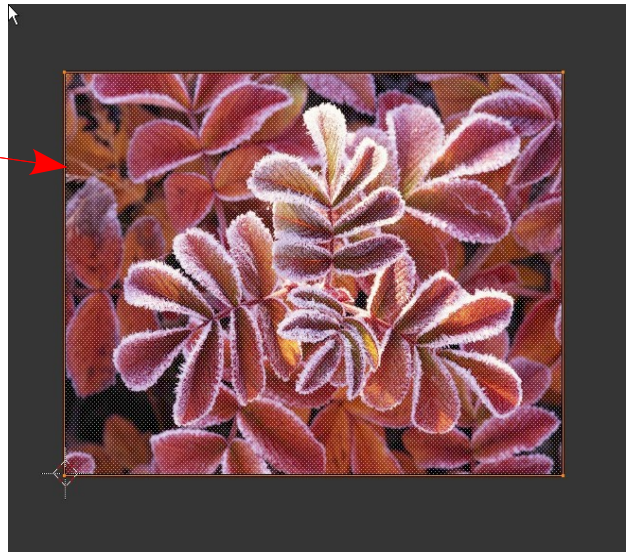
Grab – Move
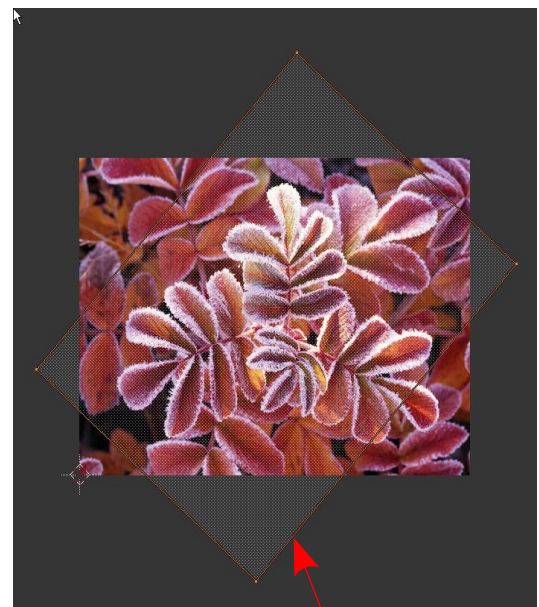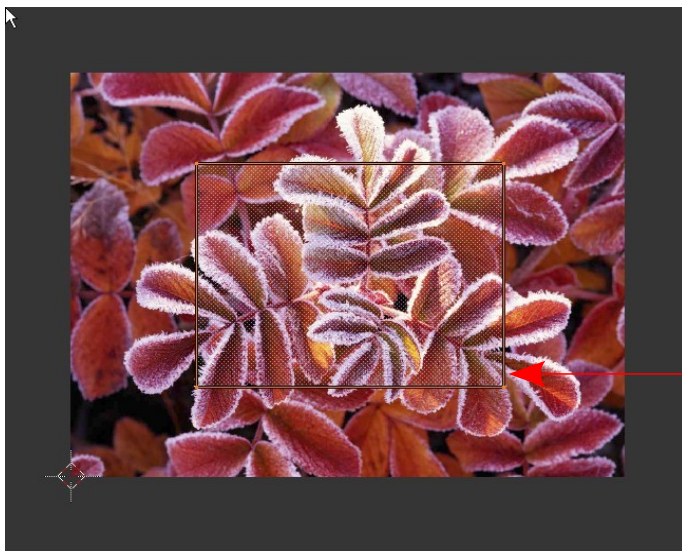
Rotate

Scale

Note the face map in the UV/Image Editor is in Vertex Select mode. There are also the options to select Edge and Face modes similar to the selections in Edit mode in the 3D Window. There is also a fourth option which is 'Island Select' mode. Some unwrapping operations divide the face mesh into separate parts and Island Select allows selection of these parts.

By selecting different faces on the cube and adding different images to the UV/Image Editor you can place the different image textures on the individual faces. You can also shift select multiple faces or shift select edges or vertices to tell Blender which part of an objects surface you want the image texture placed.

Let's go back and consider the mesh unwrapping. Pressing the Unwrap button gives you different options. I will not try to explain what results these unwrapping methods produce but a further method is available where you mark a seam on the surface of the object which tells Blender how to unwrap that part of the mesh on which you wish to place your texture.

Unwrapping Using Seams

In a new Blender Scene add an Isosphere. An Isosphere is chosen since by default it comes with just enough vertices for beginners to play around with.

Set up the UV/Image Editor Window as we did previously.

In the 3d Window with the Isosphere selected tab to edit mode then press A Key to deselect all vertices. Change to Edge select mode and shift select edges dividing the surface of the sphere into three parts. It's best to zoom in on the sphere and rotate the view while selecting the edges. With the edges selected press 'Mark Seam' in the tools Panel. The selected edges will turn red showing that a seam has been marked.
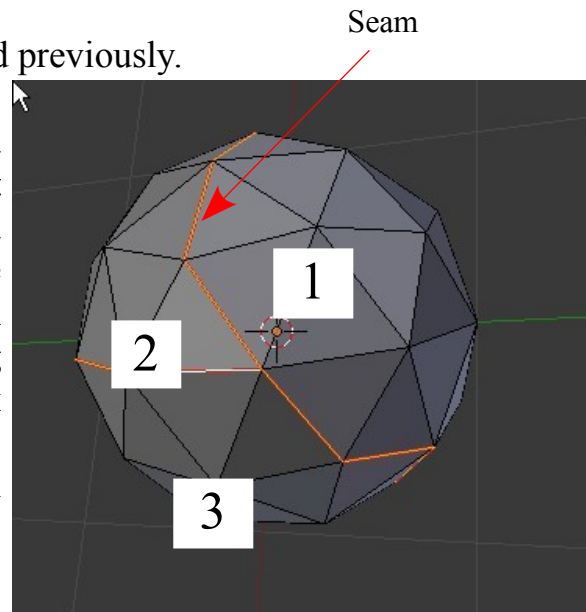
Seam

The next trick is to select all the edges of the faces of the sphere not just the edges marked as the seam.

A Key to deselect the seam edges then A Key to select all edges.

All edges selected
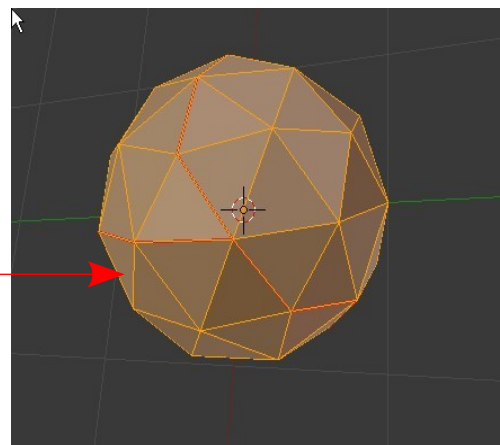
Having done, press 'Unwrap' in the Tools Panel then in the drop down select 'Unwrap'.
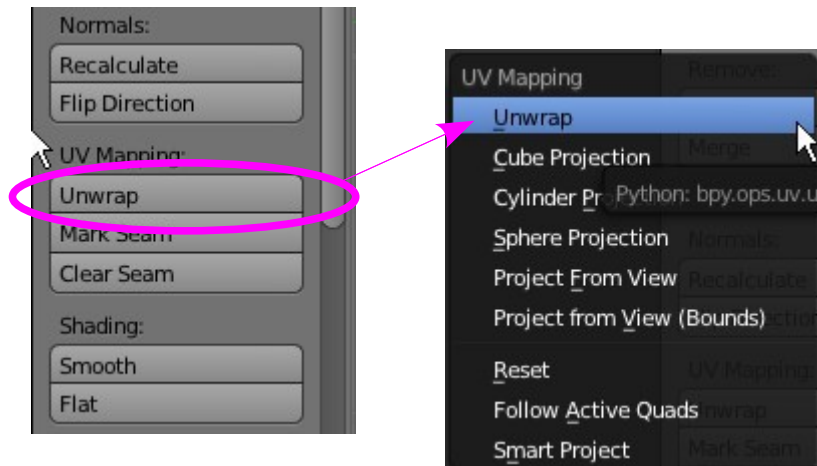
The separated parts of the spheres surface will be mapped in the UV/Image Editor.

Island to be selected
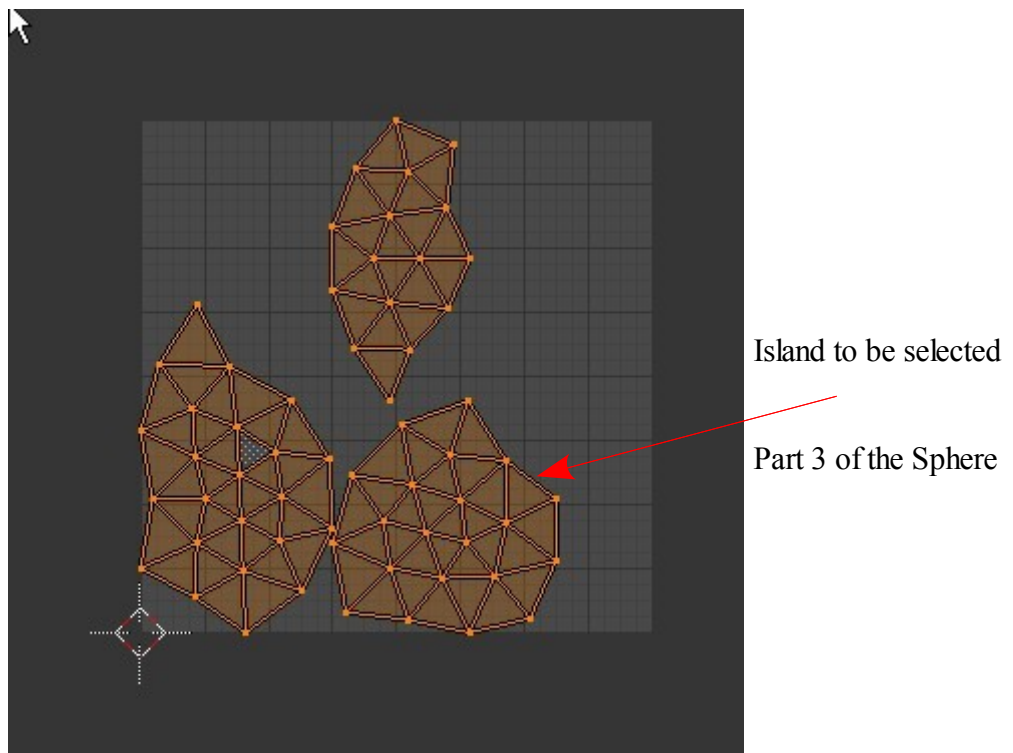
Part 3 of the Sphere

You can now go ahead and open an Image as a texture. In the 3D Window in Edit mode with 'Textured' Viewport Shading you will see the image on the surface of the sphere mapped to the three parts you set up with the seam.
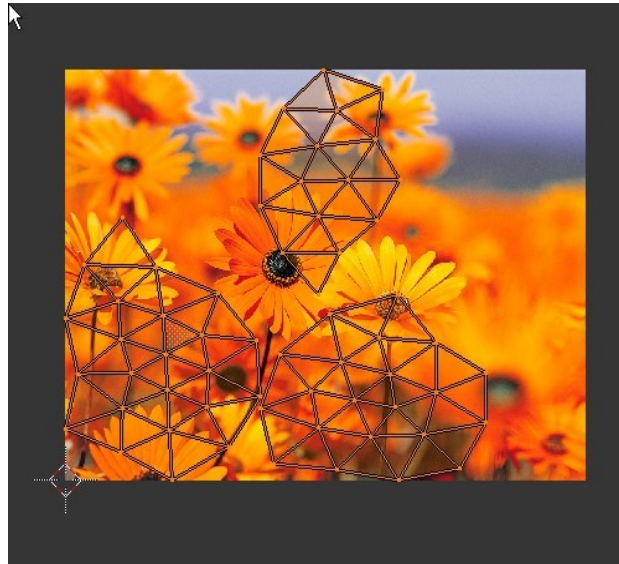
In the UV/Image Editor select 'Island select' mode in the header.

This will allow you to select separately each of the three surface parts. With a part selected you can manipulate it to position the texture on that part.
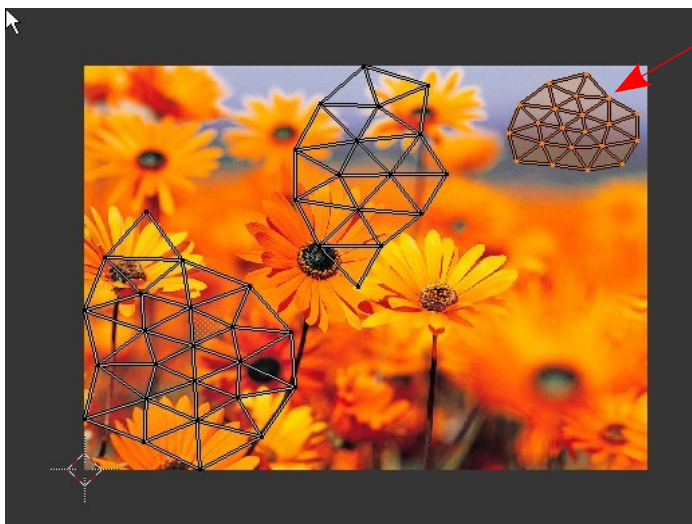
Selected Island scaled down and positioned over grey blue part of the image.

Blue grey part of the image applied as texture to Part 3 of the Sphere
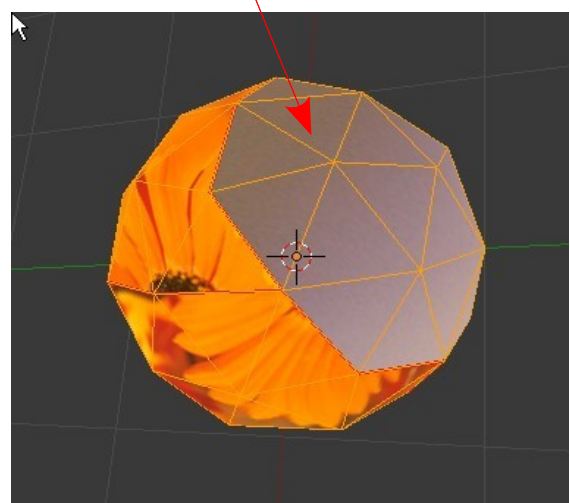
This has been a very brief introduction to UV Texture Mapping. The possibilities are endless therefore it is over to you to experiment and discover the capabilities of the procedure.

Texture Paint

Texture Paint is a built in painting mode designed specifically to edit UV Image Textures. It is not a method for painting textures on to a surface.

A UV Texture is an image (picture) which is mapped to the surface of an object providing color and surface definition (See UV Texture Mapping).

With Texture Paint you can paint color over the image or directly on to the surface of the object once the image has been mapped. Before you can Texture Paint the surface of the object must therefore first be unwrapped to the UV Image Editor Window and an image must be applied as a texture (See UV Texture Mapping).

To demonstrate Texture Paint use the default Blender Scene with the default Cube object. Remember the default Cube in the default scene comes with a Material already applied. If you are introducing a new object to the scene you must apply a material before you can introduce a texture.

Select the Cube and unwrap the surface to the UV Image editor Window using the 'Follow Active Quads' method. Apply an image as a texture.
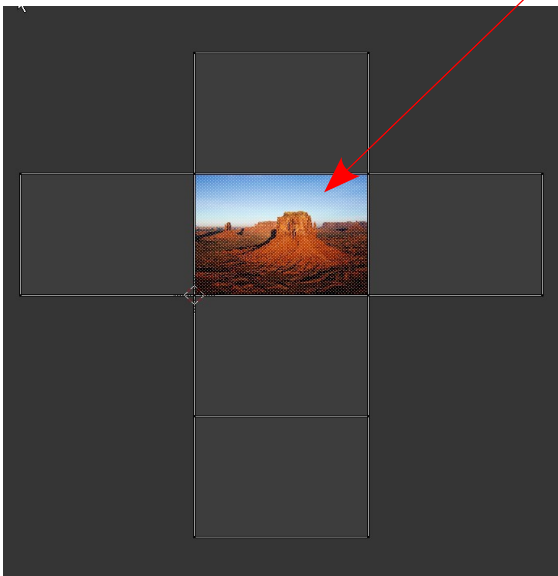
UV Image Editor Window

Cube unwrapped using 'Follow Active Quads'

Image applied as Texture
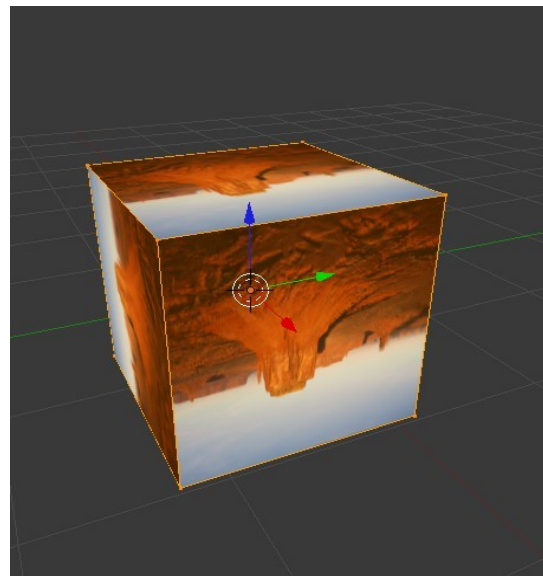
3D Window

Texture Image mapped to surfaces of Cube
Texture Display Mode

In the 3D Window change from Edit Mode to Texture Paint Mode. The 3D Window will now be very similar to the Vertex Paint Window with the exception that there is a 'jitter' slider in the Brush tab , a 'Texture' tab and a 'Project Paint' tab.
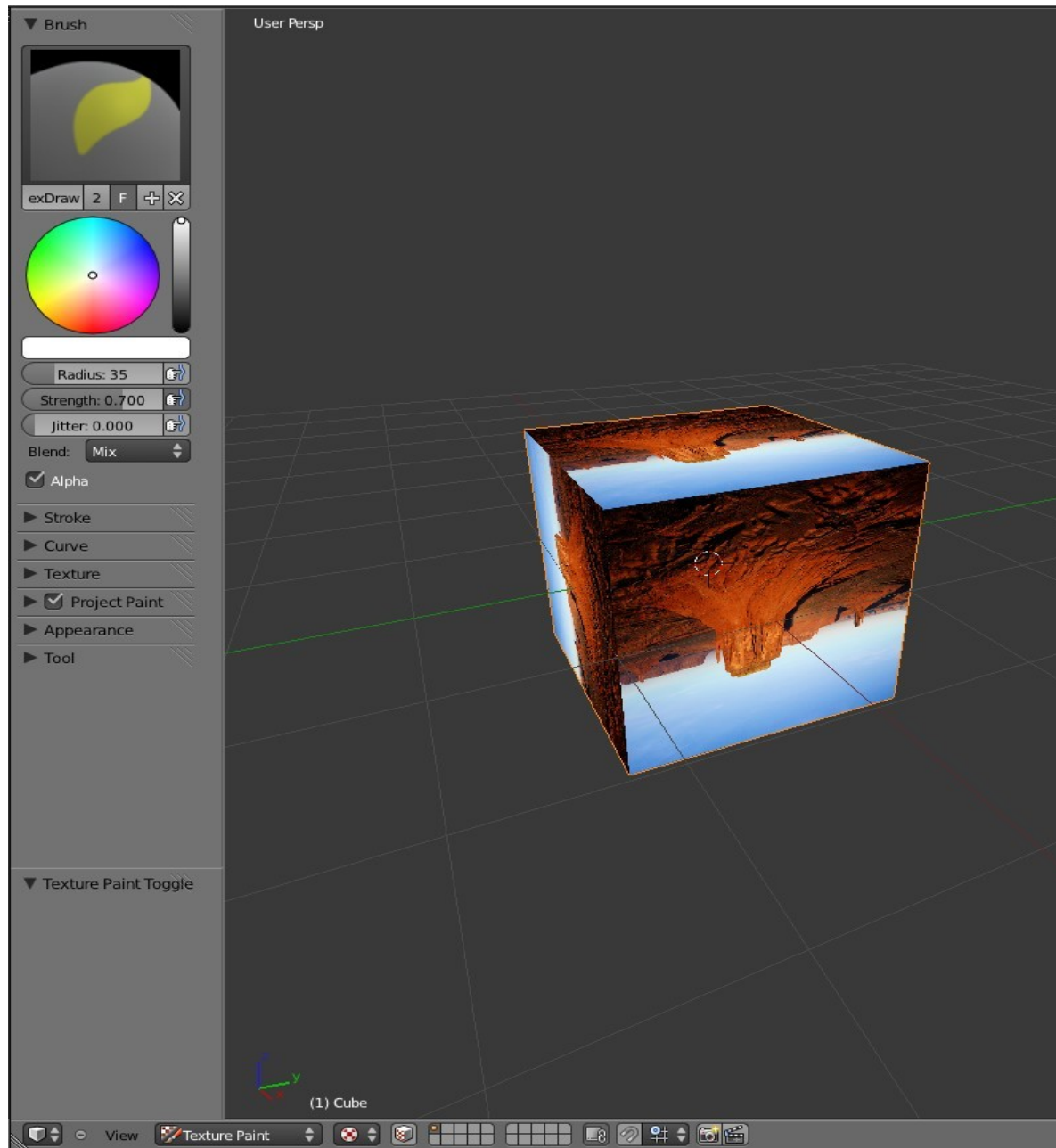
Texture Paint Mode

3D Window in Texture Paint Mode

UV Image Editor Window

Only selected image displays when the
3D Window is in Texture Paint Mode.
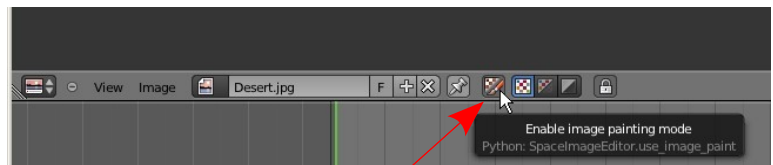
In the UV Image Editor Window header activate the ' Enable Image Painting' button.

In the 3D Window – Texture Paint Mode you may now select a color from the color picker, set the Brush size and strength and the type of stroke. Click, hold and drag the Brush to paint on the image in the UV Image Editor Window or on the surface of the object in the 3D Window. Whichever Window you paint in is reflected in the other Window.

UV Image Editor Window
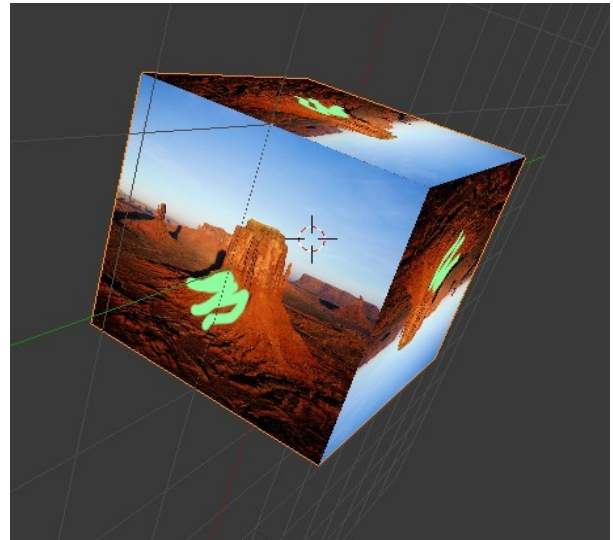
3D Window

Paint in either Window

To see what you have painted when you render you must tick 'Face Textures' in the Properties Window – Material button – Options tab.
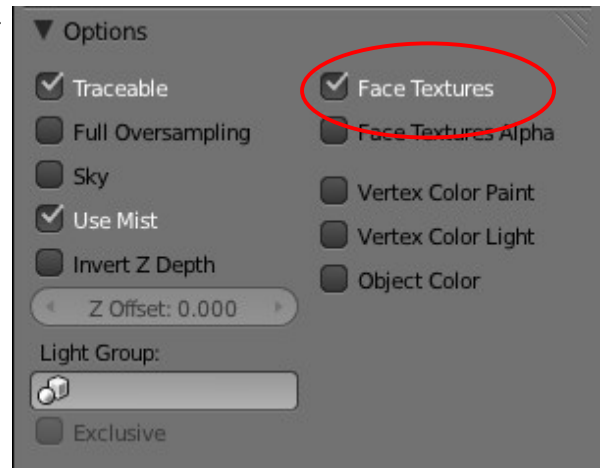
Once again this is only a basic introduction. There are plenty of options for experimentation and there are excellent tutorials on the internet covering this topic.

Here is another revelation to demonstrate that we have only seen the tip of the iceberg. If you look closely in the upper corners of the Windows you will see a small white circle with a plus sign in side. These indicate that there are hidden tool panels. Clicking on these icons will display the panels but you can also toggle the displays with the 'T Key' and the 'N Key' on your keyboard.
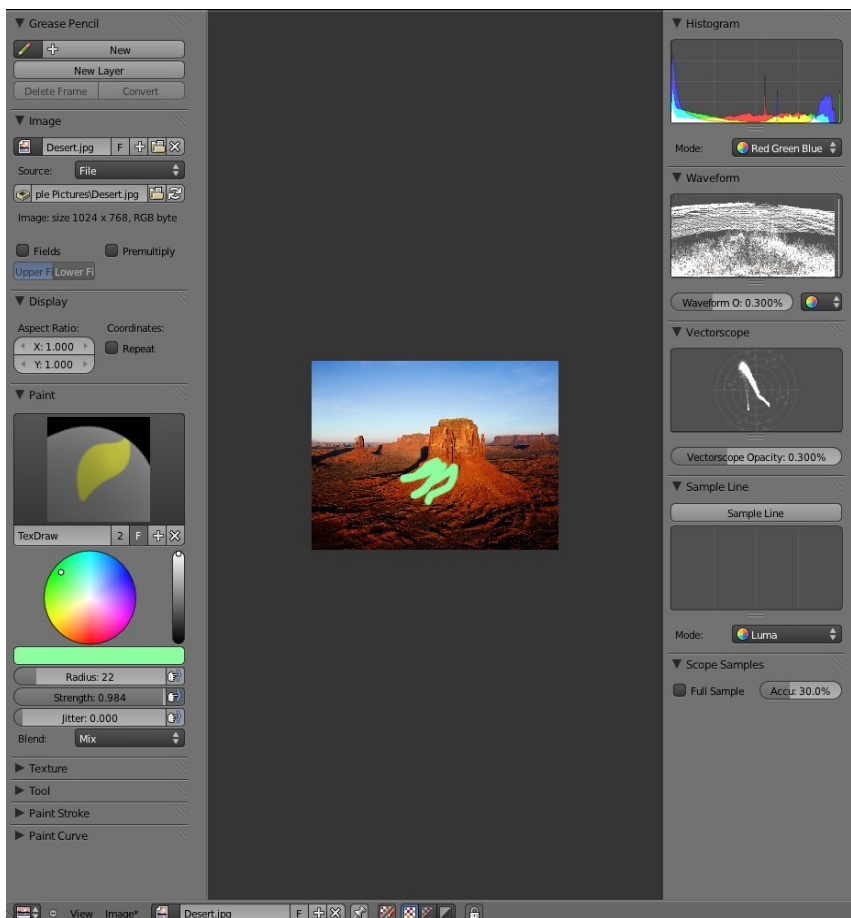
UV Image Editor Window
With the Tool Panels
Displayed

CH06- World Settings

01-World Settings

02-Mist

03-Stars

04-Texture as Background

05-Image as Background

06-Image as Template

Return to Contents

World Settings

The World Settings allow you to set background for your scene. The default World setup is the dull grey which displays when an image is rendered. The background in the render is not the same as the background in the 3D Window. The World button in the Properties Window displays the settings tabs, the first one being a Preview panel.

Preview Panel showing Horizon Color
set to gold with a combination of
Paper Sky, Blend Sky and Real Sky

You only see the gold background when you render an image of your scene.

Click on the color bars in the World tab to display color pickers for setting background color.
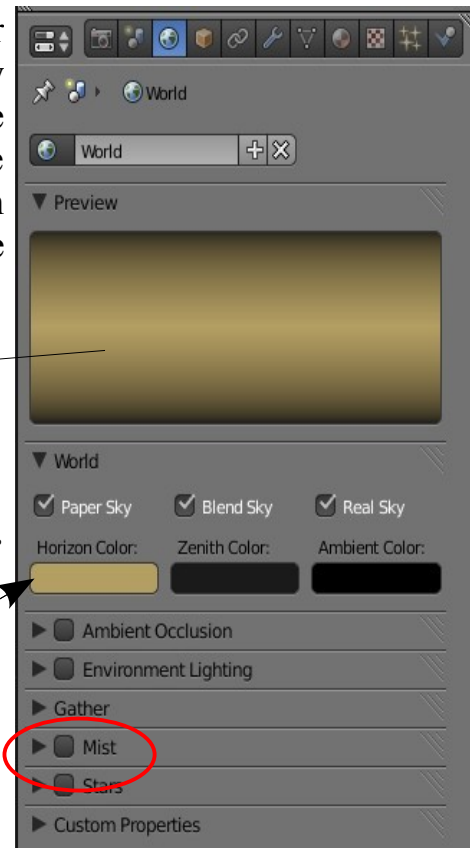
Horizon Color: Color at the horizon.
Zenith Color: Color at the top of the scene.
Ambient Color: Provides an overall lighting effect. An object in the scene will reflect this color regardless of its own Material Color.

Sky: Paper, Blend, Real. These options provide combinations of color gradient across the rendered image.

Vertical Pole Object   Wall Object with Horizontal Slats
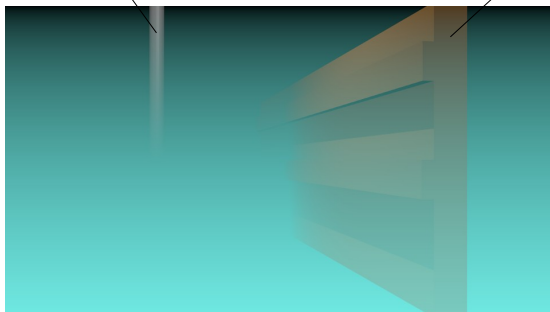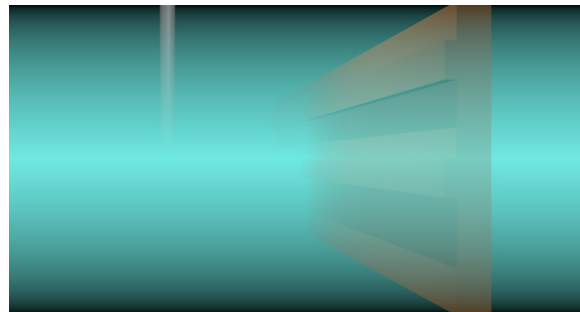
Paper Sky + Blend Sky   Paper + Blend + Real Sky

Rendered Images of 3D View

The examples of Sky background combinations shown have a Mist effect added.

Mist

Learning Unit 7
World Editor - Mist

Mist settings allow you to introduce a mist or fog effect to your scene

▼ ☑ Mist

Intensity: 0.507	◄ Depth: 5.00 ►
◄ Start: 5.50 ►	◄ Height: 2.100 ►
Falloff:	Quadratic ▲▼
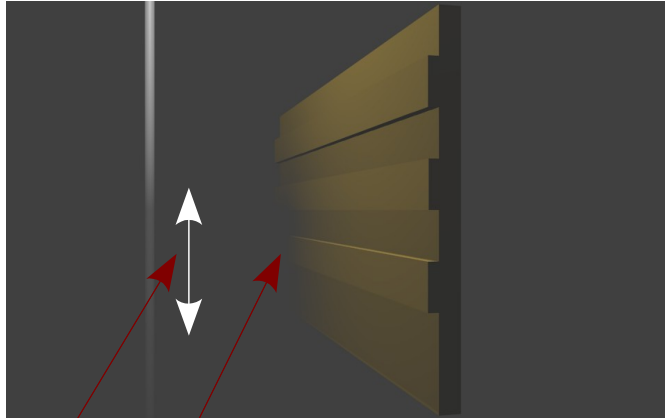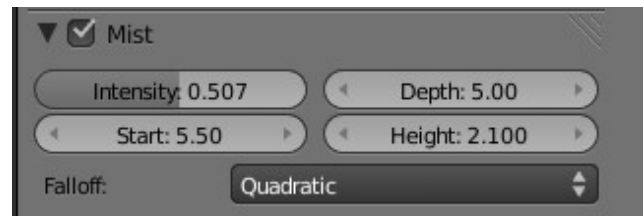
Mist Height

Mist

Rendered Image
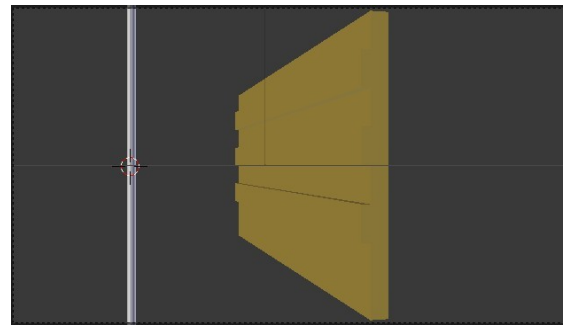
3D Window Camera View

3D Window View
Camera set on Mid Pane
To see Mist Limits select the Camera - go to properties Window – Object Data button
In the Display tab click the Mist box.
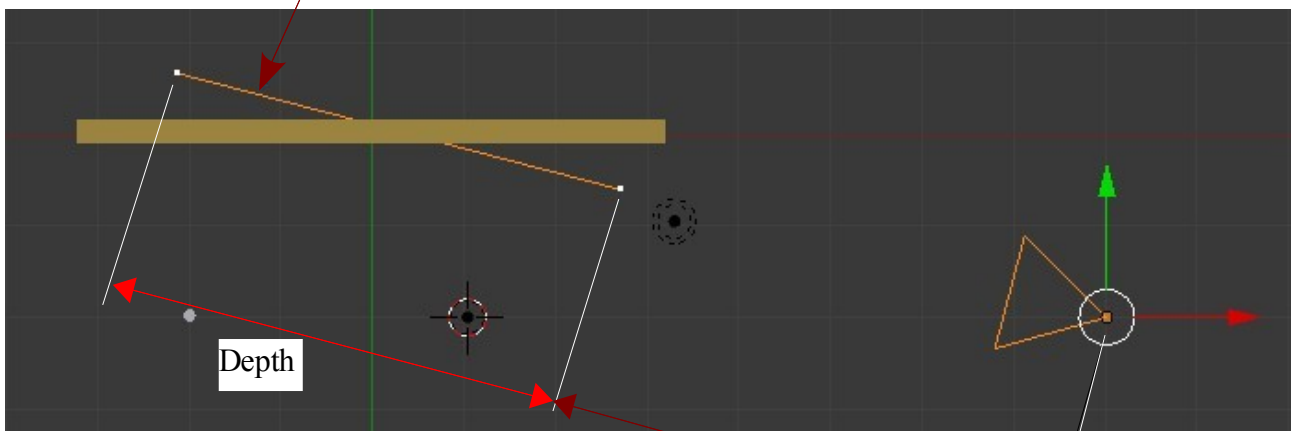
Depth

Start

Top View of Scene in 3D Window

Start: Distance from the Camera where Mist starts.
Depth: Distance over which Mist increases from 0% to 100%
Height: height of the Mist.

Stars

Learning Unit 7
World Editor - Stars

The Stars tab allows you to introduce stars to your background.

▼ ☑ Stars

| ◄ Size: 10.000 ► | ◄ Min. Dist: 0.000 ► |
| ◄ Colors: 0.000 ► | ◄ Separation: 8.600 ► |

Stars
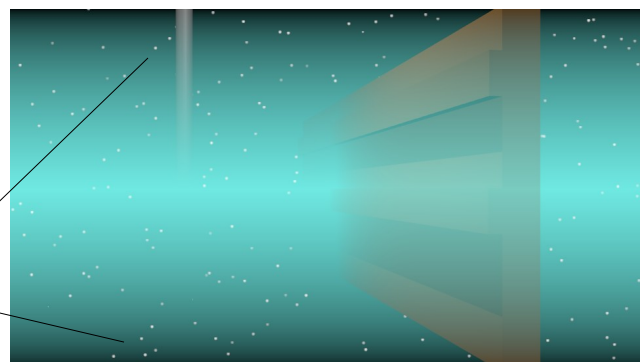
Texture as a Scene Background

Blenders inbuilt Textures can be used to create a background for your Scene. The following demonstration will show you how but yo will soon realise that their are many many combinations of settings to experiment with. It is a good idea to search the internet and find tutorials showing how to achieve specific effects but remember that the effects have probably been derived by experimentation.

Begin with the default Blender Scene containing the Cube object. You can leave the Cube selected since the Texture we will be applying will effect the Scene background and not the Cube.

Remember that Textures do not display in the 3D Window. You have to render an image to see them.

To make life a little simpler, just a little, divide the screen as shown in the following diagram.

Properties Window 2 Copies

3D Window
Note: This 3D Window shows a
Rendered Image

Texture buttons
World Texture Mode
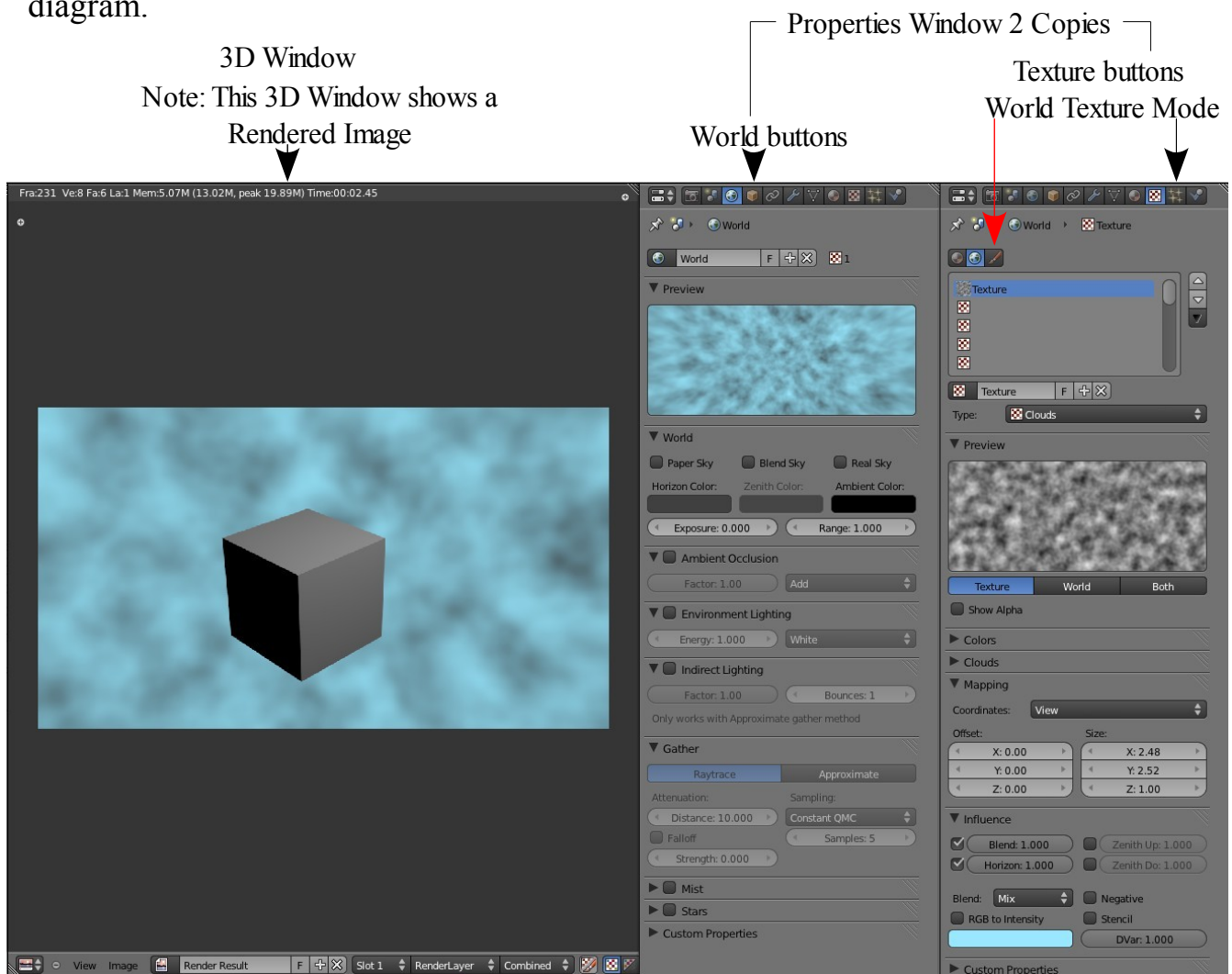
World buttons

By default the Properties Window displays with the Render buttons active. In the set-up make one copy of the Properties with **World button** active and the other with

Texture buttons active. The Texture buttons should be in **World Texture Mode**.

This set-up will allow you to see a preview of your background texture without rendering an image in the 3D Window every time you change a setting. The preview only gives an indication of the render and you will have to render an image to see the true result. Note the difference in the diagram.

OK! How do we get the background?

When the Properties Window – Texture buttons for the first time click on 'New' to display the buttons tabs. By default Texture type 'Clouds' opens. You see the Clouds Texture in the preview panel but it is a black and white image.

There is no display in the Properties Window – World buttons and if you render an image in the 3D Window (F12) there is only the dull grey background. At this stage you haven't told Blender what to influence with the Texture.

In the Properties Window – Texture buttons (World texture Mode) – Influence tab check (tick) the 'Horizon' button (Amount texture affects color of the horizon). You will now see the Texture as a background in the World buttons Preview tab. The clouds are pink because of the color in the color bar of the buttons 'Influence tab'. Click on the color bar and select a nice pale blue color and the clouds in the preview should look more realistic. A render in the 3D Window will give you precise image of your Scene background.
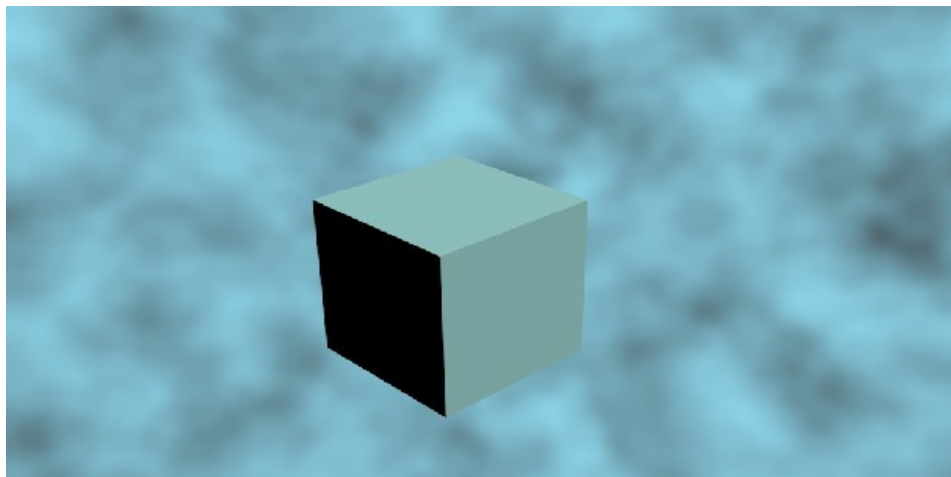
The rendered image is not the same as the preview so now you adjust values in the Properties Window to get the desired effect.

In the Properties Window – World Texture – Mapping tab adjust the 'Offset' and 'Size' settings and change 'Coordinates' in the drop down menu.

In the 'Influence tab' try changing the 'Blend', 'Mix' to something else.

In the Properties Window – World buttons – World tab, checking the different 'Sky' settings and choosing different colors from the color bars in the Horizon, Zenith and Ambient settings produce different effects.

In the 3D Window select the 'Lamp' and change the lamp type, adjust the intensity and change the lamp color.

Don't forget to try out all the different texture types.

As previously stated there are many many combinations. You just have to experiment and record your settings. When you find something you like that suits your purpose save it in a .blend file for future use. In this way you create your own library.

Image as a Background

You can use any image stored on your computer
 as a background.

    Deselect objects in the scene.

    In the Properties Window – Texture buttons – click 'New' to add a Texture.
    Select Texture type : Image or Movie in the Image tab click Open then navigate
              and select your Image.
    In the Texture buttons – Influence tab click Horizon.

The Image will display as the background to your scene when you render.

    Image renders as background to the scene.

    Note: Altering values in the Mapping tab
adjusts how the image displays in a render
of the scene.

Using an Image as a Template

An image can be displayed in a scene as a template to aid in modeling

With the mouse cursor in the 3D Window press the N Key on the keyboard.

Tick Background Image ───────────

Click Add Image ───────────

Click Not Set ───────────

Background Images

Add Image

Not Set ⊠

Axis: All Views

Open

Click Open ───────────

Background Images

Add Image

Street.jpg ⊠

Axis: All Views

Street.jpg

Source: File

//Street.jpg

Transparency: 0.500

Size: 5.000

X: 0.000   Y: 0.000

Image Axis			
X Axis	Y Axis	Z Axis	Other
Left	Back	Bottom	All Views
Right	Front	Top	Camera
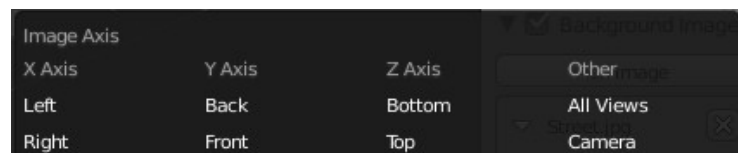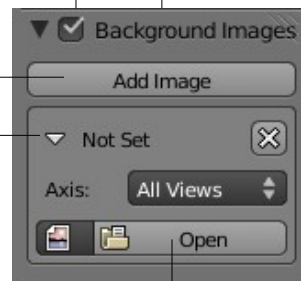
Select Views for Displaying Image

Controls for adjusting Transparency Size
and Offset if Image in 3D View

Image in 3D View

Background Images

Add Image

Sculpture.jpg ⊠

Axis: All Views

ulpture.jpg

Source: File

\Sculpture.jpg

Transparency: 0.500

Size: 2.900

X: 0.000   Y: 0.000

Transform Orientations

Transfor Global

Create
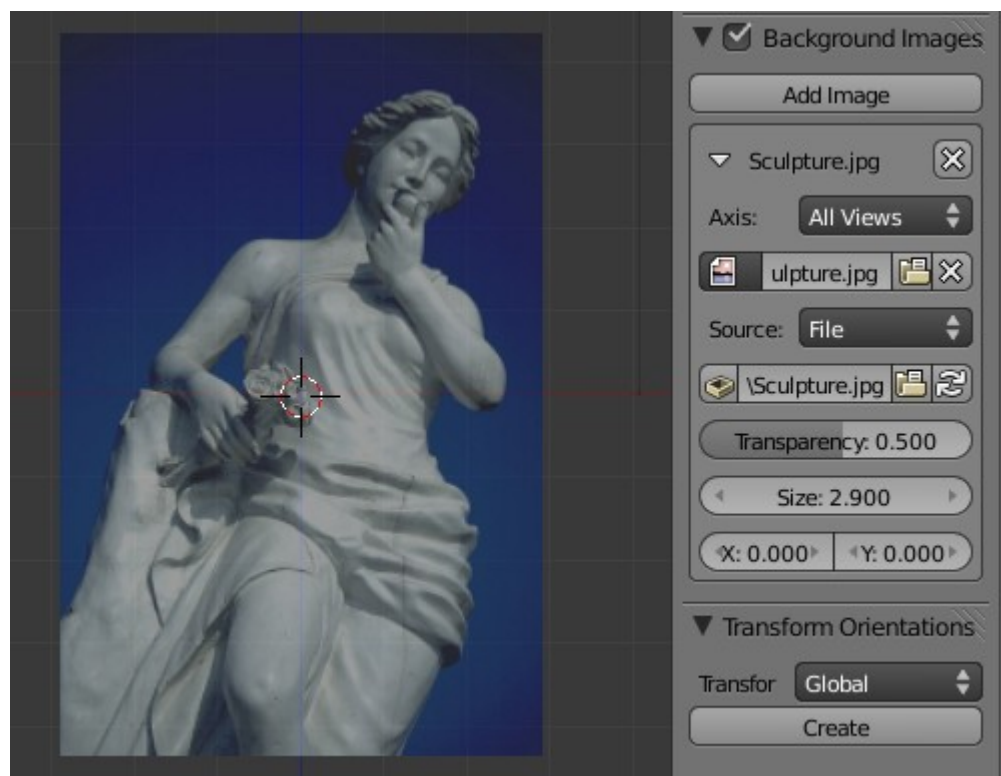
CH07- Lighting

01-Lighting

Lighting and Cameras

Lighting Types and Settings

The default scene in Blender starts with a Cube object, a Camera and a Lamp. What the camera sees is what will render out as a picture or movie depending on what you tell the program you want as a final output. To get a simple rendered view, press the F12 Key. This will open a window that will display the rendered output of what the camera is focused on. If the picture shows the Cube object as a black silhouette you do not have a lamp or the lamp settings or placement is incorrect. To exit the render window, press the Esc Key.

In most cases, you will need more than one lamp in order to properly illuminate your scene. Be careful not to use too many lamps! Instead of adding too many lights, experiment with the Distance and Energy settings. Most scenes usually require 3-4 lamps.

Lamp Settings:

To create or add a lamp to the scene, position the 3D cursor in a desired location and press the Alt + A and select 'Lamp' from the drop down menu. The lamp will be placed in the scene.

Lamp Type Selection

Light Color

Brightness

How far the light shines

With the lamp selected go to the Properties Window – Lamp button to display the setting options. The options displayed vary depending on what type of Lamp you select.

Shadow Color
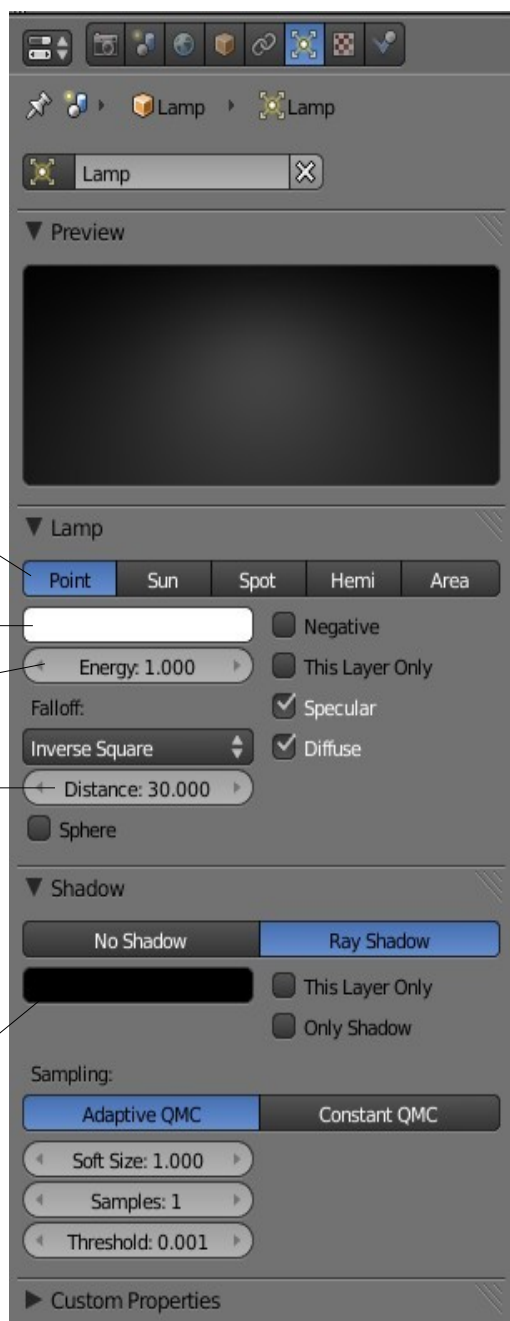
The diagrammatic representation of the Lamp in the 3D Window also varies depending on the type.

Point
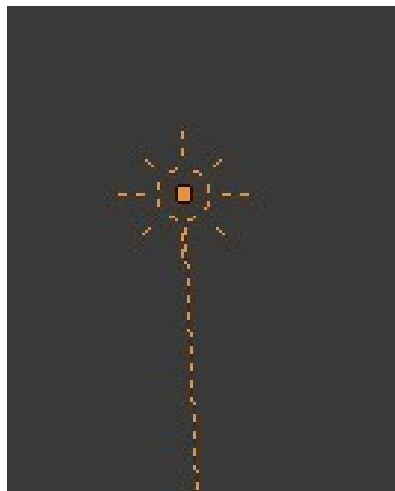
Sun
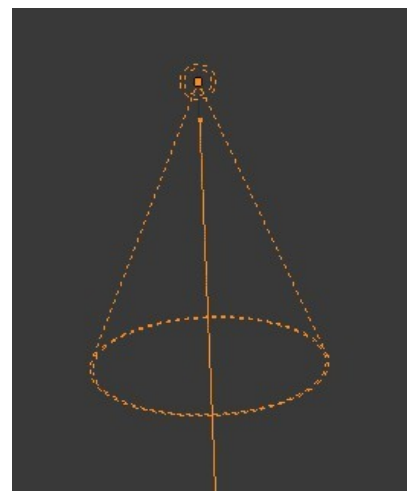
Spot
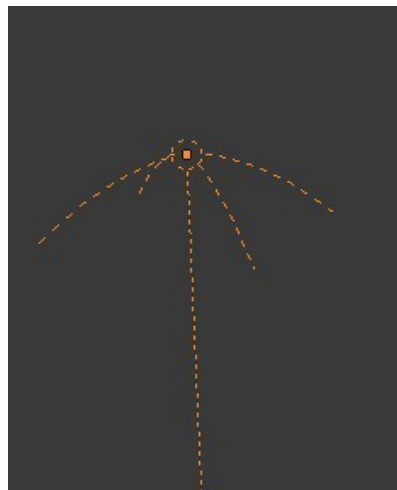
Hemi
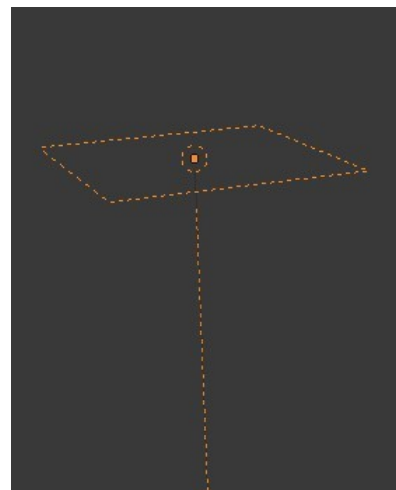
Area

If you decide that the Lamp you have selected is not correct for what you want to achieve you can change the type in the Properties Window. Click on the Lamp Type Selection in the Lamp tab.

Spotlights are particularly useful in creating great effects. As with all Lamps spotlights can be scaled, rotated and positioned to cast shadows and they can also be used with a halo effect giving a simulation of a light shining through a fog.

With all lamps experiment with settings and record results
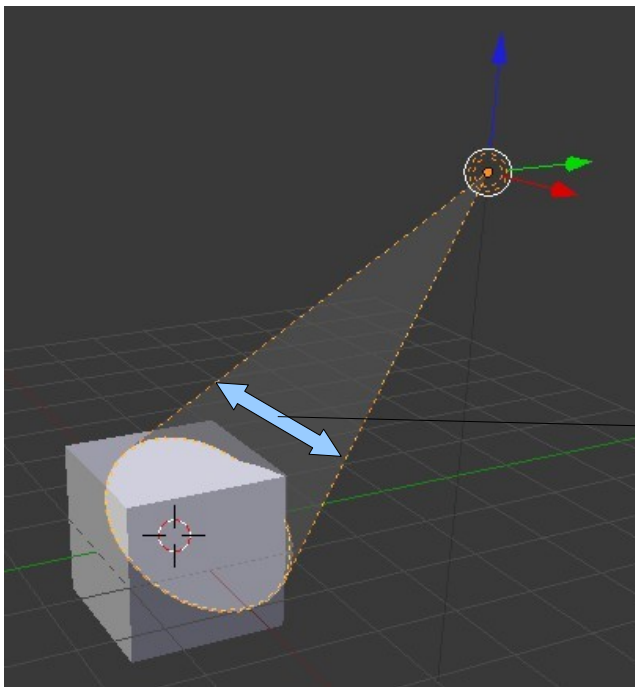
Spotlight with Show Cone turned on

Tick for Halo Effect

With Halo on adjust Intensity for smoky effect
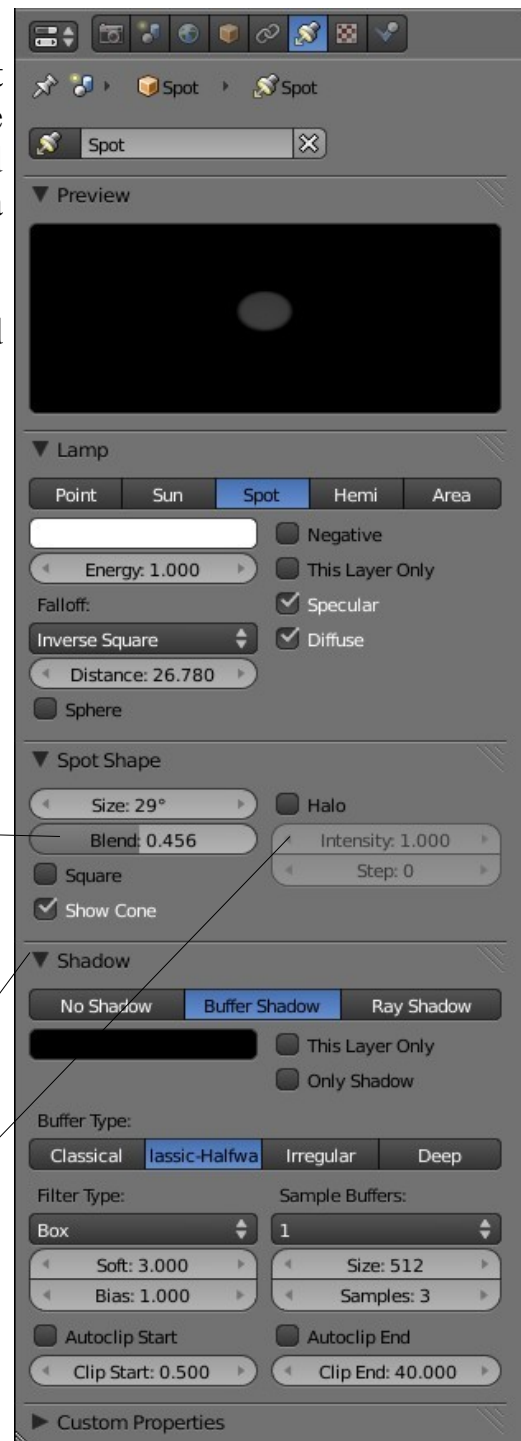
Learning Unit 7
Blender Lighting – Point Lamp

Blender Lighting – Sun Lamp

Blender Lighting – Sun Lamp – Sky and Atmosphere

Blender Lighting – Hemi Lamp

Blender Lighting -Area Lamp

Blender Lighting – Spot Lamp

Blender Lighting – Ambiant Occlusion

CH08- Camera

01-Cameras

02-Settings Options

Cameras:

By default, your scene already has one camera and that is usually all you need, but on occasion you may wish to add more cameras. You add more cameras by pressing 'Alt + A' and selecting 'Camera'. The new camera will be located where your 3D Cursor is positioned and you will have to orientate the camera. Too change which camera is active, you need to select that camera and press "Ctrl + Num Pad 0".

Settings options :

Learning Unit 5
Camera Constraint
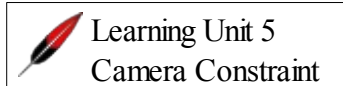
Perspective Orthographic -
>	Used to set the camera from showing a true-life perspective view to an orthographic view.

Lens Angle -
>	Set-up a lens length much like a real camera. 35mm is a good, safe setting, but wide and tight angle setting work for different needs.

Shift- Pushes the camera's view in a direction, without changing perspective.

Clipping Start -
>	How close an object can get to the camera and still be seen.

Clipping End -
>	How far away objects can be seen by the camera. In very large scenes, this needs to be set higher or things "disappear" from view.

Depth-of-Field-
>	Used with nodes to blur foreground and background objects. Working with Nodes This will be discussed in a later chapter.

Limits- Draws a line in the scene to help you visualize the camera's range

Mist - Show Mist
>	Used to give you a visual display of how far the camera sees if using Mist.

Title Safe-
>	Displays the inner dashed box to help with placement of objects and text.

Name- With all objects, the name of the object or camera can be displayed on the screen, but this will display the name in the camera view.
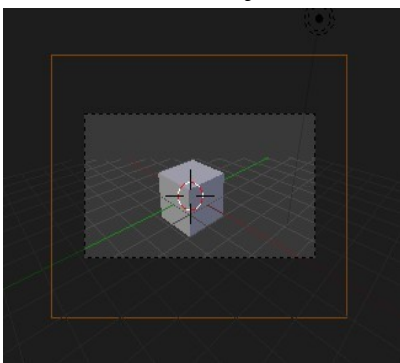
Size - How big to draw the camera on the screen. You can also control size with scale.

Passepartout- Shades the area on the screen outside of the Cameras view

.

Alpha – Control the darkness of the shaded area with the   slider
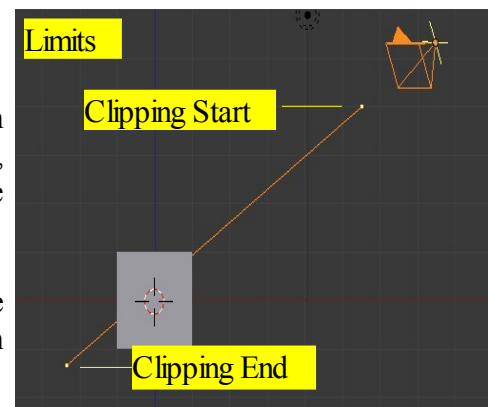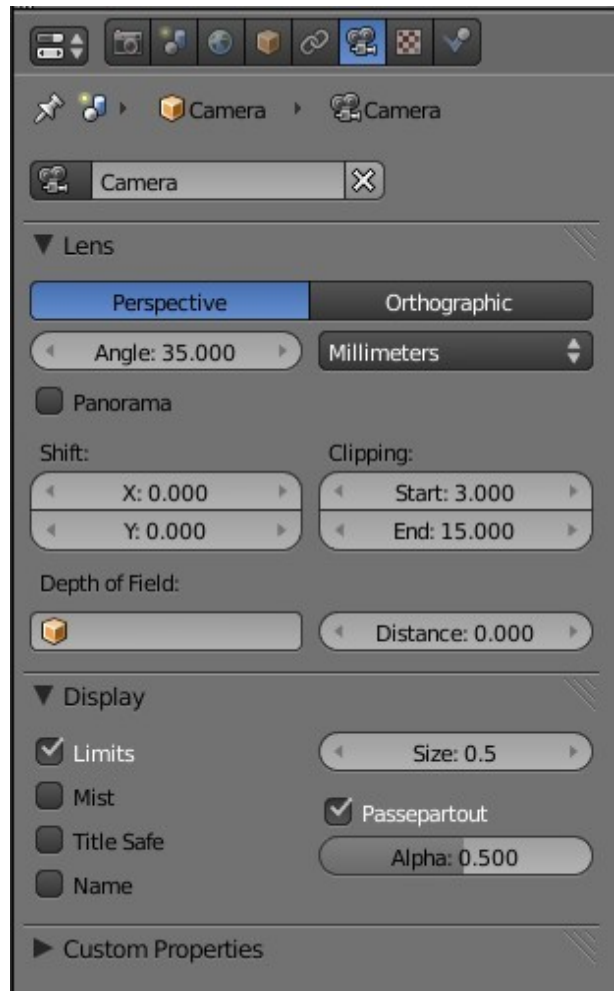
CH09- Rendering

01-Render Settings

02-Rendering a JPEG Image

03-Creating a Video Clip

Return to Contents

Render Settings

Rendering is the conversion of the data of the camera view in your Blender scene file into an image file or a movie file.

The Render buttons in the Properties Window is where you tell the program what you want as an output from your scene. Do you want a JPEG picture image or a movie? What size do you want the output to be? Do you want a high quality output or a draft style format? Do you want shadows or Raytracing effects? How about motion Blur? If you're doing a movie, how many frames-per-second do you want the movie to run? Last, but not least, where do you want to save the file? All of these issues are addressed in the   Render buttons . Obviously, the higher the quality of the output, the slower it will render and the larger the file size will be when finished.

The Rendering Settings:

There are many options that need to be addressed in order to save your work as an image or movie. Some of these feature will be discussed in more detail in later chapters. For now, we are just interested in saving basic images in JPEG (.jpg) format and movies in the Windows (.mpg) movie format. Be aware that other options exist and more are added every few releases.

The Render settings are found in the Properties Window – Render button.

Render:
    Image- Renders an image the same as pressing F12.
    Animation – Renders a movie or simple files of
    your   animation. This can take considerable
    time   depending on the animation size.

Display: Dropdown menu for render display options.

Dimensions:
    Dropdown- Venue for Preset Rendering Sizes for different output formats.
    Resolution- Manual input of X and Y values for rendering size instead of using presets.
    Percentage- Slider for setting size of render display in the 3D Window.
    Frame Range- Set the start and end frame for render
    Frame Rate- Animation playback rate.
    25 FPS for PAL output 30 FPS for NTSC output.

Anti-Aliasing: Output quality settings. Normally set at 8 to   give a nice output without loss of render time.
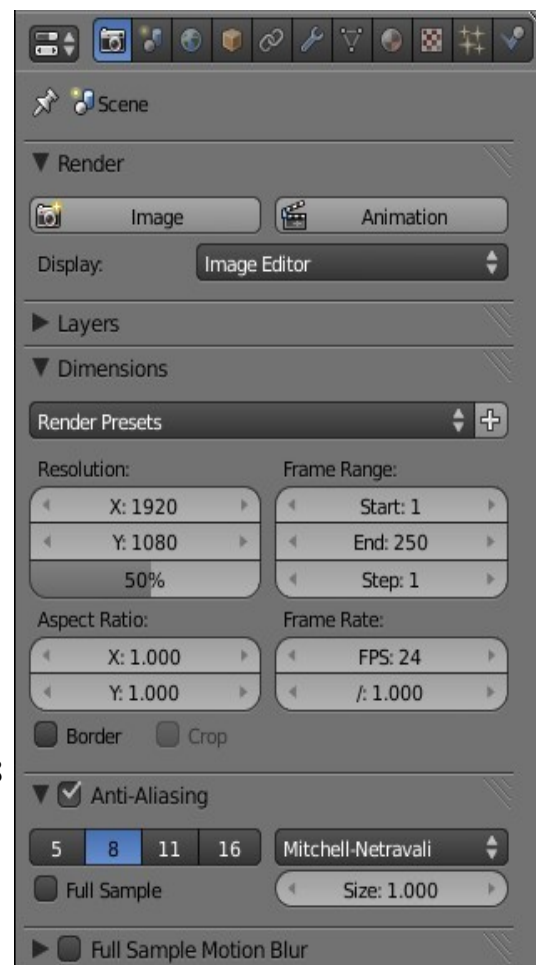
Shading: Settings that can be turned off to exclude features from the render. The Alpha Sky drop down gives options for the render background.

Output: The output bar allows you to set where you wish your render to be saved. The default location is the 'tmp' folder. The file type dropdown menu provides options for the type of file to be rendered. The default file type is 'PNG'.

> Learning Unit 5
> Rendering to an Image
>
> Learning Unit 7
> Render Slots

Rendering a JPEG Image

To render a simple JPEG image set all the options previously discussed. In fact the default settings will do just fine except for the output file type in the Output tab of the Properties Window. Change the default PNG to JPEG. With your scene created in the 3D Window press 'F12' or the 'Render Image' button. With the default settings the Render Window will display. Press 'F3' to open the Save Window. In the Save Window type in a file name for image, press 'Enter' then 'Save As'

File Path for Saving

Enter File Name Here
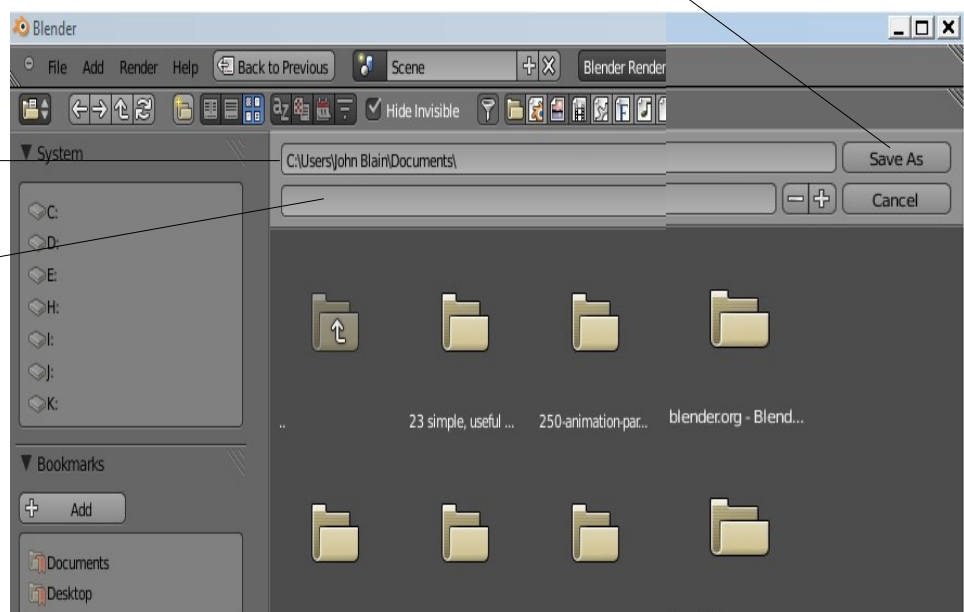
In the Save Window you can navigate to a different folder for saving other than that in the Output tab of the Properties Window. Note: If you forgot to change PNG to JPEG it will not suffice to add a .jpeg extension to the file name. If you entered

'FileName.jpg' it will be saved as 'FileName.jpg.png' and remain a PNG file type.

Creating a Video Clip

After you have created your scene with an animation sequence you will be ready to make a movie file. A movie, weather it is a full length three hour feature or a short thirty second television add is made up of a sequence of Clips (Movie Files) spliced together to tell a story. The following steps are the basics for creating a file.

1. In the Output tab select the file format from the format selection drop down menu. File formats for television are 'NTSC' for the US or 'PAL' for Europe and Australia. You can also select 'AVI' for playing on your computer.

2. Change the file type from the default 'PNG' to 'FFMPEG'

3. Also in the Output tab set the path name to the location for saving the file.

4. Make sure 'Anti-Aliasing' is ticked and that 8 is selected.

5. Check that the 'Start' and 'End' frames of the animation are selected.

6. Check the frame rate is correct. 30 for NTSC or 25 for PAL.

7. In the Shading tab make sure Shadow and ray tracing are ticked.

8. Finally press the 'Animation' button in the render tab.

The Video clip (Movie file) will take some time to compile depending on the length of the animation. Each frame of the animation has to be rendered and saved. Depending on the complexity of the scene a frame can take from a few seconds to several minutes to render. To begin it is best to keep everything very basic and simple. If you get to the stage where you have created a wonderful movie you can send the animation files to a render farm on the Internet to have them rendered. It saves you time but it costs you money.

CH10- Raytracing

01-Raytracing

Raytracing

Raytracing is used to produce mirrored and reflective surfaces. It is also used to create transparency and refraction (bending of images through transparent surfaces like a magnifying glass or lens). Raytracing can create stunning effects but can incur a high cost in render time. Use it sparingly. Don't attempt to Raytrace everything. You can get some great shadow and texture effects with spotlight and material settings.

The image below has been created using the settings shown in the Sphere's Properties Window – Material buttons on the RHS.

Sphere Diffuse Color

Raytracing Selected

Transparency with
Raytracing selected

A Sphere has been added to the scene positioned above a Plane. The Plane has a Material and an Image Texture added. The Sphere Materials button settings are shown on the right.

Mirror Effect On

With the settings as shown an image has been rendered as shown below
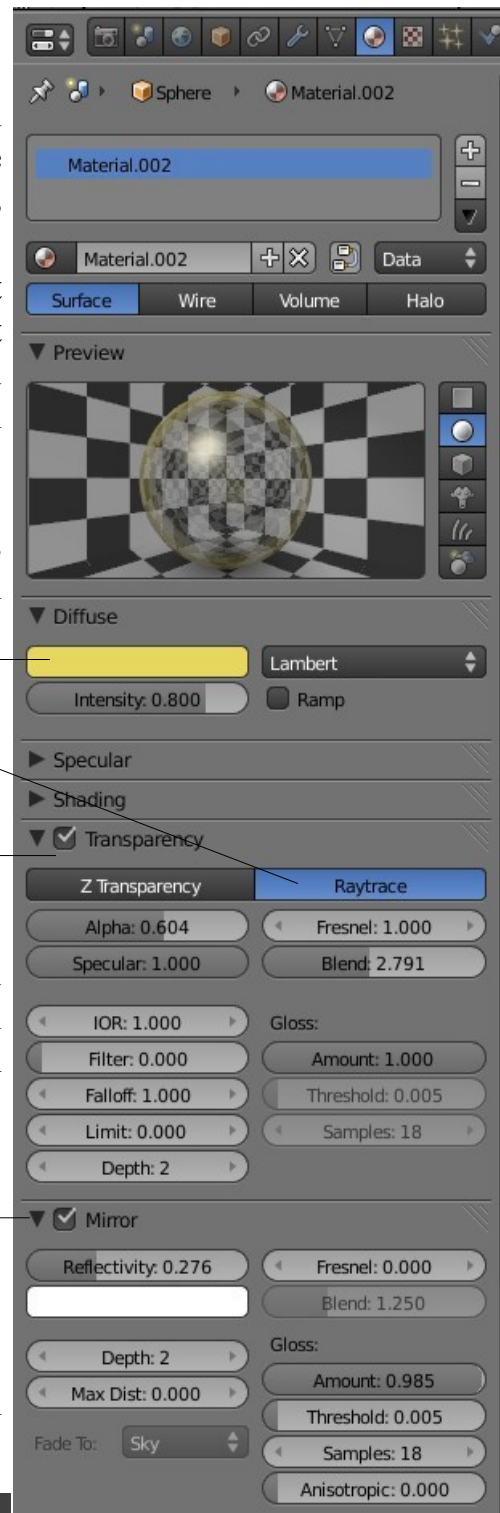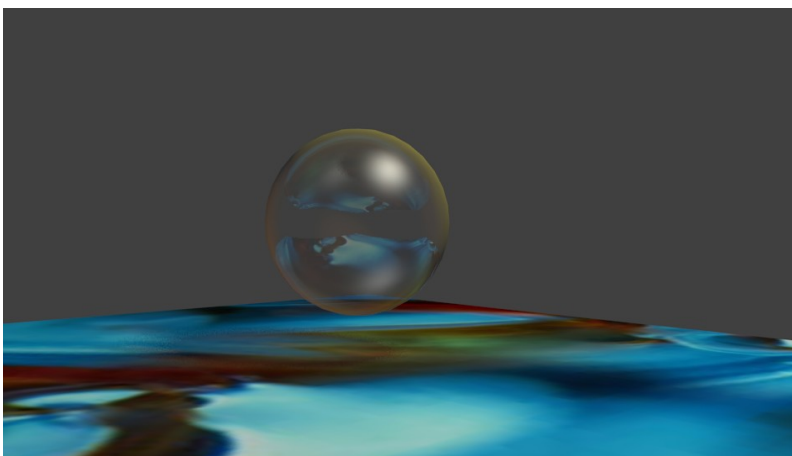
CH11- Animation Basics

Animation Basic

In this chapter we will explain how to make objects move about in the scene. This is a big section in Blender with many features. Many of the features will become understandable with practice and will then allow you to progress beyond the basics. This is a highly developed section and new features are being added all the time so it is likely that before this document is printed new features will be available. We will therefore only attempt the basics.

Before you start make sure you understand the section on Rendering .

Next consider what an animation is. In Blender we are talking about a method of making something appear to move on a computer screen which may later be transformed into a movie file. This is accomplished by creating a series of still images each one slightly different to the next which when displayed one after the other in quick succession create the allusion of movement. Each still image is a single frame of the animation. Each frame (image) is rendered which means the data you enter in the Blender program is correlated and turned into the digital image. This is usually in a JPEG format. Finally all the images are compiled into one movie file.

After you set up your scene with the object that you wish to animate (The Actor) consider what the actor is required to do and how long it should take to do it. Also consider what format you will use in the final render. The render format determines how many **Frames Per Second** the animation should run at (NTSC – US 30 fps, PAL- Australia 25 fps). One of the problems that beginner animators experience is making the motions occur in an appropriate time. Remember to look at the frames per second and relate it to time. For example if you want a movement to take 3 seconds and you are running at 25 frames per second then the animation has to happen in 75 frames.

In Blender 2.50+ the animation method could be considered as being in two stages. The first stage is to set up what you want your actor to do in a given time such as move, change size or rotate. The second stage is to set up how your actor behaves during the process of moving, changing size or rotating. The first stage is accomplished by inserting Keyframes in the animation. Keyframes are exactly what the name implies, that is they are 'Key Frames' within a series of frames. Think of a 10 second animation which when running at 25 frames per second would consist of 250 frames. If you want your actor to go from point A to point B and then to point C within the 250 frame animation you first insert a Keyframe at point A. This is giving Blender data which says at the frame nominated locate the actor at position A. Then at the next frame nominated locate the actor at position B and so forth for position C. These are the Keyframes for the animation. Blender will work out all the in-between frames.

The Keyframes will also include the data for scaling and rotating the actor as well as other features. This may be stating the obvious but it is important to understand the concept.

Moving, Rotating and Scaling:

Moving, Rotating and Scaling along with other features are accomplished by what is termed, applying modifiers to the actor. Moving, Rotating and scaling are the three basic modifiers to use in an object animation. When you create Keyframes in Blender with these modifiers, that is tell Blender where and how to display the actor at specific frames in the animation, Blender will figure out all the data for the location, scale and rotation at the in-between frames.

Determining the in-between data is called **Interpolation.**

By default Blender uses what is called Bezier type interpolation which gives a nice acceleration and deceleration between Keyframes. Remember we are considering the movement of an object. When an object moves from point A to point B in a given time it is said to move at a certain velocity (Speed). In theory the speed could be represented as a straight line graph but in practice an object at rest (motionless) has to first of all attain the velocity. The rate at which it attains the velocity is called acceleration. Blenders Bezier interpolation draws curves at the beginning and end of the straight line graph (acceleration and deceleration). You have the options to choose Constant or Linear type interpolation if appropriate. Selection of interpolation types will be discussed later in this section.

Using the term Bezier to describe interpolation is an anomaly. Bezier actually describes a type of line (the line on a graph described in the previous paragraph).
A Bezier line or curve in Blender, is a line which has control points on it which allows the shape of the line to be altered or edited. In Blender the control points are located at the position of the Keyframes. Interpolation or the figuring out of in between frames is done according to a mathematical formula which determines the shape of the line. When the data for the frames in the animation is drawn as a line on a graph the line conforms to that mathematical formula. The shape of the line drawn is much like a sine curve therefore the Interpolation could be considered as being type sine.

For the moment we will accept the default Bezier type interpolation and demonstrate the insertion of Keyframes and the creation of a simple animation.

We will use the default Blender screen with the 3D Window containing the default Cube object as the actor. The default screen also displays the Outliner Window and Properties Window at the right hand side of the screen and the Timeline Window across the bottom.
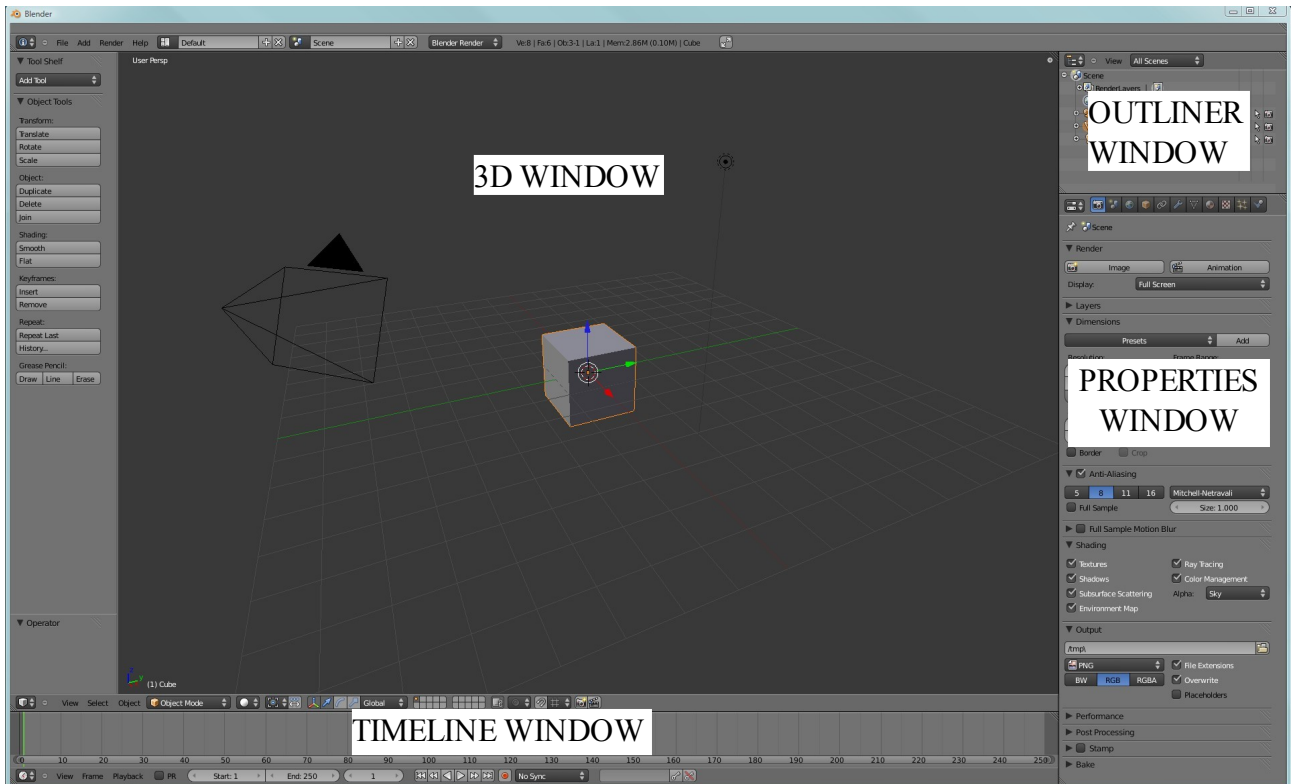
To set up our animation first change the 3D Window to top view with orthographic projection (With the cursor in the 3D Window – 7 Num Pad Key – 5 Num Pad Key). This just keeps the view simple so we can see where we are going.
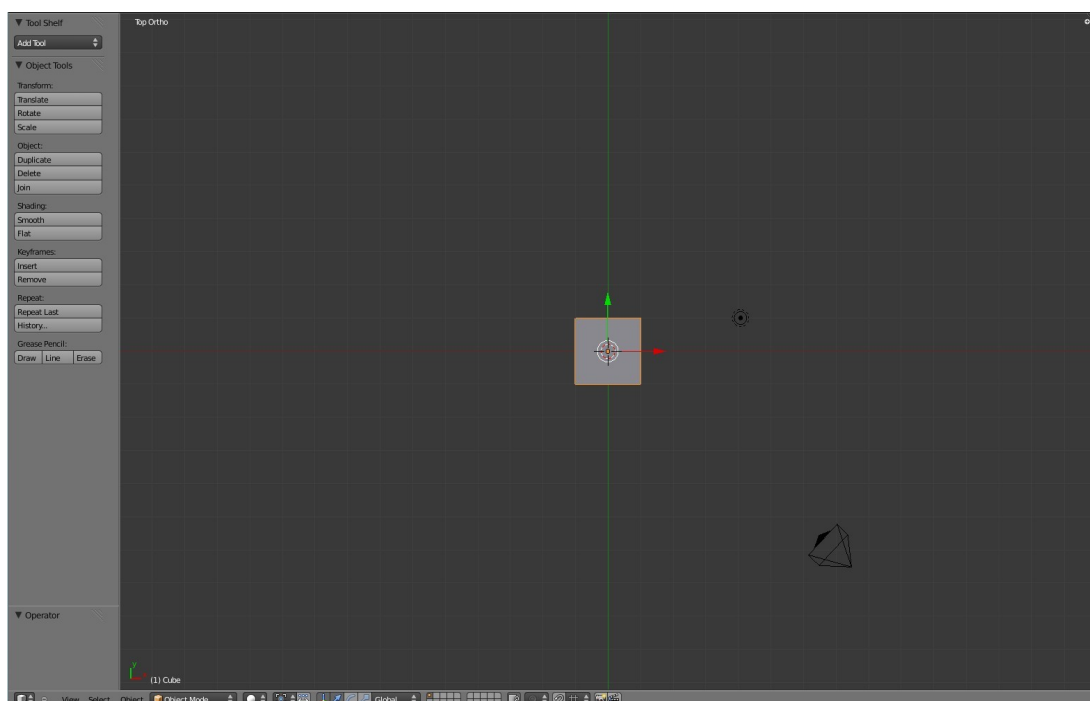
The first step in an animation is to decide what you want your actor to do in a given time. In this case the actor is the cube object.

How long it takes your actor to do something will depend on how many frames per second your animation is run at and this is determined by what format your final render will be in.

Let's set our animation to run at 25 frames per second which would be good for PAL format (Go to: Properties Window – Render button – Dimensions tab – Frame rate). Note the Frame Range settings: Start:1 , End: 250. This says that our animation will begin at frame 1 and end at frame 250. Running at the rate of 25 frames per second will give an animation time of 10 seconds. If you think about it, 10 seconds is quite a long time for a single action to take place in a video clip.
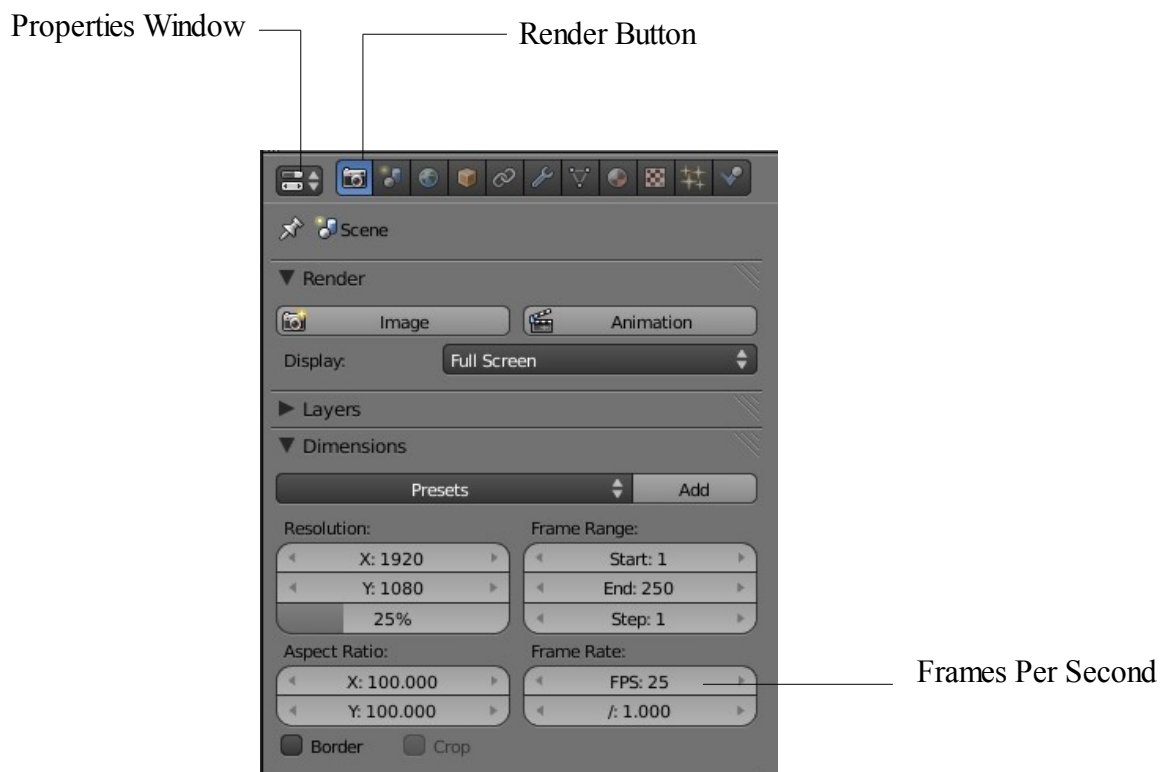
To make things relatively simple we will only make our actor (The Cube) move in a straight line across the screen along the X axis and at the same time increase in size. Make sure the cube is selected in the 3D Window.

We will now insert Keyframes, only two to start with, just to keep it simple.

The default scene is set at frame 1. In the lower left hand corner of the window you will see **(1)Cube** in white lettering. This says you have the Cube selected at frame 1. Obvious?! If you had ten objects in the scene all of which were actors with maybe some hidden, it would be nice to know what was selected .

Before we insert a Keyframe change to frame 25. Go to the Timeline Window at the bottom of the screen. In the header you will see buttons with **Start:1**, **End:250** then **1**. This shows the start frame and end frame that we previously set for the animation and the current frame of the animation. Above the header with these buttons you will see a scale going from 0 to 250 (The length of the animation in frames). At the 0 point you will see a vertical green line showing that you are at frame 1. Click on the green line with LMB and drag the line across to frame 25. Note the number change next to Cube at the lower LH side of the window and in the header bar of the Timeline Window. Another way to change the frame is to click on the little arrows either side of the **1** in the timeline header or click on the button with the **1** and drag the cursor to the right or click on the **1**, hit delete and retype the required frame number. *"There is always more ways than one to skin a cat"*.

Located at frame 25 ─────────── Click to change frame
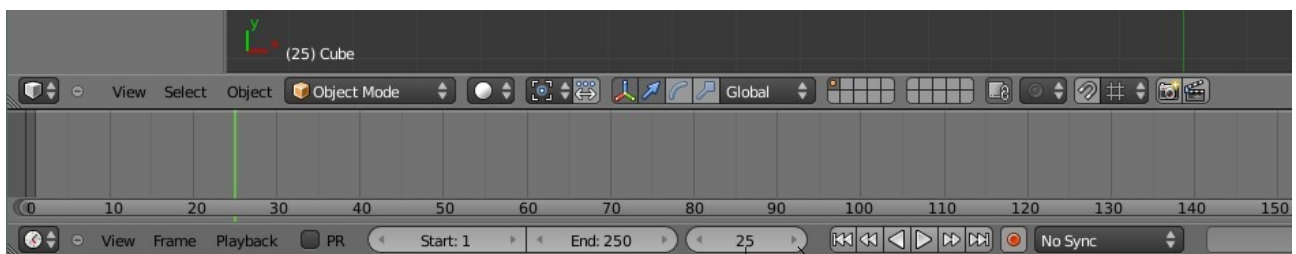
Now you are at frame 25, with the cursor in the 3D Window press the 'I' Key. In the selection list that displays select (click on) 'LocRotScale' which covers us for moving, rotating and changing the size of the object.

Selection List

Insert Keyframe

Location	I
Rotation	I
Scaling	I
LocRot	I
LocRotScale	I
VisualLoc	I
VisualRot	I
VisualLocRot	I

LocRotScale ───────────────
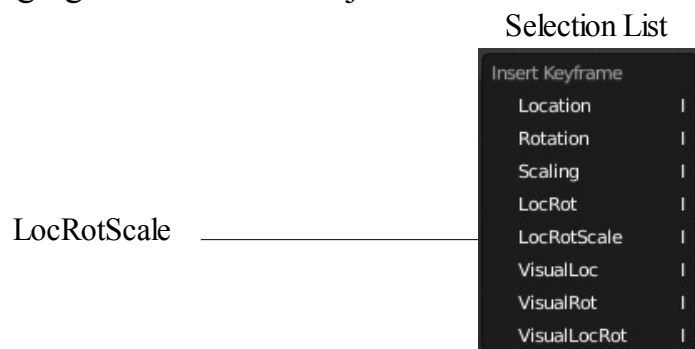
You have just inserted a Keyframe. At this stage the only way to see this is to click on the green line in the Timeline Window and drag it away from frame 25. By doing this you will see a vertical yellow line at frame 25. This indicates a Keyframe.
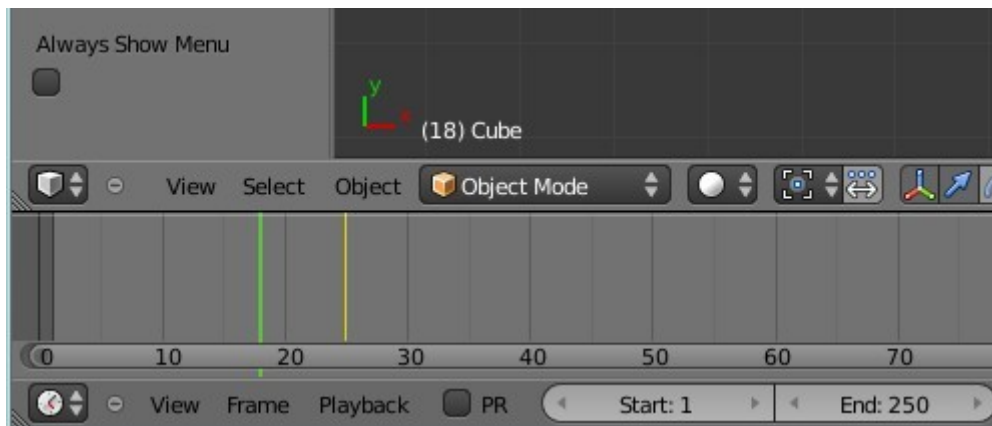
So far we have only inserted one Keyframe, our actor hasn't done anything as yet. This is like pulling the curtains on a stage play and the actor just stands there doing and saying nothing for the first second (A pregnant pause). Going from frame 1 to frame 25 at 25 frames per second equals 1 second. Clicking and dragging the green line in the Timeline is called **scrubbing the animation** and is actually manually playing the animation but since we haven't told our actor to do anything, nothing happens.

Continue by changing to frame 75 (drag the green line). In the 3D Window grab and move the cube 5 blender units to the right and scale it up to twice its original size. With the cursor in the 3D Window press the I key and select 'LocRotScale' again to insert a second Keyframe.

If you move the green line in the Timeline Window you will see another yellow Keyframe line.
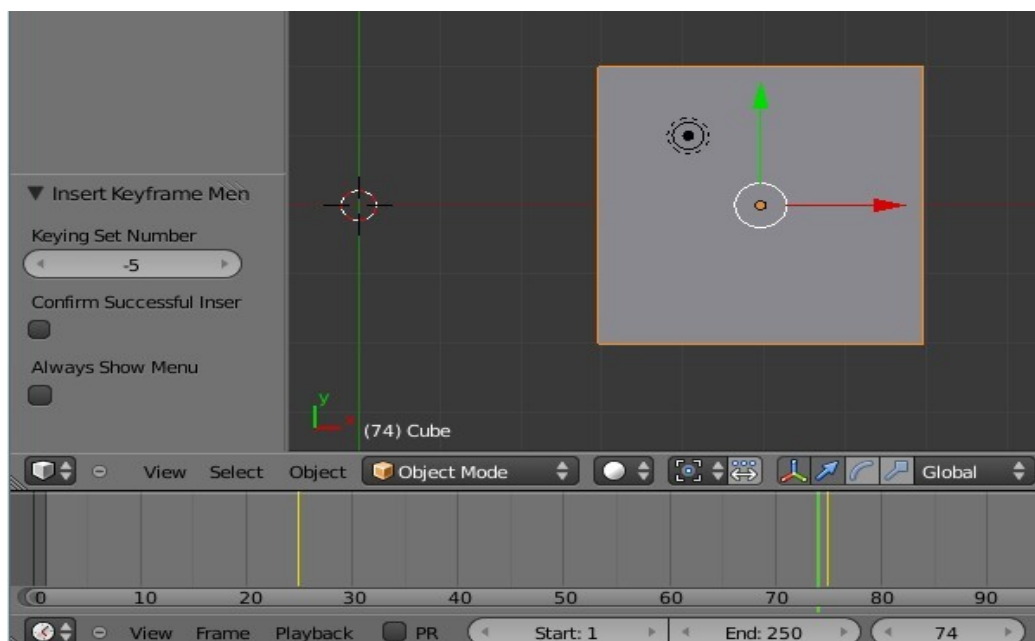
If you continue moving the green line between frame 25 and 75 you will see the cube move and change in size. You are scrubbing or manually playing the animation. Note the action only takes place between frames 25 and 75, the location of our Keyframes. Either side of the Keyframes no action takes place.

Viewing Your Animation:

To actually play a preview of the animation move the green line in the Timeline to frame 1 then press 'Alt+A' with the curser in the 3D Window. Say "o n e t h o u s a n d" to yourself slowly (counting one second, while the green line in the Timeline moves across to frame 25) and you will see the cube move and increase in size. At frame 75 it stops moving and changing size. The green line in the Timeline continues on to frame 250 then jumps back to frame 1 and the preview of the animation plays again. Press 'Esc' to stop playing.

Another way *to skin this cat* is to press the play buttons in the Timeline window. These buttons are much like the play buttons an any video or audio player.
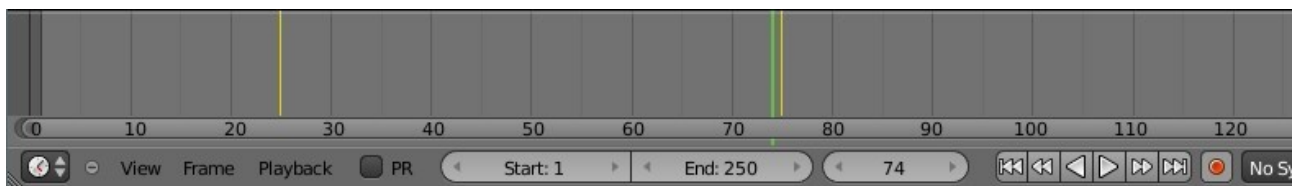
Play Buttons

You can add more Keyframes to your animation to move scale and rotate your actor around the screen. For the most part, location and size keys work flawlessly but care needs to be taken with rotation keys. If you try to rotate an object too far in one set of keys the object may not rotate in the direction you want it to and it may rotate oddly. Try small angular movements between keys while rotating. There are ways to control this better and tools to simplify the process which will be discussed later.

Besides rotation, the movement of your actor may not be exactly as planned. Blender automatically defaults to trying to create a smooth flow through the Keyframes (Interpolates).

Working With The Graph Editor Window:

The Graph Editor Window displays the actions of your actor and your Keyframes on the Timeline in a graphical form and allows refinement and modification of the animation.

Split the 3D Window vertically and change the lower section to the Graph Editor Window. You will now see a window with two panels. The left hand panel is called the **Dope Sheet** and the right hand panel is the **Graphical Display** of your animation. Even for our simple animation there is a whole bunch of graph lines shown.
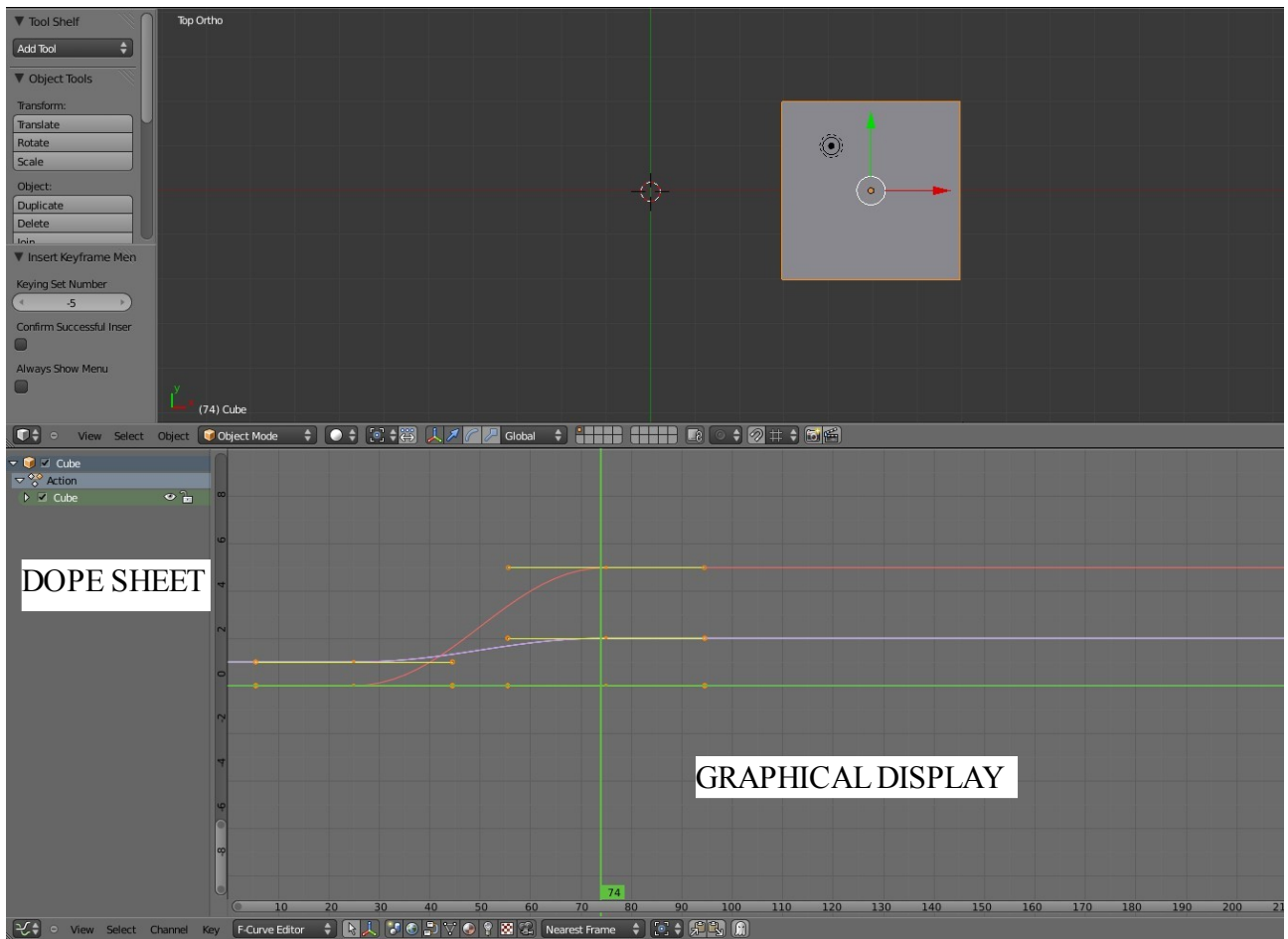
To make sense of this first consider the **Dope Sheet**. Click on the little black tick arrow in front of '**Cube**'. Either of the ticks above and below the word 'Action' will do the same thing at this stage, that is toggle the graphical display on and off. Now click on the little white arrow in the lower green Cube bar. Clicking here opens up the display and reveals a list of '**Action Channels**' relating to the Cube actor. Clicking the tick in the colored boxes in each channel toggles on/off the display of that particular channel in Graphical Display.
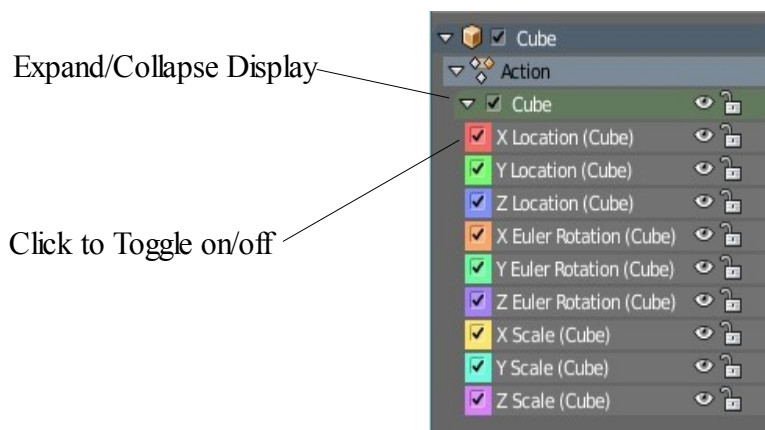
Lets discover what we actually have in the Graphical Display. Click on the tick, removing it, in each colored box in the dope sheet channels except for the first **X Location(Cube)** channel. Now click on **X Location (Cube)** which selects that channel (Highlights the channel in white). You now see only one graph in the Graphical Display panel which shows as a red line. The green horizontal and vertical lines are a 2D cursor. Click somewhere in the graphical display panel and the green lines will relocate. This is similar to clicking in the 3D Window and positioning the cursor in that window. With the green lines relocated you can better see the red line representing the animation of the cube object (Actor) along the X Axis in the 3D Window.
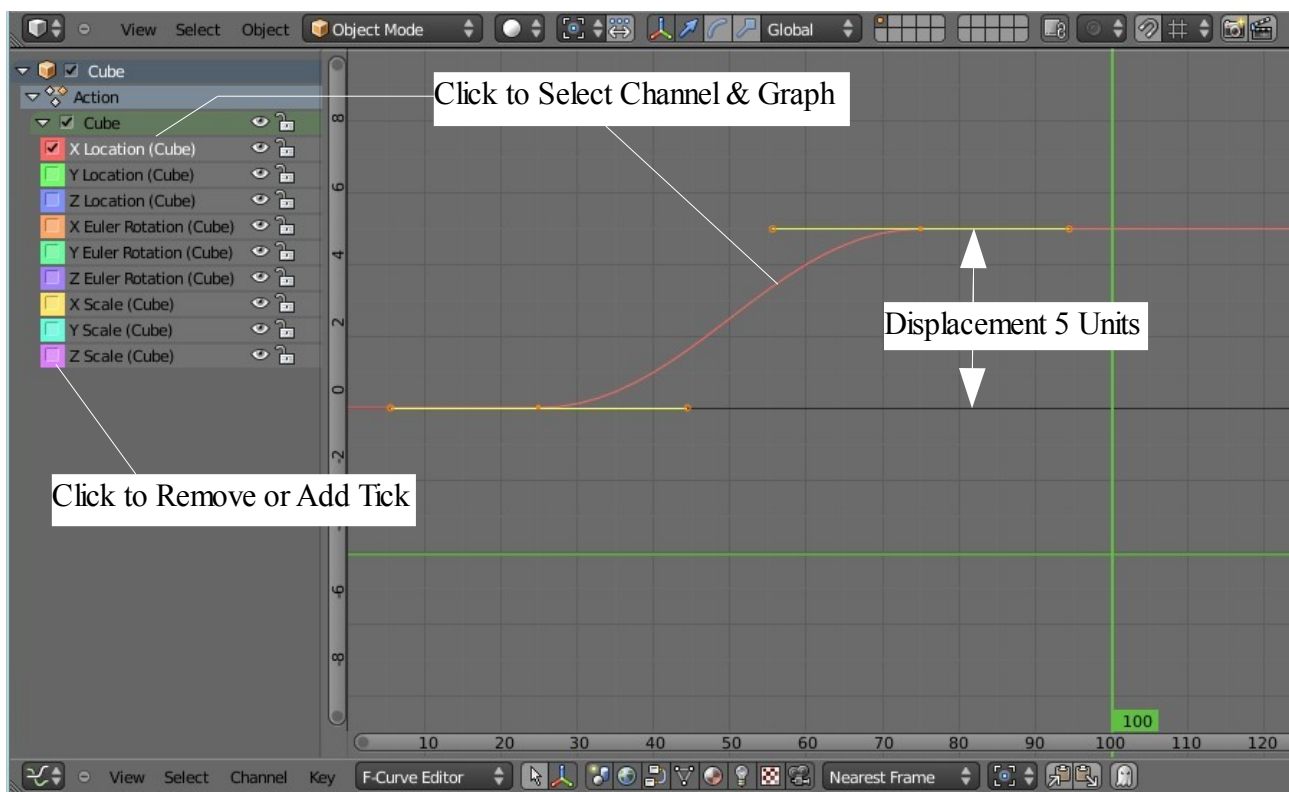
The red line has two short yellow lines attached to it. Each yellow line has a dot at the center and a dot at each end. The yellow lines are called handles. What we are looking at is what is termed a **Bezier Curve** and the yellow lines are called control handles. The control handles are used to change the shape of the curve. We mentioned this type of curve before and will come back to this topic later.

The location of the vertical green line of the cursor represents the frame number of the animation. You will see it aligns with the frame numbers across the bottom of the window and at the lower end of the line a green box holds the frame number. You can click on this line and scrub through the animation the same way as you can in the Timeline Window.

At the left hand side of the Graphical Display is a vertical bar with positive and negative numbers representing displacement from the mid point of the 3D Window.

On my screen these numbers appear to be a little out of alignment with the background scale lines. This varies depending on how the Graphical Display panel is scaled. Like all windows in Blender, with the cursor located in that window pressing the Num Pad + and – Keys will scale the panel up or down.

Lets get back to the red line. The red line shows that from frame 1 to 25 there is no displacement of the actor from the mid point. From frame 25 to frame 75 the actor moves from the mid point of the 3D window to 5 Blender units along the X axis. From frame 75 to frame 250 the actor remains displaced from the mid point by 5 Blender units. This is the movement observed when we play the animation.

If you now click on the tick in any one of the **Scale (Cube) channels** in the Dope Sheet you will see a yellow, turquoise or purple lines representing the fact that the actor change from size 1 Blender unit to 2 blender units between frame 25 and frame 75. The three lines represent the X,Y & Z axis.

Editing The Curve:

So far we have introduced Keyframes to set up how we want our actor to behave during the animation and we have seen how that action is graphically represented. We will now see how we can alter the behavior of our actor by altering the shape of the curve representing that action. Remember the type of curve being considered is a Bezier curve which is designed to be edited.

Go back to the red line. With the cursor in the Graphical Display panel press the A Key twice to make sure you have the line selected. If the line shows solid red with the two yellow handles you are in Edit Mode if not press the Tab key. If you are not in Edit Mode the line will be a broken red line without handles.

Select (Clk RMB) the red line in Edit Mode (Solid red with handles). Now press A Key to deselect the line. You will have a faint red line with black handles. Select the handle at frame 75 (Clk – RMB, Click right mouse button on the center dot of the handle). The handle will be yellow and the line will be bright red.

OK , now click on the right hand dot on the end of the handle (RMB). The left hand half of the handle fades. Now RMB Clk on the Right hand dot on the end of the handle and while holding the mouse button pressed drag the end of the handle down and to the left. The shape of the curve arches up.

RMB Click and Drag
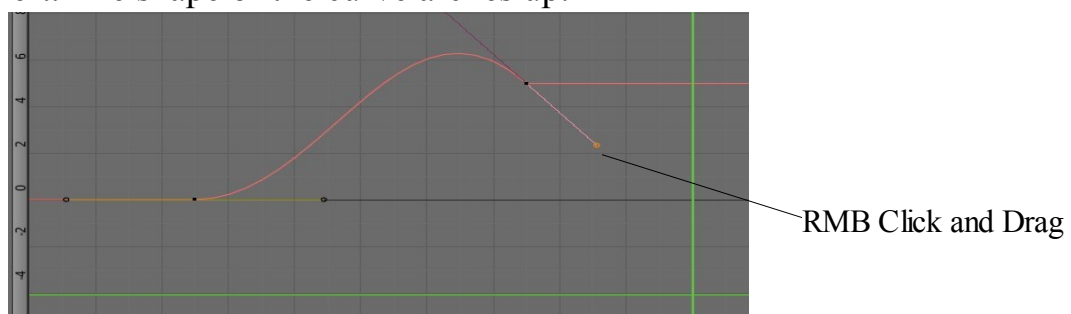
Now, if you scrub through your animation between frame 25 and 75 you will see the actor move along the X axis from zero displacement at frame 25 to something more than 5 Blender units then return to 5 Blender units at frame 75. The movement of the actor is being dictated by the shape of the curve. The shape of the curve can thus be altered by moving the ends of control handles. By selecting the center point of the control handle then pressing the G Key and dragging the whole handle the shape of the curve will also be altered thus changing the movement of the actor.

Another feature of the Bezier curve is that control handles may be added anywhere on the curve. In the Graphical Editor panel with your X Location (Cube) graph (Red Line) selected place your **arrow cursor** on the line between frame 25 and 75, hold the Ctrl key and click on the line with the LMB. Another control handle is created. This is actually another Keyframe. You can actually enter a new Keyframe this way anywhere on the red line in the animation. *Another way to skin the cat.*
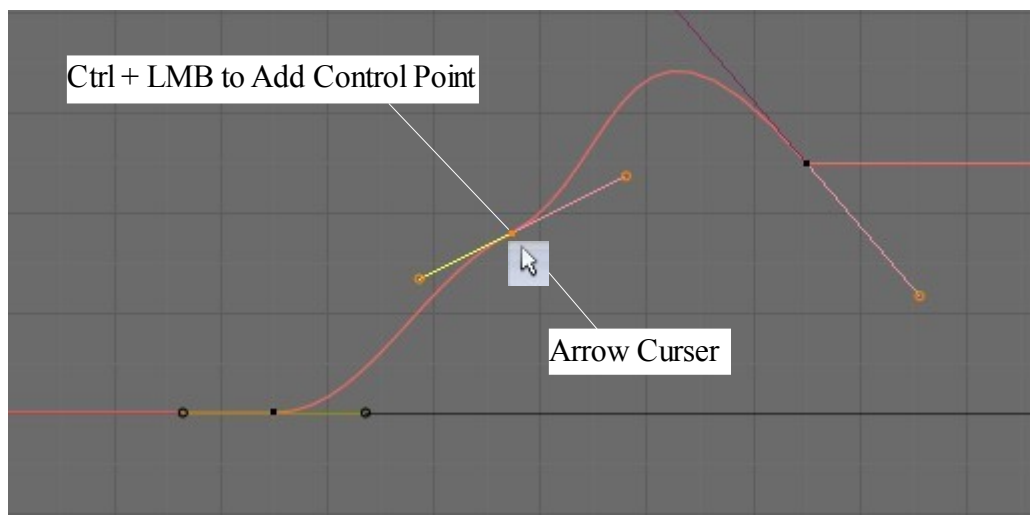
Other Types Of Curves:

We had previously made note that by default Blender selects the Bezier type Interpolation to insert frames between keyframes. At this point it should be noted that there are two other options. In the Graphical Editor Window select all the channels in the Dope Sheet panel by clicking in the colored boxes. All the graphs will display in the graphical Editor panel. Now A Key twice to make sure they are all selected.

Go to the Graphical Editor Window header – Key – Interpolation Mode and you will see the option to select Constant, Linear or Bezier. Clicking on Constant or Linear will change the type of graphs and therefore change the action of the actor. 'Constant' results in a dramatic quick change from one state to the other at a given frame while 'Linear' produces a change following a straight line graph between points.

CONSTANT INTERPOLATION

LINEAR INTERPOLATION
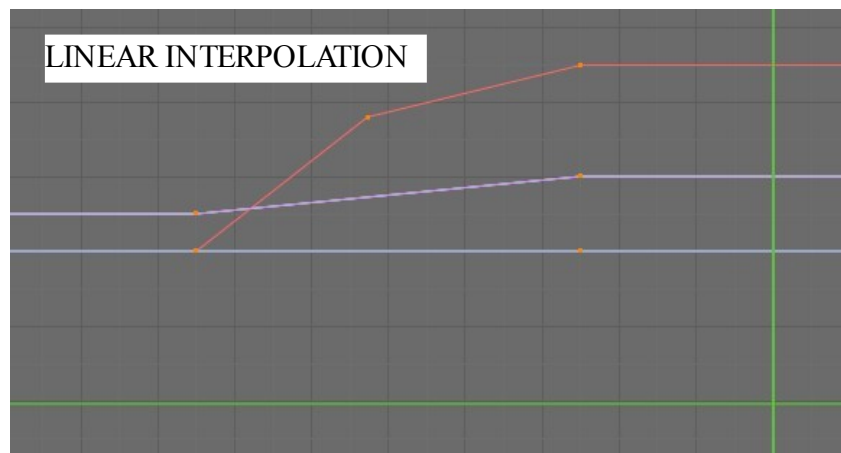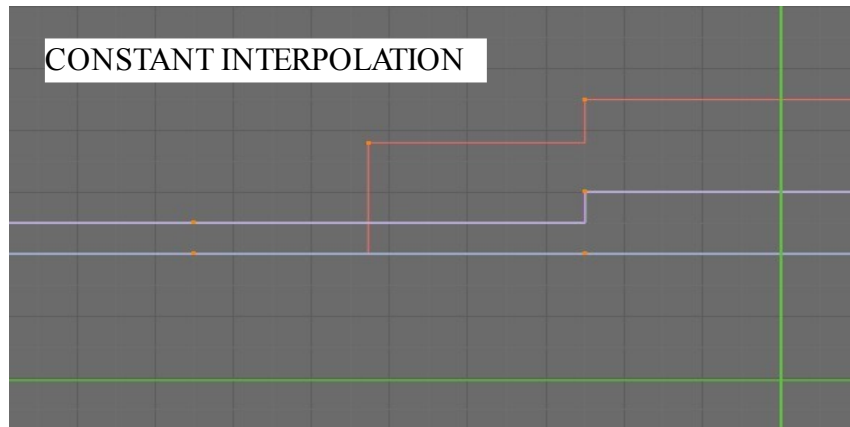
The choice of these types of graphs and hence motions depends on how you want your actor to behave in the animation. Both of the alternatives to Bezier give the option to grab and move points and to add additional points on the graph but Bezier is by far the more flexible.

Blender Interpolates to add frames between the keyframes according to which of the above options were selected. Blender also figures out what to do with the frames of the animation before the first keyframe and what to do after the last keyframe. Figuring this out is called **Extrapolation**. There are two options in Blender, Constant and Linear. By default Blender selects Constant.

Constant Extrapolation can be seen with the **X Location (Cube)** channel selected in the Dope Sheet. With Keyframes at frame 25 and frame 75 Blender has Interpolated the in between frames according to the default Bezier method. That is Blender has inserted frames which comply with a Bezier curve. Either side of the Keyframes you see horizontal lines which dictate no further change in status. This is Constant Extrapolation. If you go to the **Graph Editor header – Key button – Extrapolation Mode** and select **Linear Extrapolation** notice what happens to the

curve. Blender takes a look at frame 25 and 26 and from the data plots a straight line coming up at an angle . Blender also looks at frames 74 and 75 and plots a straight line curve leaving the curve . The action of the actor before and after the two Keyframes will follow these straight line curves.

Modifying Curves:

We have so far discussed creating graphical curves and how to change them or modify them thus changing how our actor behaves in the scene. Blender has more options for more subtle control of animation.

In the Dope Sheet panel, display all the channels and have them all selected. With your arrow cursor in the Graphical Editor Window press the A Key until all channels are highlighted in white and all the colored boxes are ticked. Now press the N Key to display a panel with a View Properties tab.
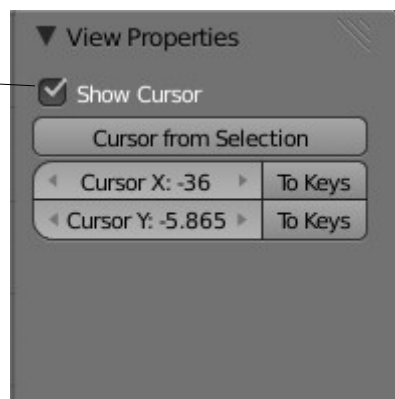
To begin with this panel will only provide the option to show or hide the cursor (The Green horizontal line). In the Dope Sheet untick all but the the **X Location (Cube)** channel. In the Graphical Editor panel Clk A Key twice to ensure all channels are selected but since only the X Location (Cube) is ticked only that graph will display.
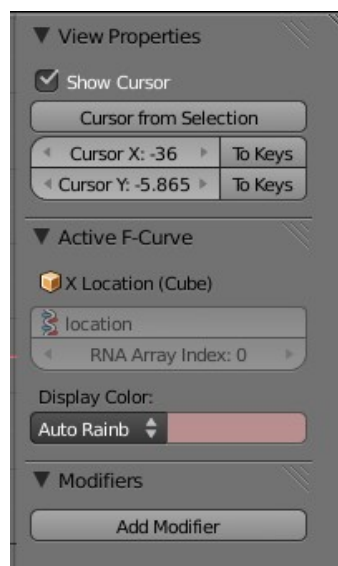
The new panel will now display three tabs. The **View Properties, Active F-Curve** and the **Modifiers** tab. The Active F-Curve tab shows that the X location curve is selected and that it is displayed in a Auto Rainbow color. This color may be changed by clicking on the drop down menu under 'Display Color'. It could be advantageous to change the color of a curve if it is required to distinguish it from another.

We are at this point interested in modifying our curve not changing its color. Note the Modifier tab with its **Add Modifier** button. Clicking on this button produces a drop down menu with seven options. We will not attempt to demonstrate all of these options at this time but several are of particular interest.

We have the X Location (Cube) channel curve selected in the Graph Editor panel. Now click on Add Modifier and select **'Cycles'**.
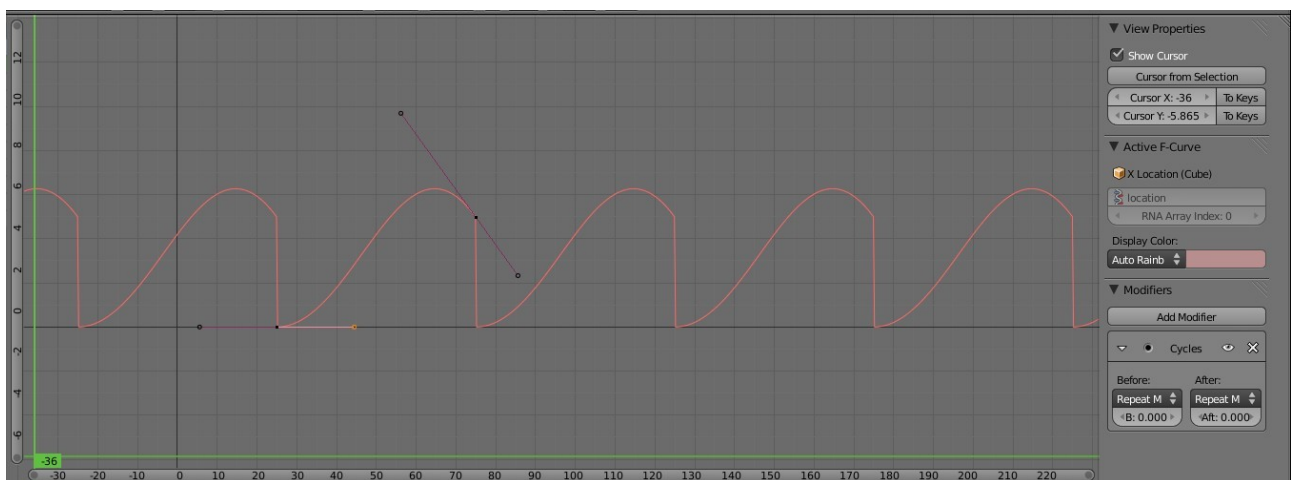
The graph changes rather dramatically. The curve between frame 25 and frame 75 is the same but instead of straight lines either side of this, Blender has duplicated this curve. In selecting Cycles we have made the movement of the curve cycle in 25 frame increments either side of the frame 25 – 75 block.

We are starting to get into the complexity of Blender and its multiple options.

Look at the little Cycles panel which has displayed under the Add Modifiers button. Note the Before and After options. Each of these have drop down menu buttons which give options for how the Cycles are to be repeated before and after the frame block. Click on the After button and select Repeat Mirrored.
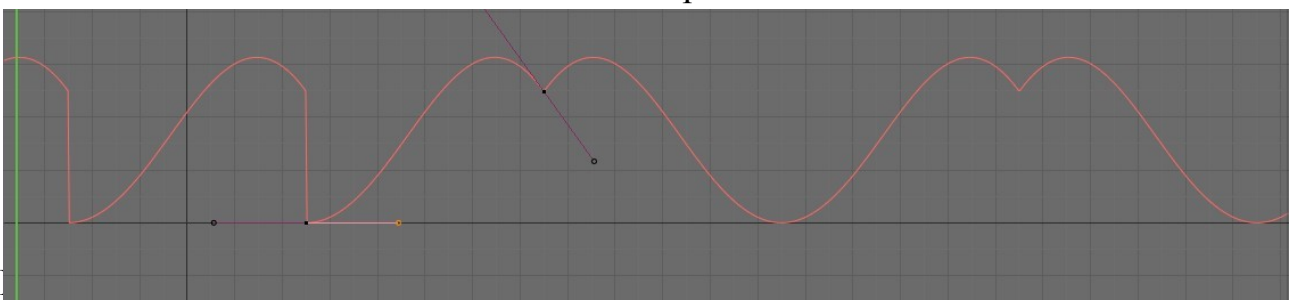
Lets have another demonstration. Click on the X at the top right hand corner of the Cycles panel to delete the modifier. Click on Add Modifier again and this time select Noise.
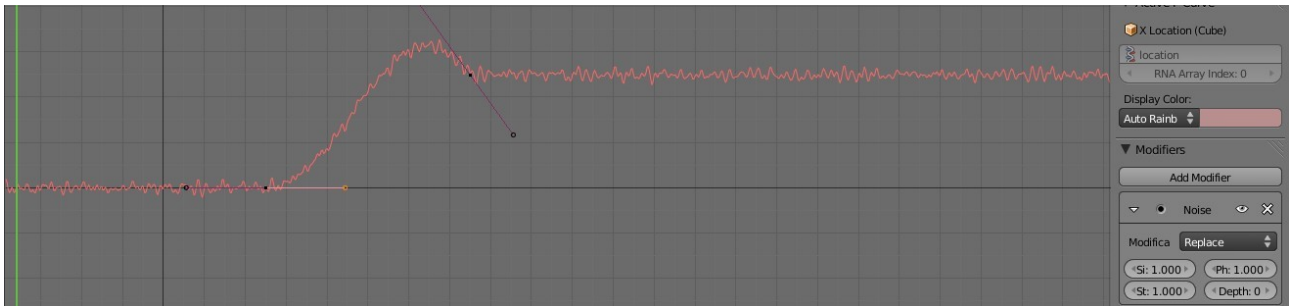
Wow! We now have our original graph with the jitters and if you scrub your animation you will see that's exactly what you get in the movement of the actor. Of course it doesn't stop there the noise modifier contains a drop down to select sub options and buttons to alter values for the options. You have plenty to play with. Good luck.

For another demonstration delete the noise modifier and select the Built In Function modifier. This produces a straight sinusoidal graph. Check out the drop down in this modifier panel for the selection of graphs based on various mathematical functions. All selections have buttons to control values being introduced. More stuff to play with.

To get more evolved try adding multiple modifiers to your curve. Just click on the Add Modifier button without deleting what you already have.

Automatic Keyframing:

Previously Keyframes have been inserted in our animation by having our curser in the 3D Window, moving the Timeline to a particular frame, changing the status of our object and then pressing the I Key and selecting a Keyframe option.

Besides this method after the frame has been selected and the object status changed we can press the Insert Keyframe button in the tool bar at the Left hand side of the 3D Window. The T Key toggles hide and show this panel.

There is another method which makes life a lot easier when multiple Keyframes are required.
In the Timeline Window header you will see a red button next to the play control buttons.

Toggle Auto Keyframing On/Off

Clicking on this button toggles automatic Keyframing on/off. With auto on whenever you move,scale or rotate your actor object in the 3D Window a Keyframe will be inserted at whatever frame you have selected. Remember to turn this off after using it.

Animating Other Features:

Having an understanding of animation basics allows us to look at some of the other things that can be animated in Blender besides movement, rotation and size of an object. It is also possible to animate among other things Materials, Textures, Lamps and World settings.

The following is a list of some of the features which can be animated:

Material Animation Options:

Material RGB Values	Color can be animated to change.
Alpha	Transparency of an object can be animated.
Halo Size	A halo can grow or shrink in an animation. Setting a halo to zero will make it disappear.
Texture Offset	Texture applied to an object can be animated. It can move across the face or change in size.

Lamp Animation Options;

Lamp RGB Values	The color of light can be animated to change.
Energy	The intensity of light can vary.
Spotlight Size	The angle of beam can be animated to change.
Texture	Texture can be applied to a lamp and animated.

World Animation Options;

Zenith RGB	Color of the zenith (top) can be animated. This is great for sunsets or sunrise.
Horizon RGB	Color of horizon (bottom) can be animated.
Mist	Fog can be animated for interesting effects.
Stars	Stars can be made to move.
Texture Offset & Size	Texture applied to a world can be made to move.

The above are only some of the features which can be animated in Blender. To give you an idea how this is possible we will take a look at a couple.

Example 1 Color

Let's start with the color of an object.

Open up a new scene in Blender. (The default scene with the cube object will do).

Go to the Properties Window at the left hand side of the screen and click on the Material button. When you open the default scene in Blender the cube object in the scene is selected. Make sure it is selected before clicking on the material button. After all we are concerned with the material of the cube object.

The Properties Window with the Material button activated show a whole bunch of tabs for controlling how the surface of the object displays in the 3D Window. To begin note the Preview tab showing a dull grey sphere and below that the Diffuse tab with a button showing the same dull grey color. Actually on my screen the diffuse color button looks a lot lighter in color than the sphere in the preview or the cube in the 3D Window. The values for all three are however identical.

Look at the Timeline Window across the bottom of the screen. The green line shows at frame 1 of a 250 frame animation (0 to 250 scale along the bottom of the window above the header).

We are again going to insert Keyframes on the Timeline. We will make the color of our cube object change from Grey to Red over 50 frames of the animation.

You could change the starting color of the cube by clicking on the diffuse color button (LMB)to display a color picker, click anywhere in the colored circle to change the color. Let's just leave things alone for the time being and stick with dull old grey.

Instead of clicking (LMB) on the diffuse color button click(RMB) and in the menu that displays click on 'Add Keyframes'. You have inserted a Keyframe at frame 1 on the Timeline. Change to frame 50 (Scrub the green line in the Timeline Window). Now click (LMB) on the diffuse color button and in the color picker that displays click on the red part of the colored circle. This changes the color of the cube to red. Click on the diffuse color button again, this time (RMB) and then click on 'Add Keyframes' to insert a Keyframe at frame 50. Now when you scrub the Timeline you will see the color of the cube change from grey to red over the 50 frames. Hitting Alt + A will play this animation. If you open the Graphical Editor Window you will see the graphical representation of this animation.

Example 2 Spotlight Size:

To show how the spotlight may be animated we first need to put a spotlight into the Blender scene. Let's start again with the default Blender scene with the cube. Change the 3D Window to show the front side view and deselect the Cube (A Key). With the cursor in the 3D Window hit the 1 Num Pad key then hit Shift + A then select Add – Lamp – Spot. You will see some orange lines appear in the 3D Window. Hit the G Key (Grab) then Z Key and move the mouse up. The G Key lets you grab the spot light so you can move it and the Z key confines the movement to the Z axis. You could also have clicked (LMB) on the blue arrow of the 3D manipulator widget and moved the spotlight up the Z Axis. *Another way to skin the cat . You* will see that you have actually moved a cone in the screen. Hit the S Key and move the cursor towards the apex of the cone to scale the spotlight down a bit. The light is at the apex of the cone and the circle at the bottom represents the circle of light it would generate.

Now go to the Properties Window and press the Object Data button to display all the buttons which control the properties of the spotlight. Look for the Spot Shape tab and see the button with' Size: 45' in it. 45 degrees is the angle of the cone.

The Timeline Window is again across the bottom of the screen and the green line indicates that we are at frame number 1.

Right click on the Spot Shape Size button and select Insert Keyframes from the menu that displays. The Size button will turn yellow indicating that you have inserted a Keyframe in the Timeline. Scrub the green line in the Timeline to frame 50. The Size button turns green (No Keyframe at frame 50 yet). Left click on the Size button and holding the mouse button move the mouse to the left decreasing the value of the cone angle. The angle of the cone in the 3D Window will decrease accordingly. Right click on the Size button and select Insert Keyframes again. Button turns yellow. We now have a Keyframe at frame 50. Scrub the green line in the Timeline Window between frame 1 an 50 to see the angle of the cone change. You have animated the spotlight size.

Many properties can be animated this way by inserting keyframes and changing property values. You have lots of experimenting to work on.

Keying Sets:

You can add multiple properties to a group called a **Keying Set** which allows you to animate whole bunch of stuff at one time. You do this by defining a Keying Set.

We will again look at our Cube actor in the default Blender Window. Let us say you want to have the cube move along the X axis and change color at the same time. Not too difficult? Just add a bunch of Keyframes. Exactly! But consider if you had a lot of property changes. Adding all those Keyframes one by one could become tedious. It

would be nice if you could do the property changes then hit a button to add all the Keyframes in one go. Let's do it.

With the Cube selected in the 3D Window go to the Properties Window. We will look at the movement part of the exercise first. Click on the Object button in the header and in the panel that displays find the Transform tab and the Location buttons. You will see X:0.000, Y:0.000 and Z:0.000. This shows that the Cube is at the center of the 3D Window in all planes. OK we are concerned with the movement on the X axis. Right click on X:0.000 and in the panel that displays click 'Add Single to Keying Set'. If you look at the Timeline Window header you will see a button with 'ButtonsKeyingSet' in it and two little Key icons next to it. One of them has a red line across it. Note in the Timeline you are at frame 1. You have just entered the information into a Keying Set telling Blender that at frame 1 the Cube is located on the X axis at position 0.000.

Now consider the color part of the exorcise. In the Properties Window click on the Material button. Right click on the Diffuse color button then click on 'Add All to Keying Set'. Make sure you click on 'Add All' not 'Add Single' Now the information for the color has been added to the Keying Set.

In the Timeline Window header click on the first of the little Key icons (Not the one with the red line). You have entered a Keyframe for the location and color of the Cube. You can see this in the Graph Editor Window by opening up all the headings in the Dope Sheet.

Now move to frame 40 or wherever you wish on the Timeline.

Change the value for the Transform Location X axis in the Properties Window Object buttons. Right click the new value and click 'Add Single to Keying Set'.

Do the same thing for the Material color value but make sure you click on 'Add All to Keying Set". Now click on the first of the Key icons again to add the new Keyframe at frame 40.

Scrub the Timeline to see the Cube move and change color.

Why it is necessary to click 'Add All to Keying Set' for the color instead of 'Add Single to Keying Set' is not known at this time.

Wind Strength Animation

Wind force can be applied to particles and cloth. The Wind Strength is able to be animated to provide a realistic reaction due to varying wind strength.

In the 3D Window add an 'Empty'. Split the 3D Window in two and make one half the Graph editor Window. With the Empty selected in the 3D Window go to the Properties Window-Physics button. In the Force Field tab click on the 'Type' panel to display the dropdown selection panel and select 'Wind'.
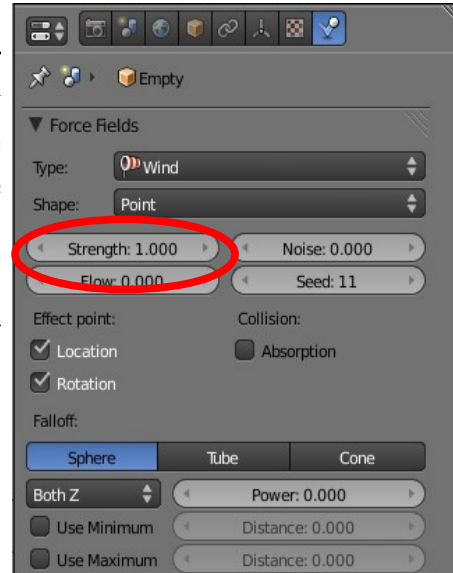
The wind force is displayed in the 3D Window as a stack of circles along the positive Z axis.

Z
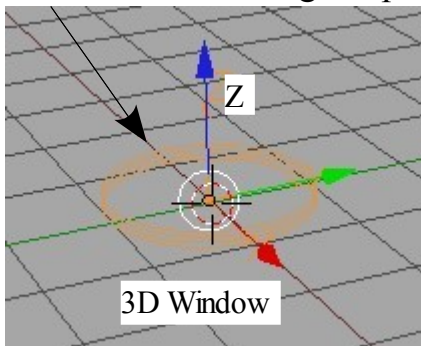
3D Window

In the Physics Force Field tab the **'Strength'** value refers to the wind strength. Increasing the value causes the circles in the 3D Window to move apart showing the increase.

Starting with the Strength = 1.000 at frame 1 on the Timeline right click in the Strength panel and select 'Insert Keyframe' in the drop down that displays.

Keyframe Added

Graph Editor
Window
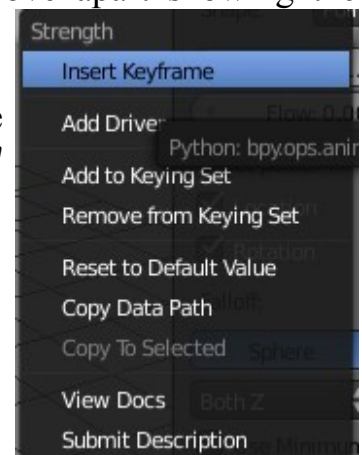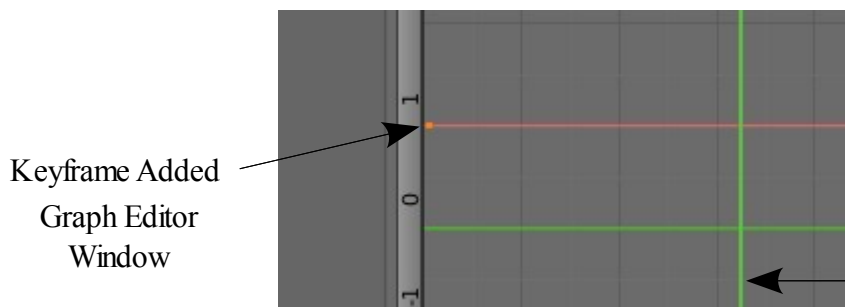
Green Line at frame 41

A Keyframe is added in the Graph Editor Window. Click on the vertical green line and drag it along to frame 41. You will see your first Key shown as the orange dot at frame 1. With the green line at frame 41 alter the Strength value to 7.000 and right click in the Strength panel again.

Select 'Insert Keyframe' and a second Key is added in the Graph Editor Window.

By moving (Scrubbing) the green line in the Graph Editor Window back to frame 1 you will see the wind strength alter in the 3D Window.

Move the green line back to frame 1. With your cursor in the 3D Window press Alt+A. You will see the wind strength animated.

The above method show you the manual insertion of Keyframes. To make life easier there is an automatic insertion of Keyframes method.

Graph Editor Window

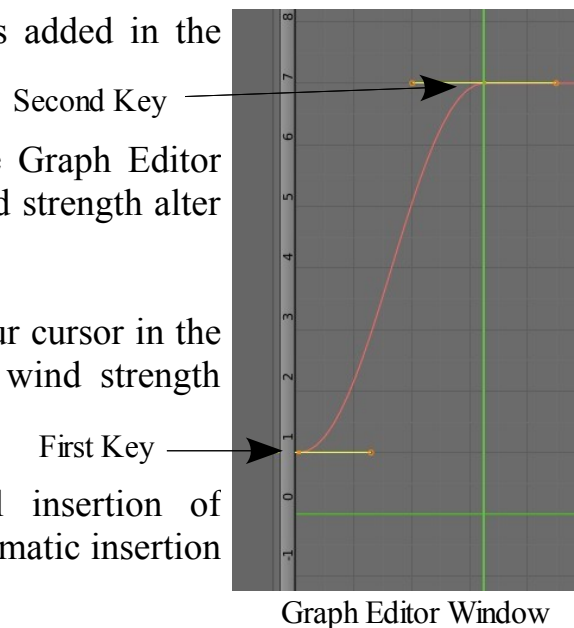Go to frame 41 (You can start where you like but lets build on to what we already have). In the Timeline Window at the bottom of the screen click on the Red button next to where it says 'No Sync'. Move the green line along the Timeline and change the Strength value. A third Keyframe is added in the Graph Editor Window. Repeat this a few times increasing and decreasing the strength value. By scrubbing through the animation you see the wind strength animated in the 3D Window. Move the green line back to frame1 and press Alt+A and play the animation.

Graph Editor Window

With the Wind Strength animated you can direct it at Particles or Soft Body objects which influences how they behave in an animation.

Animation Following Curves

Animating the movement of objects in a scene by inserting Keyframes can be very tedious when the movement is complex. To animate the movement of an object which twists and turns in the scene over many frames you have to insert many many Keyframes. Editing the movement at a later stage after executing this method can be difficult. There is an easier way.

Actually, there are at least two ways, both of which involve having an object follow a predetermined path. One method requires you to set a 'Child Parent' relationship between the object and the path, the other method requires that you place a 'Follow Path' constraint on the object.

Follow Path – Child Parent Relationship Method

Open Blender with the default scene containing the Cube object. The scene will be displayed in user perspective view. Change to top orthographic view (Num Pad 7 for top perspective view then Num Pad 5 for top orthographic view). By default the Cube is selected in Object mode. Deselect the cube (A Key).

We want the Cube to move in the scene following a predetermined path. The path will be a 'Curve Path' (Press, Shift + A Key – Add – Curve - Path). You can use any of the 'Curve' options for your path but for the time being we will use the 'Path' option since it is the simplest.
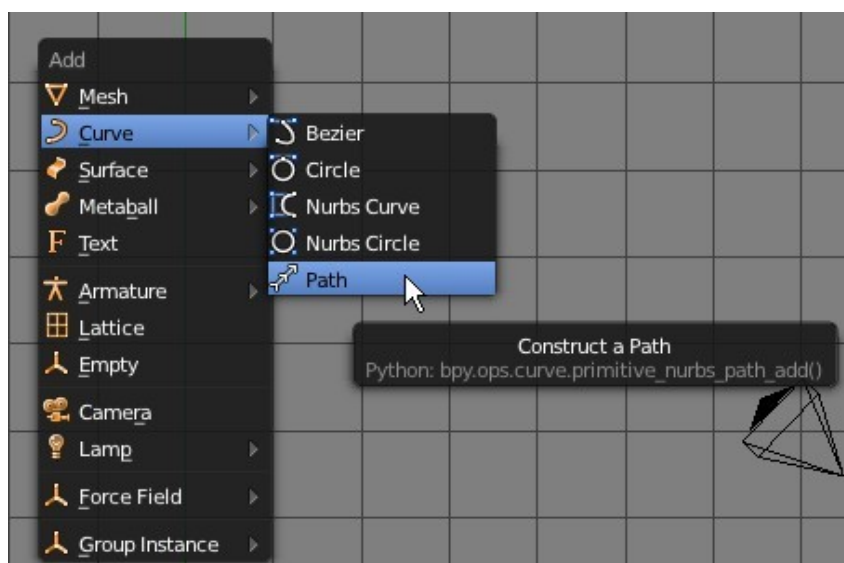
Adding a 'Curve Path' places a straight line on your screen in Object mode. Do not be confused. In Blender this particular straight line is considered to be a Curve and it is also a Path. Scale the line to make it five times as long (S Key – 5 Key, Click LMB). If the line runs off the edge of the window press the Num Pad Minus Key to zoom out of the scene. The Num Pad Plus Key will zoom in.

To start we will make the Cube move along the straight line of the Curve Path. This isn't very exciting but it will show you the principles of the operation.

Deselect the path (A Key). Select the Cube (Click RMB with the mouse cursor on the Cube). Hold the Shift Key and click RMB on the Curve Path. The Cube and the

Path will both be selected at the same time. Make sure the Cube is selected first followed by the Path. Think of this as if you were pointing to the Cube and saying "Cube follow Path".

We will now apply a specific 'Child Parent Relationship'. In a normal case selecting the Cube then shift selecting the Path and applying an 'Object' Child Parent relationship would simply make the Cube the child of the Path. If the Path moved the Cube would follow. We want the Cube to move along the Path.

With both the Cube and the Path selected press the Ctrl + P Key and select 'Follow Path' from the options displayed. Remember that in the selection process the Cube must be selected first, followed by the Path.
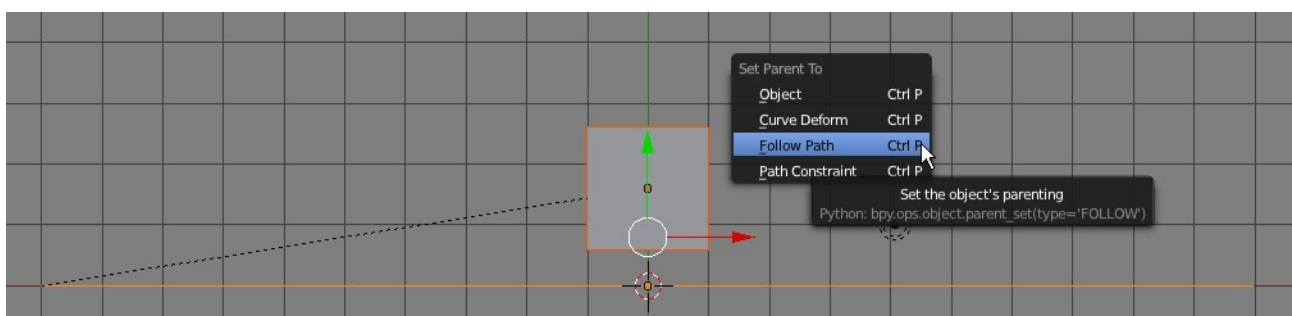
Deselect both the Cube and the Path (A Key). Select only the Cube. Move the Cube along the Y axis of the scene (G Key – Y Key and move the mouse). You will see a dotted line drawn from the Cube to one end of the Path. The line indicates that the child parent relationship is in place. Move the Cube to the end of the Path where the dotted line is attached.
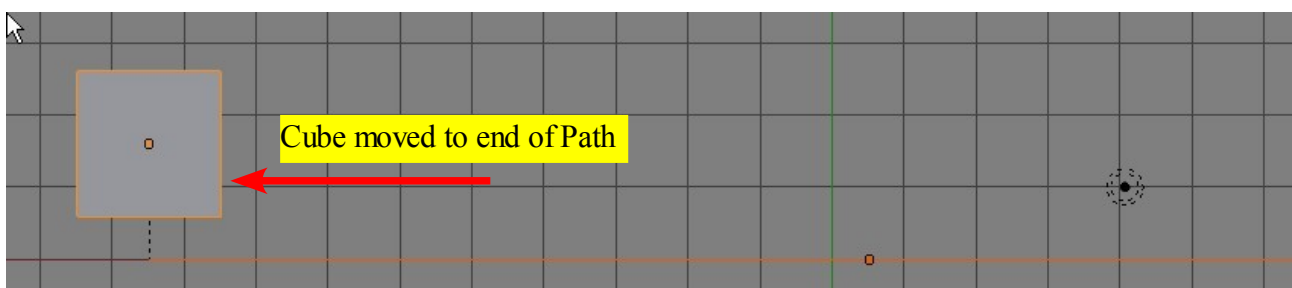
Press Alt + A on the keyboard or in the Timeline Window click on the 'Play' arrow. Either method will play an animation showing the Cube moving along (Following) the Path.
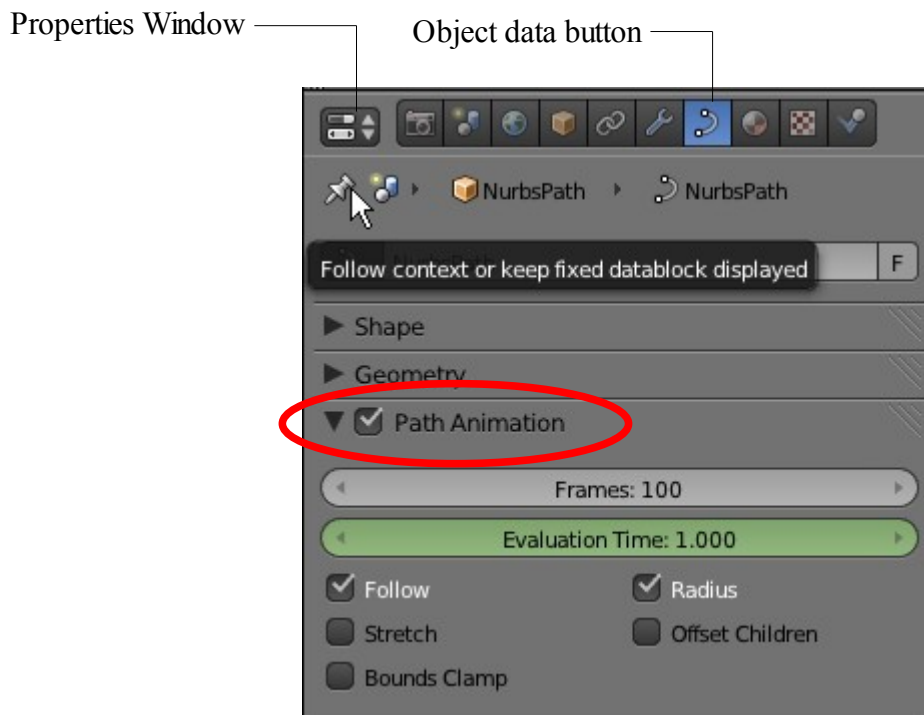
Blender has created a 100 frame animation. With the Path selected the details of the animation can be seen in the Properties window – Object Data button – Path Animation tab. You can also see a graphical display in the Graph Editor Window.
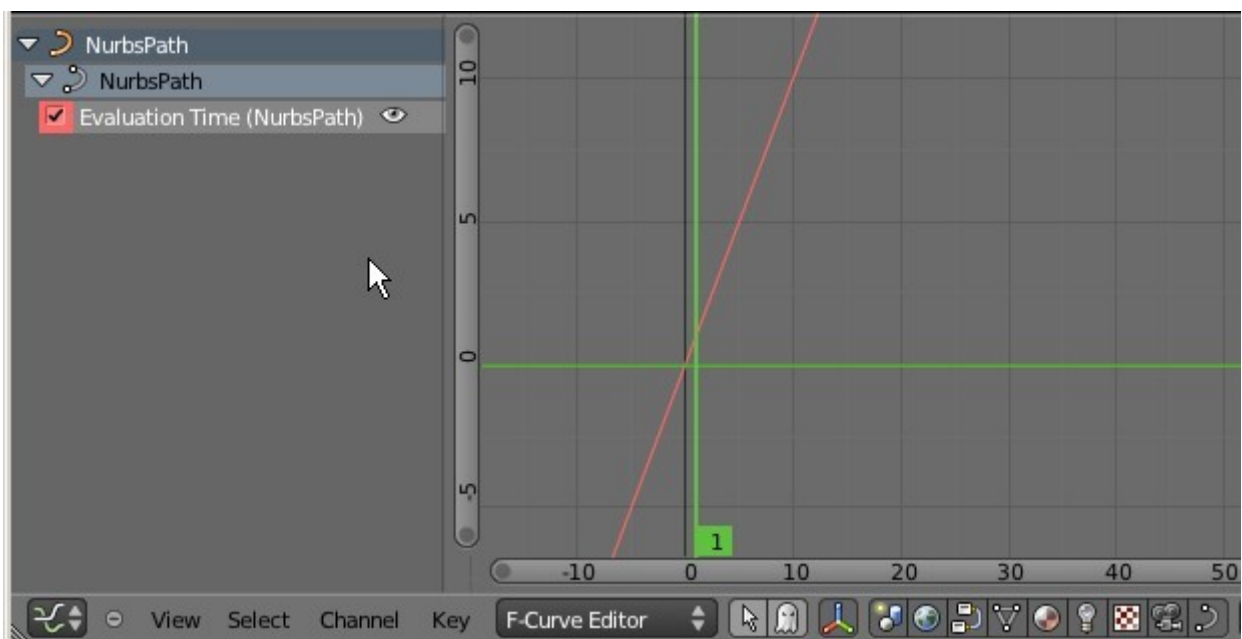

Note: In the Graph Editor Window the movement of the Cube is drawn as a red line inclined rather steeply. Since the line is straight it shows that the Cube moves with constant velocity (Speed) along the Path. The scale along the bottom of the window shows frames of the animation and the vertical scale on the LHS shows displacement (how far the object moves). The displacement from one frame to the next is always the same, hence constant velocity (speed). There is no acceleration or deceleration as would be the case if you had used Keyframes.

OK! if your object was a school bus full of kids instead of a Cube you wouldn't want the bus to take off at one hundred miles (kilometres) an hour and finish up with everyone crammed into the back seat. Maybe you have decided that you want to move in something other than a straight line. Maybe there was a little old lady in front of the bus. My point is, the speed, acceleration and direction of movement may have to be modified.

The direction of movement is modified by altering the shape of the Path in the 3D window. The variation in velocity (speed) and acceleration are altered in the Graph Editor window.

We will first alter the direction of movement by reshaping the Curve Path.

In the 3D window select the Path (Right click on the path). Tab (press the Tab Key) to put the Path into Edit mode.

Remember, in the beginning of this section we scaled the Path to make it longer while it was in Object mode. You can do the same thing in Edit mode. Just press the S Key and drag the mouse or if you know how many times longer you want the Path to be press the S Key followed by a number Key (Number Key at the top of the keyboard not a Num Pad Key).

Note that increasing the length of the Path does not increase the length of the animation. You still have 100 frames in the animation therefore when running the animation at 25 frames per second your object will move along the Path in four seconds. If you made the Path twice as long the object would move on the screen twice as fast. Another way to change the speed is to alter the number of frames in the animation in the Properties window – Object data button - Path Animation tab. If you increase the number of frames to 200 it will take the object twice as long to move along the same path length.

Controlling the speed of the object can also be done in the Graph Editor window but we will come back to that in a moment.
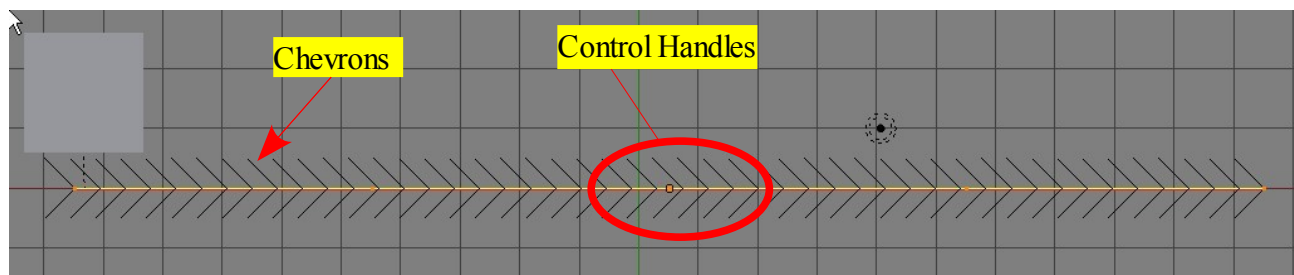
Note: With the Path selected in Edit mode, there are black chevrons along the Path and several orange dots . The chevrons indicate the direction of motion and velocity. In this case they are evenly spaced indicating constant velocity. The orange dots are

control handles for shaping the Path. There is one at each end and others in between the ends. By default when you enter Edit mode all the control points are selected. Press the A Key to deselect them, then right click on one point to select it alone.
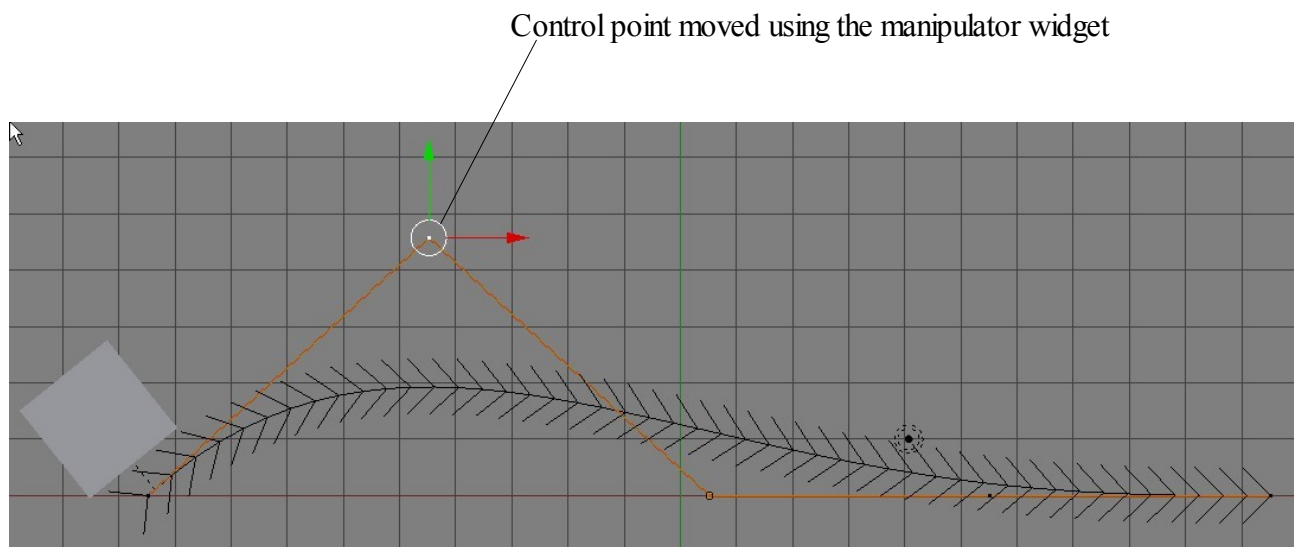
If you have the manipulation widget turned on the widget will be located at the selected control point. If you click on the widget handles (With the widget in Translate Manipulator mode) and drag the mouse, the control point will be moved and the shape of the path will be altered. You can select any of the control points and reshape the path in this way. Selecting an end control point and pressing the E Key then dragging the mouse will extrude the end of the Path.

You can go into front side view or end view and reshape the Path in three dimensions creating any shape you wish.

After reshaping the Path press Alt + A Key to see the Cube move along the Path. For the Cube to follow the path with its axis aligned to the Path you must have 'Follow' ticked in the Properties window – Path Animation Tab .

Shaping the Path gets the Cube moving around in the scene but it moves along the Path at a constant speed. In real life, if the Cube came to a sharp corner without slowing down it undoubtedly would suffer an accident. To create a realistic movement we need to vary the speed.

Varying the speed is performed in the Graph Editor window.

It helps at this stage if you have both the Graph Editor window and the 3D Window displayed at the same time. Divide the 3D Window in two horizontally and change one half to the Graph Editor window.

You will probably have to zoom in on the Graph Editor Window and pan the window

into position. At this point all we have is the red line showing a constant velocity (speed) and unfortunately the line is uneditable. The horizontal and vertical green lines are cursor lines. The vertical line is a cursor for positioning along the horizontal timeline measured in frames of the animation. The horizontal line positions on the vertical displacement scale measured in Blender units.

On the LHS of the Graph Editor you will see the Dope Sheet panel. Having the Path selected in the 3D Window the Dope Sheet shows information associated with the Path (The NurbsPath). Click on the lower white arrow (triangle) at the LHS of the panel. A channel will display labelled 'Evaluation Time (NurbsPath)'. Clicking on the tick box at the LHS of the channel toggles the display of the red line on/off. Clicking on the little eye icon at the RHS of the channel toggles selection/deselection of the channel.

The channel in the Dope Sheet panel is a graphical representation of information associated with the display in the 'Evaluation Time' button in the Properties widow – Object data button – Path Animation tab (the green bar). The same information is displayed as the red line in the Graph Editor window.

OK! so what is this Evaluation Time business?

Let's "evaluate" what we have at this stage. In the 3D Window we have a Cube object parented to Curve Path. Blender has set the Cube to traverses the Path in 100 frames of the animation. This happens to be the first 100 frames of the animation.

In the Timeline Window at the bottom of the screen the total animation is set at 250 frames starting at frame number 1 and ending at frame number 250.
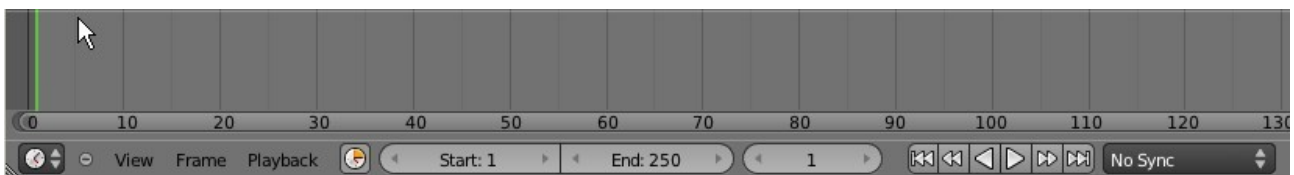

Playing the animation shows the Cube moving along the Path starting at frame 1 and reaching the end of the path at frame 100. The animation continues to play on to frame 250.

In the Properties Window – Object data button – Path Animation tab (with the Path selected in the 3D Window) 'Frames: 100' = The number of frames to traverse the Path. 'Evaluation Time: 1.000' = Where the Cube is located on the Path at frame 1.

Increasing the 'Evaluation Time' value moves the Cube along the Path. Increasing the value to 100, places the Cube at the end of the Path.

Note: At frame 1 the Cube is not located exactly at the end of the Path. It is in fact positioned one, one hundredth of the path length from the end. The animation starts at frame 1 not from zero. You see this shown where the dotted line between the Cube and the Path is attached. Obviously you can't have zero frames or you wouldn't have an animation.
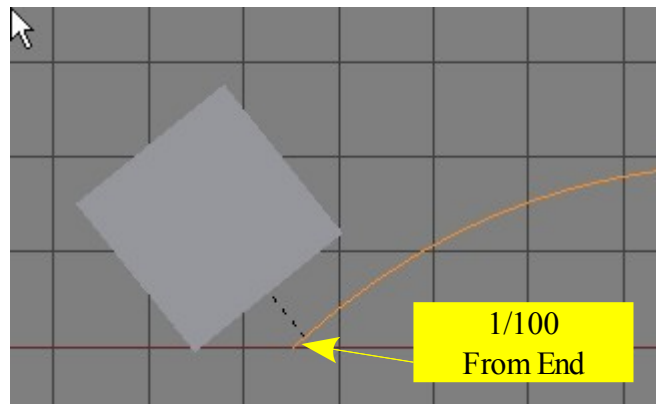

You may consider that the 'Evaluation Time' is saying, "This is what our Cube is doing at this position". We are only considering location here but if the Cube were animated to change scale, rotate or change color its state would be evaluated at whatever position was selected. The Evaluation Time value is a percentage of Path length.

We were considering how to change the velocity (speed) of the Cube as it moved along the Path. Let's get back to it.

We have established that the 'Evaluation Time' data can not be modified. We will therefore remove it.

With the Evaluation Time channel selected (highlighted in white) in the Dope Sheet panel of the Graph Editor, place the mouse cursor in the panel and press the X Key. The channel and the red line are deleted. If the animation is played the Cube does not move.
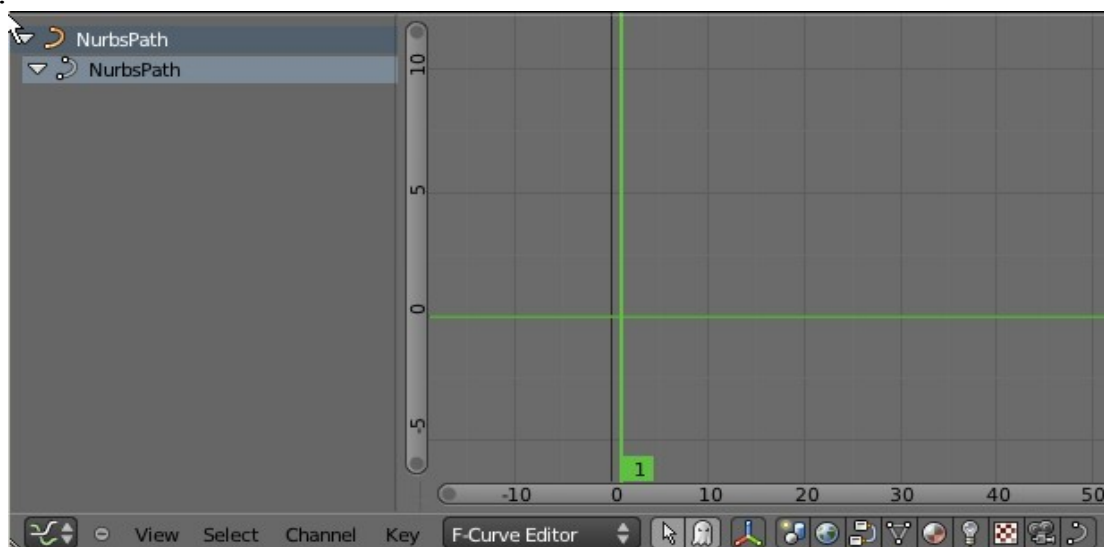
The Cube remains parented to the Path but there is no longer an animation associated with it.

We will now set up a new animation.

In the Timeline Window make sure the cursor (green line) is located at frame 1 and that the Cube is at the start of the Path in the 3D Window. With the Path selected in the 3D Window go to the Properties Window – Object data button – Path Animation tab and set the Evaluation Time button value to 0.000. Right click on the 'Evaluation Time' button and select 'Insert Keyframe' from the drop down menu that displays. (Right click on the button a second time if the 'Insert Keyframe' fails to display the first time. The first time I click on the button I get an option to align the tabs in the window.)
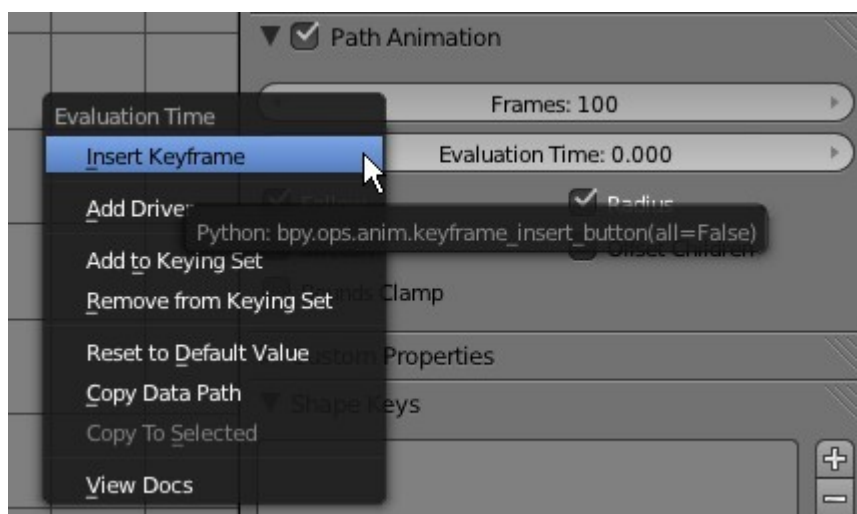

The Evaluation Time button becomes shaded yellow and an 'Evaluation Time (NurbsPath)' channel is entered in the Dope Sheet panel. A horizontal red line is drawn in the Graph Editor window with a dot under the vertical green line (cursor).
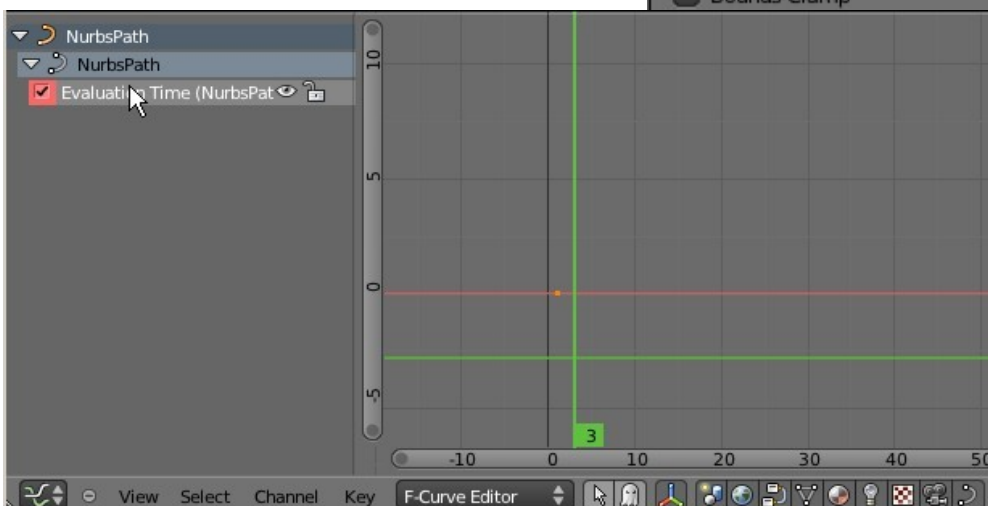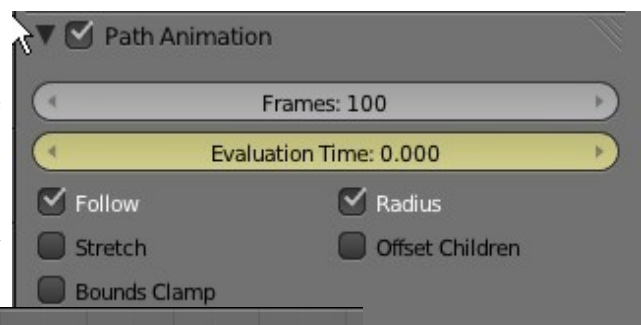

The red line is an animation curve and the dot is a Keyframe at frame 1.

In the Timeline Window move the cursor to frame 150. We will make the Cube move along the Path in 150 frames. Change the Evaluation Time value to 100 to place the Cube at the end of the Path. We now have the Cube at the end of the Path at frame 150. Right click on the Evaluation Time button and insert another Keyframe. Zoom in on the Graph editor window and you will see a second Keyframe entered displaced above the first at frame 150. The Keyframes have now have handles attached showing that the animation curve is a Bezier type curve which means it is editable.
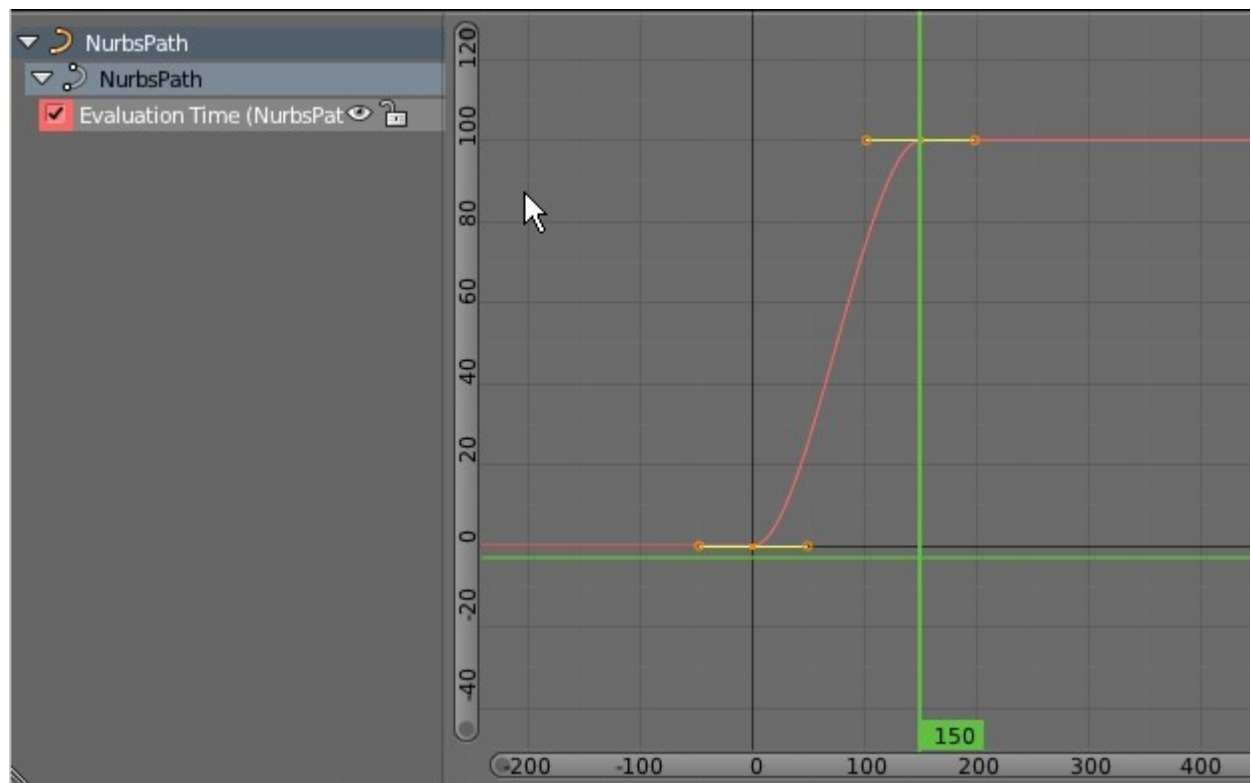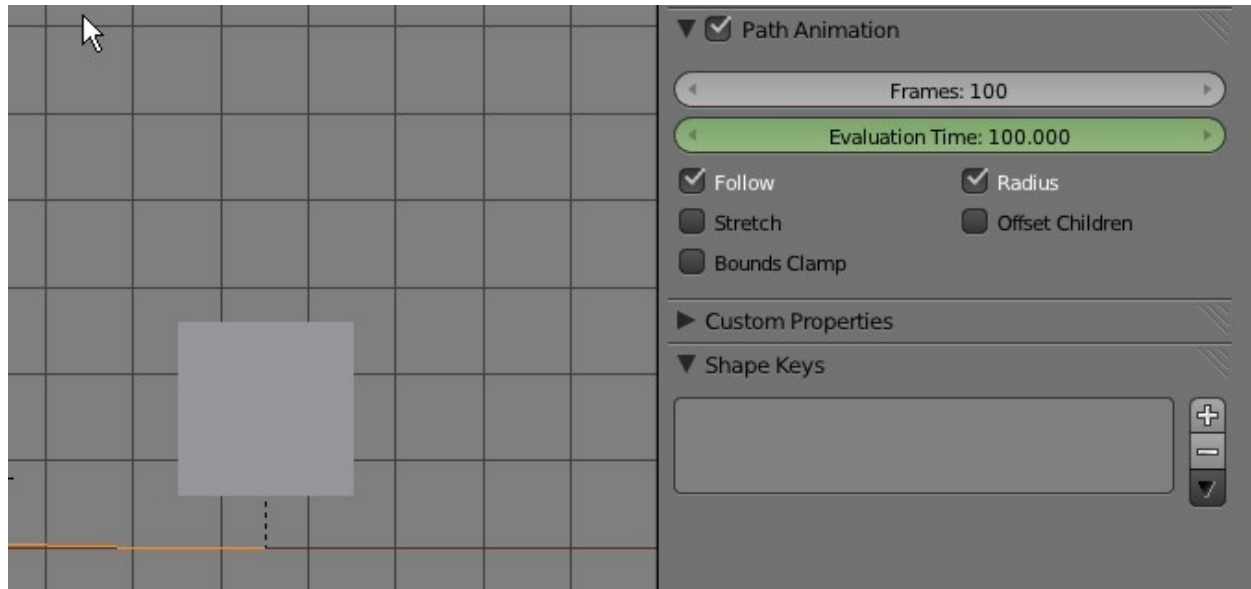
In the Timeline Window return to frame 1 and Press Alt + A Key or press the Play button in the Timeline to play the animation. When the Cube moves along the Path there is acceleration at the start and deceleration at the end.

Timeline Window

Go to Start   Go to End
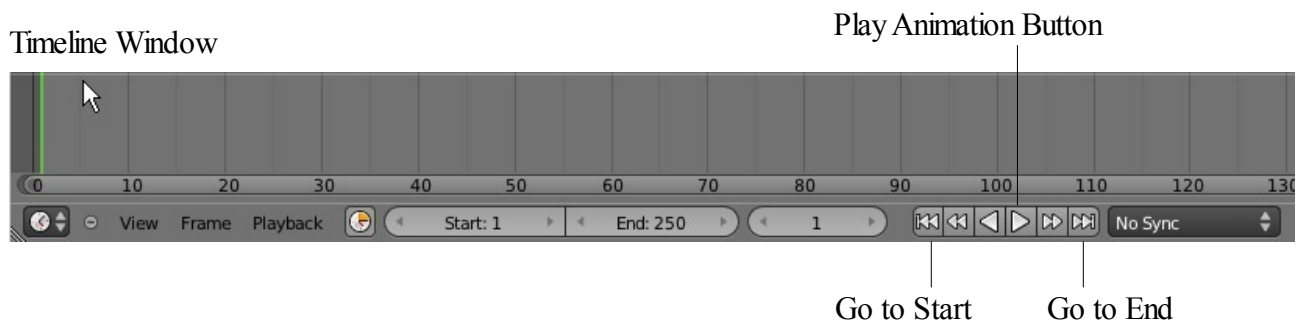
Let's play with the movement of the Cube as it traverses the path.

To alter the movement of the Cube we will edit the animation curve in the Graph Editor window.

To start we will make the Cube take longer to traverse the length of the Path in the 3D Window.

With the mouse cursor in the Graph Editor window press A Key to deselect the animation curve then Right click on the Keyframe handle at frame 150 (the upper handle). Press G Key and move the mouse dragging the handle to the right to frame 400. We have told the Cube to move along the Path in 400 frames instead of 150 frames. Play the animation to see the Cube crawl along.

Whoops! The Cube doesn't reach the end of the Path.

In the Timeline Window the End frame of the animation is still set at 250 so the animation replays after 250 frames. The Cube never reaches the end of the Path.
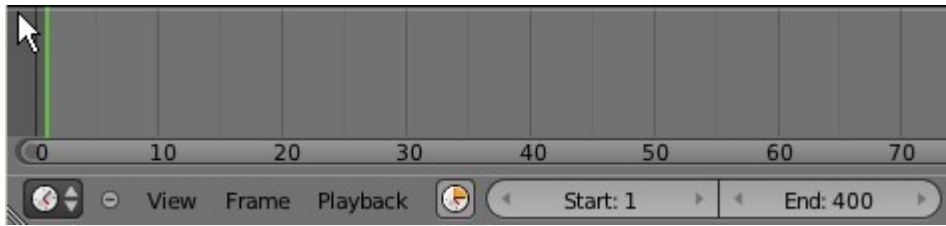
In the Timeline window change the 'End' value to 400. Replay. Now we're right (Aussie slang for OK).

Since the animation curve in the Graph Editor Window is a Bezier type curve we can add handles to it to further refine movement.

Press Ctrl and LMB click on the curve to add a handle. Add another handle and then press G Key (Grab) and position the handles approximately as shown in the diagram.

When the animation is replayed the Cube moves along the Path then reverses before continuing on to the end. If the animation curve were horizontal between the two intermediate handles the Cube would simply stop for a rest along the way.

By playing with the animation curve in the Graph Editor and changing the shape of the Path in the 3D Window you have full control over the movement of the Cube in the 3D Window.

Now you will hate me. ???

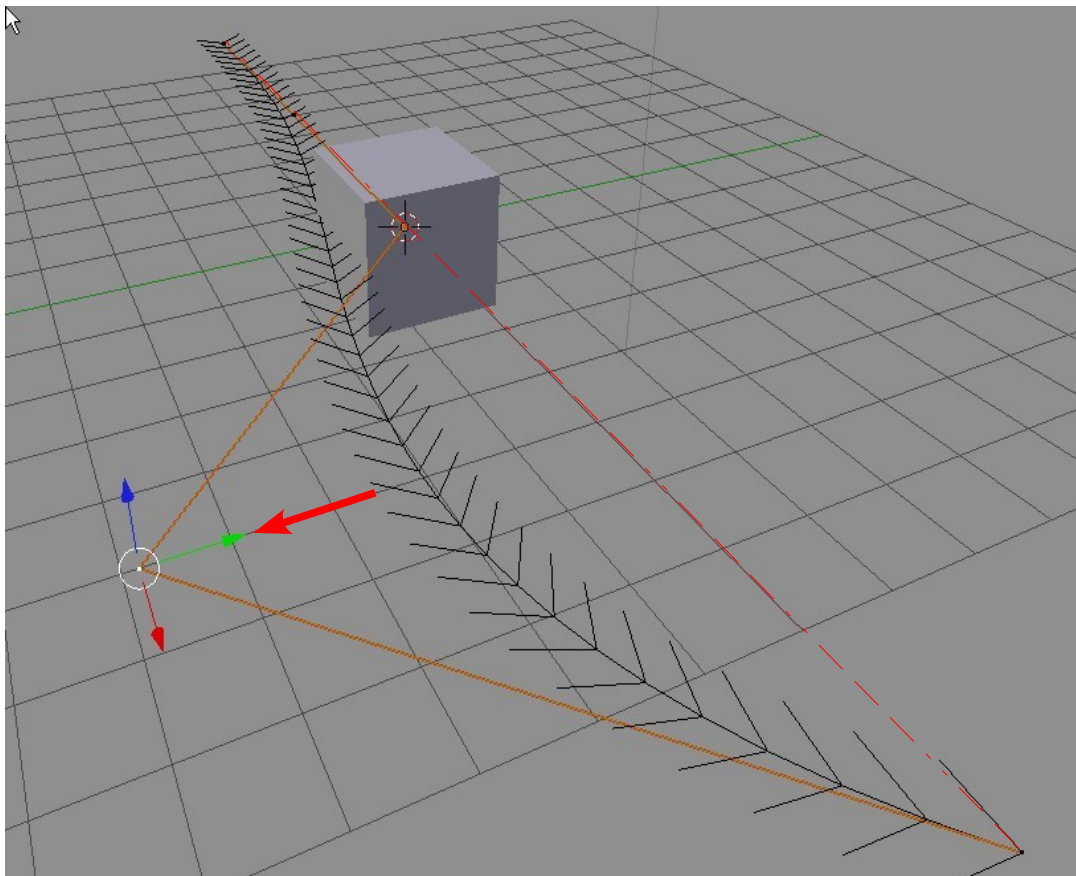**Follow Path – Follow Path Constraint Method**

The foregoing tutorial involving the Child Parent relationship is akin to following the long and winding road. Now take the shortcut but remember that shortcuts miss out on the the detail of the journey.

We will now have the same Cube object follow the same Path but immediately have an editable Bezier curve instated in the Graph Editor Window.

Start with the default scene with the default Cube object. Leave the 3D Window in user perspective view (The default view when Blender opens).

Deselect the Cube and add a Curve Path as previously described. Scale the length of the Path x5.

With the Path selected Tab into Edit mode and using the handles on the curve shape the Path as shown in the diagram.
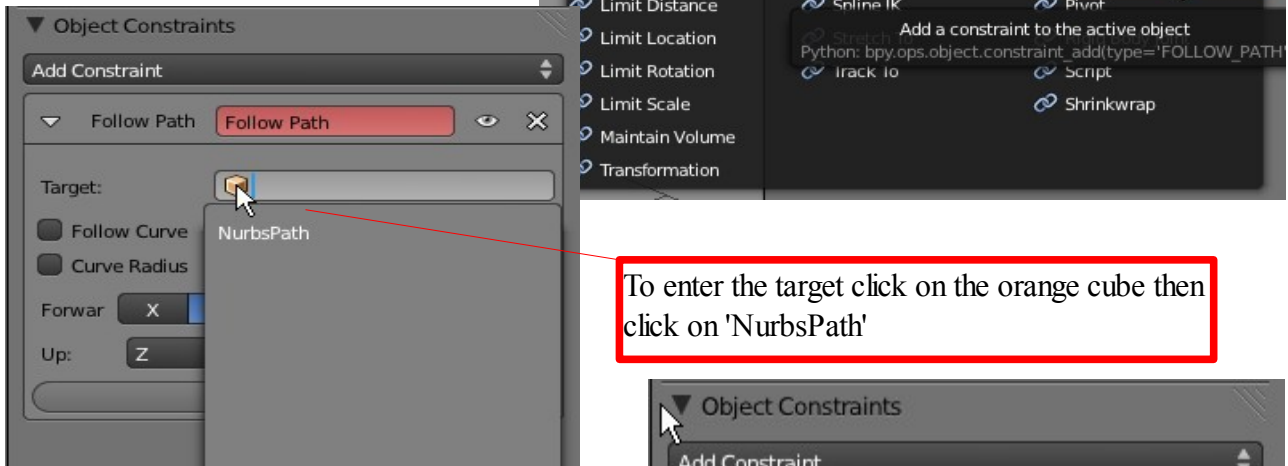
Deselect the Path and select the Cube.

In the Properties Window – Constraints button click on 'Add Constraint' and select 'Follow Path' from the selection menu.
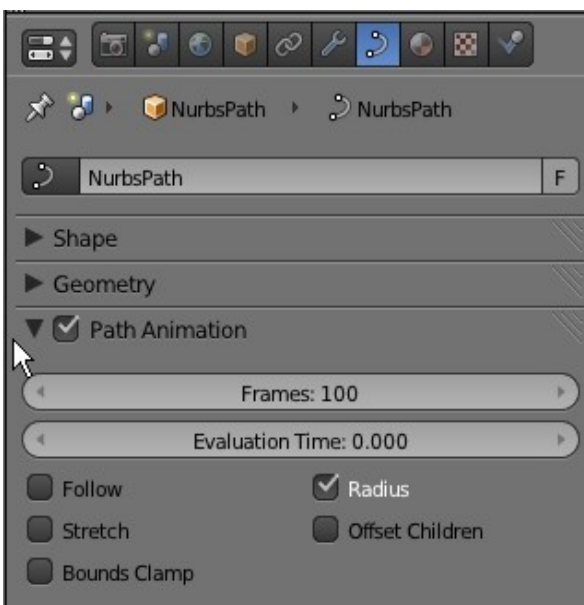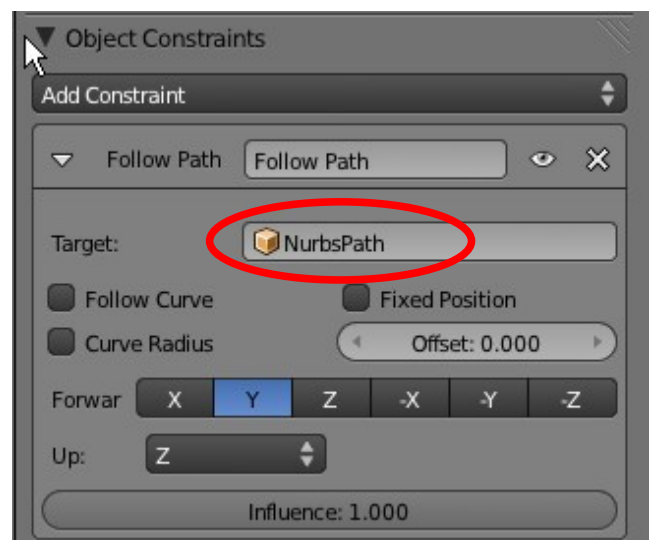
In the Constraint tab that opens enter the target as ' Nurbs Path' and tick 'Follow Path'.

To enter the target click on the orange cube then click on 'NurbsPath'

The Cube is positioned at the start of the Path.

Deselect the Cube.

Select the Path then in the Properties Window - Object data button – Path Animation tab note 'Frames: 100' and 'Evaluation Time: 0.000'.

This says that there is a 100 frame animation with 0.000 being the start position.

Right click on the 'Evaluation Time' button and select 'Insert Keyframe'.

Note in the Timeline Window the 'Start:1' and 'End:250' values which indicate the animation duration i.e. 250 frames.

Click on the 'Go to End' button in the

Timeline Window to locate the Timeline cursor at frame 250.

In the Path Animation tab change the 'Evaluation Time' value to 100 which positions the Cube at the end of the Path in the 3D Window.
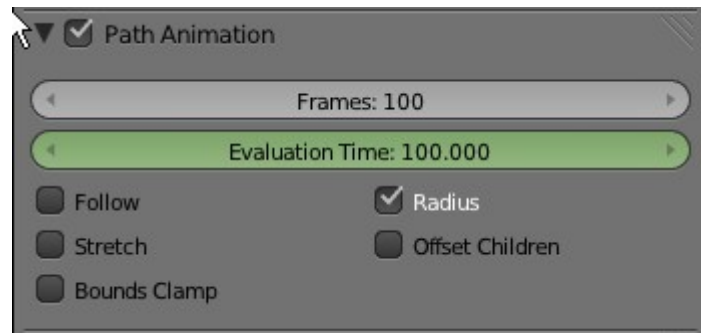
Right click on the 'Evaluation Time' button and select 'Insert Keyframe'.

In the Timeline Window click on the 'Return to Start' button to go to the start of the animation.

Click 'Play' to see the Cube move in the 3D Window following the Path.
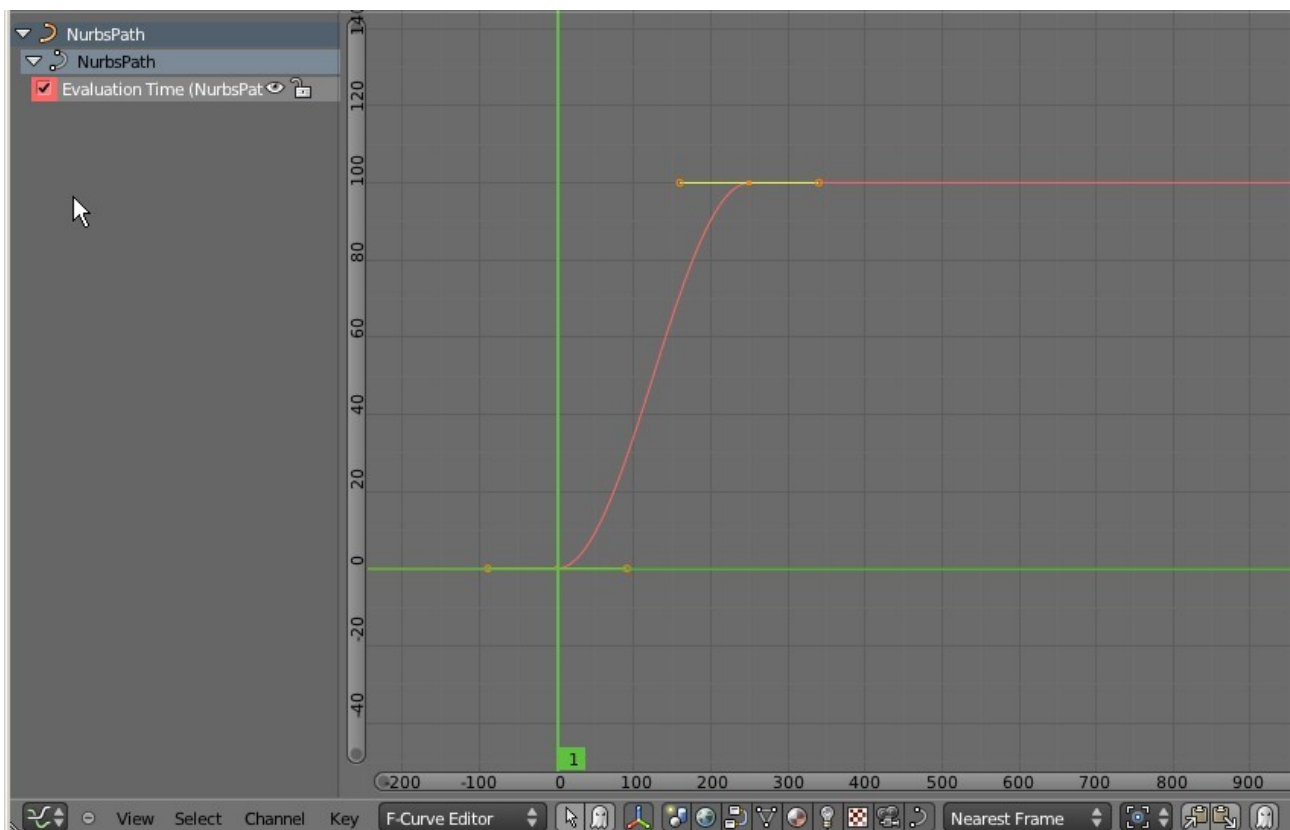
In the Graph Editor Window you have an animation curve which is the editable Bezier type as discussed in the previous method.

CH12- 3D Text

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3D Text

3D Text can be considered a very important element to add into a scene. Think of all the television advertisements that contain text and how it is animated. There are two ways of adding text to a scene in blender. One way is to use the inbuilt text generator and the other is to use an external program to generate the text. Text made in Blender can be easily edited in the Properties Window. Text made in an external program like **Elefont** may give you additional options and different fonts.

Creating 3D text in Blender

To create text in Blender put your scene into top view orthographic projection (Num Pad 7 then Num Pad 5). Text is entered into the scene in the top view. Locate the cursor at the point in the scene where you want your text to go. Press 'Shift + A' and select 'Add Text'.
The word 'Text' displays in the 3D Window in Object mode.
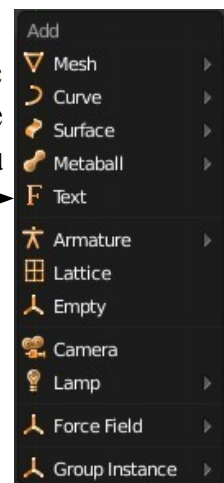
Object Mode

Edit Mode   Typing Curser

Tab into Edit mode. The word 'Text' will now have a typing cursor at the end of the word. You can now backspace to delete letters and type in your own words just like in a text editor. Don't worry about the Font style or size at this stage. When you have typed in the words you want, tab into Object mode. This is where you shape and color the text.
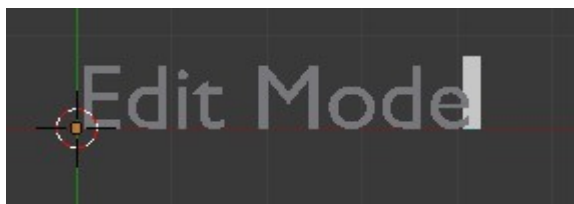
The word 'Text' deleted and 'Edit Mode'
typed in its place

Tab to Object Mode

Before you do any shaping or coloring you can move, rotate and scale just like any Object in Blender.

Changing the text into something interesting is done in the Properties Window.

Select the text in the 3D Window then go to the Properties Window – Object data buttons.

Properties Window – Object data

Width, extrude and bevel depth sliders control exactly what they say.
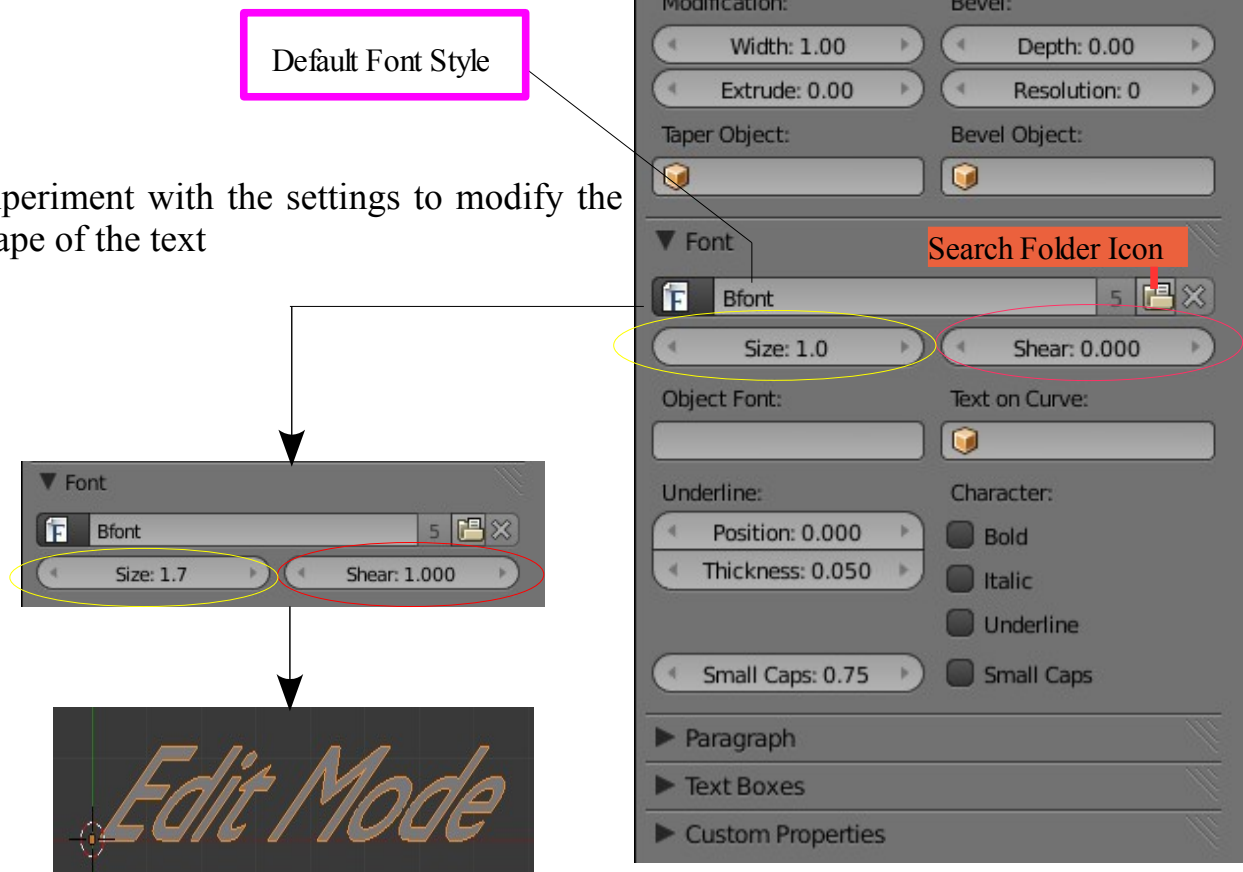
        Width: The text width.
        Extrude: Extrudes text to a 3D shape.
        Depth: Bevel size.

Default Font Style

Experiment with the settings to modify the shape of the text

Search Folder Icon

The default Font Style is entered as Bfont. You can change this to whatever Font Styles you have on your system. If you are using a Windows operating system you can find Font Styles in the Windows Fonts folder. (C:/ Windows /Fonts). To change the Font style click on the **Search Folder Icon** and in the search window navigate to your Fonts folder and select a different Font. Blender will accept any of the Windows fonts but some may be distorted when they are extruded into 3D shapes.

In the Fonts tab, the Underline Position and Thickness values only operate when 'Underline' is ticked under Character: Underlining occurs as you type your text in Edit mode.

Creating Text on a Curve

Text in Blender can be made to follow the shape of a **Curved Path**. Begin by adding text to your scene as previously described then when it is in Object mode deselect it **. A Key.**
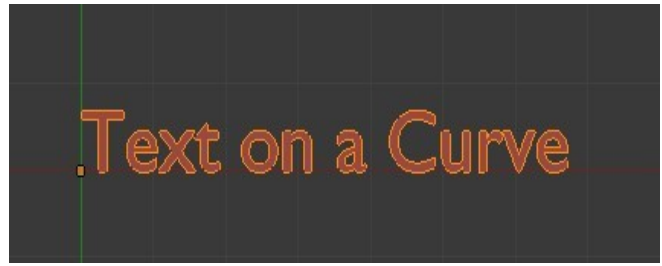
Add a curved path to the scene. **Shift + A – Curve – Path.** Note that by default the Path is named 'Curve'. The curve path is added to the scene in Object mode and appears as a straight line. You can scale it to make it longer and reposition it in Object mode but you will have to Tab to edit mode to extrude or shape it into a curve. With the curve shaped to whatever you want Tab back to Object mode and deselect it.
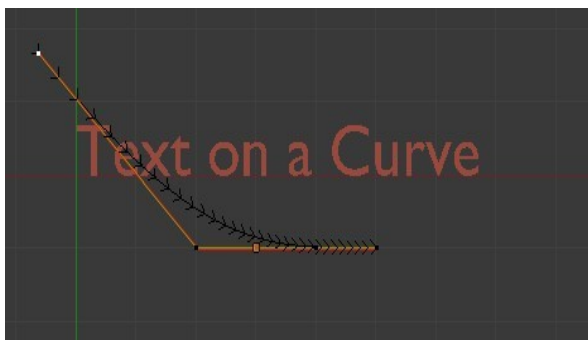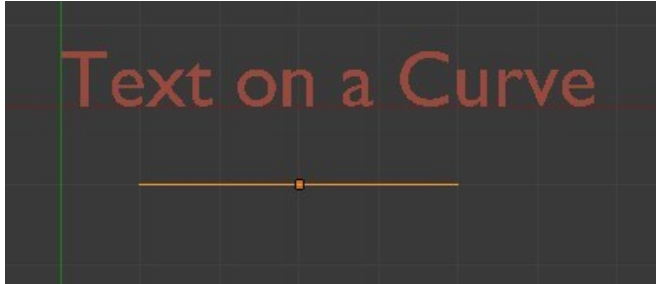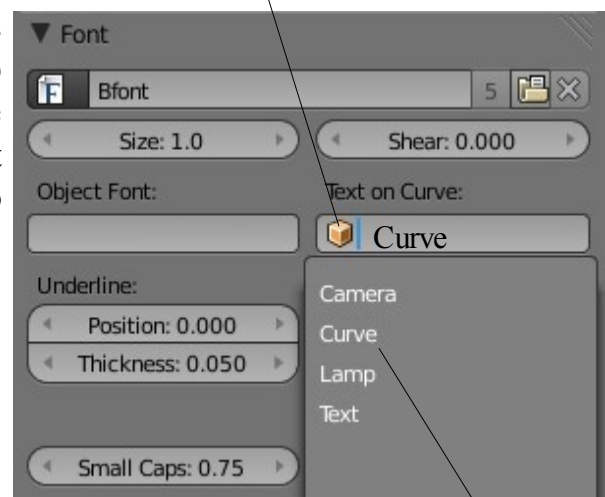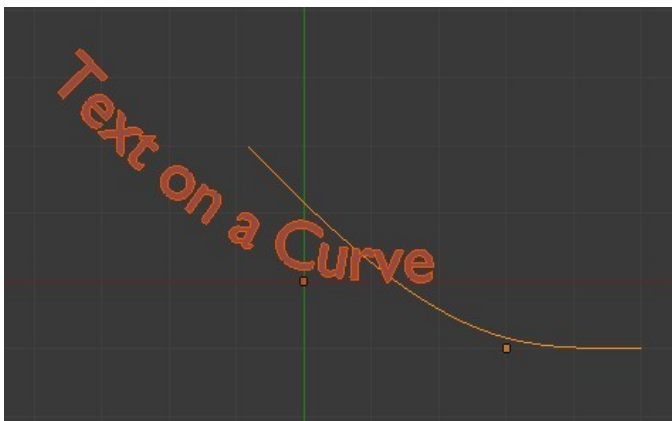
Edit Mode
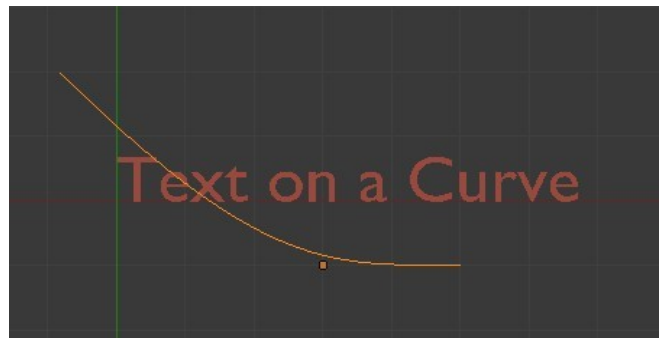
Object Mode

Click on Cube icon

Select the text Object. In the Properties Window – Object data buttons – Font tab find the 'Text on Curve' panel. Click on the little cube icon and in the drop down that displays select 'Curve'. The text is shaped to follow the profile of the curve.
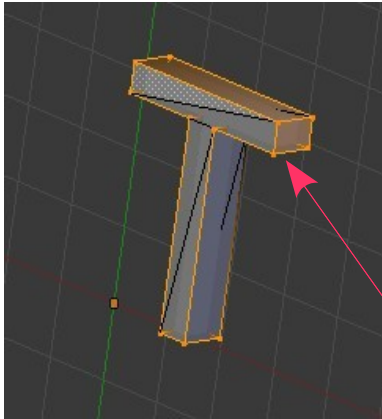
Select 'Curve'

Converting Text to a Mesh Object

There is only limited functionality in the text Object data buttons geometry tab for modifying the text shape. Unless you have extruded the text it remains a two dimensional plane object. Entering edit mode only allows you to retype a text change. To perform editing which actually

changes the shape of the text you have to convert to a Mesh object. To do this select the Text in Object mode then press **Alt + C** and in the drop down menu that displays select ' **Mesh from Curve/Meta/Surf/Text**'. Tab to Edit mode and you will see that the text is now a mesh object with vertices that can be moved, rotated and scaled.
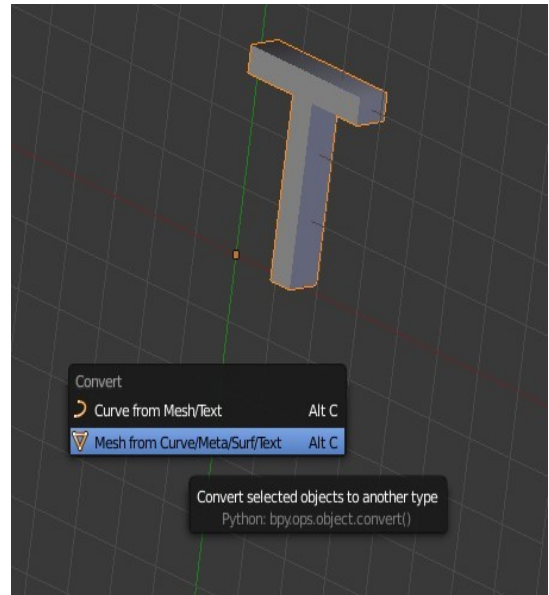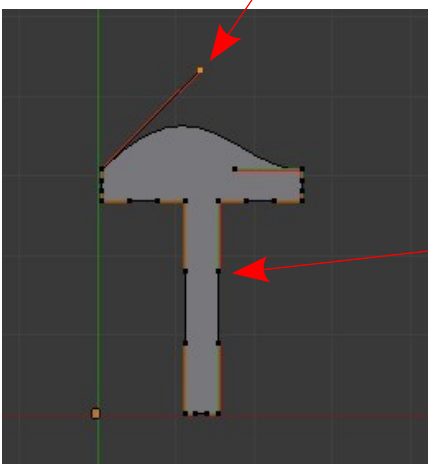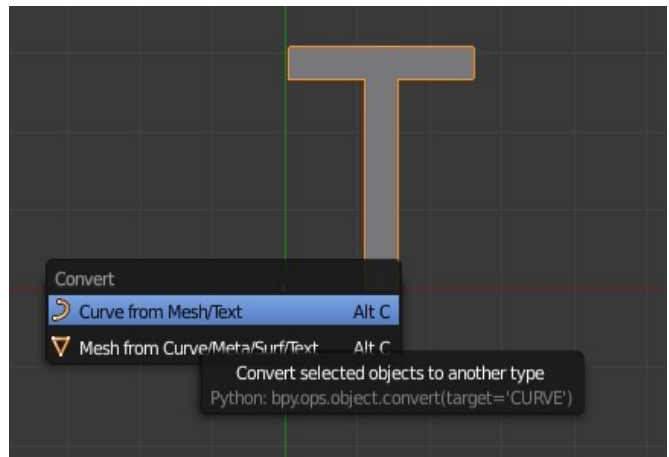
Edit Mode

Converting Text to a Curve

If you would like to perform some fancy editing of a single letter you can convert the letter (Text) into a curve. The outline of the letter becomes a curve with handles which allow you to manipulate the shape into anything you wish.
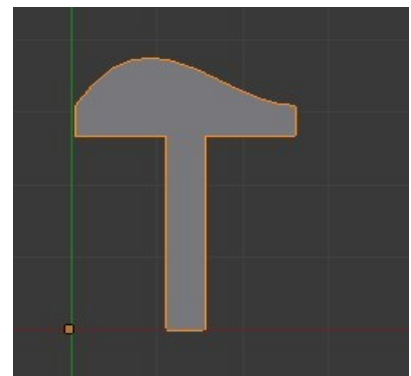

Drag Handle

Add Text then in edit mode delete and retype your letter. Scale it up, rotate and move it where you like then Tab to Object mode. Press **Alt + C** and select **'Curve from Mesh/Text'**. Now in Edit mode you will see the outline of your letter as a curve with manipulating handles.
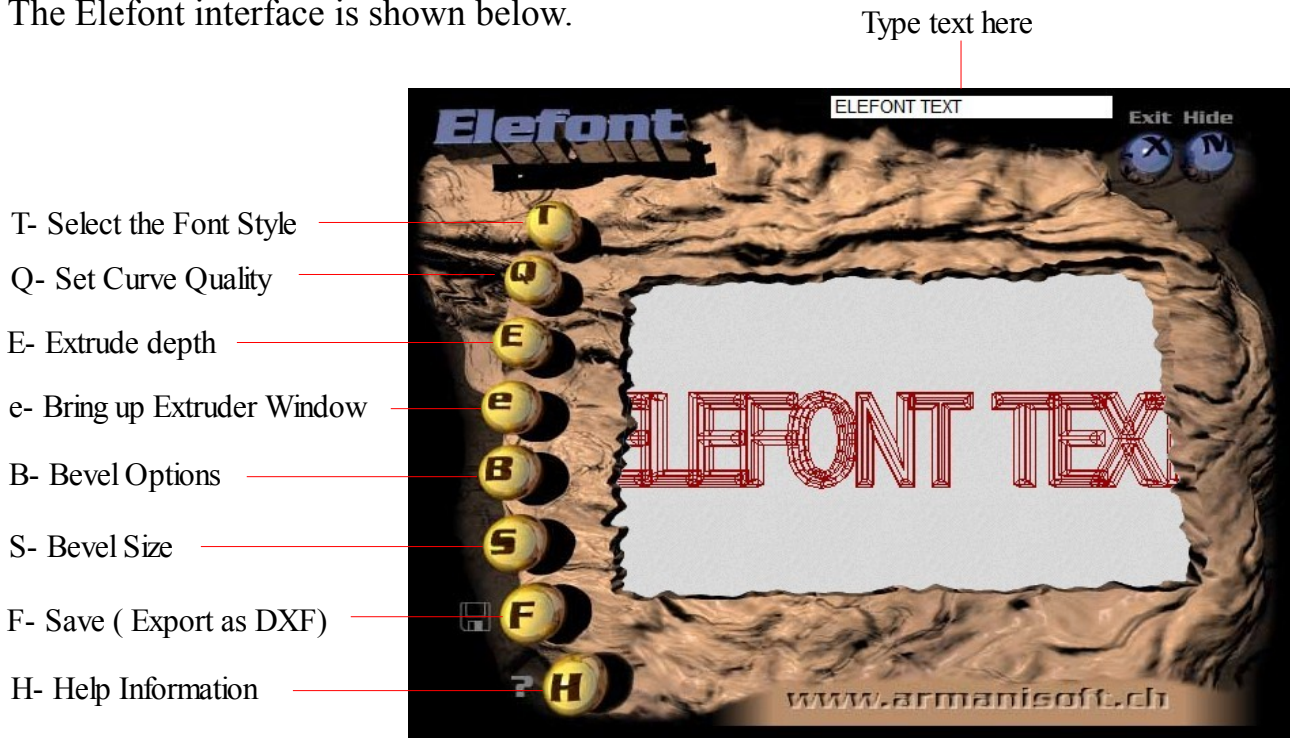
Edit Mode

Object Mode

Elefont 3D Text

Text can be created in an external 3D Text Editor and imported into Blender. A popular program to use is the freeware program **Elefont** available at www.armanisoft.ch. This is a simple to use program that saves the file in a .DXF format. Any program that exports 3D text as .DXF or VRML(.wrl) will work.

The Elefont interface is shown below.

After you have created your text in Elefont save the .dxf file and make note of where you saved it. Open Blender and go into Top View in the 3D Window. In the information Window header click on 'File' then 'Open'. The blender File Browser Window will open. Navigate to the folder where you saved your file. Note: By default Blender does not display all files in the Browser Window. Go to the header at the top of the window and click on '**Enable Filtering**'. This will display all the files in any folder.
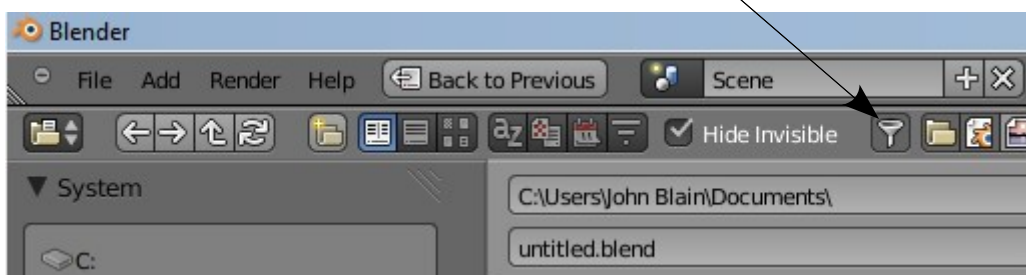

Click on your .dxf file and then click on '**Open Blender File**' (Upper LH Side of window). Your text will be displayed in the Blender 3D Window but **note each letter is a separate Object.**
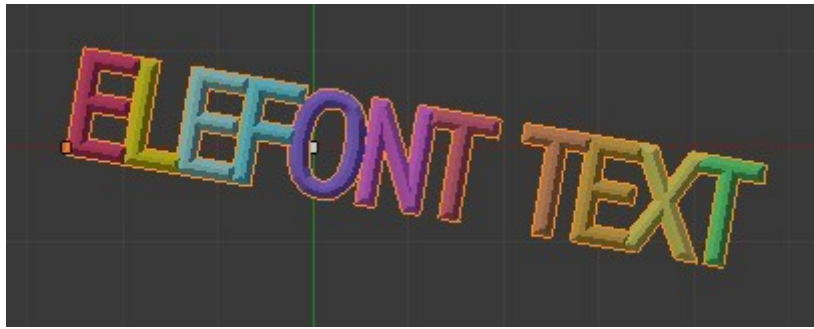
Object Mode Letters Joined

Since each letter is a separate object you can apply a different material color to each letter. To join all the letters into a single object, shift select all the letters then press 'Join' in the Tool Shelf (Alternative Ctrl + J).

Tab to edit mode to see the mesh object.
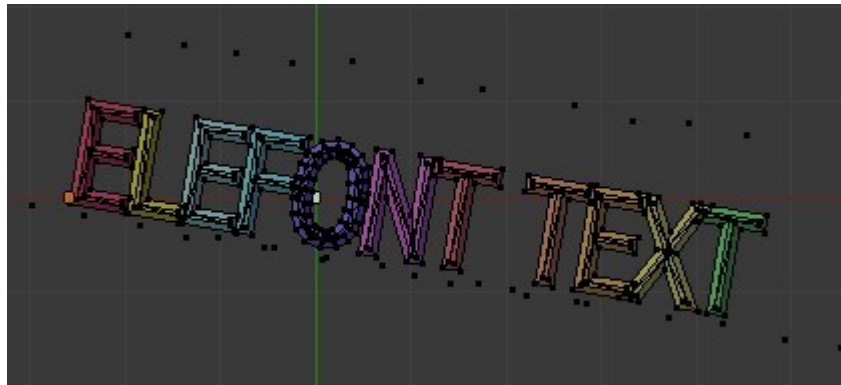
Edit Mode showing Mesh

The text can now be edited as a single object and made to follow the profile of a curve by adding a Modifier to the Text Object. Modifiers will be discussed later.
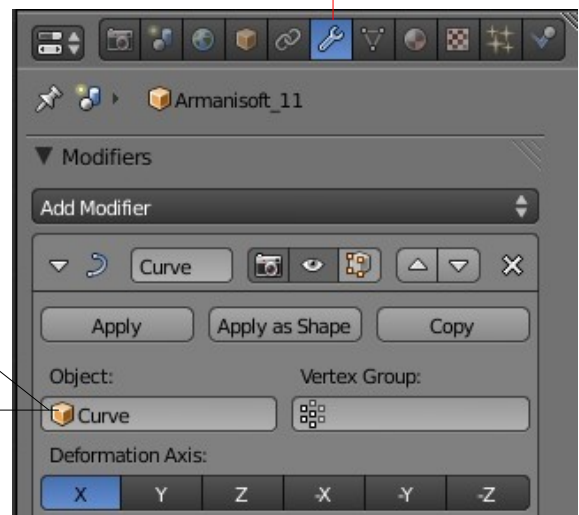

Modifier Applied to Text Object
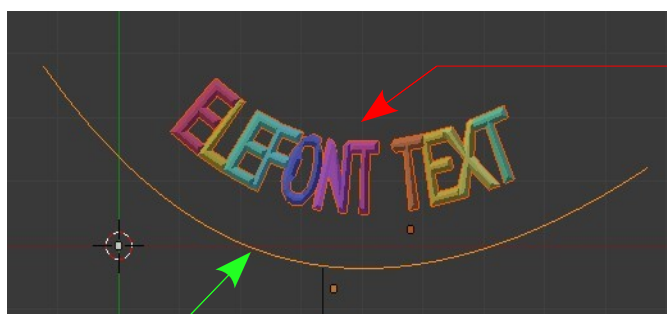
Curve Path
Named Curve

Click on Cube Icon
select curve

Curve Path Deformed

CH13- Nurbs and Metashap

01-Using Nurbs

02-Creating a Lofted Tunnel

**03-Meta Shapes**

Return to Contents

Nurbs

When you press the 'Shift + A' and select ' Add', you will notice other object types beside meshes, cameras and lights that can be created. One type of object that can be created is Surface (NURBS).

Using NURBS

If you look at the Surface menu, you will see a variety of shapes that can be created. These shapes can be used as they are or converted to meshes so you can work with vertices. To get you started and give you the idea how this is achieved follow the procedure outlined below.

Start a new scene in Blender and delete the default cube. Place the scene in top view (Num Pad 7). Add a Nurbs Circle (Shift + A Key – Add – Surface – NURBS Circle). The NURBS Circle will be displayed in the scene in Object mode.
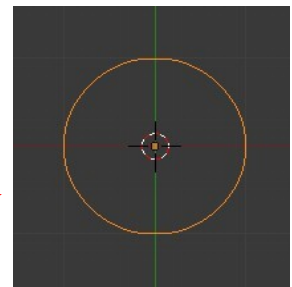
Tab to Edit mode and you will see the circle surrounded by manipulation handles which by default are all selected. Deselect the handles (A Key). Right click on a handle to select it. If you have the manipulation widget turned on you can use it to **move the handle and deform the circle**. Alternatively G Key and drag the mouse.
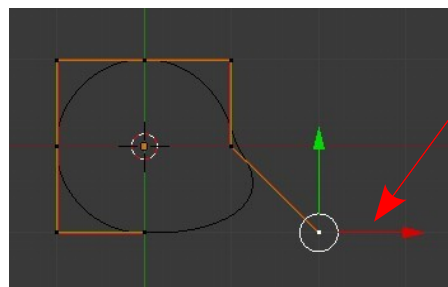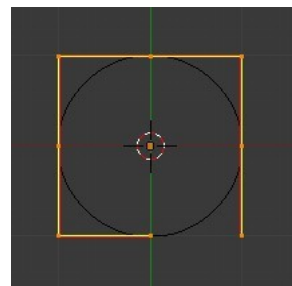
Widget
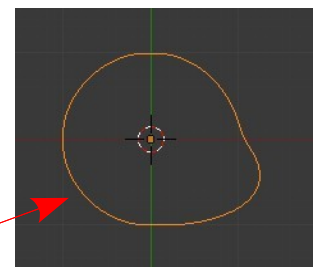
Tab into Object mode to see the deformed circle.

The deformation may be what you want or you may wish to further refine the shape. You can do this by converting the NURBS shape (Surface) in to a Mesh object. With the shape selected in Object mode press Alt + C and in the drop down select ' Mesh from Curve/Meta/Surf/Text'. We are converting 'Surf' (Surface) into a Mesh. Obviously this same command is applicable to converting Curve, Meta and Text into a Mesh object.
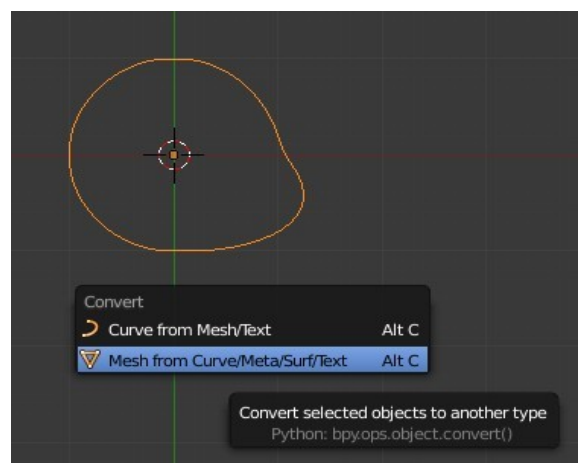
Tab to edit mode and you will see the shape now has vertices applied which you can select and manipulate to further modify the shape. A Key will deselect the vertice you have just moved and A Key again will select all vertices.
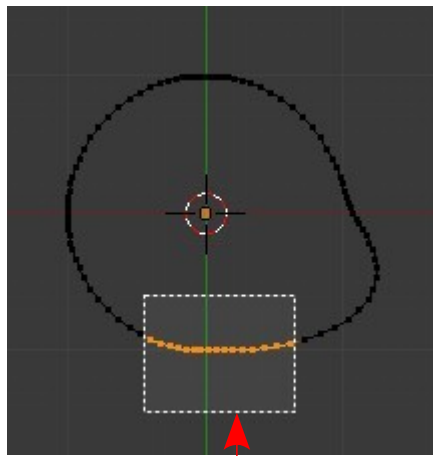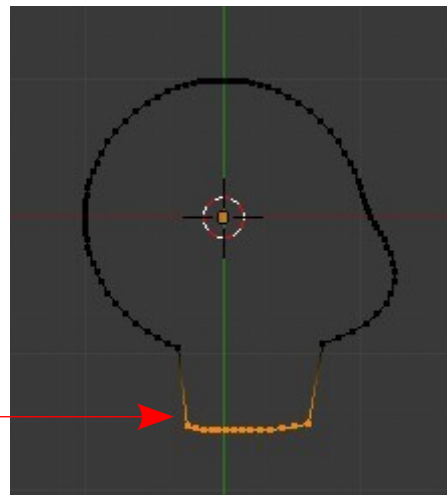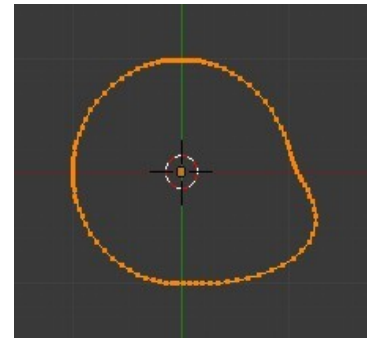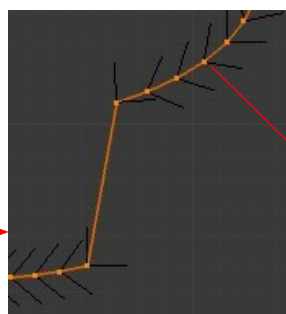
Vertices selected and Moved

Tab to Object mode then Alt + C and this time select 'Curve from Mesh/Text'. This is creating a Mesh Curve object from the Mesh Object. Tab back to edit mode and you now have a Curve Circle object. You can now use the Geometry values in the Properties window – Object data buttons to manipulate the objects shape or select vertices and move them. Since this is a Curve circle it can be used as a path in animating.

Convert
Curve from Mesh/Text   Alt C
Mesh from Curve/Meta/Surf/Text   Alt C
Convert selected objects to another type
Python: bpy.ops.object.convert(target='CURVE')
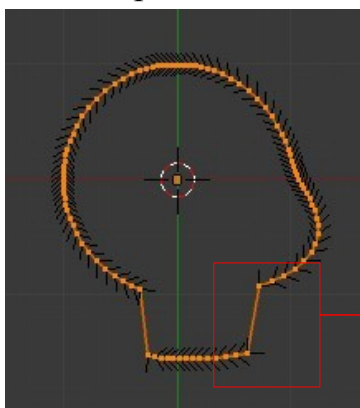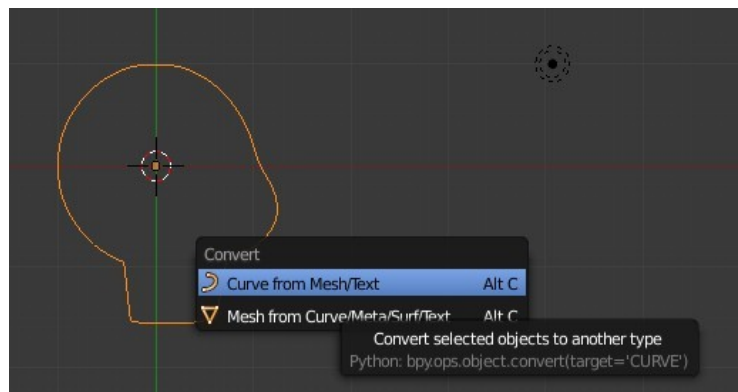
Single Vertice Selected and Moved
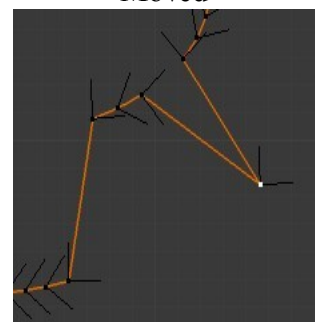
This is simply showing that by converting from one type of object to another gives different options for shape manipulation.

Creating a Lofted Tunnel

This process will take several profiles of a NURBS Circle which are all manipulated to different profiles and connect them together forming a hollow object (Tunnel).

Shift select Circles and Join
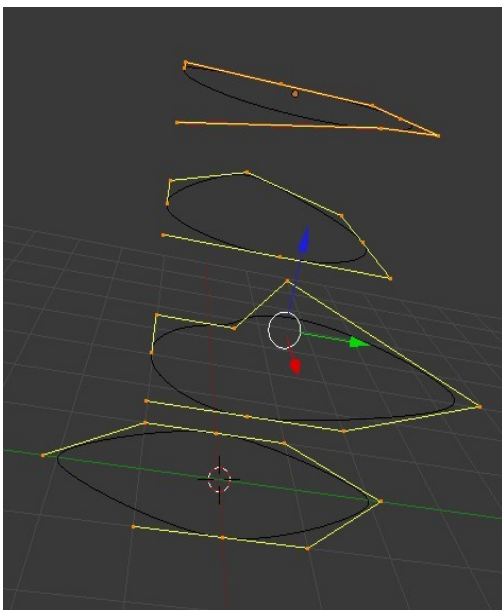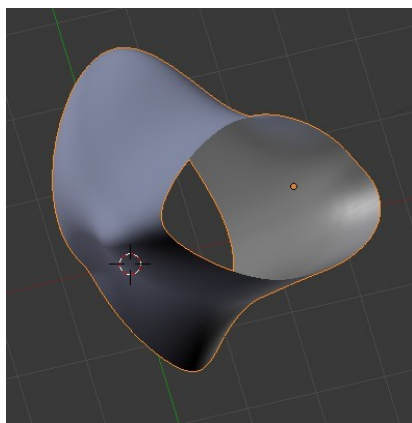
The first thing you need to do is create a NURBS Circle as previously described. The circle is entered in the scene in Object mode. Tab into Edit mode. Select the points and shape the circle a bit. After shaping go back into Obj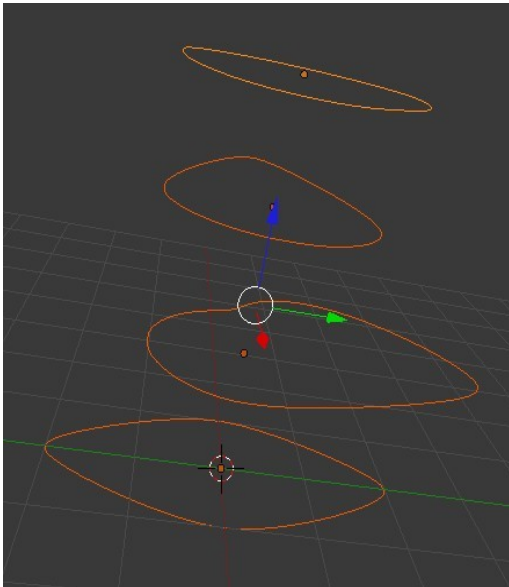ect mode. Change your view so you are looking down on the circle (Top view Num Pad 7). Use the " Shift-D " keys to duplicate the circle several times and position them. Then rotate your view so you can select each circle. In Edit mode edit the shapes . After shaping the circles, exit edit mode and select them all by RMB clicking on them while holding 'Shift'. Join them together, pressing Join in the Tool Shelf. For the final step press Tab for Edit mode then A Key to select all vertices then F Key.

All Vertices selected
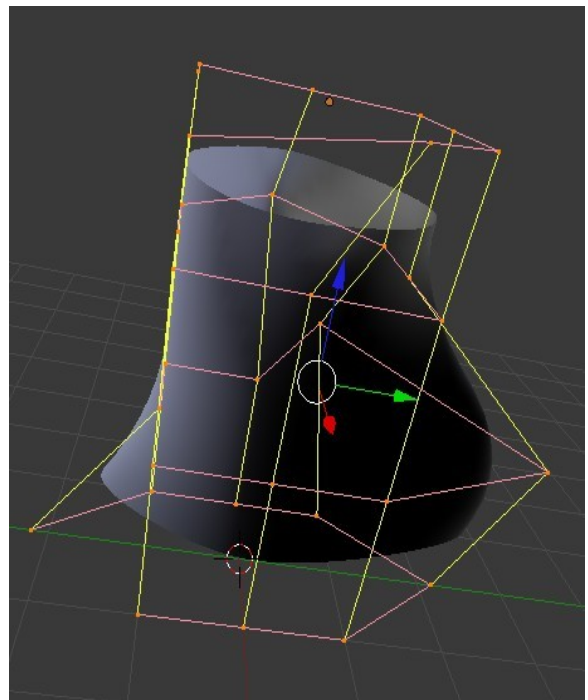
F Key Creates Lofted Shape

Shape Rotated

Meta Shapes

There are several Meta Shapes you can use in Blender. When Meta Shape get close to one another they begin to pull and flow together like droplets of liquid. The shapes can be animated, textured, and reflection and transparency can be applied to create some stunning effects. Meta shapes are added to a scene like any other object.
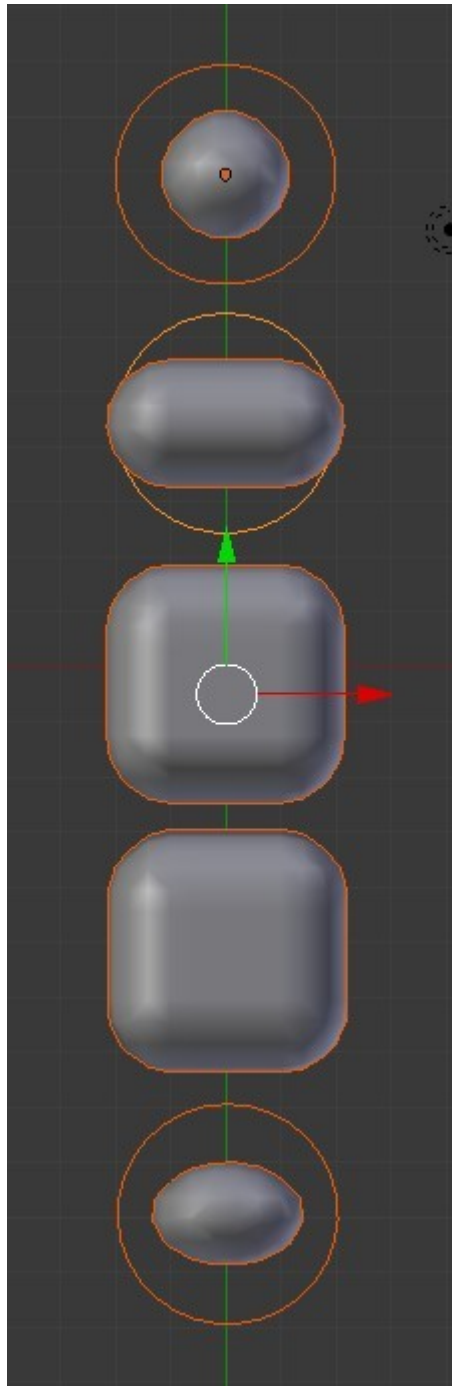
Meta Ball

Meta Tube

Meta Cube

Meta Plane

Meta Ellipsoid

Meta Ball and Meta Tube
In close proximity

Meta Shapes are added to a scene in Object mode. Remember to deselect one shape before adding another otherwise they will be joined.

CH14- Modifiers

Modifiers

Learning Unit
See listing following

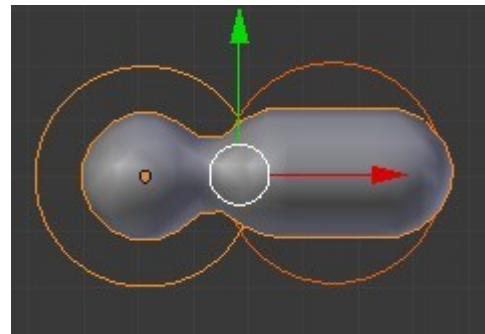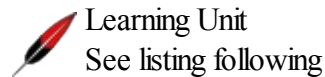A Modifier is defined as the application of a "process or algorithm" upon Objects. In other words once you have created an object in the scene you can apply a neat little (and sometimes not so little) set of data that will change the shape or way the objects behave. The modifiers are designed to take some of the hard work out of shaping an object. Be warned though, that applying some of Blenders modifiers is not straight forward and has to be performed in conjunction with other processes. Without some instruction in how to apply the modifiers a lot of hit and miss, trial and error, messing about can be involved. To save you all that trouble the following section on Modifiers is offered as a guide. You will still have to experiment and record your findings to become proficient in the application of modifiers.

Modifiers are found in the Properties Window – Modifiers button. The Modifier button is only displayed when an object is selected in the 3D Window and only when it is possible to apply the modifier to that object.

Start with the default Blender scene with the default Cube object. Select the Cube. Go to the Properties Window – Modifier button and click on 'Add Modifier' to display the Modifier drop down selection menu. You will see there are quite a number to choose from. Some of the names seem self explanatory, some not so clear in their meaning.

Properties Window

Drop Down Selection Menu

Modifier Panel Displayed
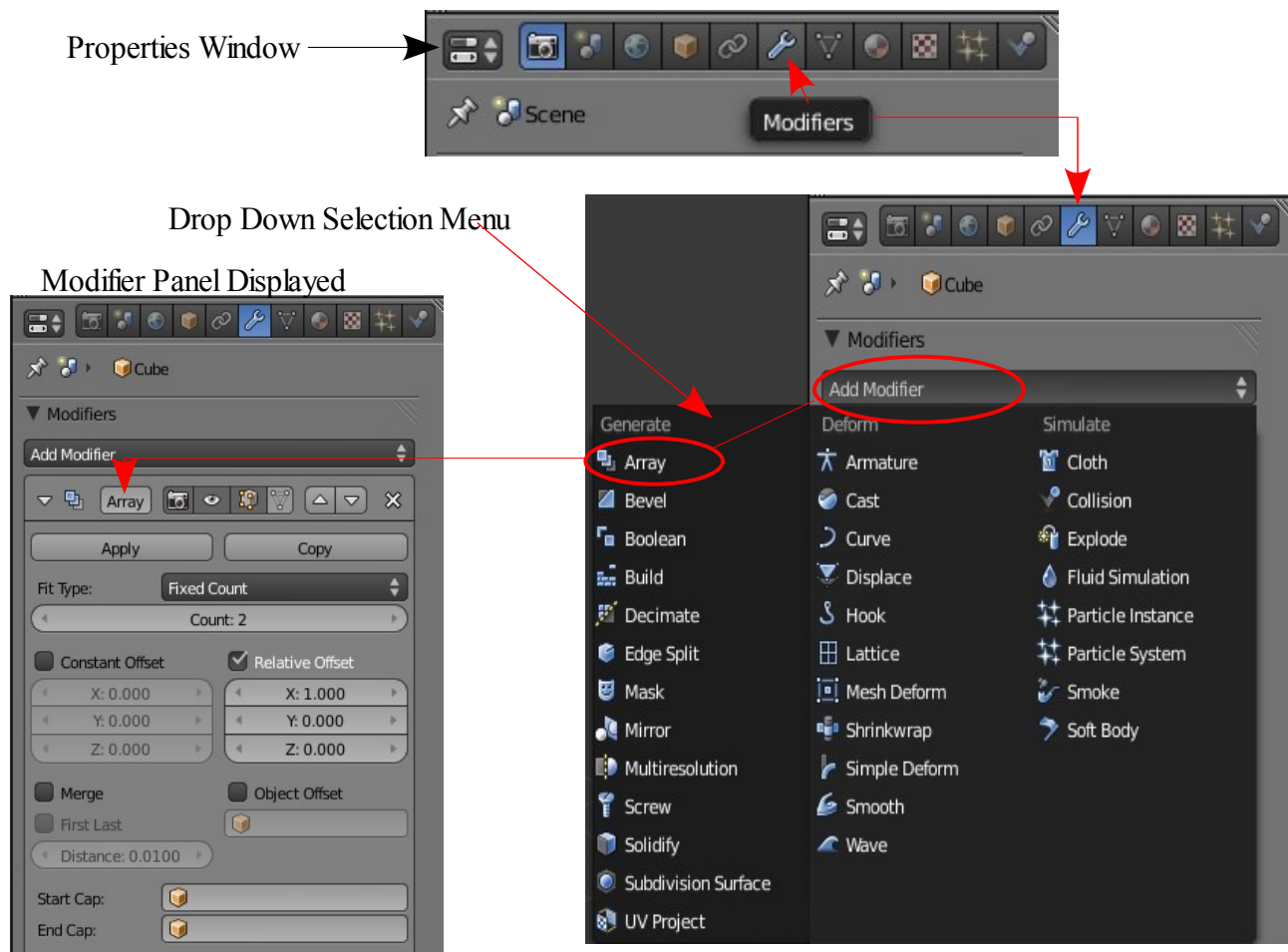
Modifier Stack

Before explaining the individual modifiers it should be noted that in some cases it is appropriate to apply more than one modifier to an object. When this is done the modifiers are placed in a stack in order of priority. The priority can be changed by moving a modifier up or down in the stack.

Also note that although modifiers are generally applied in Object mode some may be used in Edit mode.

This Screenshot shows an Array Modifier and a Bevel Modifier applied.
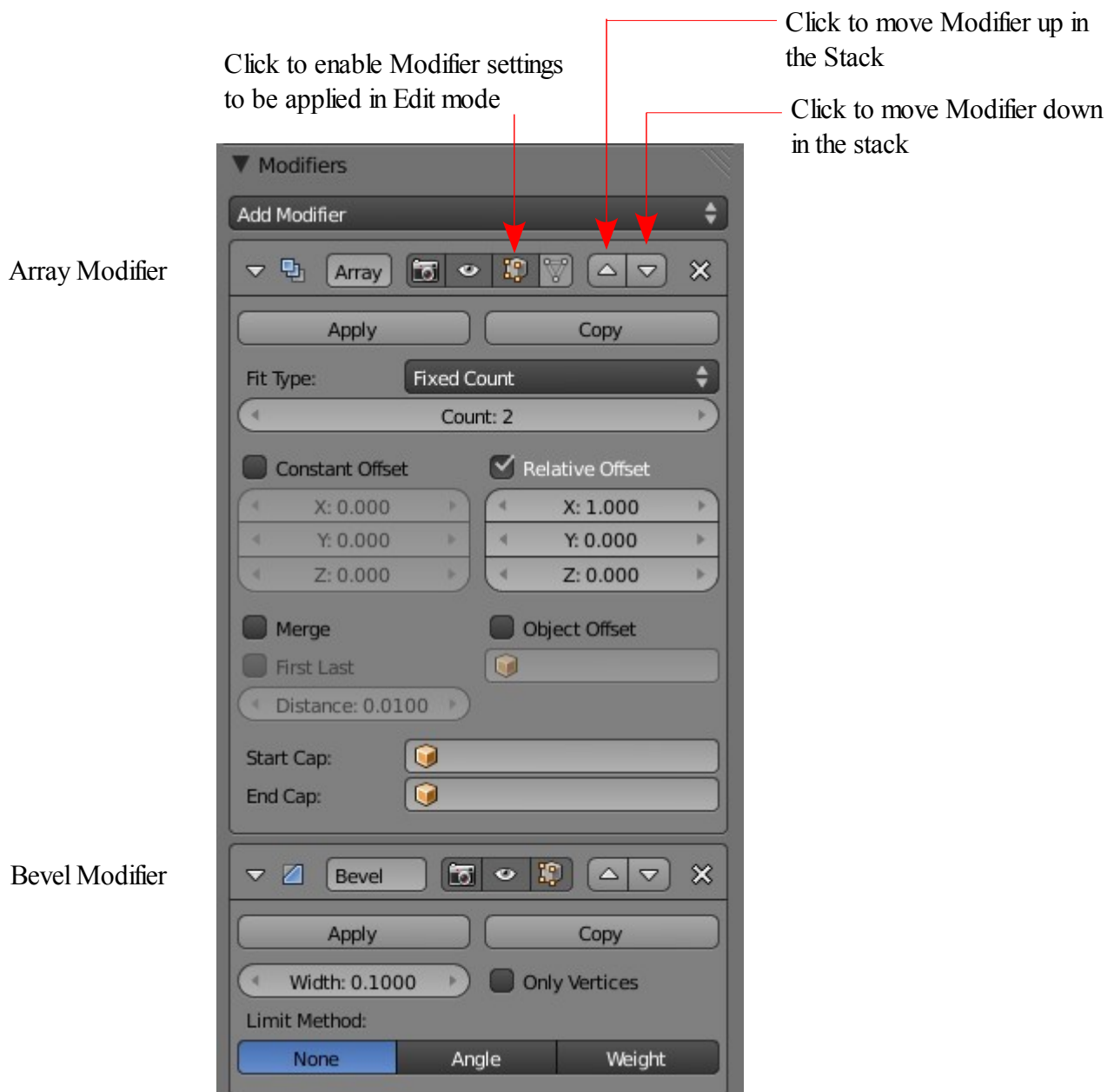
The following pages will give a basic insight into how some of the modifiers are employed. The full listing of modifiers available are as shown in the modifier selection drop down menu.
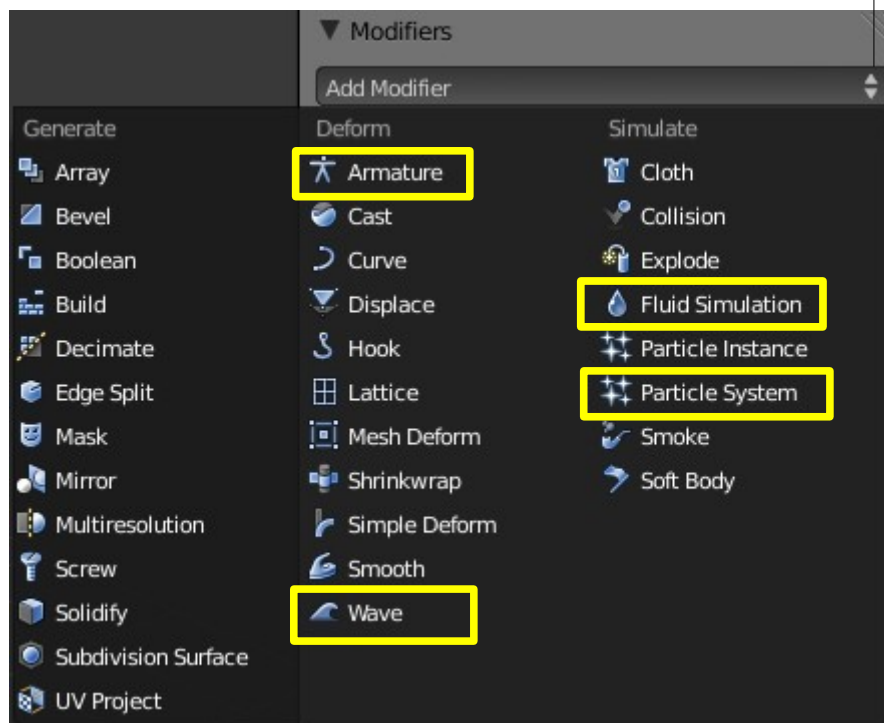
The modifiers marked in yellow will also be covered in later sections relating to Armatures, Particles and Physics.

Learning Unit 6
Array Modifier

Bevel Modifier

Curve Modifier

Bolean Modifier

Simple Deform Modifier

Multiple Modifiers

Learning Unit 8
Mirror Modifier

Lattice Modifier

Displace Modifier

Wave Modifier

Solidify Modifier

Decimate Modifier

Array Modifier

The Array Modifier creates an array of copies of the base object with each copy being offset in a number of possible ways.
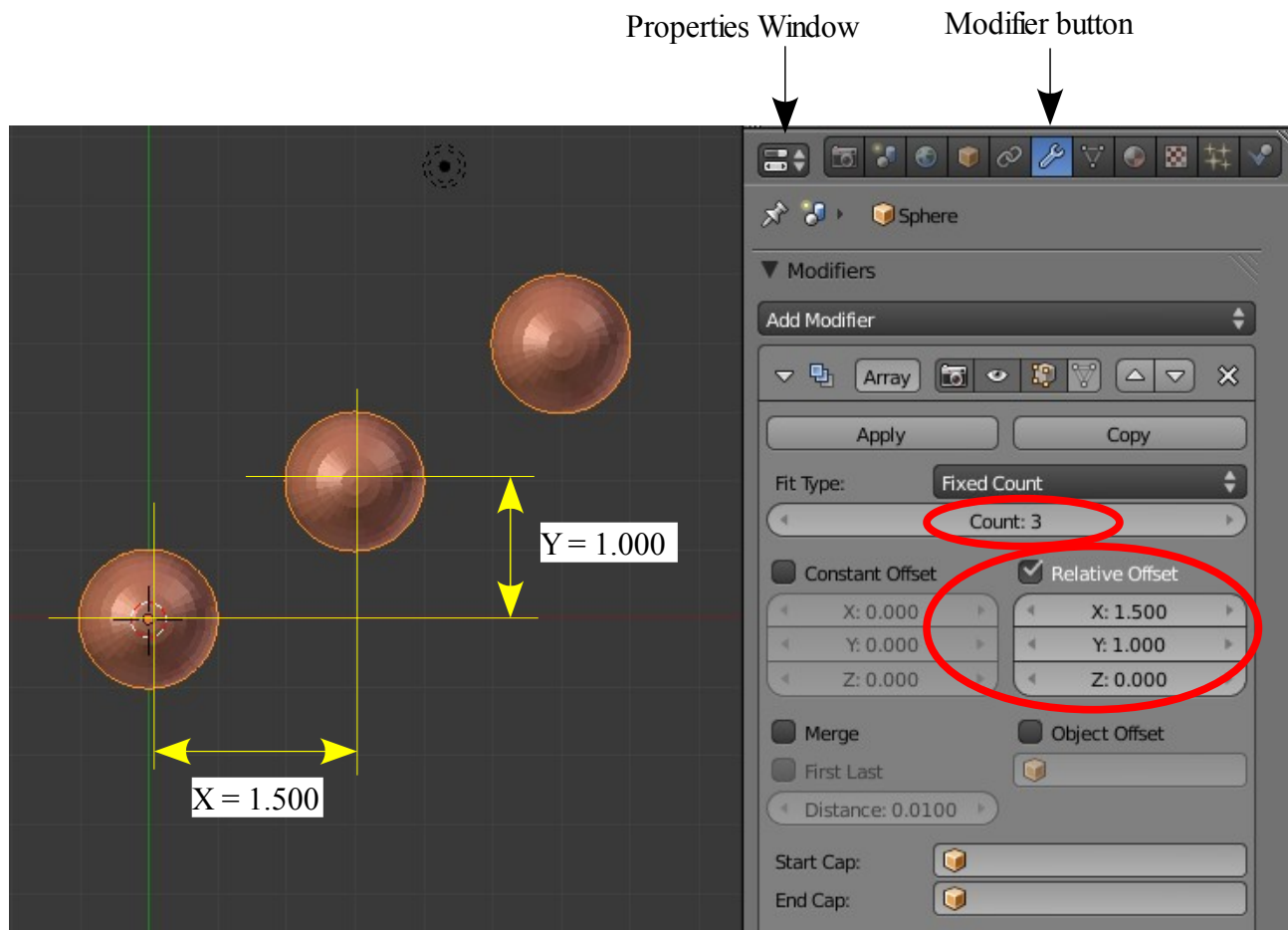
UV Sphere object with Array Modifier applied with Count = 3 (the base object plus two copies equals an array of three) and X and Y Offsets.

Note the above is using the Relative Offset function.

There are three types of offset functions available. Relative, Constant and Object.

With a Count value of 2 and offset along the X axis of 1 the difference between Relative and Constant is shown here.

The third offset option 'Object' is show as follows and is combined with the addition of a second Array Modifier..
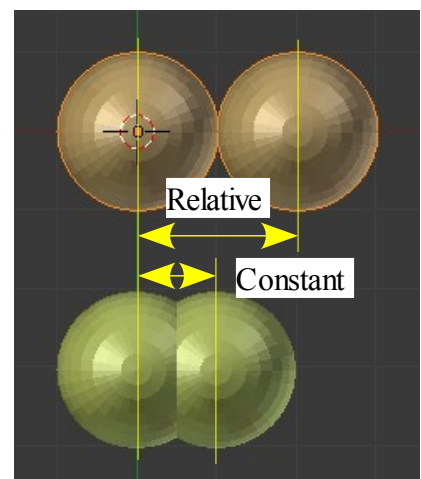
Object Offset

In this example the Sphere has an Array modifier with Count = 2 and a Constant offset x = 6. In addition a second Array modifier is added with an Object offset.

The Object Cube is located at x = -1.5 and y = -1.5

The first Array modifier places a second Sphere at x = 6. The second Array modifier uses the coordinates of the Object Cube to place a third Sphere relative to the second Sphere at x = -1.5 and y = -1.5

Remember Count 2 means an Array with two objects the original object plus one. Adding a second modifier with Count 2 still tells Blender to make an Array comprising the original plus one. We therefore have the original plus one and the original plus one. Three.
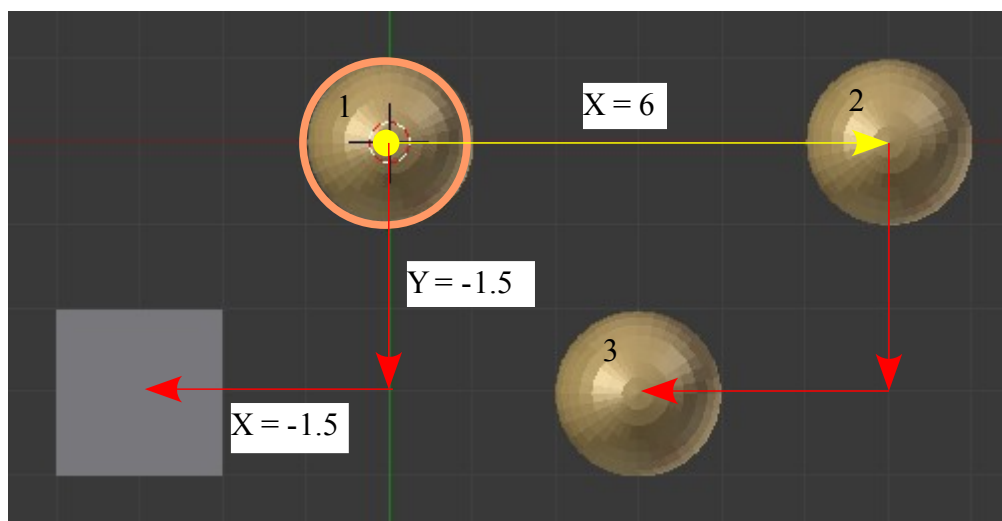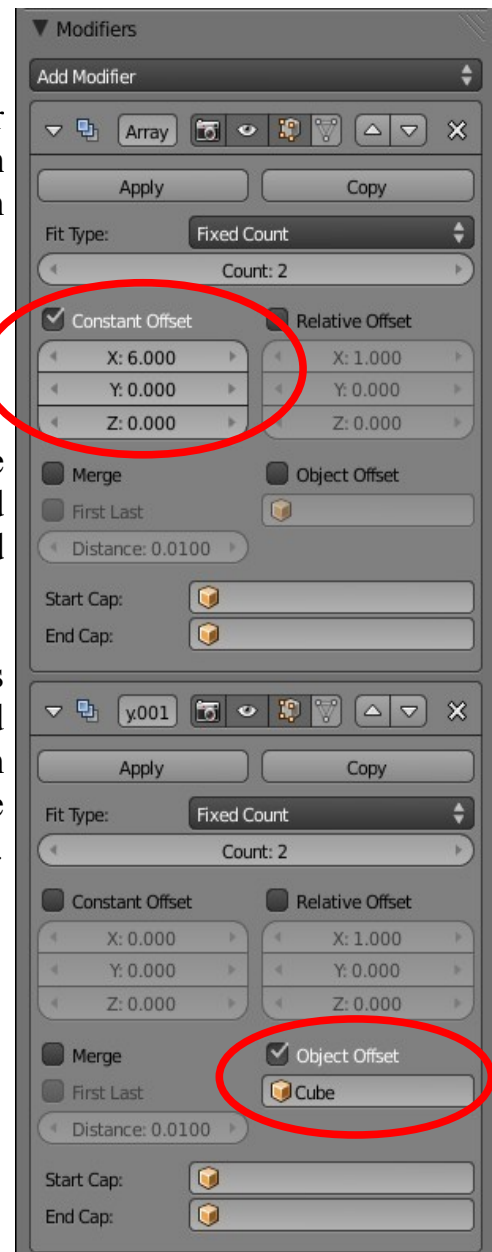
Bevel Modifier

The Bevel modifier simply adds a bevel to the corners of an object.

Default Cube with Bevel
Modifier applied
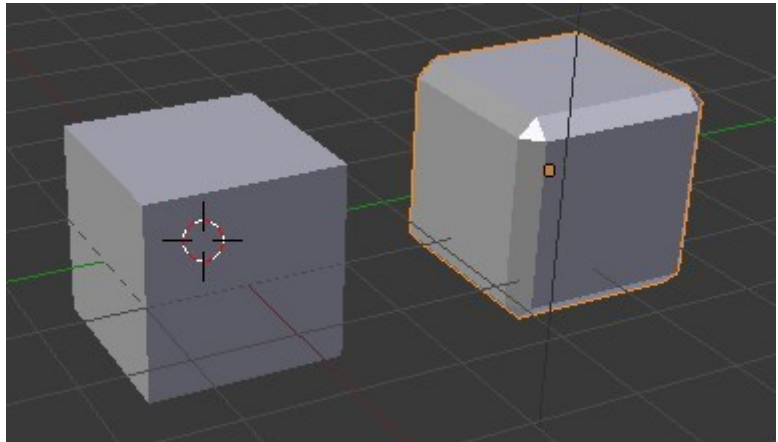
Width of Bevel

Extruded Cube with Bevel Modifier applied
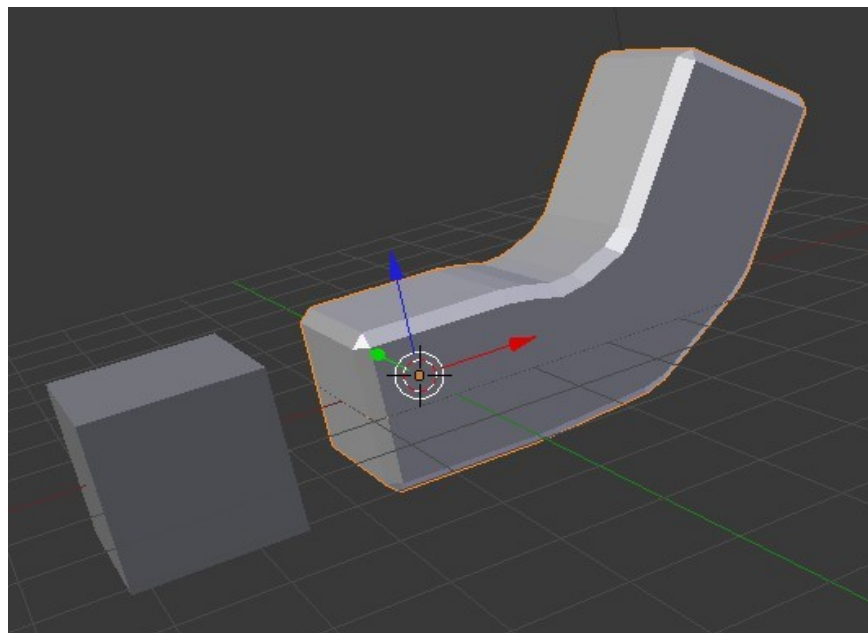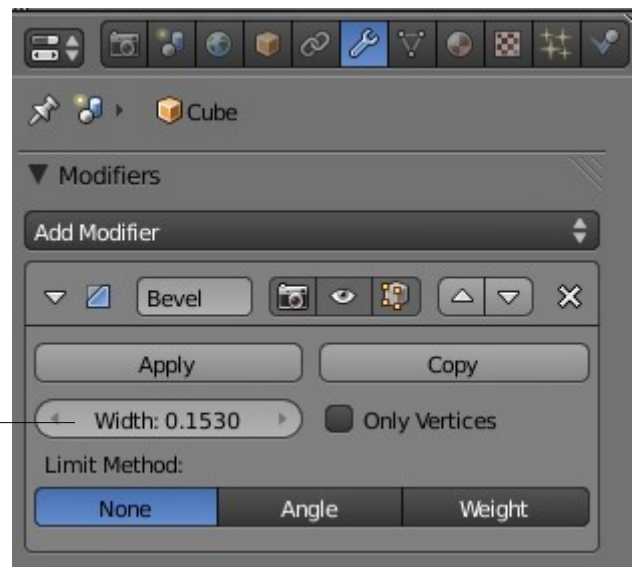
Boolean Modifier

Boolean Modifiers are used to create shapes by using a Difference, Intersection or Union between Objects. To demonstrate this we will use the default Cube and a Tube object.

Be warned that unless you have a super fast computer some calculations can take several seconds.

Start with the Cube and Tube and position them as shown. This will be the same set up for all three Operation types. Begin with the Boolean type 'Intersect'

To make sure the procedure works set the vertices count to 16 when you add the Tube. My old clunker of a computer stalls if I try the default 32 vertices. Add the Tube then change the vertices in the Tool Shelf.

Intersect
(Creating an Object which is the shape of the overlap of two objects. The Cube will be the object that is modified).

Select the Cube. In the Properties Window – Modifier button – Click 'Add Modifier' and select type 'Boolean'.

The Operation type by default is 'Intersect'. In the Object panel click on the little cube icon and select 'Tube' in the drop down menu. (Note this panel allays shows a little cube icon despite the shape of the actual object being selected).
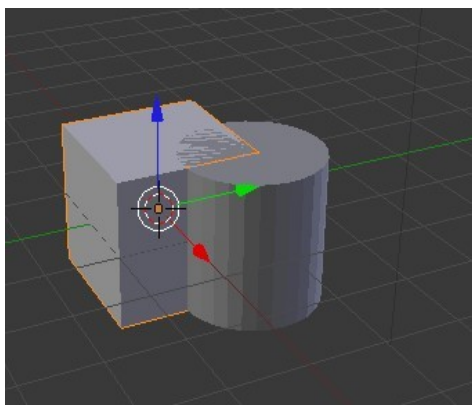
Start position for Cube and Tube
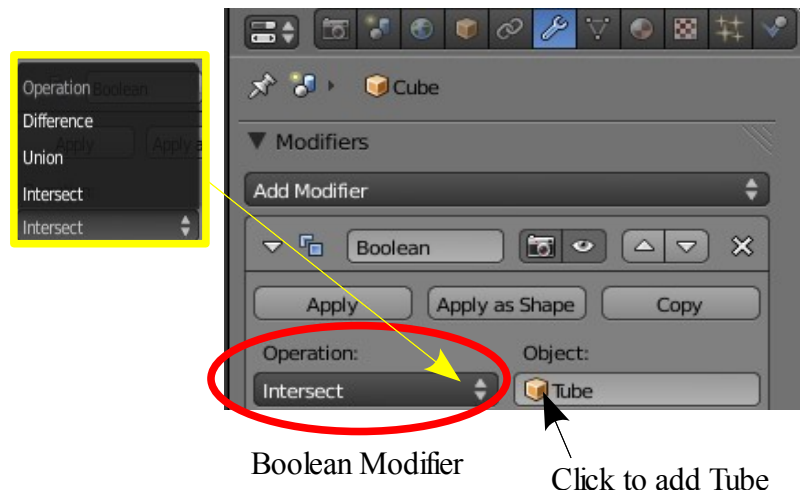
Boolean Modifier   Click to add Tube

in the 'Display' tab click on 'Apply'. The modifier panel disappears. In the 3D Window move the selected object to reveal the new object being the shape of the overlap. The Tube object remains in the scene.
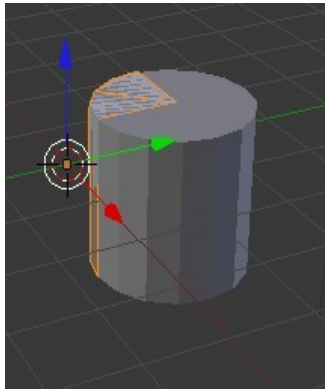
3D Window after applying
modifier
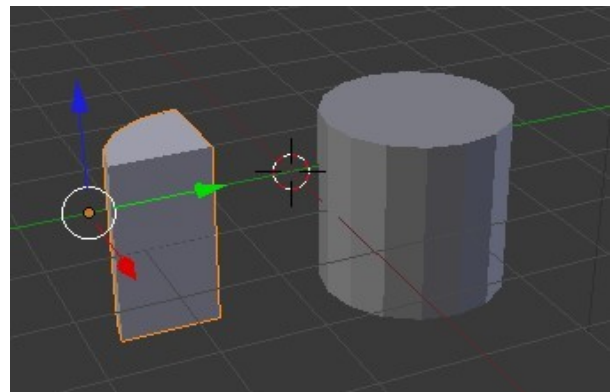
Separate the objects to see the Intersection

Union
(Creates a shape which is a union of two objects).

Add a Modifier to the Cube and select Operation type 'Union'. In the Object panel (Little cube icon) click and select 'Tube'. Click "Apply'. Move the selected object in the 3D Window.
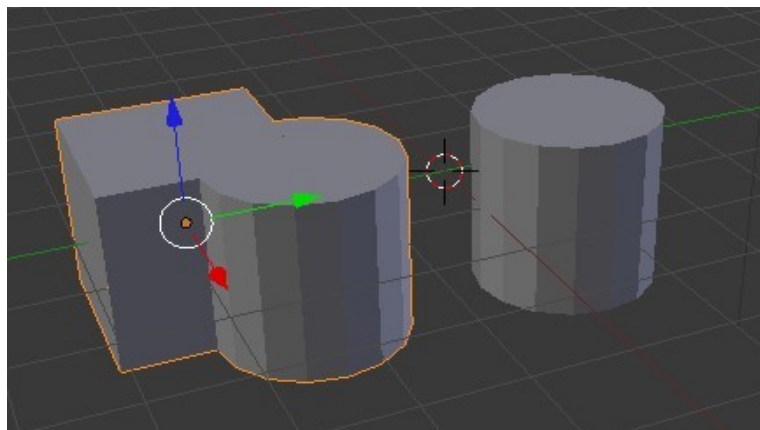
Difference
(Creates a shape which is the difference of the two objects. In other words subtract the overlap of the objects from the object being modified).

Follow the same procedure as the foregoing examples selecting Operation type 'Difference'.
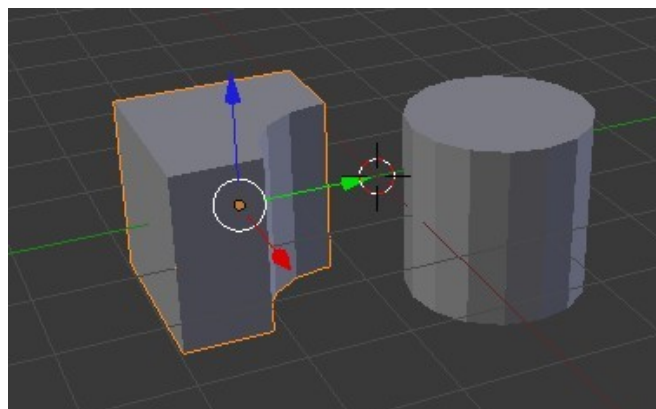
Build Modifier

The Build Modifier creates the effect of something building linearly over a period of time.

For example Text can be animated to build across the screen. Any object can have a Build Modifier but to see a nice affect a high vertices count is required.

Add some text to the scene (See the section on 3D Text).

Select the text in the 3D Window and add a Build Modifier.

As soon as you add the modifier the text disappears from the screen. Press Alt + A to see the animation of the text building.

Text in the 3D Window selected in Object mode.

Text with the Build Modifier added.
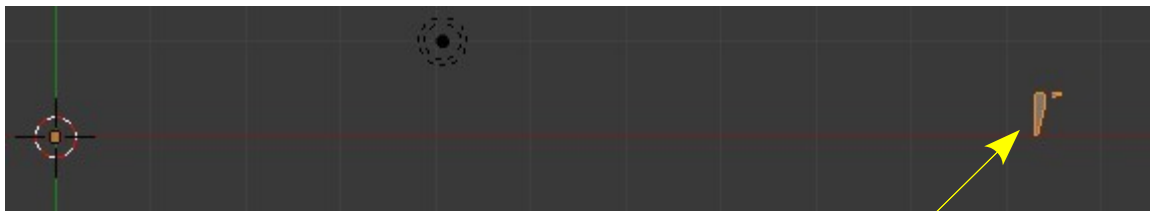
Part of the text showing

Text building while playing the animation

Build direction

Decimate Modifier

The Decimate Modifier allows reduction in vertex count without too much alteration to shape.
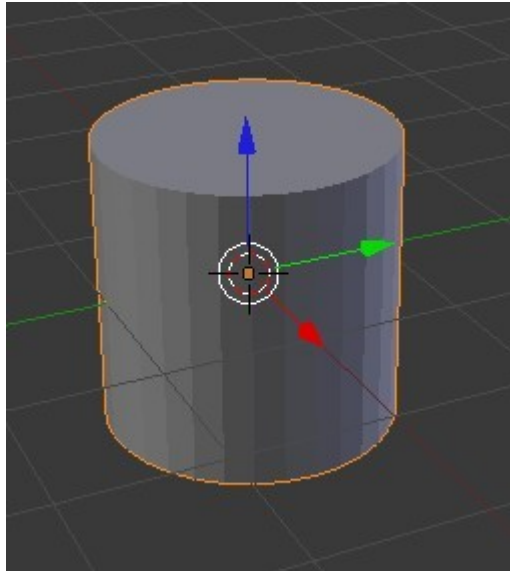
Default Tube before Modifier applied
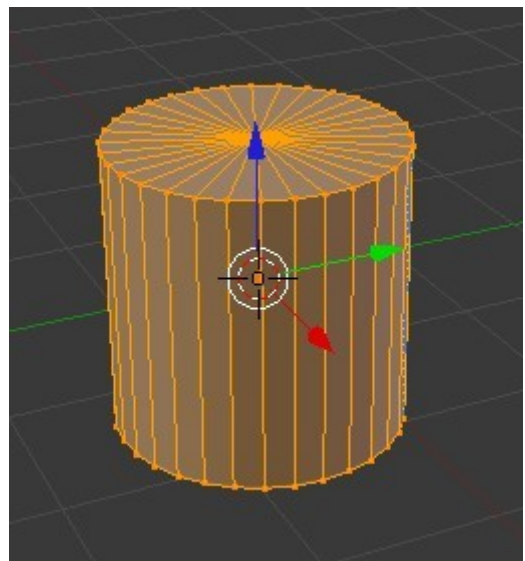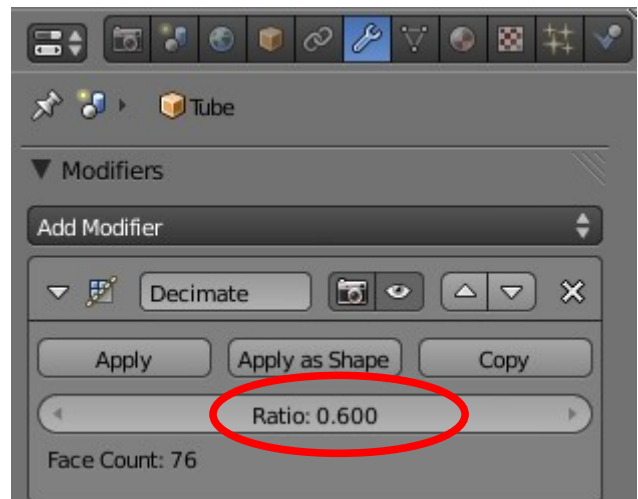
Default Tube in Edit mode showing vertices before Modifier applied
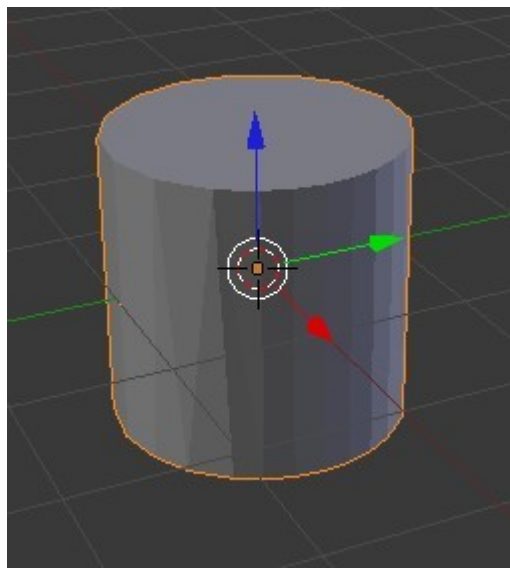
Tube after Modifier applied with Ratio: 0.600. There is not too much change to the appearance.

Edit mode shows the reduction in the number of vertices
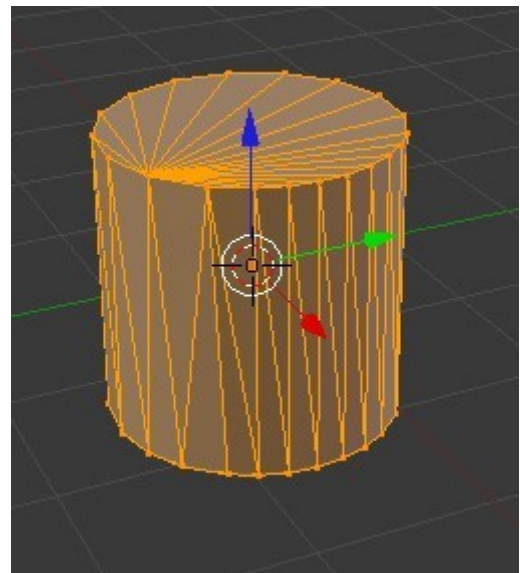
Edge Split Modifier

The Edge Split Modifier allows you to split an object apart by selecting vertices, edges or faces.

As an example start with the default scene with the default Cube object.

In Object Mode with the Cube selected add an Edge Split modifier and Click 'Apply' (Properties Window – Modifier button – click 'Add Modifier – Click on 'Edge Split' – Click 'Apply').
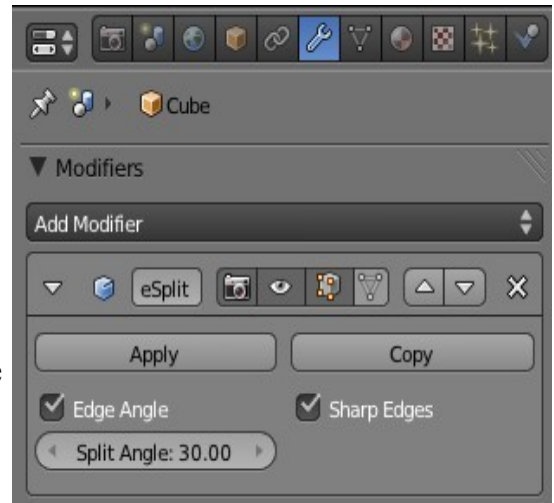
Tab to Edit Mode. Select a face and drag the mouse to pull it away from the Cube. The face remains part of the object even though it is separated.
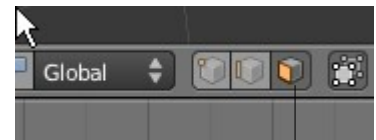
Face Select Mode
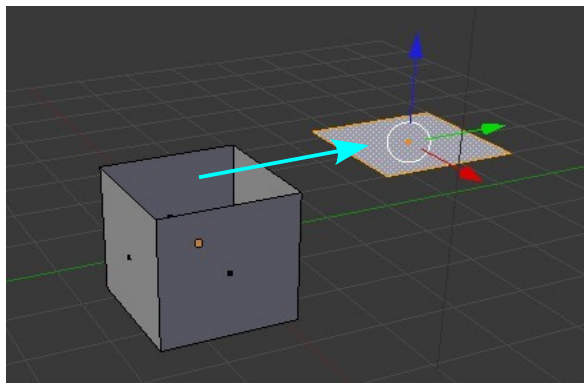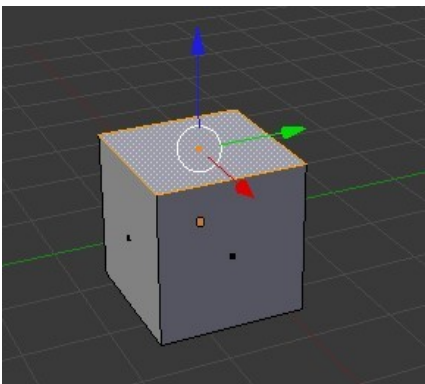
Selecting an edge will open a face like the lid on a box.
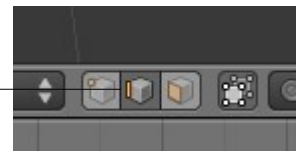
Edge select Mode
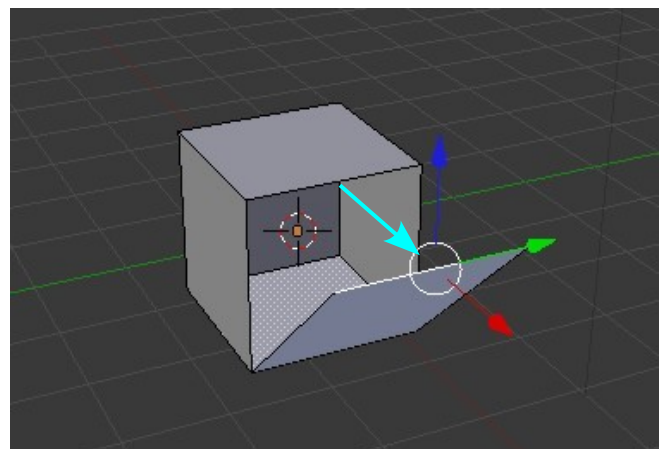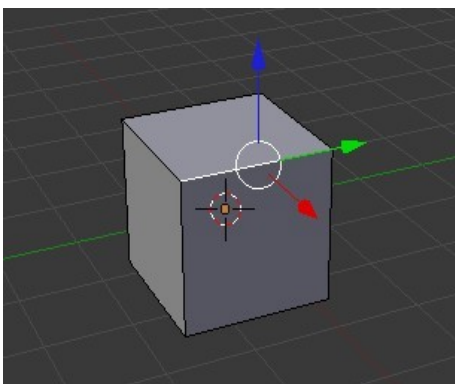
Selecting a vertex will allow a corner to be moved.
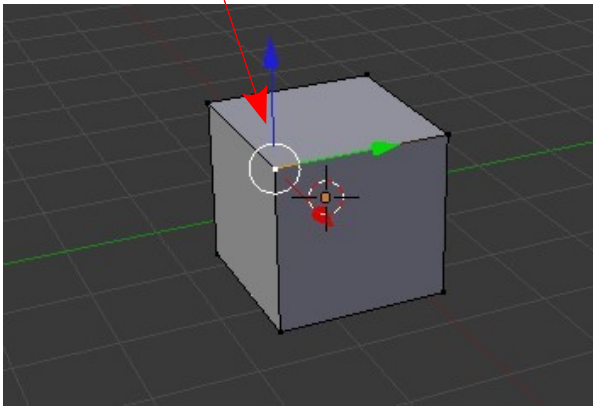
Do not forget Vertex select Mode
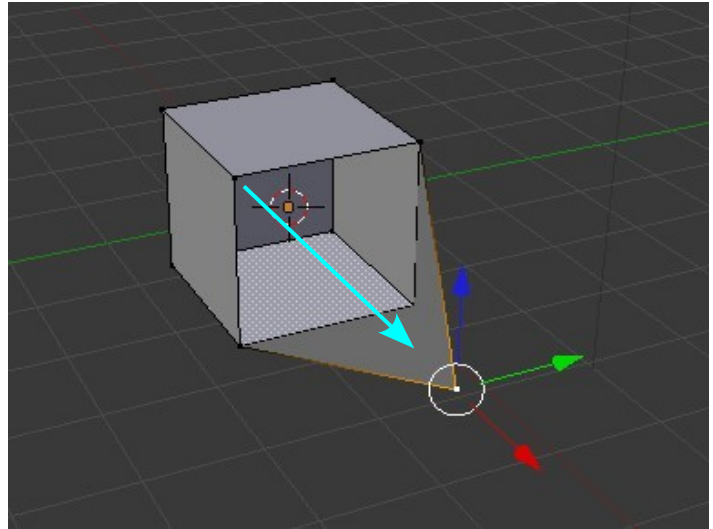
Selecting all (A Key deselect – A Key select) + Ctrl + V Key select 'Remove Doubles' will rejoin the faces.

Mask Modifier

The Mask Modifier allows portions of a mesh which are defined by Vertex Groups to be the only part of the mesh that is visible or inversely to be the only part of a mesh that displays. By using the modifier visibility can be controlled without removing vertices.
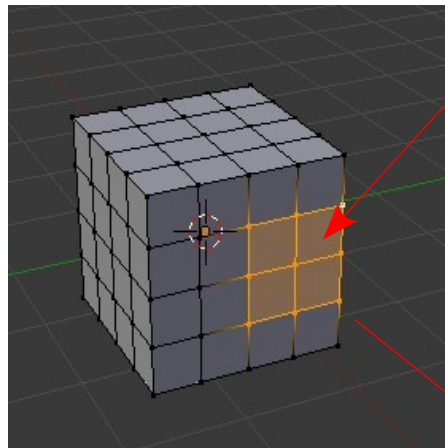
Vertices selected in Edit mode

Object data button

Vertices assigned to the Vertex Group named 'Group'

Click to add Group

Click to assign vertices to 'Group'
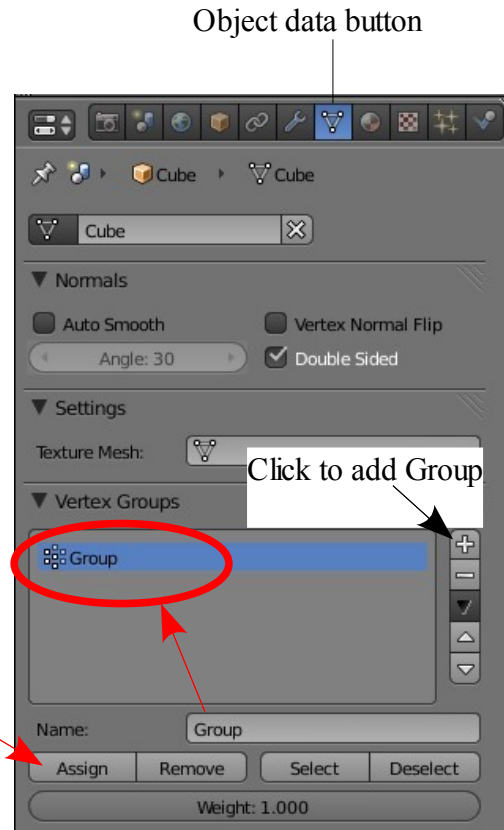
Mask Modifier added to Cube
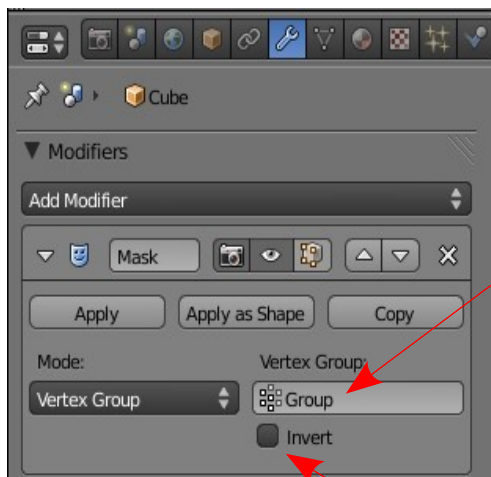
Group entered

Group invisible with 'Invert' ticked
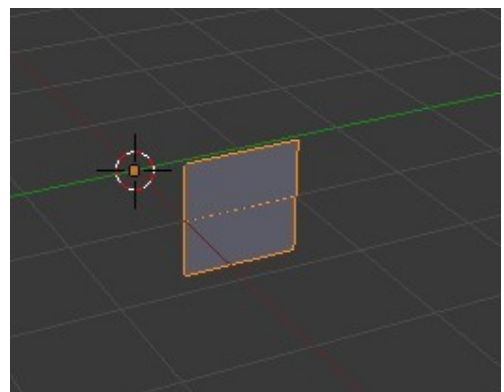
Only Group visible with modifier applied
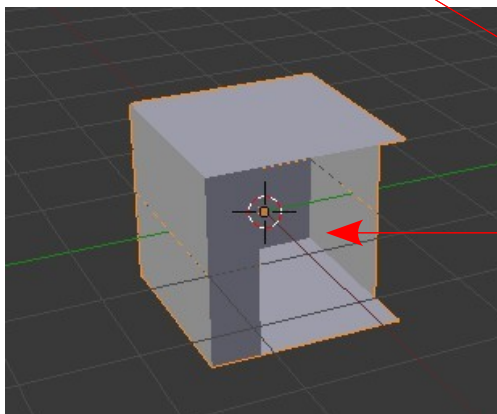
No vertices have been removed from the Cube

Mirror Modifier

The Mirror Modifier allows the construction or deformation of a mesh on one side of a center point to be duplicated (Mirrored) on the opposite side.

Mirror Modifier
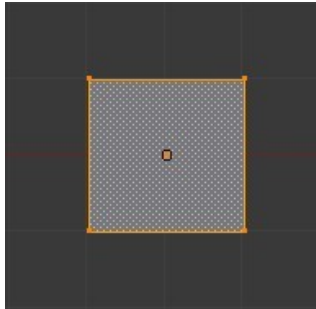
Example 1.

1. Plane in Edit Mode
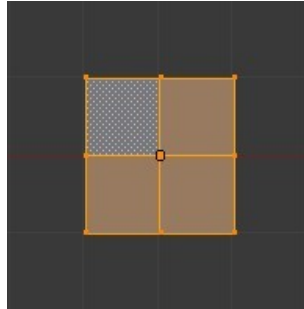
2. Plane Subdivided
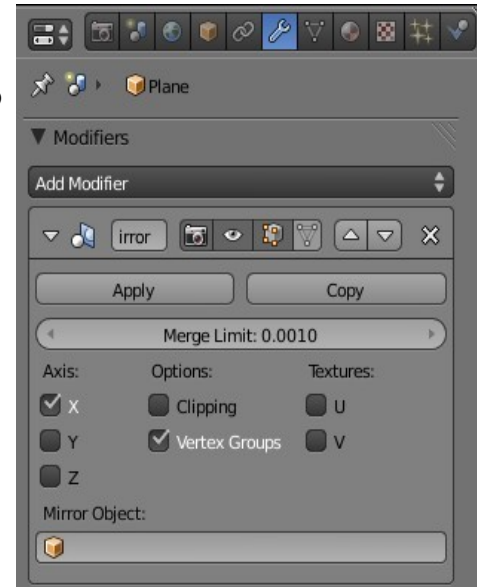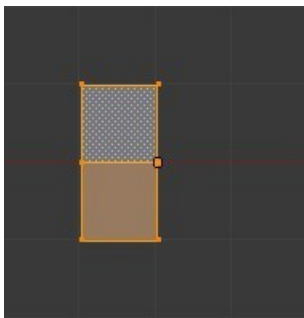
3. Vertices removed on one side
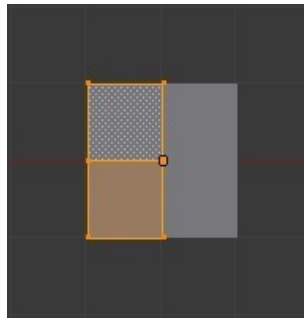
4. Mirror Modifier applied
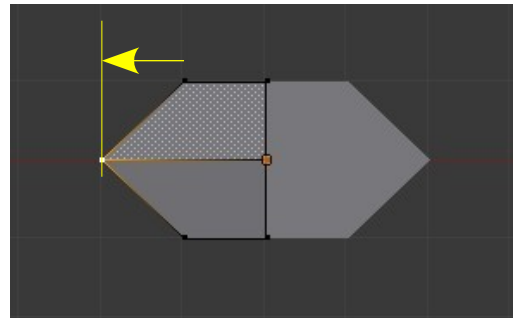
5. Mesh deformed by moving vertice with Mirror applied

Example 2.
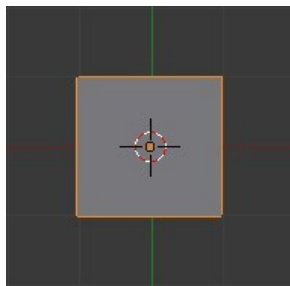
1. default Plane
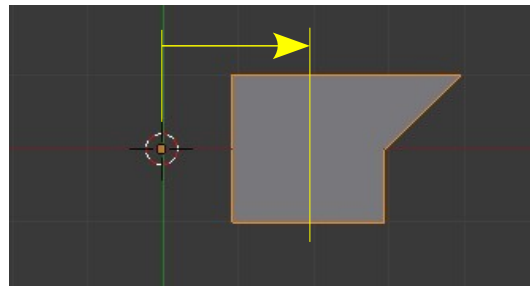
2. Plane deformed and moved from center

Move vertices away from center in Edit Mode

3. Mirror Modifier Applied
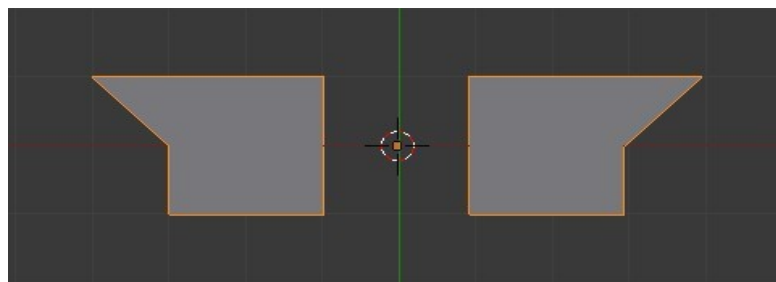
Multiresolution Modifier

The Multiresolution Modifier is much like the Subdivision Surface Modifier.

The following insert is taken from the Blender documentation and perhaps, beginners should be put aside for future study. The insert is placed here to make you aware of the modifiers existence.

Multiresolution Modifier

Multiresolution is now a modifier, much like the Subdivision Surface modifier. This means it can be placed after for example an armature modifier, as is typical for animation, and the displacement will follow the deformation. A restriction is that it can't be placed after a modifier that changes the mesh topology, for example a mirror modifier.

External Displacements File

Multiresolution displacements can now be stored outside of the .blend file. This helps keep the .blend file small, and makes it possible to load the displacements in memory only when needed.

This can be considered much like a displacement texture map that only applies to a particular mesh, and that you might store as boots_disp.btx next to a boots_color.png, for example. Saving to this file happens automatically when saving the .blend file. For performance, you can ensure that it does not get loaded into memory when opening the .blend file, by setting the viewport level to 0 in the multires modifier.

▼ Modifiers

Add Modifier

Multires

Apply	Copy
Catmull-Clark	Simple
Preview: 7	Subdivide
Sculpt: 7	Delete Higher
Render: 7	Optimal Display
Save External...	
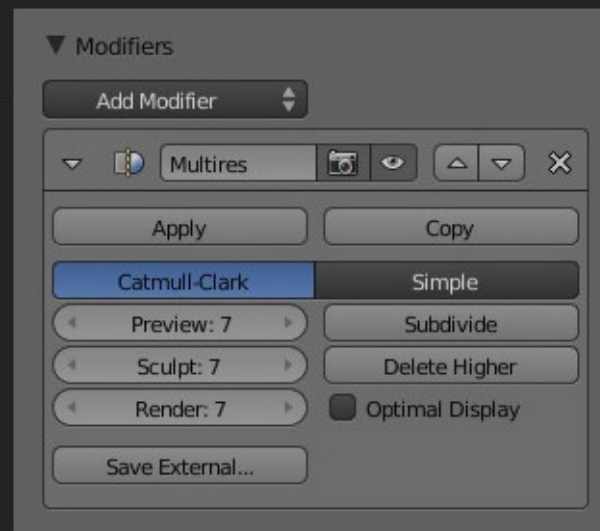
Screw Modifier

The Screw Modifier allows a shape to be generated by revolving a profile around an axis. To demonstrate this we will construct a spring.

All operations are conducted in the default camera view.

Follow the steps in the exact order listed.

1. Delete the default Cube object and add a circle. Scale the circle down 0.500.
2. Tab to Edit mode and move the circle along the X axis (N key to display the Transform panel, Median: -6.000).

Edit Mode
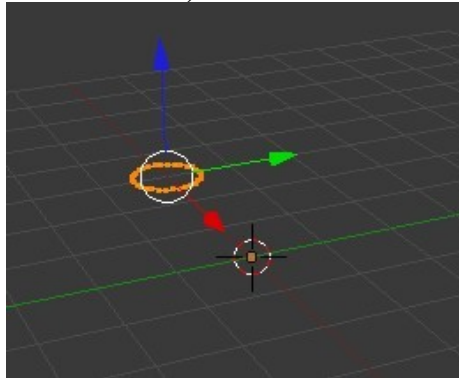
3. Tab to object mode.

Object Mode
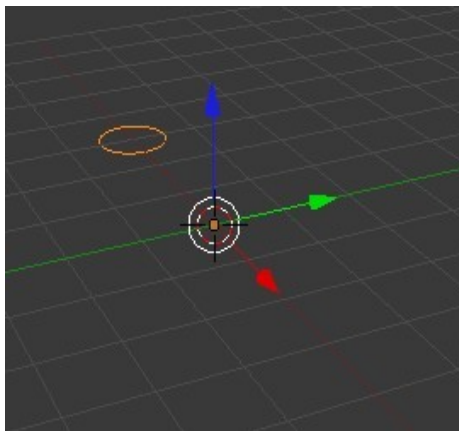
4. Add a Screw Modifier to the Circle.
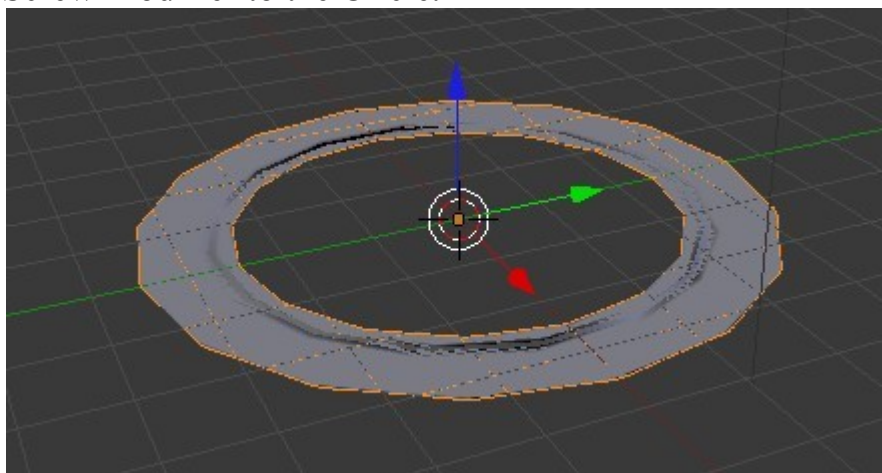
Circle revolved about the default Z axis

5. Change the settings in the modifier panel.

Modifier panel shown with the default settings

6. Axis: y (Revolve about the Y axis)
7. Steps: 100 (To produce a smooth surface)
8. Screw: 10 (Offsets the revolution)
9. Angle: 1000 (Number of revolutions)
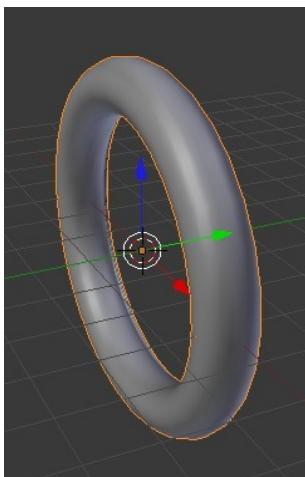
Revolved about Y axis
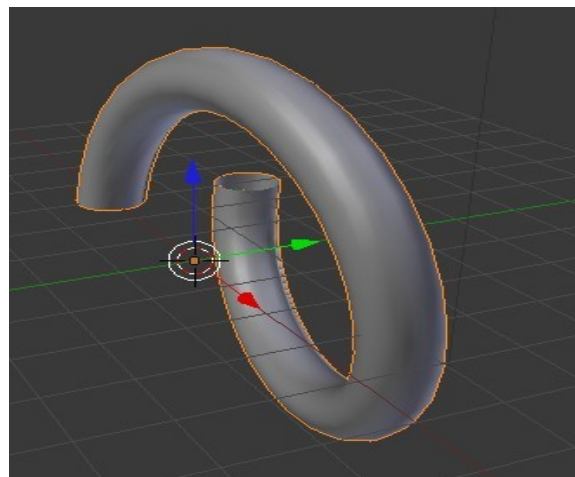
Screw: 10 Offset
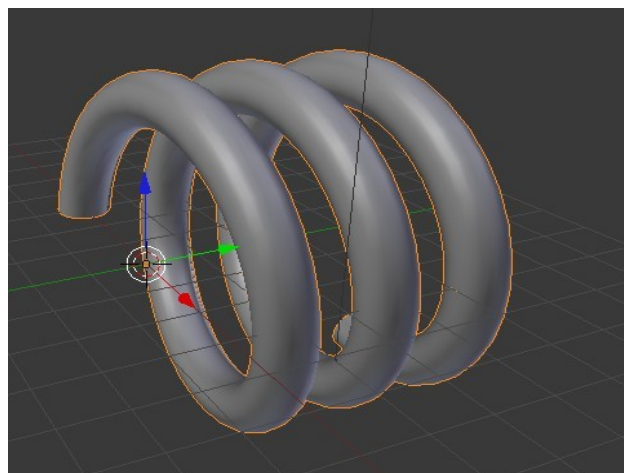
Angle: 1000 Revolved

Solidify Modifier

The Solidify Modifier provides a tool for creating solid objects from thin walled objects.

To demonstrate this begin with a simple Plane object selected in the 3D Window. Add a Solidify modifier in the Properties Window. Look closely at the Plane and you will observe that it now has a thickness. Note in the Properties Window the Solidify Modifier by default has two values, Thick: 0.0100 (Thickness) and Offs: -1.0000 (Offset).
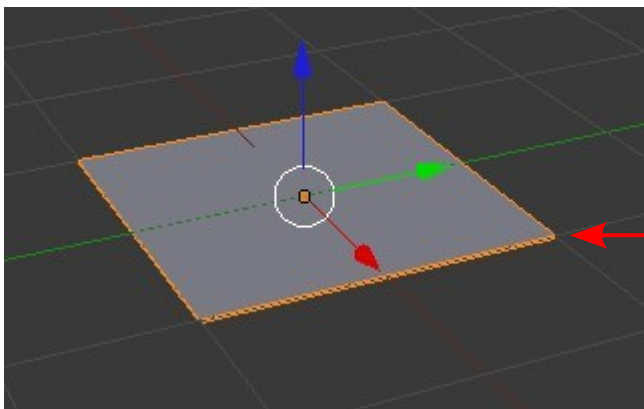
Thickness: 0.0100

To better see what these values mean increase them to, Thick: 0.2000 and Offs: -2.0000. Change the 3D Window to front view (Num Pad 1).
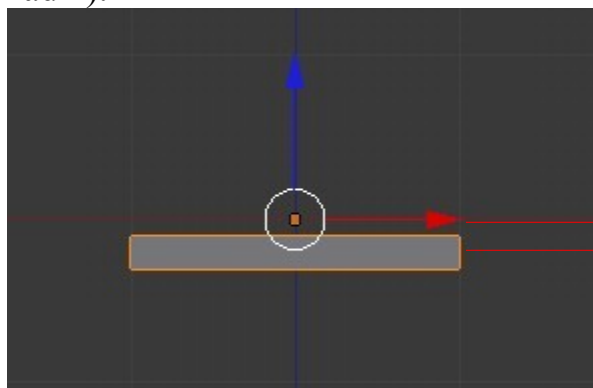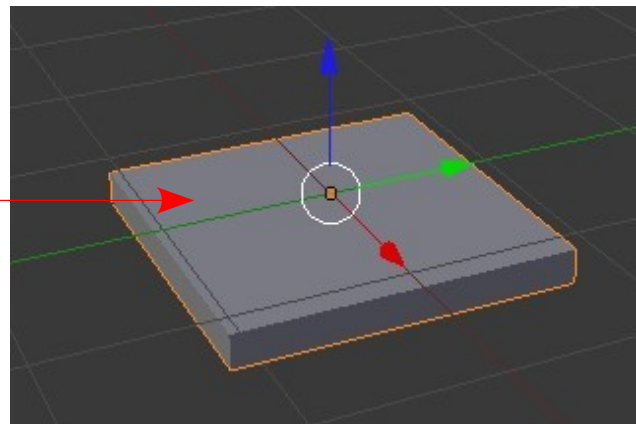
Offs: -2.0000 (Offset)

You will see that the Plane has a thickness of 0.2000 Blender units and that it is offset -2.000 Blender units below the mid plane of the scene.

Tab to Edit Mode. See the original vertices of the Plane object remain on the of the mid plane of the scene.

Tab back to Object mode and change the 3D Window to User Perspective view. In the Modifier panel untick 'Fill Rim'. Instead of a single thick plane there are two thin planes.
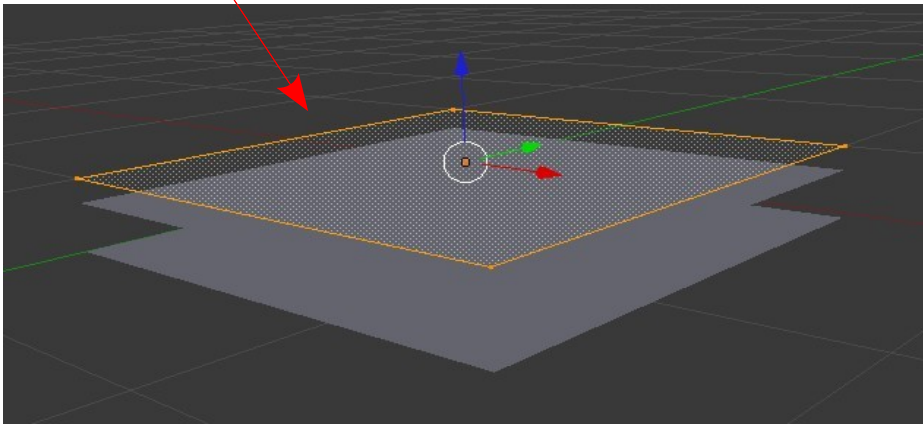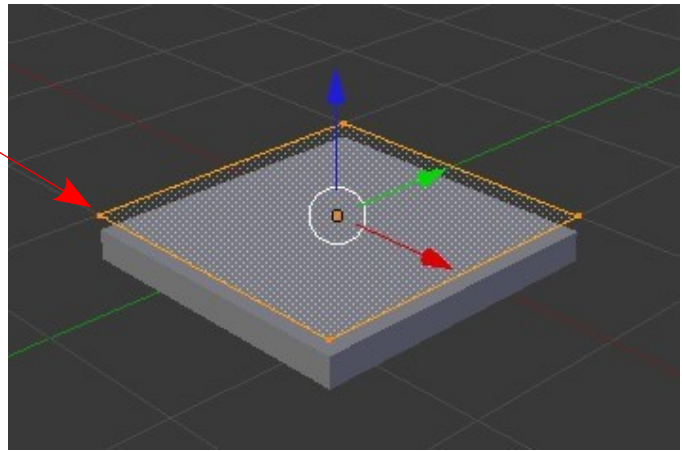
Tick Fill Rim again in the modifier and then add a Subdivision Surface Modifier below the Solidify Modifier. The thick plane will look like a flattened octagonal shape. This shape can be modified by changing Inner, Outer and Rim Crease values in Solidify Modifier panel. Change all three values 1.000 produces the Thick Plane object.

With Inner, Outer and Rim set back to 0.000, note the value 'View: 1' under 'Subdivisions' in the Subdivision Surface Modifier panel. If you change this to 'View: 0' you have the Thick Plane again. Changing the 'View' value from 0 to 1 then 2 then 3 then 4 changes the Thick Plane progressively into a smooth flat disc.

For a practical demonstration of the Solidify Modifier start a new scene with a Cylinder object instead of the default Cube. Delete the upper end cap by deleting the single vertex in the centre in Edit mode. You now have a thin walled container. Add a Solidify modifier and increase the Thickness value to produce a thicker wall. Play with the Offset value to change the size. Add a Subdivision Surface Modifier and alter the View value to modify the shape. With the Subdivision Surface Modifier added you can can use the Inner, Outer and Rim Crease values to control the shape.

Subdivision Surface Modifier

The subdivision Surface Modifier is used where the Smooth button in the Shading section of the Tools Shelf does not quiet do the job and you do not want to subdivide your mesh adding more vertices.

This example shows the method.
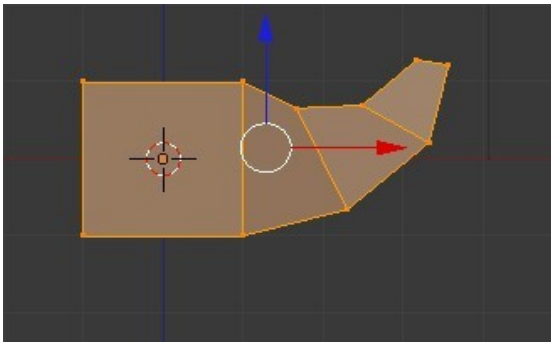
1. Default Cube with one face extruded
Front view Num Pad 1- edit mode.
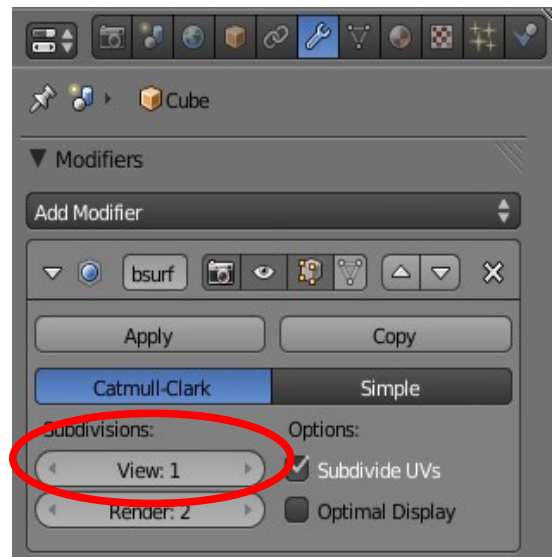
2. Sub Serf Modifier Panel
Default settings
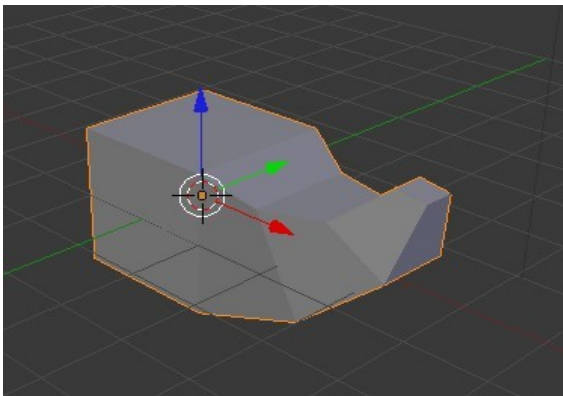
3. User perspective view of extrusion
Object mode
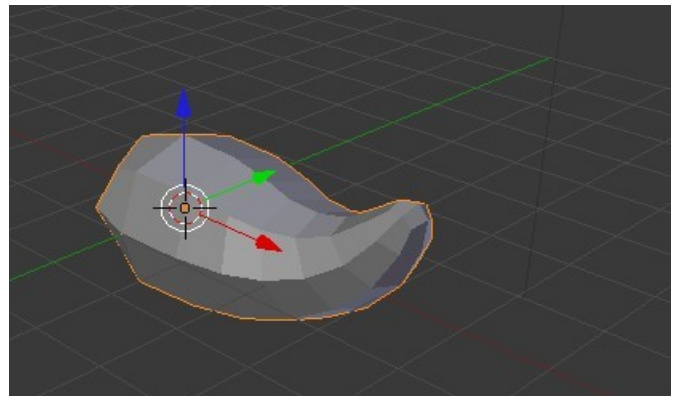
4. User perspective view
With Sub Serf Modifier added (default settings)
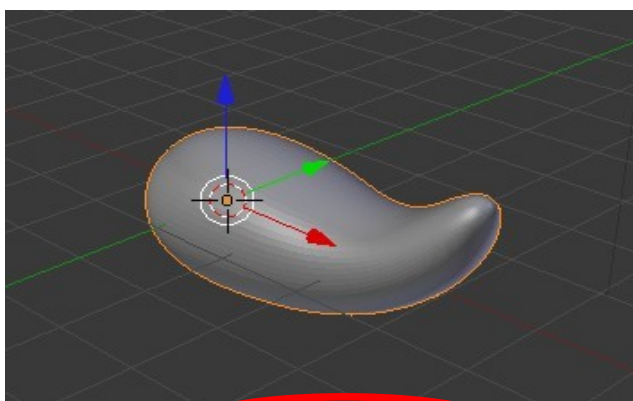
5. View value 1 changed to 4
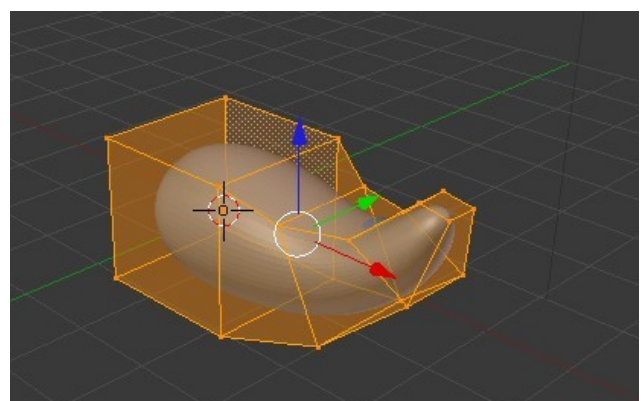
6. Tab to edit mode to show
Origional number of Vertices unchanged

UV Project Modifier

The UV Project Modifier allow projection of an image on to the surface of an object.

Before the modifier can be applied the scene must contain the following items and settings are required. To demonstrate the very basics of the process we will project an image on to one face of the Cube in the default Blender Scene.

Before we begin we must have the following items.
1. An Object on which to project the image (Default Cube).
2. An image to be projected (Know the location of an image on your computer).
3. A Camera to see what is being projected and to allow rendering.
4. A Projector to do the projecting.

Start with the Default Blender scene and go to top view (Num Pad 7) in Top Orthographic projection (Num Pad 5).

The scene already contains a Cube object, Camera and Lamp. For this exercise the Lamp isn't necessary since the image we will be projecting will be self illuminating. We will leave the Lamp in place anyway.

The first thing to do is add a Projector. Any object can be used as a Projector and it is common to use an Empty or a Camera for the purpose. Since we already have a Camera it is very simple to duplicate it (Shift + D). When the Camera is duplicated Blender automatically names it Camera.001. Go to the Properties Window – Object button and rename 'Camera.001' 'Projector' (Click on the name, delete, retype, press 'Enter').
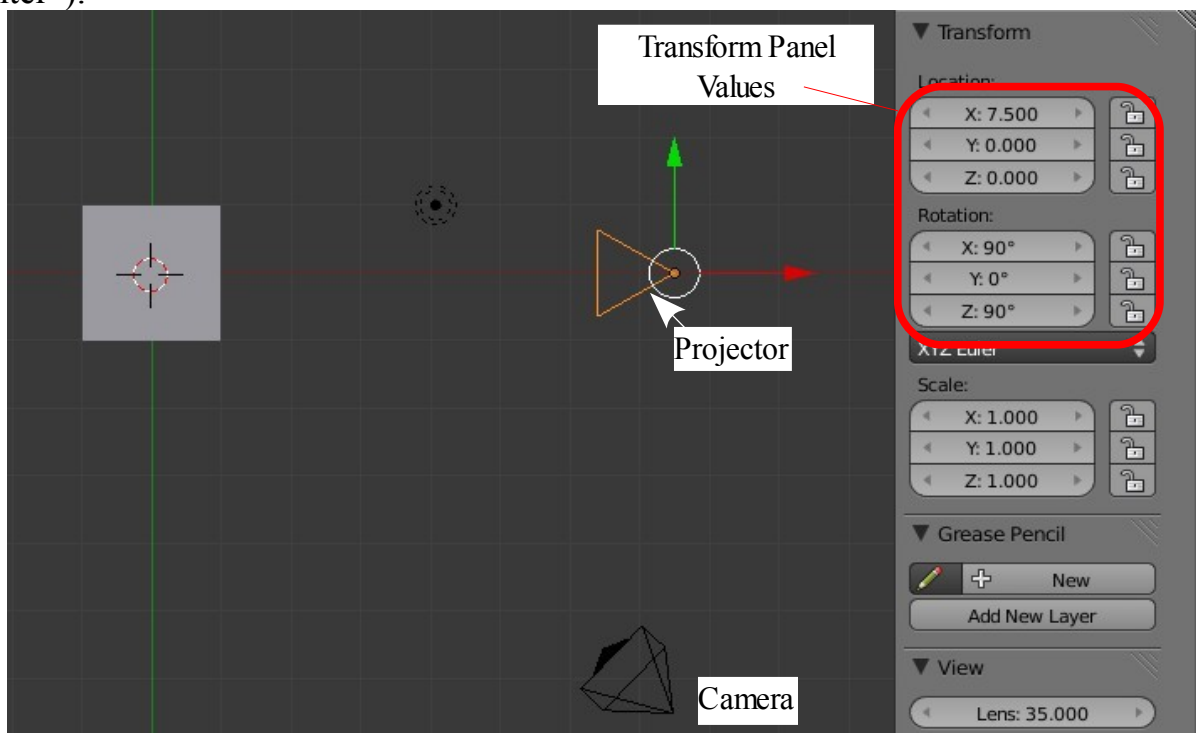
In the 3D Window move the Projector and position it as shown above.

You may position the Projector anywhere you like but it will make this demonstration easier to follow if you copy the example exactly. To precisely position the Projector use the Transformation panel and enter the values as shown. This will put the Projector squarely pointing at the Cube on the X and Y axis.

Deselect the Projector and change the 3D Window to Camera view (Num Pad 0).

To perform Image projection the Object being projected on must have a Material with some unique settings. In the 3D Window (Camera View) select the Cube. Go to the Properties Window – Material button. The default Cube in the default scene comes preloaded with a material. That's the dull grey color that you see. If you have added a new Cube object you will have to add a new material.

With a material added change the following settings in the Material buttons.

1. In the Diffuse tab set - 'Intensity: 1.000'
2. In the Shading tab tick – 'Shadeless' and set 'Ambient: 0.000'
3. In the Transparency tab tick – 'Transparency' and check ' Alpha: 1.000' is set.
4. In the Options tab tick – 'Face texture' (Leave 'Traceable' ticked)

We now have to tell Blender what image we want projected and give some coordinates to project to.

Split the 3D Window in two and make one half a UV Image Editor Window.

In the 3D Window with the Cube selected change Viewpoint Shading to 'Textured'.
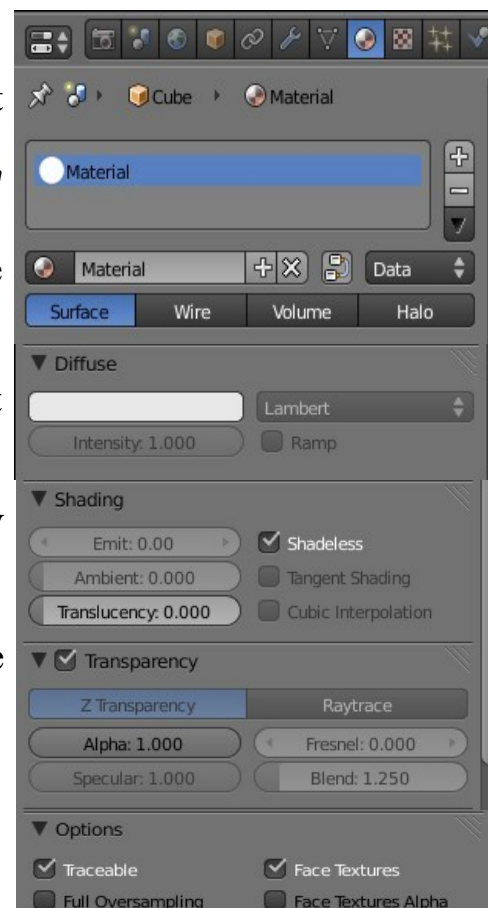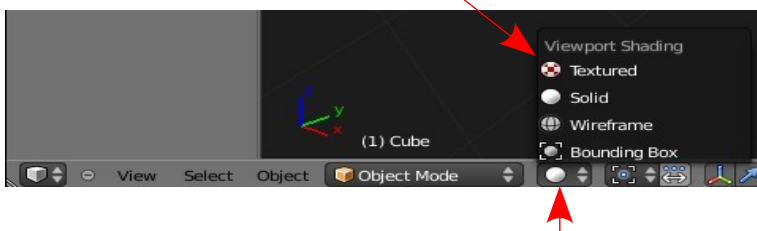
Tab to Edit mode and set it in Face select mode. Press A Key to deselect all faces then R Click on one face of the cube to select one face.

Face select mode

With the cursor in the 3D Window press U Key and select 'Project From View'. You will see the face you have selected appear in the UV Image Editor.
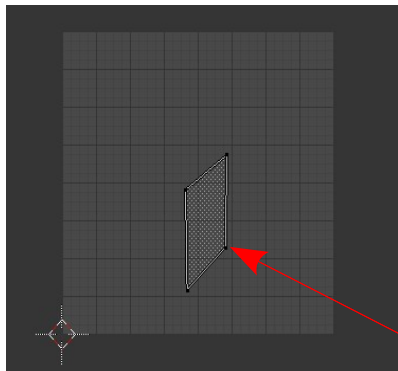
UV Image Edit Window
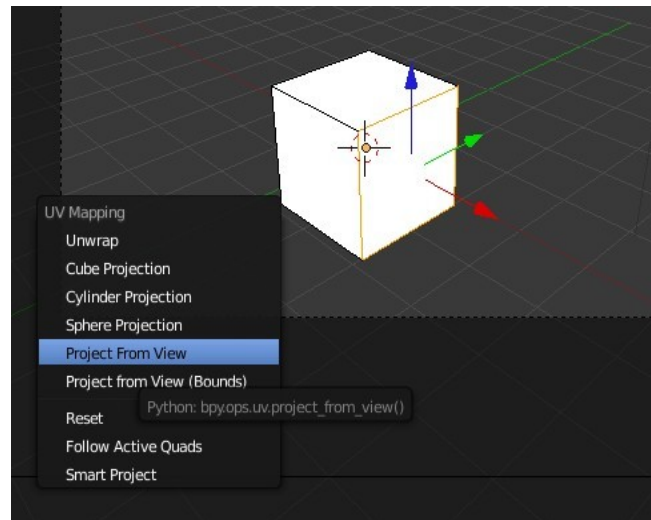
Outline of Selected Face

In the UV Image Editor load your image. In the header click 'Image' then select 'Open'. This opens a file browser window where you navigate to the folder containing you image. Click on the image file and click on 'Open' (Upper RHS).

Image File Location ———— C:\Users\John Blain\BasicsRewrite\CH14-Modifiers\01-Generate\UV-Project\Screenshots\

File Name ———— Lotus.jpg

Image File selected ————
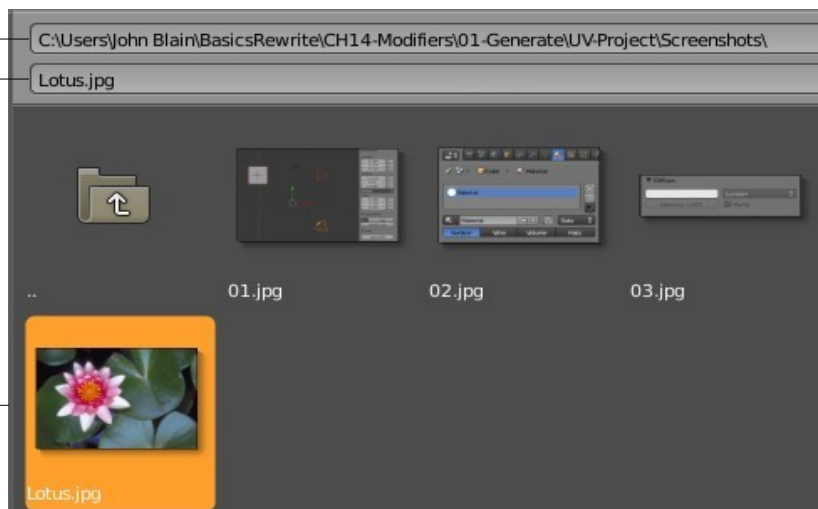
Your image displays in the UV Image Editor window. You can still see the outline of the face you have selected.
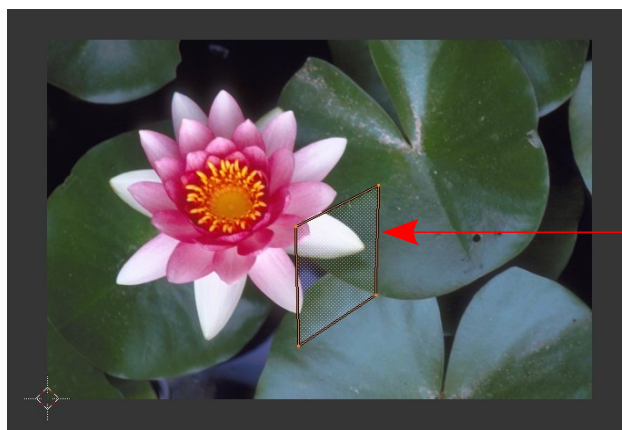
Outline of Selected Face

If you Press A Key to select the face outline and G Key and move the mouse you will see the image projected on the face in the 3D Window move at the same time.
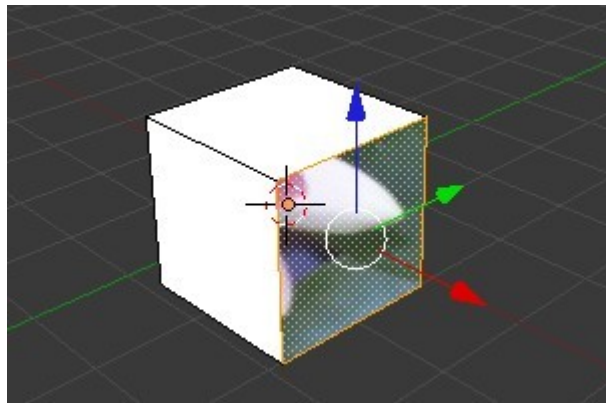
Image on selected face

If you press F12 and render with the cursor in the 3D Window you will see whatever portion of the image is covered by the face outline in the UV Image editor is rendered on to the selected face of the Cube. You can also scale the face outline to capture more or less of the image.

This shows you one method of projection but that is not where we were heading to begin with. We want to use our projector but we have given Blender the information about our image and have established some mapping coordinates.

At long last we can add our UV Project Modifier.

Click and select your Image file

Click and select Projector

Click and select UV Tex
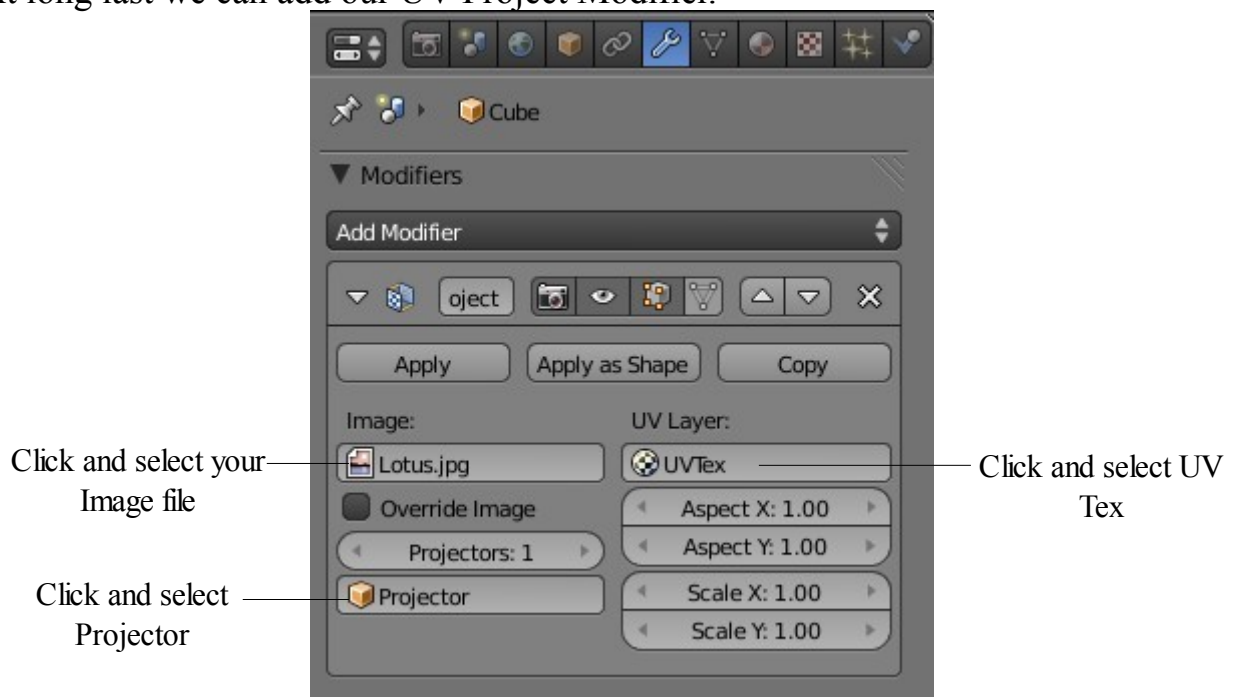
The Cube remains selected. In the Properties Window – Modifier button click 'Add Modifier' and select 'UV Project' to display the modifier panel. In the modifier click on the panels shown and select your Image ,the Projector and the UV Tex coordinates.

Render (Press F12) to see the image projected on to the face of the Cube.

By moving the Projector in the 3D Window relative to the Cube or moving, rotating or scaling the Cube relative to the Projector the portion of the image displayed can be controlled.
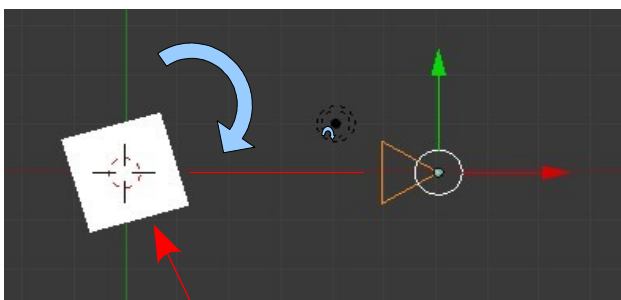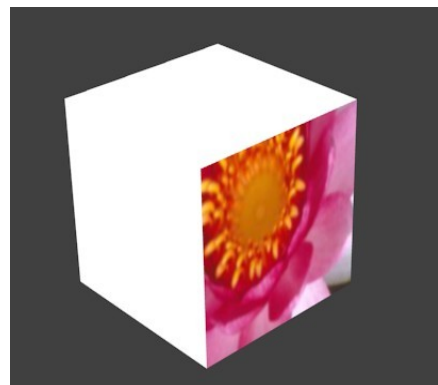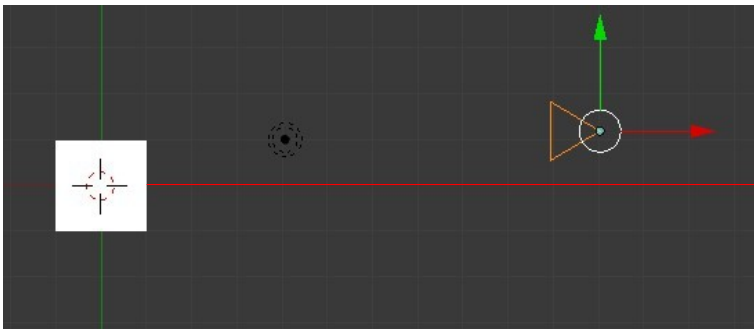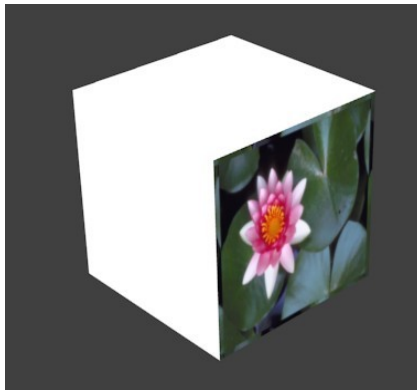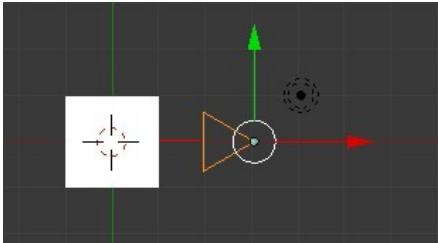
Selected Face
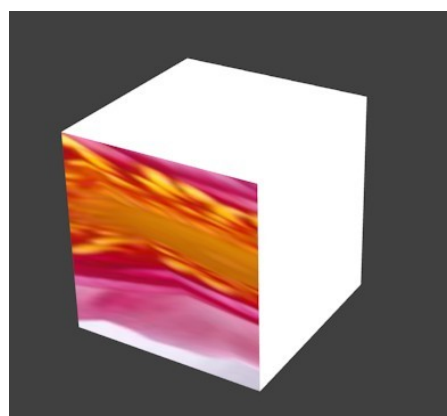
Armature Modifier

The Armature Modifier is the mechanism that links a mesh object to a deforming armature. In CH18-Armatures, the procedure for automatically assigning an armature to a mesh is described by setting up a Child Parent relationship. Setting this relationship automatically adds an Armature Modifier to the mesh being deformed. Instead of setting a Child Parent relationship the Armature Modifier can be manually added and the deforming Armature named.

Armature Modifier Added with Mesh object selected

Armature named in Object panel

Armature selected

Armature Bone .000 Rotated deforming the Mesh object
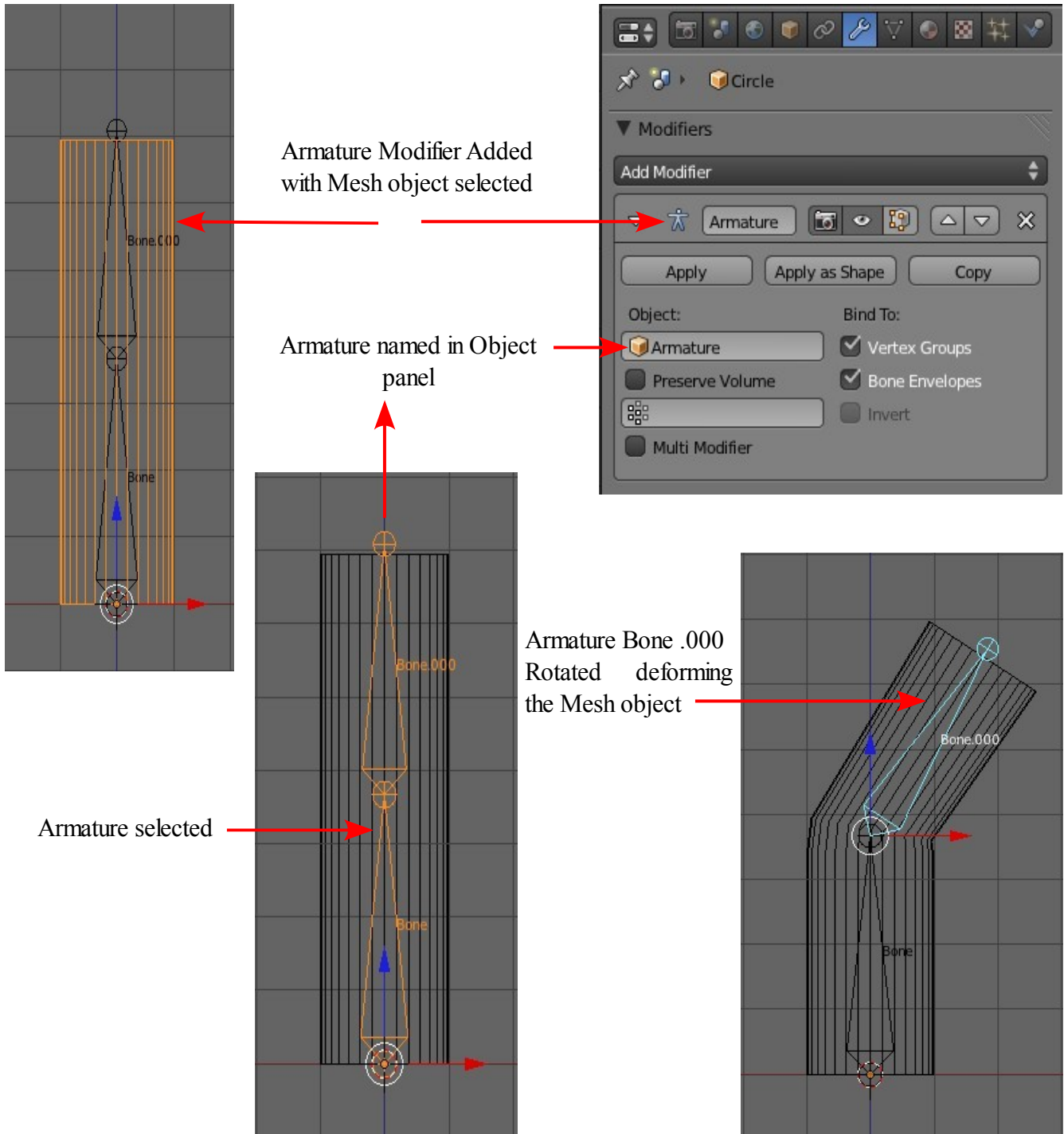
Cast Modifier

The Cast Modifier shifts the shape of a mesh, curve, surface or lattice to any of the predefined shapes included in the modifier ie. Sphere, cuboid or cylinder.

X, Y, Z: ——— Untick to disable the deformation on that axis.

Factor: ——— Slider controls the deformation. 0 = original + or – to deform.

Radius: ——— Only deform vertices within this distance from the center (0 = infinite).

Size: ——— Size of the projection shape (0 = automatic).

Vertex Group: If vertices are assigned to a vertex group only those vertices will be effected.

Control Object: If a control object is used it determines the center of the effect.
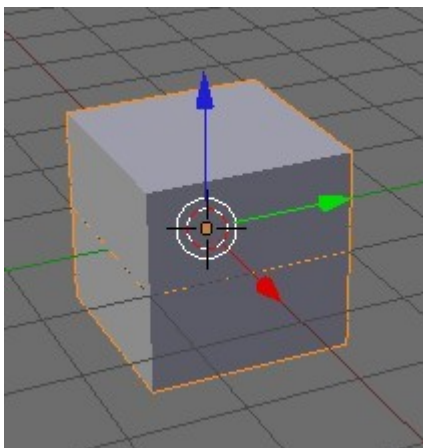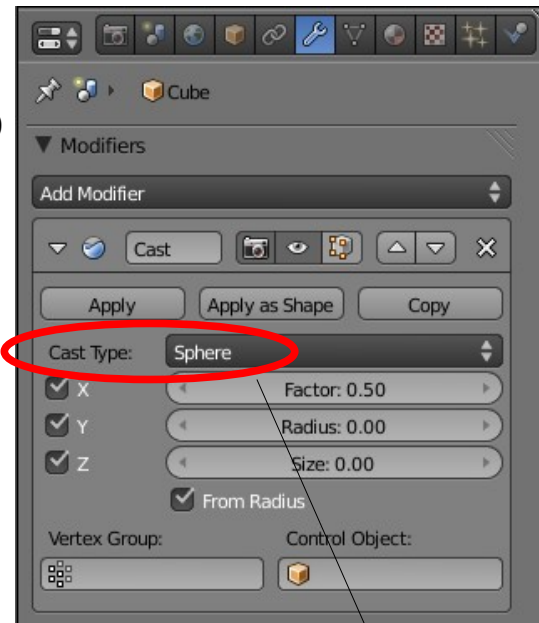
Default Cube
Subdivide x3 in Edit mode
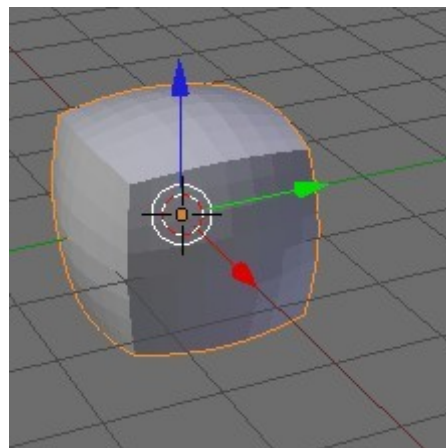
Cast Type Sphere
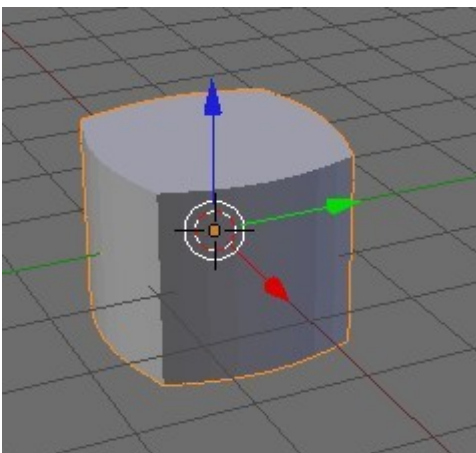
Cast Type Cylinder
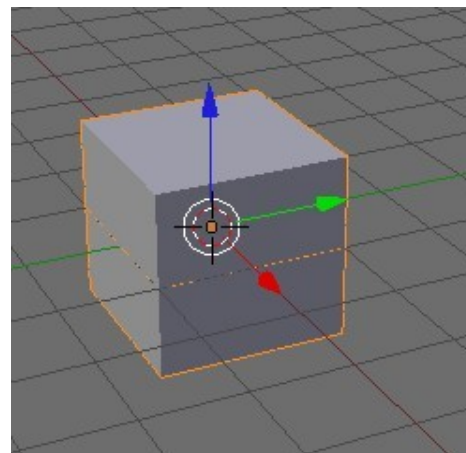
Cast Type Cuboid

Curve Modifier

The Curve Modifier uses a Curve to deform a mesh.

Curve Modifier

Scale and subdivide Cube mesh. Add a Bezier
Curve to the scene and scale up.
Add Curve Modifier to the scaled Cube and
enter the name of the Bezier Curve in the Object
panel

Default Cube scaled on X axis and
subdivided six times in Edit mode.
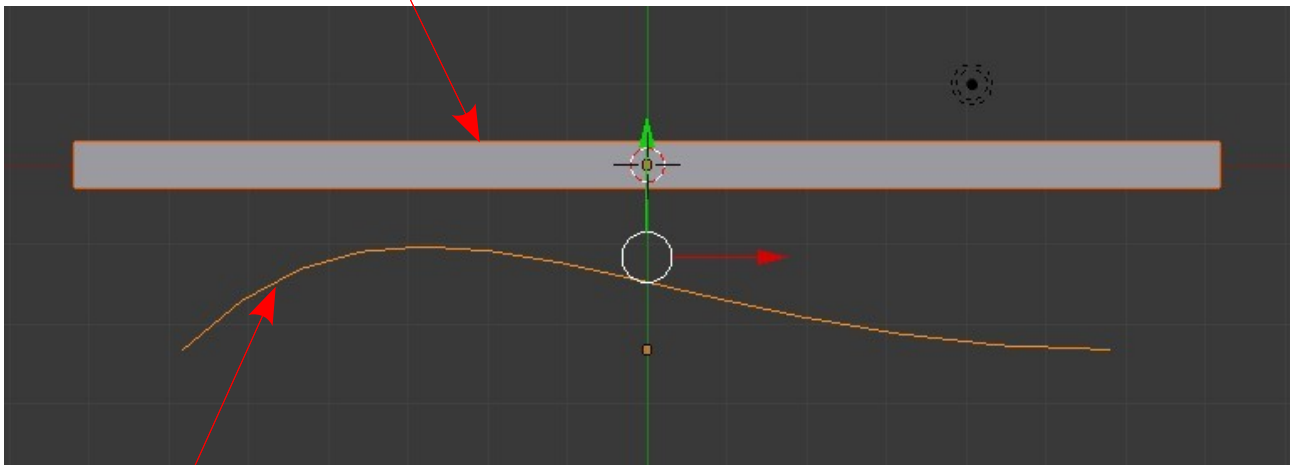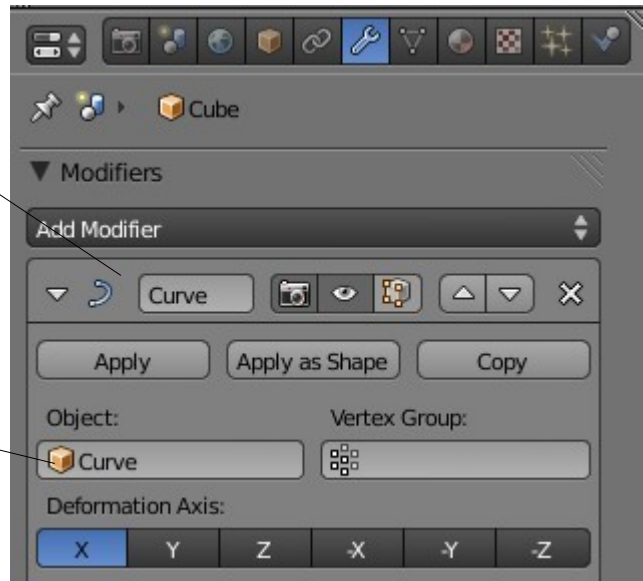
Bezier Curve scaled on the X axis
Name = 'Curve'

Scaled Cube with Curve Modifier added
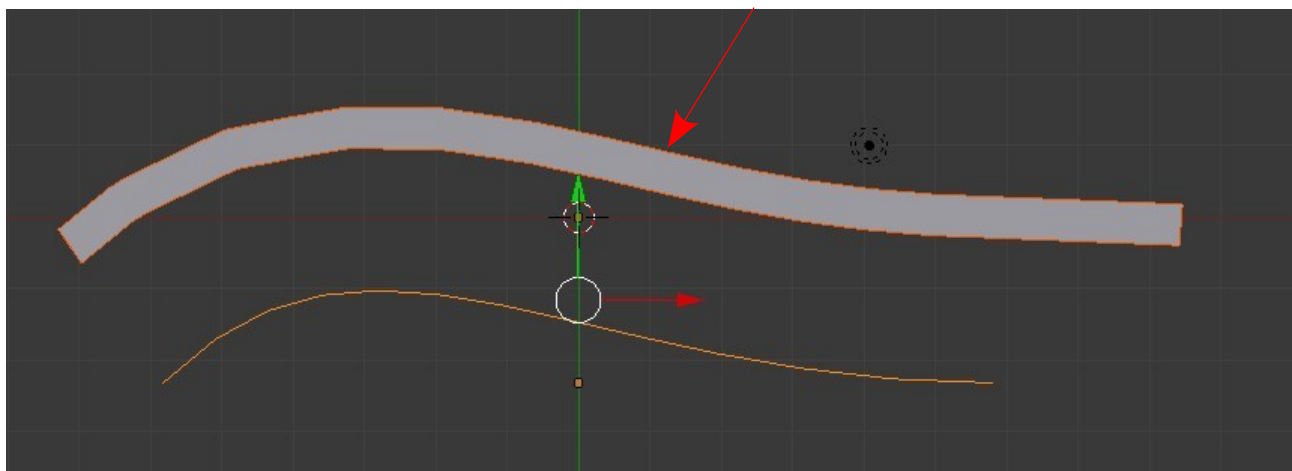
Select the Curve and change its shape in Edit mode to manipulate the shape of the Scaled Cube

Displace Modifier

The Displace Modifier uses a Texture to displace the vertices of a mesh. If vertices are assigned to a Vertex Group and the group is entered in the modifier only the vertices belonging to the group will be effected.
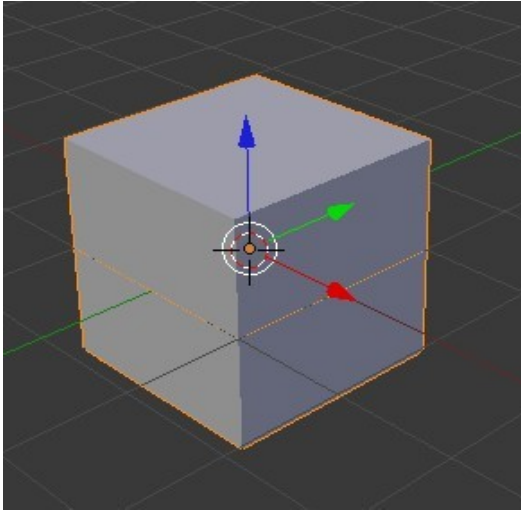
Default Cube
Subdivided in Edit mode

Modifier
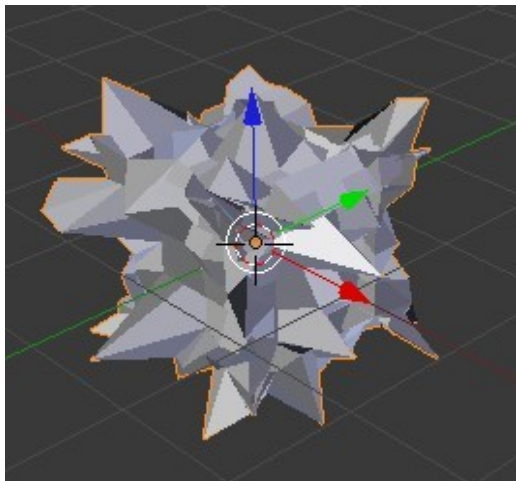
Enter 'Group'

Default Cube with Displace Modifier
Distorted Noise Texture entered
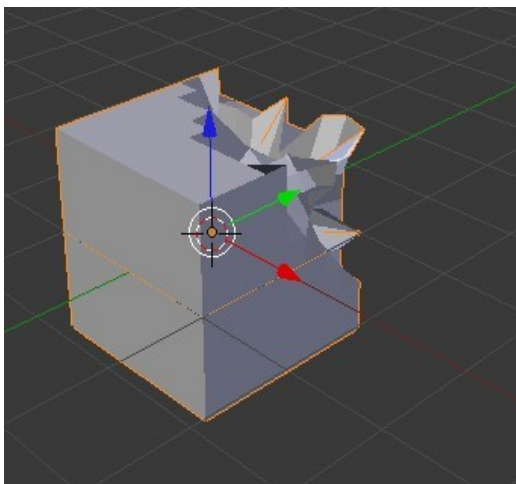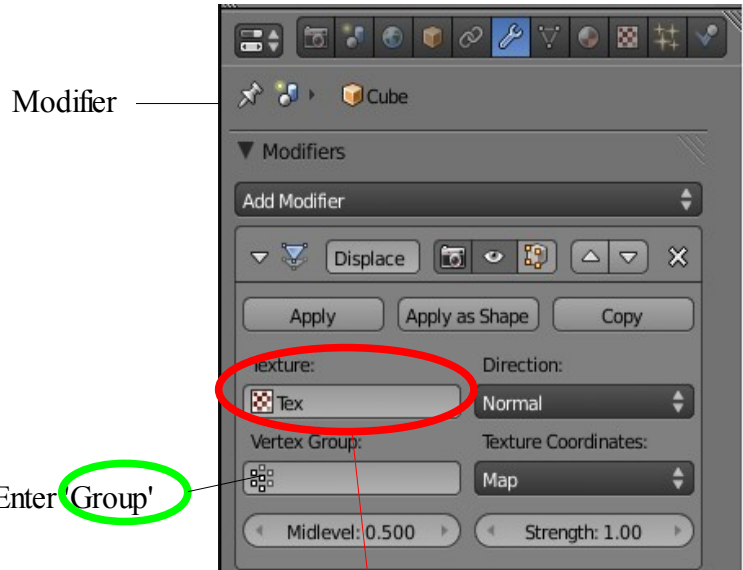
Texture
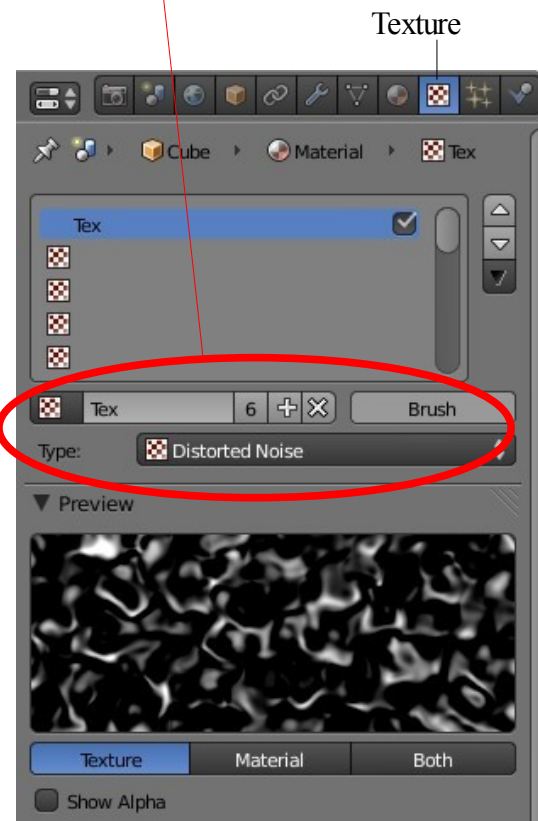
Vertex Group Selected

Select vertices in Edit mode and assign to
Vertex Group. Enter 'Group' in the modifier

Hook Modifier

The hook modifier allows you to manipulate or animate selected vertices of a mesh while in Object mode. Vertices are assigned (Hooked) to an Empty object which can be moved in Object mode pulling the selected vertices with it. This can be use for a static mesh deformation or the movement can be animated.

Simple Example: Moving one corner of a Cube.

Start with the default scene with the Cube object selected. Tab to edit mode and deselect all vertices then select one vertice (Corner). Press Ctrl + H Key and select ' Hook to New Object'.

An Empty is added to the scene and by going to the Properties Window – Modifier buttons you will see that a Hook Modifier has been added named:
 'ok-Empty'.
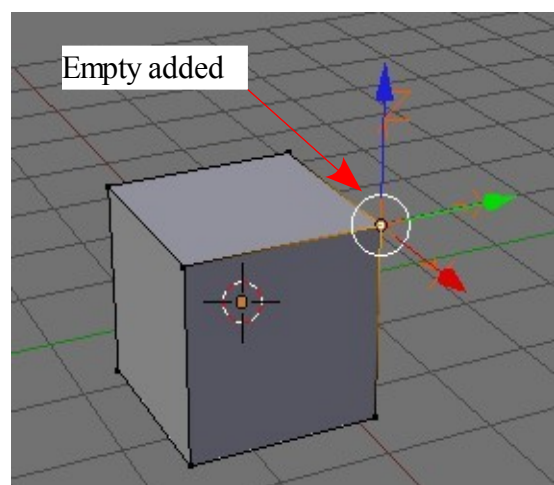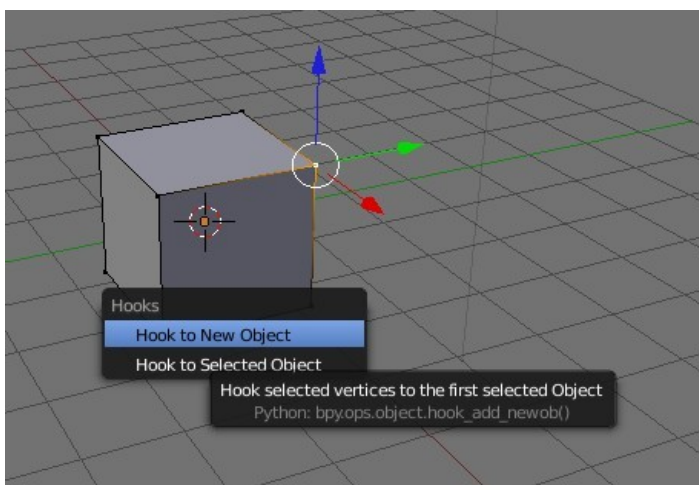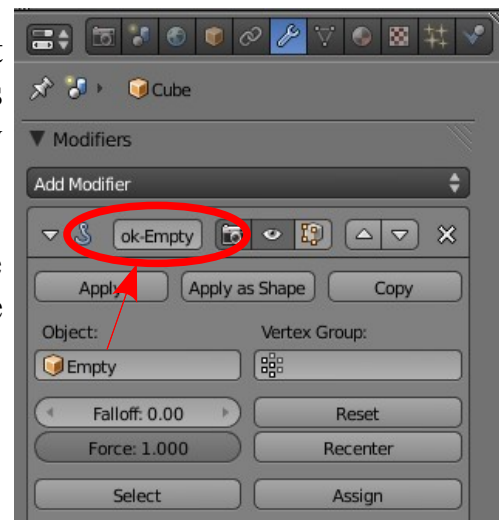
Select and move the Empty in Object mode and the Cube is deformed.
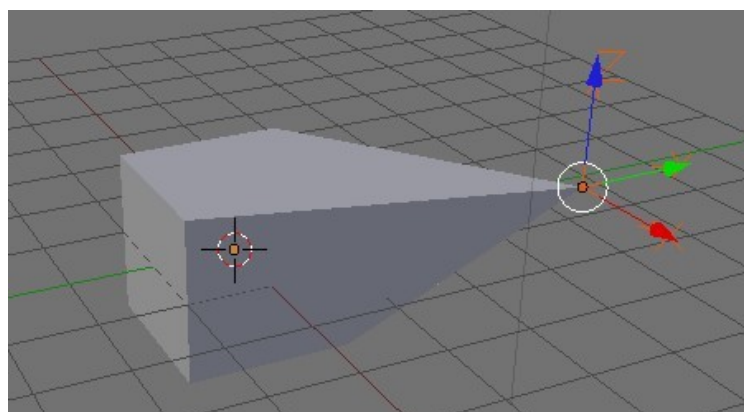
Lattice Modifier

The Lattice Modifier is used to deform a mesh object or to control the movement of particles. By using the modifier it is simple to shape a mesh object that has many vertices. A Lattice is a non renderable grid of vertices therefore it does not render in the scene. You can use the same lattice to deform several objects by giving each object a modifier pointing to the lattice.

Example: Deform a UV Sphere object with a Lattice. Add a UVSphere to the scene then add a Lattice. Before you can see the Lattice mesh you will have to scale up (S Key – Drag Mouse).

Lattice Modifier added to Sphere

Enter 'Lattice' here

\

The Lattice is entered as a simple mesh cube. Go to the Object data button in the Properties Window and alter the <u>U, V and W values in the Lattice tab</u> to subdivide the Lattice mesh.

UV Sphere   Lattice Mesh
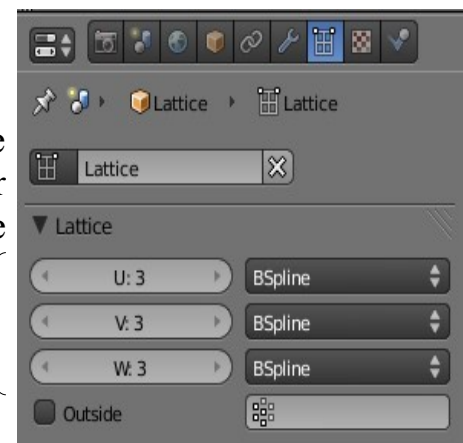
Single Lattice vertice selected and moved deforming the UV Sphere mesh.
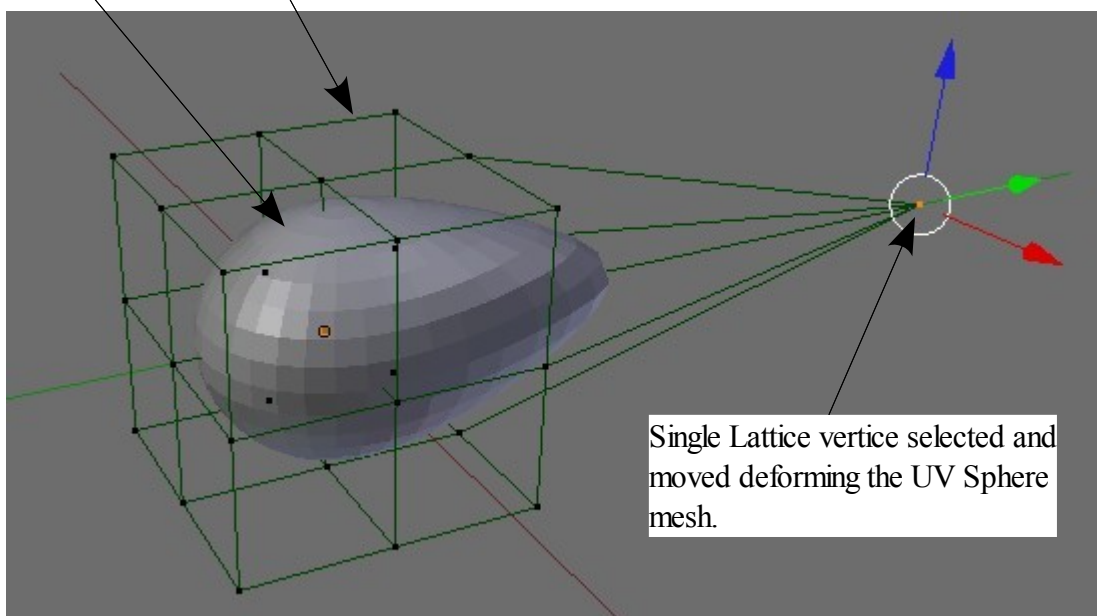
Mesh Deform Modifier

The Mesh Deform Modifier can deform one mesh with another 'cage' mesh. This is similar to a Lattice Modifier but instead of being restricted to the regular grid layout of a lattice, the cage can be modeled to fit around the mesh object being deformed.

The cage mesh must form a closed cage around the part of the mesh to be deformed. Only vertices within the cage will be deformed. Typically the cage will have far fewer vertices than the mesh being deformed.

After modeling your object surround it with a simple cage mesh and apply a Mesh deform modifier to the original object. Enter the name of the cage mesh and press 'Bind' to link the two meshes. The 'Bind' operation may take several seconds to calculate depending on the complexity of your model. Wait until 'Bind' changes to 'Unbind' before selecting vertices on the cage. By dragging scaling and rotating the selected vertices the original mesh will be deformed. The proximity of the cage to the original object has an influence on how to deformation reacts.
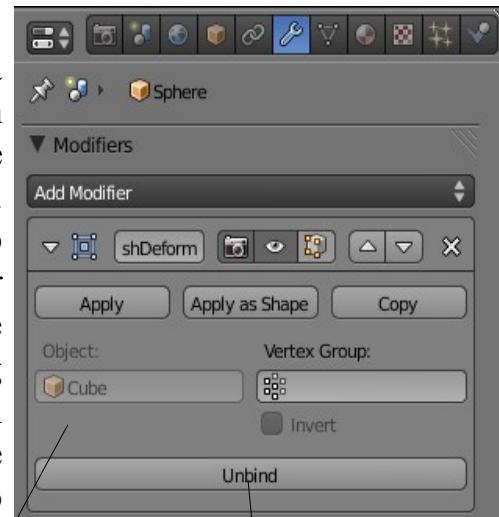
Mesh deform Modifier applied to Sphere.

Click on 'Bind' and wait until it changes to 'Unbind'

UV Sphere scaled to form an elongated worm shape.

Cube extruded to form cage
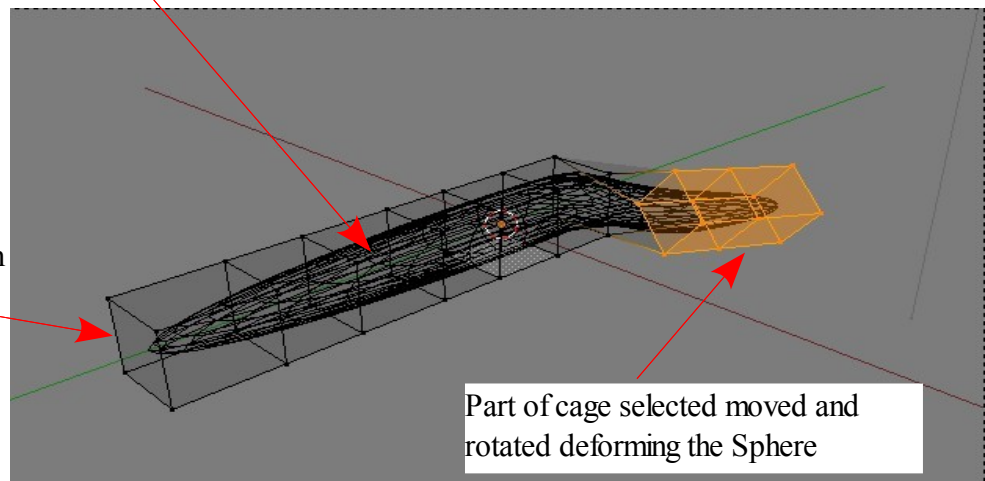
Part of cage selected moved and rotated deforming the Sphere

Note: The cage mesh will render in the scene therefore with the cage surrounding the elongated sphere all you will see is the cage. You can select the cage and move it away from the sphere keeping the deformation but the cage will still render. To see the elongated sphere deformed without the cage click on 'Apply' in the modifier tab. The modifier is applied to the sphere and removed. You can now delete the cage and the elongated sphere remains deformed.

Shrinkwrap Modifier

The Shrinkwrap modifier takes a mesh and shrinks it down wrapping the mesh around another object. The deformed mesh can then be offset to produce shapes in between the original shape and the deformed shape.

Shrinkwrap Modifier added to UV Sphere

Enter 'Cone" here

Increase 'Offset'
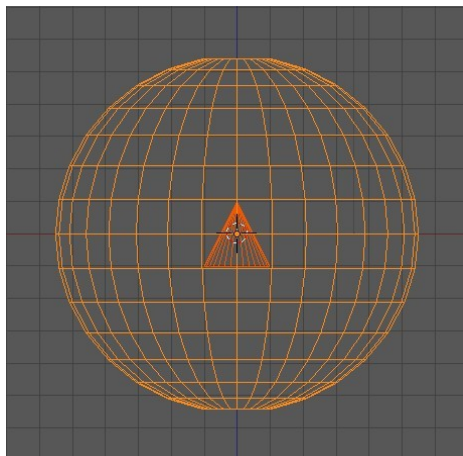
UV Sphere with Cone inside

UV Sphere wrapped around the Cone
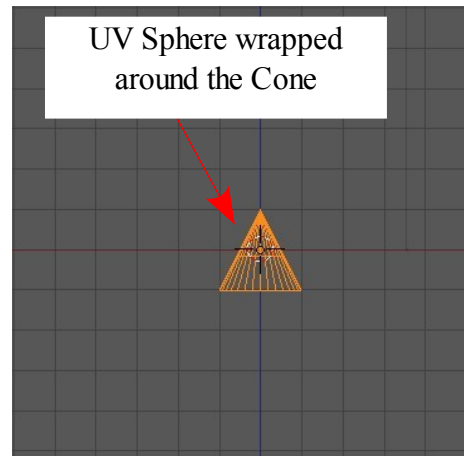
Shrinkwrap Modifier added
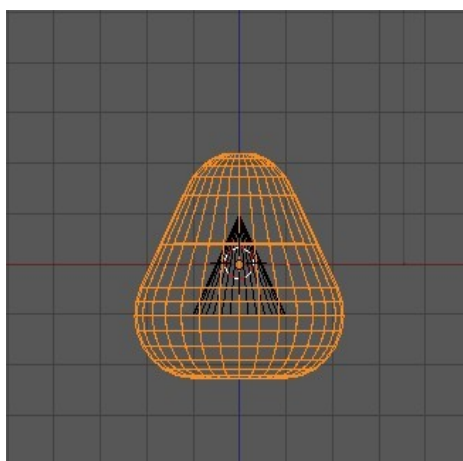
Offset increased to 1.25
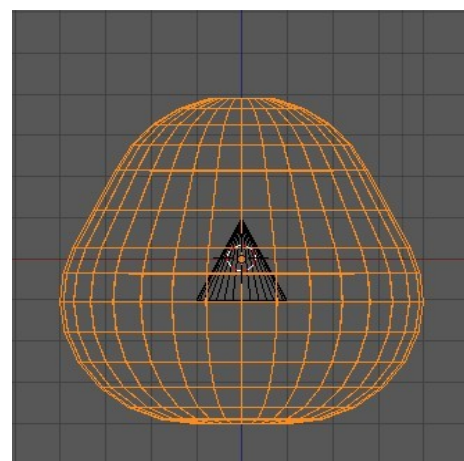
Offset increased to 3.00

Simple Deform Modifier

The Simple Deform Modifier deforms a mesh by increasing factor values in the modifier and having a second object having an influence.

To see this modifier in action have a UV Sphere in the scene with a scaled down Cube located on the center inside the sphere.

Sphere with Cube
inside on the center
Wireframe Mode

Front View
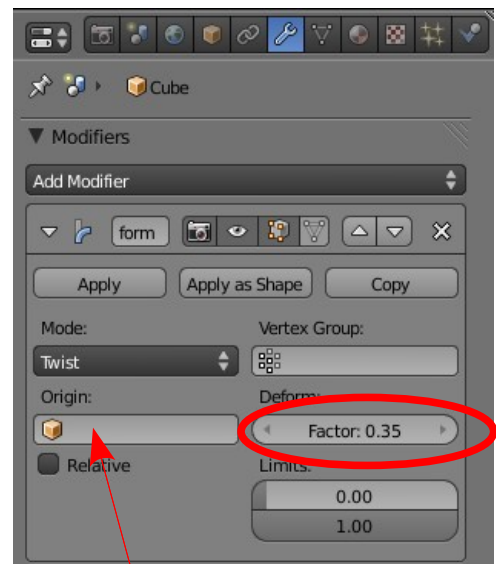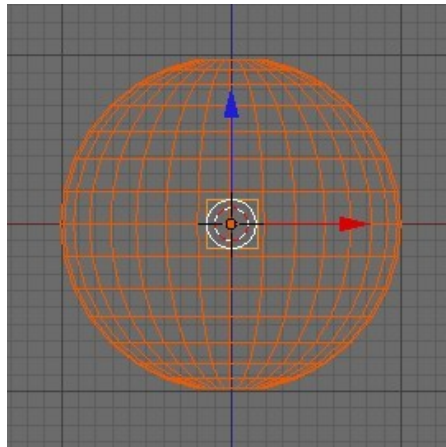
Enter 'Cube' as Origin
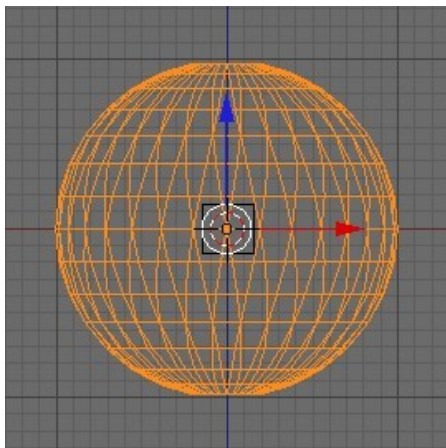
Modifier added Factor: 1.25
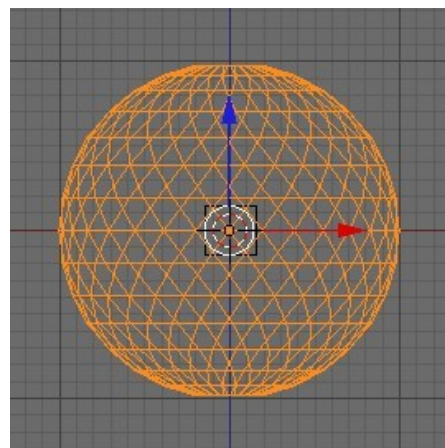
Factor: 3.00
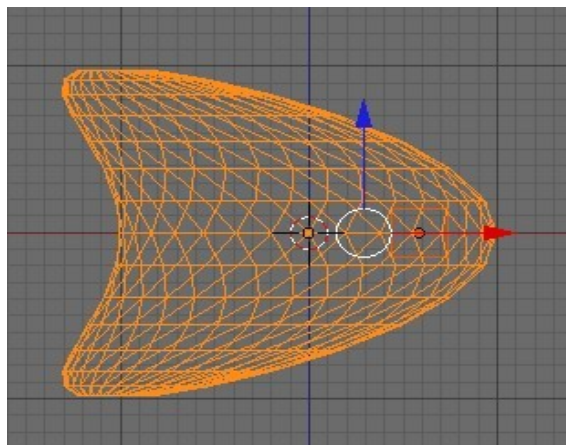
Cube entered in Origin and moved sideways.

Smooth Modifier

The Smooth Modifier smooths the mesh object by softening the angles between adjacent faces. This probably shrinks the size of the original object at the same time. The modifier is based on the 'Smooth' function in the Tools Panel.
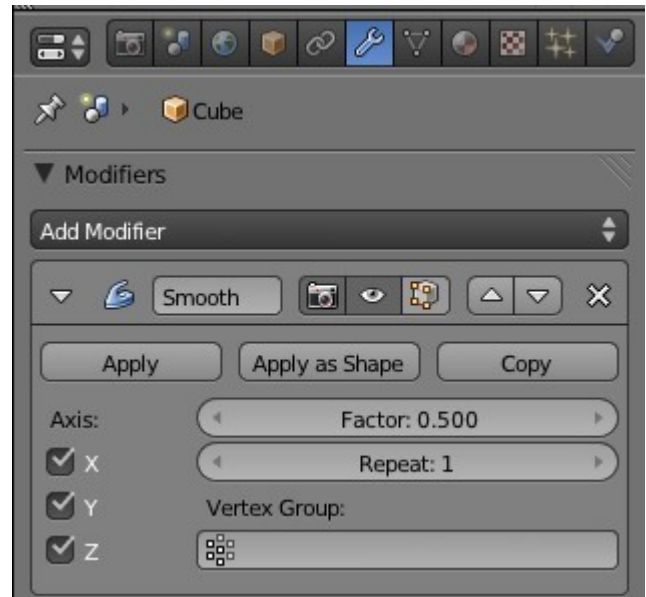
X, Y, Z: Specifies along which axis the modifier will be applied.

Factor: Defines the amount of smoothing in a range from 0.000 to 1.000. Lower or negative values can be used but can deform the mesh object.

Repeat: Specifies the number of smoothing iterations.

VGroup: Vertex Group named to specify which vertices are affected (The whole object if no vertex group specified).

Factor: 0.500
Repeat: 1

Factor: 2.00
Repeat: 1

Factor: 2.00
Repeat: 2
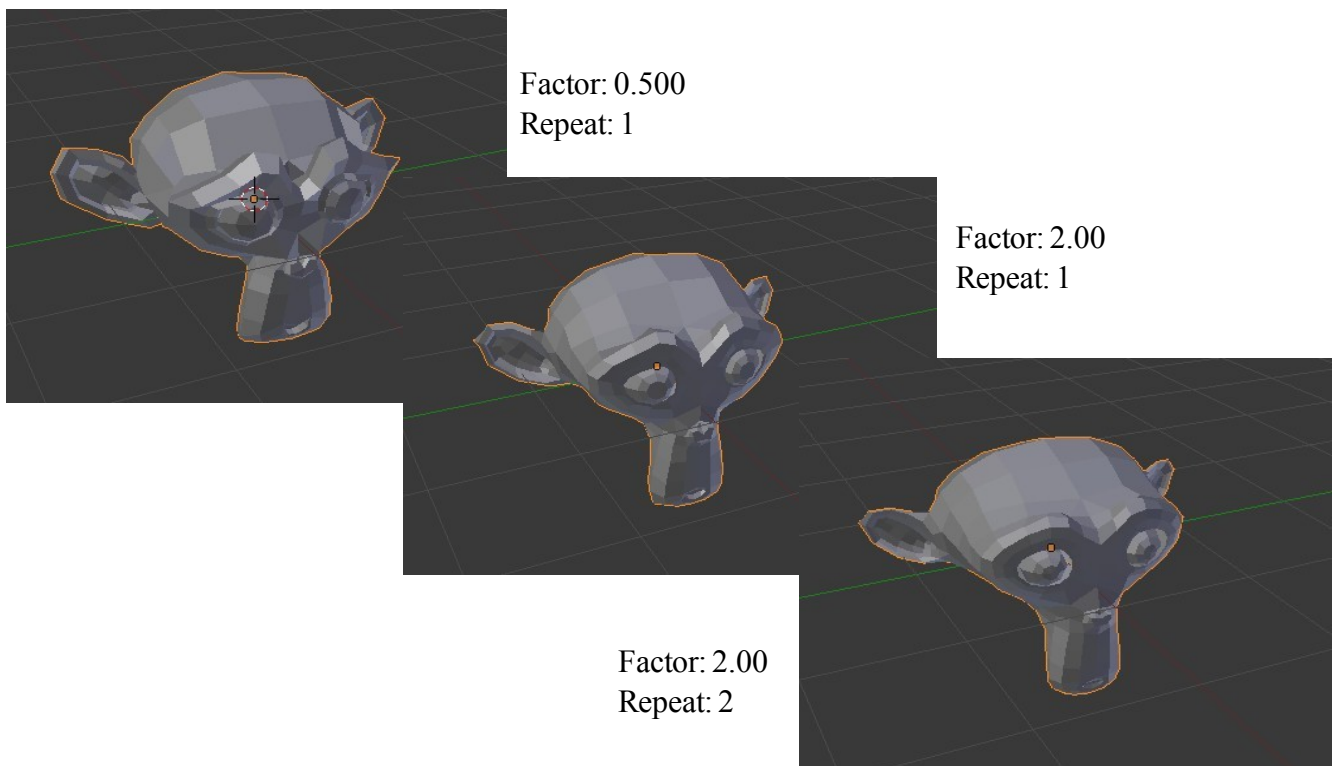
Wave Modifier

The Wave Modifier applies a deformation in the form of a wave. To demonstrate we will apply the modifier to a Plane.

In the default Blender scene delete the Cube and add a Plane. Scale the Plane up (S key+6). Tab into Edit mode and subdivide (Click 'Subdivide' in the Tools Panel 5 times). Tab to Object mode. You have to subdivide the Plane to get a nice affect.

Go to the Properties Window-Modifier button and click 'Add Modifier' to open the drop down selection menu. Select 'Wave'.
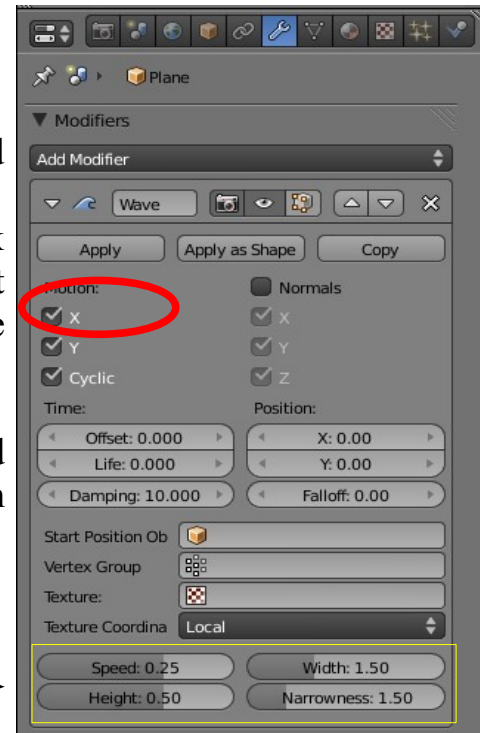
Wave Form Control Values ⟶

In the 3D Window you immediately see the Plane deform. It is pulled up in the middle and punched in at the top of the bulge. The Wave Modifier has been applied on both the X and Y axis. In the Modifier tab you see x, y and cyclic ticked. X and Y are the axis and cyclic means that an animation of the wave will repeat over and over.
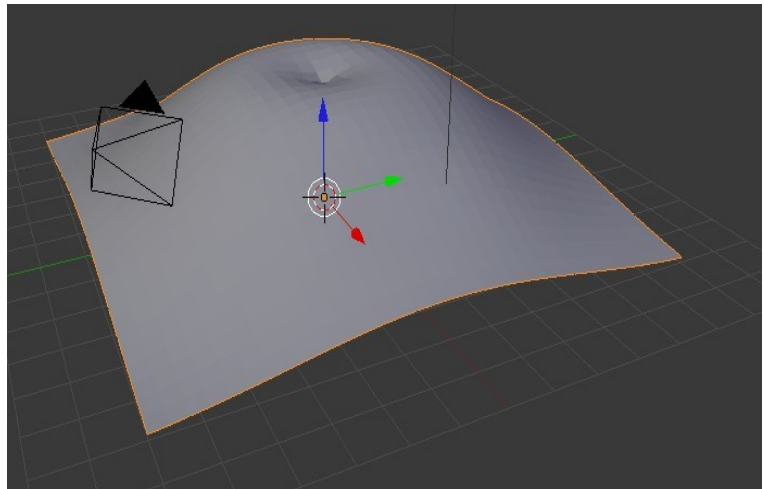
With your curs0r in the 3D Window press Alt+A to see the animation play. Press Esc to stop.

Untick the X axis in the Modifier tab and play again. A wave along the Y axis results.

Change Values

At the bottom of the Modifier tab change the 'Speed' to 0.09, the Width to 1.08 and the 'Height' to 0.34. Play the animation again. You can change these values to whatever you want. In fact, go ahead and play around with different values to see what happens. Its the only way to get the idea.

Cloth and Collision Modifier

The Cloth Modifier allow a mesh object to be animated to exhibit the characteristics of a cloth material or fabric.

To demonstrate the application of the Modifier follow this brief tutorial.

Modifier button

This refers to the Physics buttons
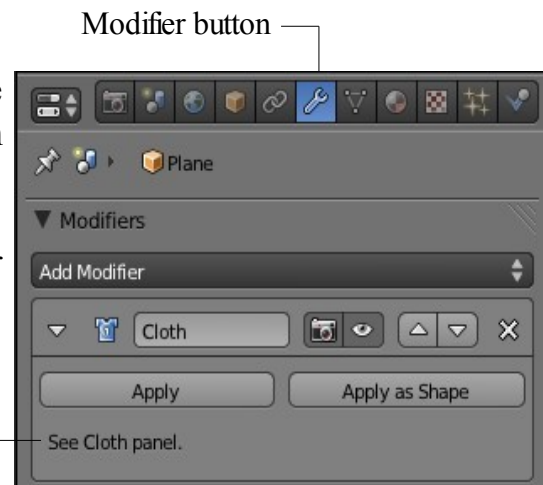
In a new scene delete the default Cube and add a Plane object. Scale the Plane up four times and in Edit mode subdivide four times. A reasonable number of subdivisions are required to produce a good effect. With the Plane selected in the 3D view go to the the Properties Window - Modifiers button and add a Cloth Modifier. With your cursor in the 3D Window press Alt + A to play an animation. At this stage the animation will simply show the Plane descending and disappearing out of view. Press 'Esc' to end the animation. If you look in the Properties Window - Scene settings you will see that a gravitational effect is applied hence the Plane descends due to this force.

Look at the Physics buttons in the Properties Window. Adding a Cloth Modifier has automatically added data for the physical properties of a cloth. Note: **'Presets: Cloth Presets'** is applied. There is a dropdown selection menu here for a variety of material types. Leave the Preset as the default setting.

Also note 'Pinning'. There is no tick in the Pinning box therefore this property is not activated. 'Pinning' refers to pinning the cloth in place such as to a noticeboard or clothesline.

Other data which controls how the Cloth reacts and interacts. {
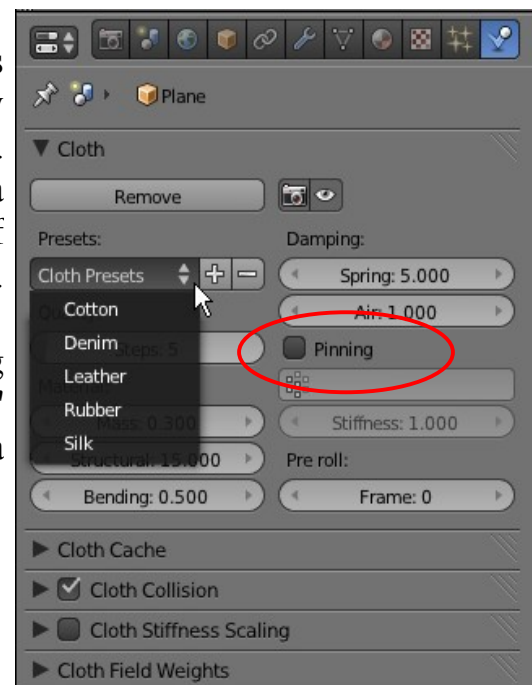
In the 3D Window with the Plane selected Tab into Edit mode, deselect all vertices and then select only the two vertices on the rear corners of the mesh. Go to the Properties Window – Object data button Vertex group tab, click on the plus sign to add a Vertex Group. With the two vertices selected press 'Assign' which assigns the two vertices to the group. Note Blender has named the vertex group 'Group'. You can of course change this name if you wish. Tab back to Object mode. Go to the Physics button and Tick 'Pinning' then click on the vertex group panel just below 'Pinning' and click on 'Group' to select the vertex group. In the 3D Window press Alt + A to play the animation again. Observe that the Plane (Cloth) falls away as if pinned in place and held by its two corners. Press 'Esc' to stop the animation.
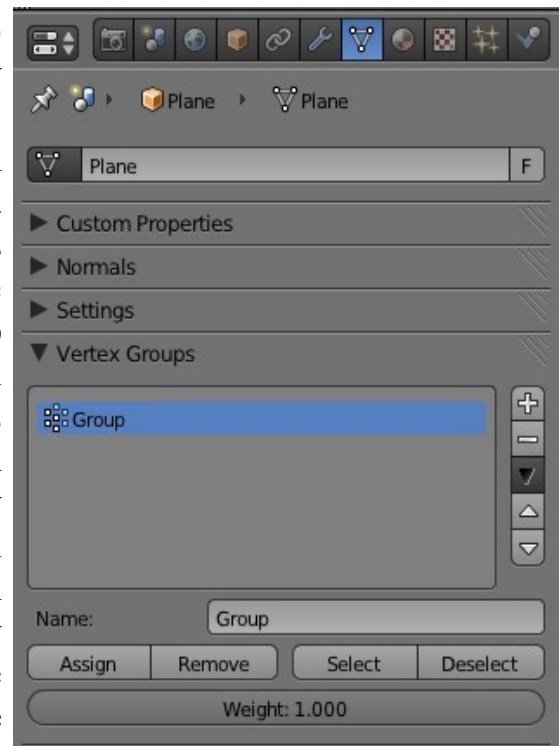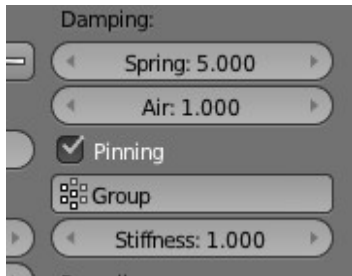
Two rear corners Pinned

Front of Cloth Plane falling away
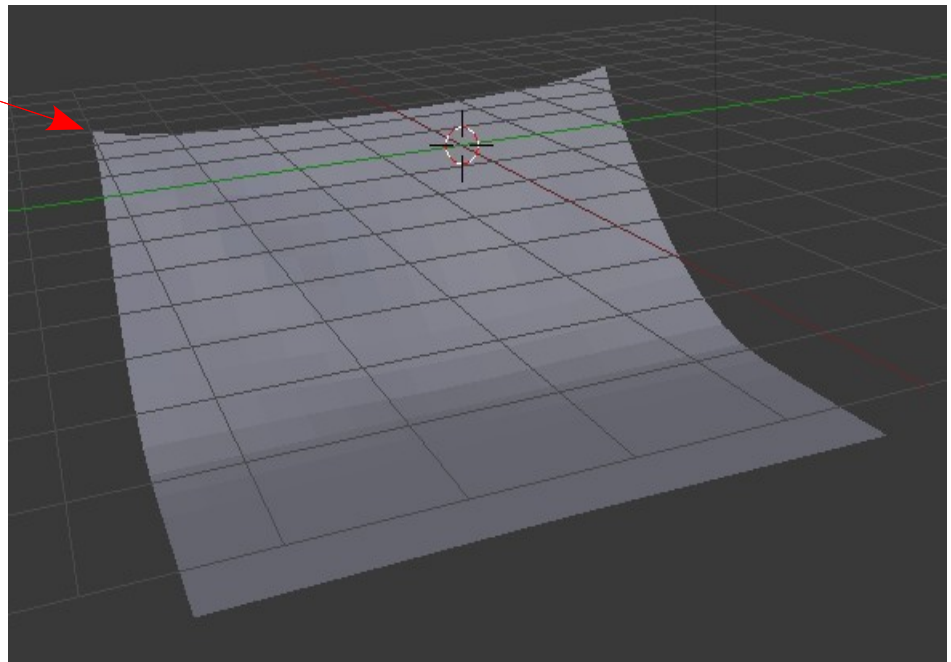
The Cloth Plane can be made to interact with other objects in the scene. Add a UV Sphere and position it below the Plane as shown in the diagram.

With the Sphere selected go to the Properties Window – Modifier button and add a Collision Modifier. Replay the animation and you will see the Cloth (Plane) fall and drape over the sphere.
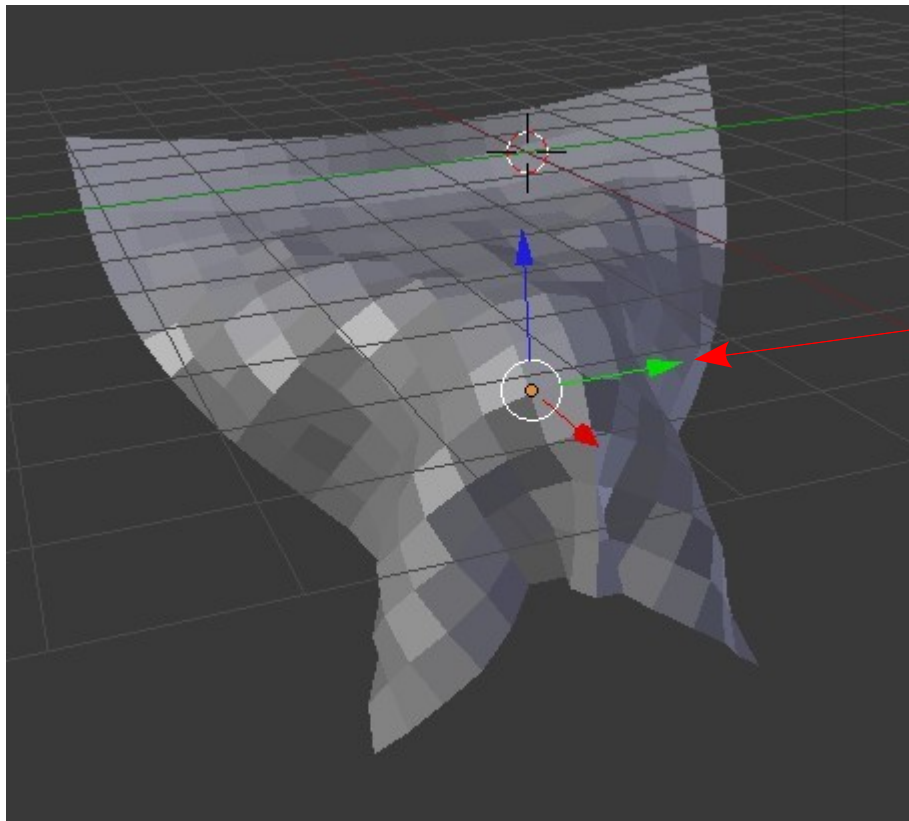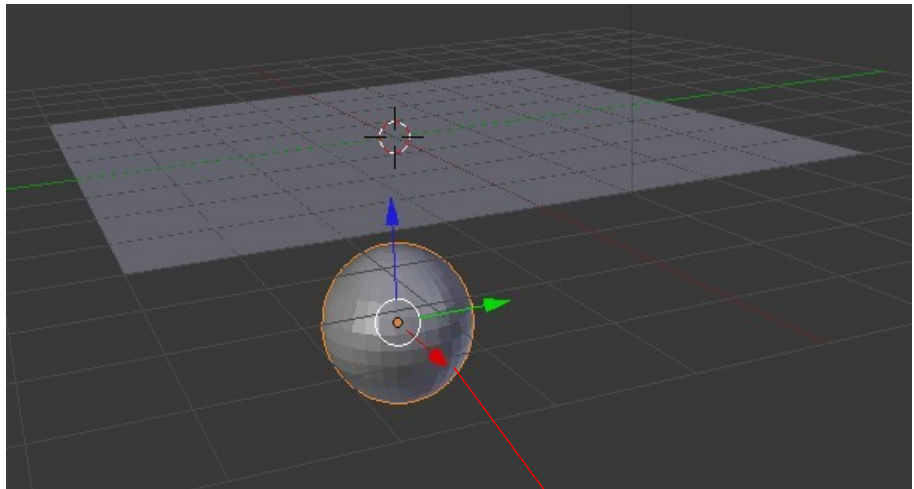
UV Sphere selected in the 3D View as indicated by the Manipulation Widget showing.

Adding Modifiers to objects introduces data in the Physics button – Properties Window which controls how the Objects react and interact. It is beyond the scope of this basic demonstration to explain all the settings. Experiment with the settings and record your findings to become proficient in the use of these Modifiers.

Explode Modifier

The Explode Modifier lets you make a mesh object fly apart or explode. Before you can apply an Explode Modifier you must have an Emitter Particle System applied.
If you are working methodically through this manual you haven't come to that yet so maybe put this on hold for a while. We will write the procedure anyway since it is such a neat modifier.

In the 3D Window delete the Cube and add a UV Sphere. Leave the default number of segments and rings. Zoom in on the Sphere a bit.

With the Sphere selected go to the Properties Window-Particles button and in the panel click on the plus sign to add a Particle System.
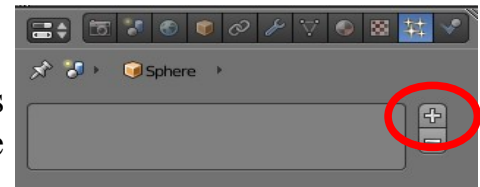
In the Emission tab change the Amount value to 100 and the Lifetime value to 250.
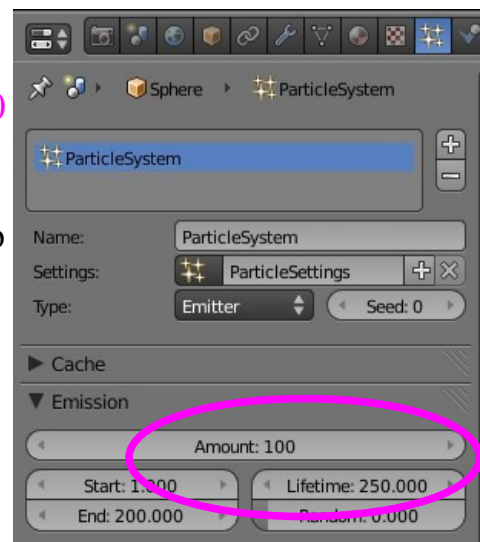
In the Properties Window- Scene button-Gravity tab **untick** Gravity.

Remove the Tick
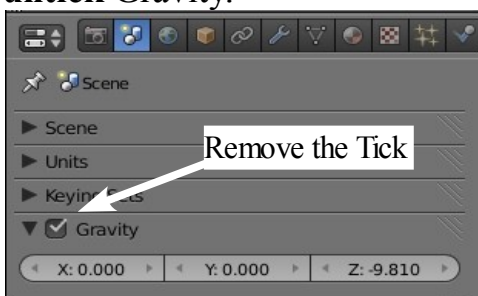
In the Properties Window-Modifier button click 'Add Modifier' (You will see that there is already a Particle System modifier applied). Select 'Explode'.
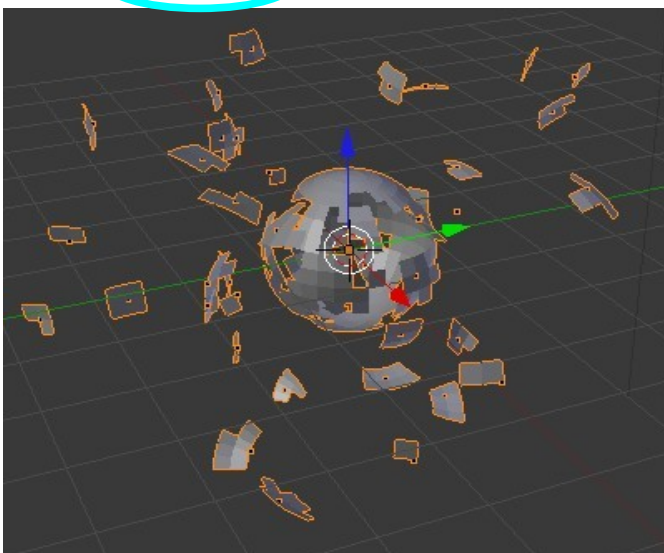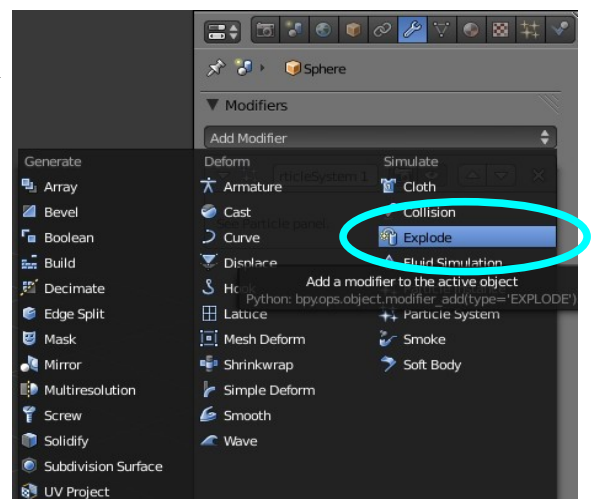
With your curser in the 3D Window press Alt+A to see the Sphere Fly Apart

Fluid Simulation Modifier

The Fluid Simulation Modifier allows the simulation fluid or liquid.

The application of this modifier has been covered comprehensively in Chapter 20.

Particle System Modifier

The application of the Particle System Modifier adds a Particle System to an Object.

The Particle System has been covered comprehensively in Chapter 15.

Particle Instance Modifier

The Particle Instance Modifier allows you to duplicate an Object and position the duplicates mimicking the position and number of particles emitted from a Particle System. It follows that in order to apply the Particle Instance Modifier to an object you must have a second object in the scene object with a Particle System attached.

As always an example is a good way to explain this type of application. Before you begin be familiar with Particle Systems as described in Chapter 15.

In a new scene delete the default Cube and add a Plane object. Leave it set as default on the centre of the world. Deselect the Plane and add a UV Sphere. Both the Plane and the Sphere will be located at the centre of the world.
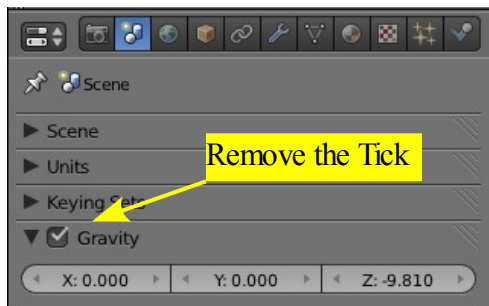
Go to the Scene button in the Properties Window and untick 'Gravity'. This is done so that particles emitted from an Object will not be subject to a gravitational force.

Remove the Tick
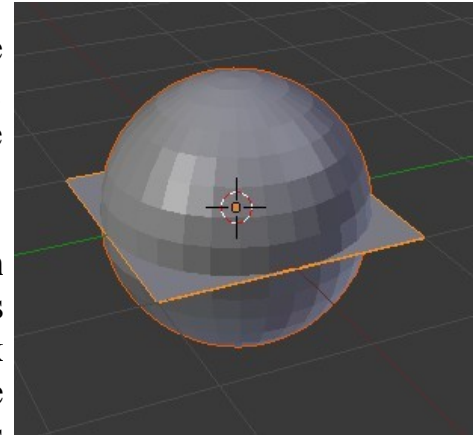
With the Plane selected in the 3D Window add a Particle System. Use the default system and change the following settings.

Emissions tab: Amount: 5
                Lifetime: 250 (The length of the default animation in frames)
                Emit From: Verts (Particles will emit from the vertices)

Velocity tab: Normal: 1.600 (Gives the particles a starting velocity)
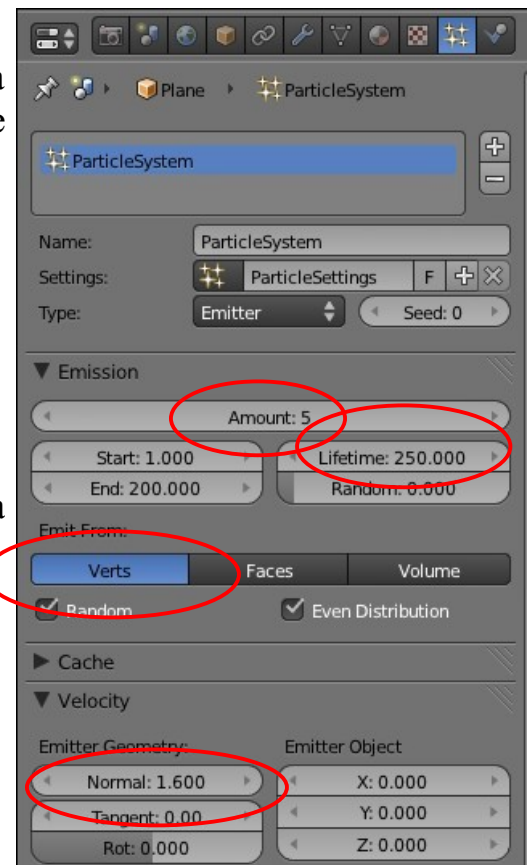
With the UV Sphere selected in the 3D Window add a Particle Instance Modifier. Click in the Object panel and select 'Plane'. In the 'Create From:' and 'Show Particles When:' columns tick the boxes as shown in the diagram. We only want to show objects associated with live particles and we want to control the size of the objects by adjusting the size of the particles.
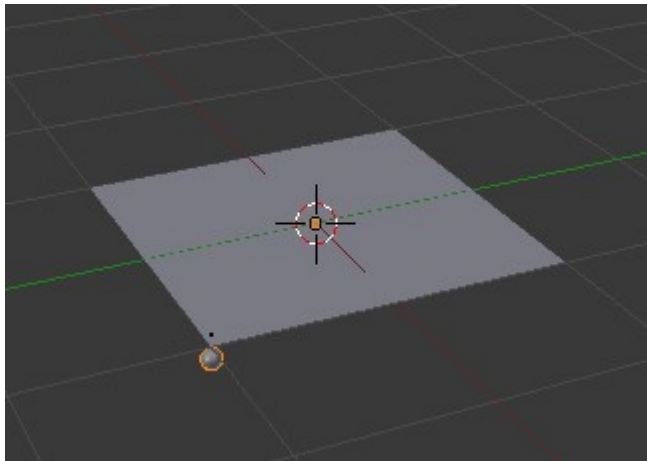
3D View After Modifier Settings Changed
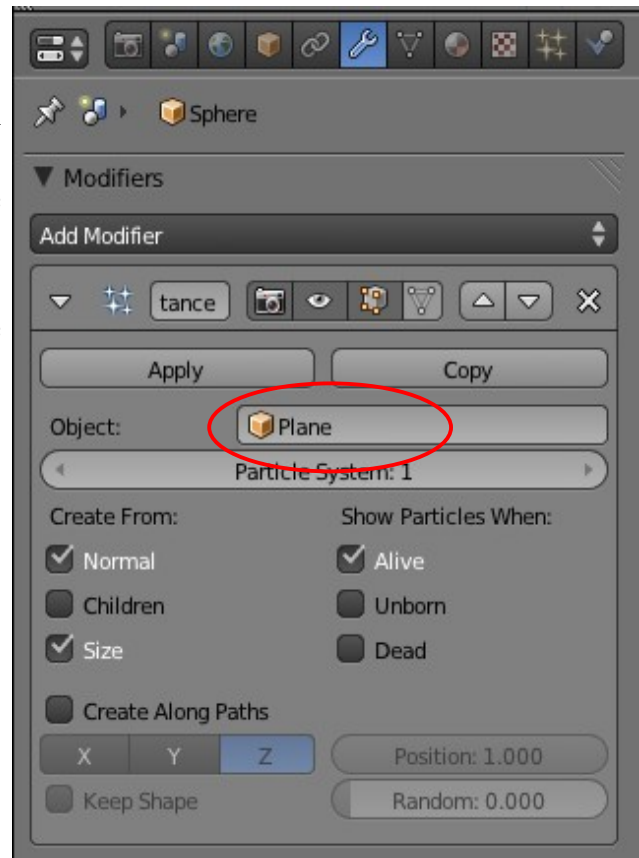
Go back to the Plane's Particle System and in the Physics tab set Size:0.300. This is controlling the size of the object instances in the 3D Window.
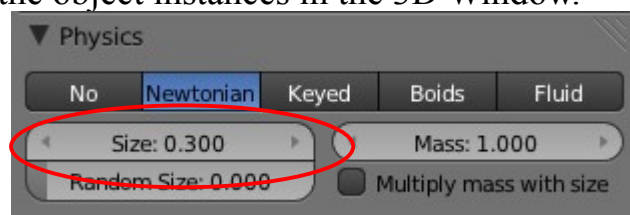
Particle Size: 0.300
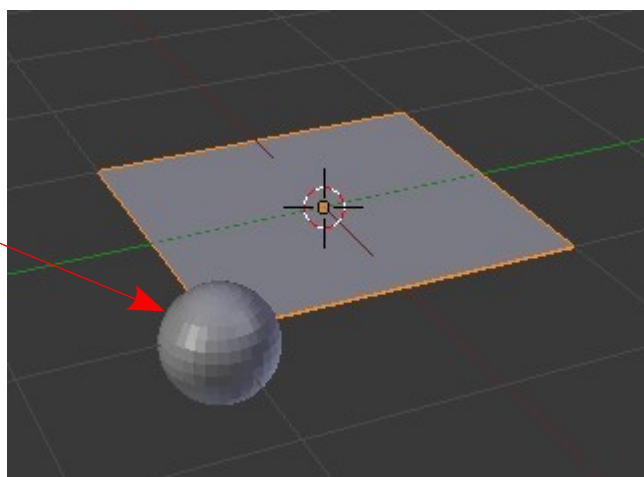
Press Alt + A with the cursor in the 3D Window animate the generation of Particles and duplicates of the Sphere. You will see that the Spheres being generated from the corners of the Plane (The vertices) in a random order. In the Plane's Particle System – Emissions tab 'Random' is ticked.
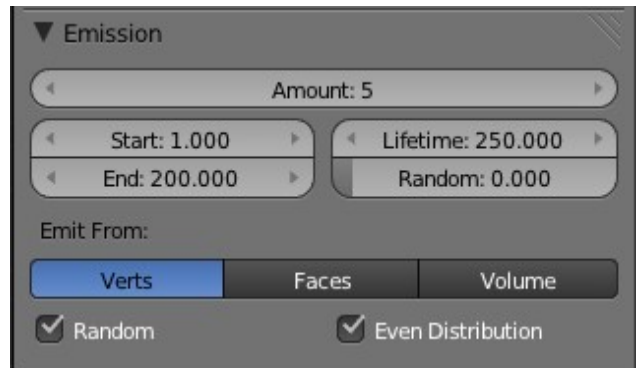
Allow the 250 frame animation to play then press Esc.

You can use the Up/Down, Left/Right Arrow Keys to move through the animation frame by frame to see the Sphere duplications and you can render an image at any stage to see the result. You will probably have to reposition the Camera to get a good view.

Emission Amount: 5 equals five Instances
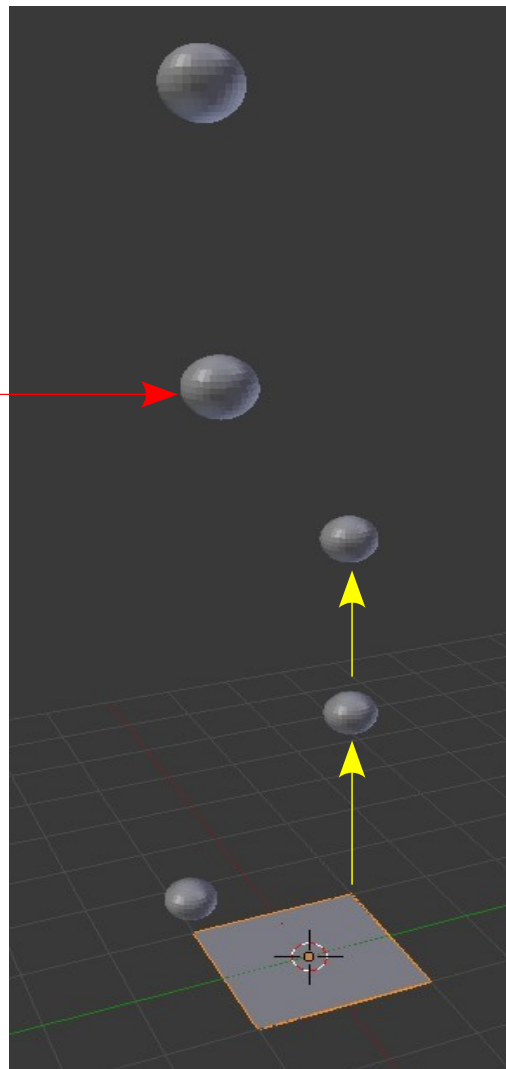
Particle Instances generated from Vertices

Finally, while at frame 1 select the Sphere and drag it away from the centre of the scene.

Step through the animation again. The Spheres are generated mimicking the position ov the Plane's vertices. If you render an image you will see the Particles rendered as halos as well as the Sphere duplicates.

Sphere moved from centre of Scene. Emitter Plane remains on centre
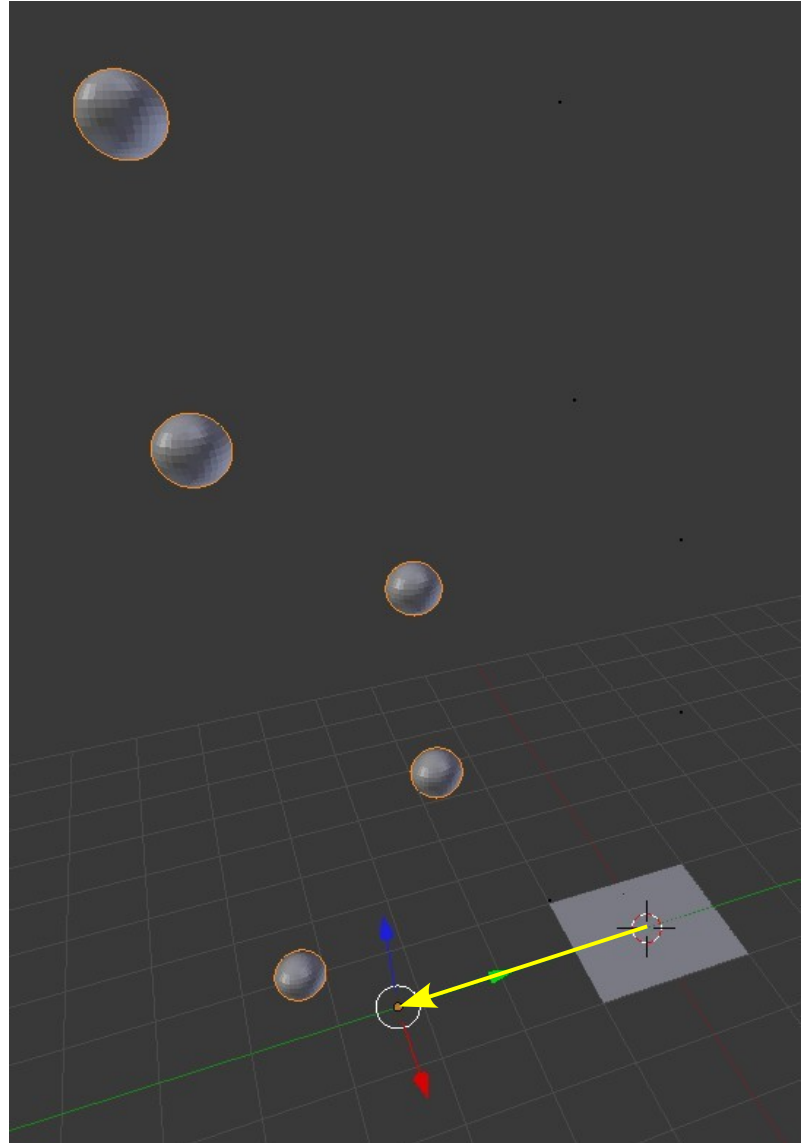
This has demonstrated that you can duplicate Objects by the use of a Particle System and control the effect with the Particle System. As always there are plenty of controls with which experiment. You will find detailed tutorials on the internet describing specific applications of the Particle Instance Modifier.

Smoke Modifier

The Smoke Modifier provides the means of adding a Smoke simulation to your scene. The following example is a procedure for demonstrating the Smoke Modifier. This procedure has been compiled from various tutorials existing at the time of writing and only encompasses a very basic example. Experimentation will be required to fully understand the application of this modifier.

Create the Domain

Camera View

Before you can add smoke to your scene you need to define the area where the smoke simulation takes place. In Blender physics this area is called a **Domain**.
In this case choose a Cube object and **scale it in Object mode** to fit the Camera view.
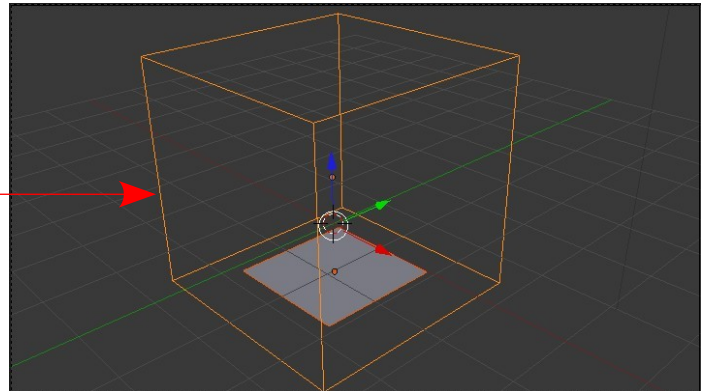
Make sure you are in Object mode and go to the Properties Window. At this point there are two methods of adding a Smoke Modifier to the object:

> **Method 1.** Select the Modifiers button – Click 'Add Modifier' – select 'Smoke'.

Note: To create smoke you define a volume of space for the smoke to occupy (The Domain) and you place an object within the Domain to make the smoke (The Emitter). Both the Domain and the Emitter have a Smoke Modifier applied.
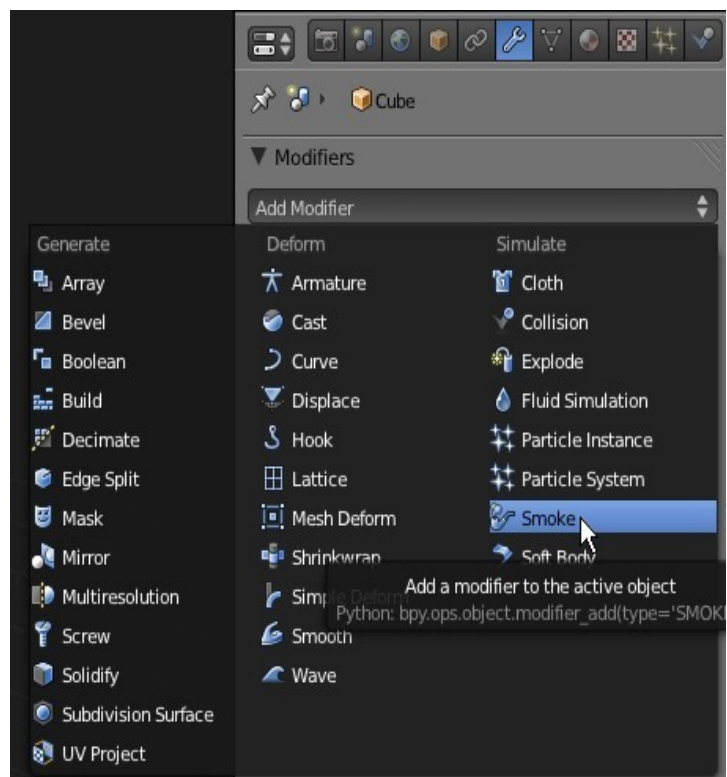
Method 2. Select the Physics button – Smoke tab – Click 'Add'.

Physics button

Smoke tab after
clicking 'Add'
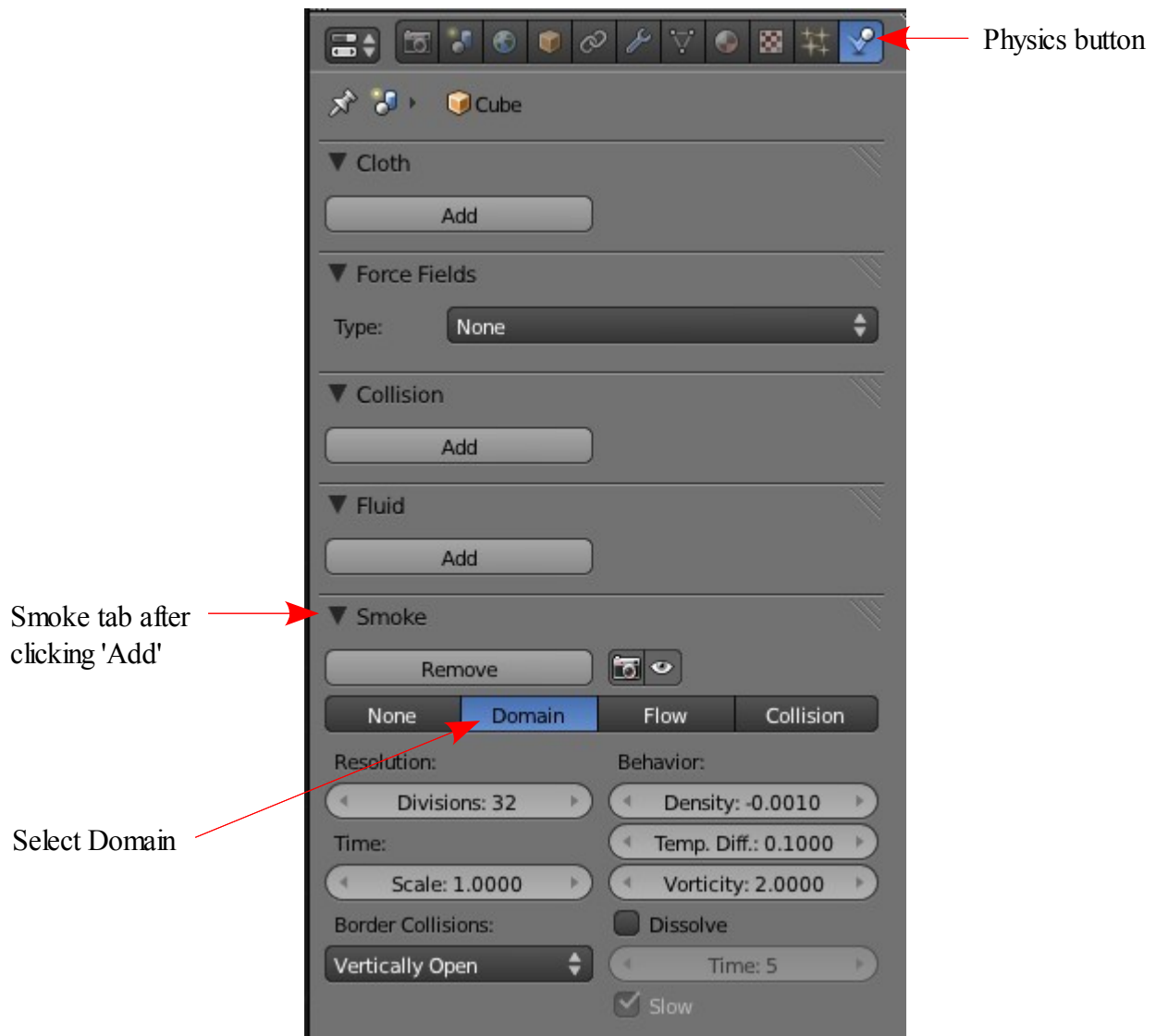
Select Domain

In either case, after adding the modifier go to the Physics button – Smoke tab and select 'Domain'. The Cube in the 3D Window changes to an orange outline indicating that 'Domain' has been applied.

Create the Flow Object

Now that we have defined the volume that will contain smoke, we will add an object from which the smoke will be emitted. Add a Plane object.

Make sure it's inside he Domain cube.
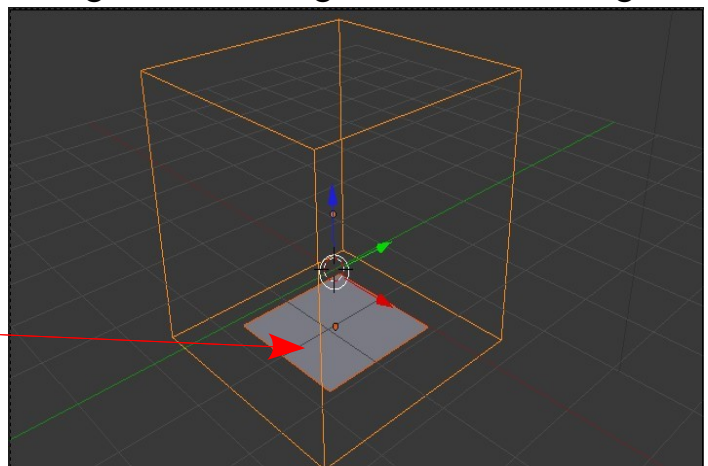
With the Plane selected go to The Properties Window – Physics button -Smoke tab and click 'Add' (Adding the Smoke Modifier). This time chose Flow.

The smoke will not be emitted from the Plane itself but from particles that are emitted. Adding Smoke in the Physics buttons and selecting 'Flow' has automatically added a Particle System to the Plane. This can be seen by selecting the Particles button in the Properties Window header. The smoke will eventually be seen to come from the Plane in a render of the scene but if you wanted to replace this with something else you can untick 'Emitter'. The small cube still emits the smoke but it doesn't render.

Particle System
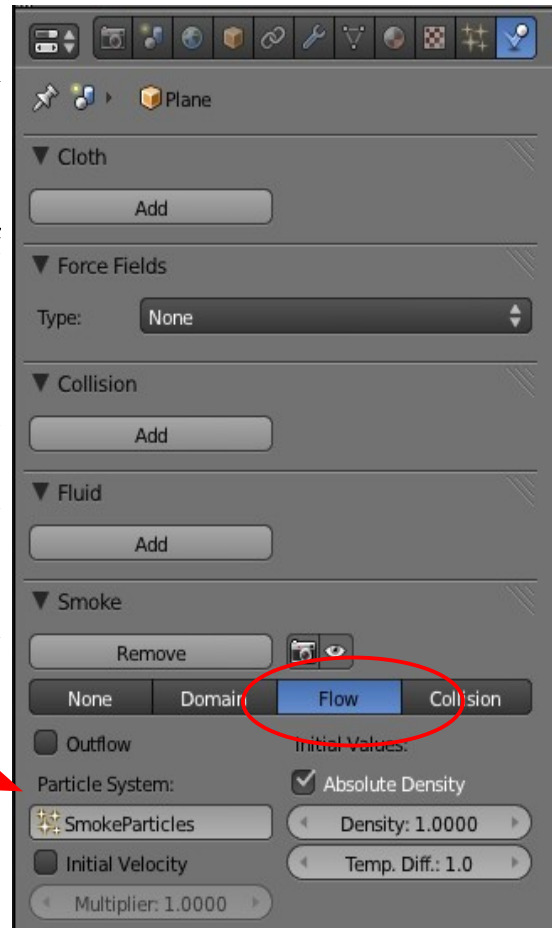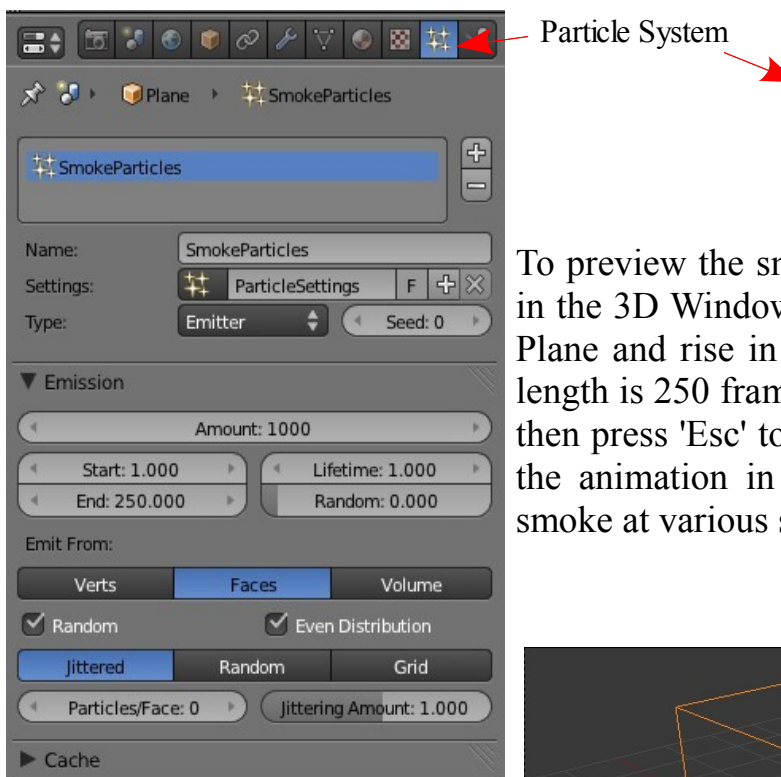
To preview the smoke press Alt + A with your cursor in the 3D Window. You will see smoke emit from the Plane and rise in the Domain. The default animation length is 250 frames so let this play to completion and then press 'Esc' to cancel. You can then scrub through the animation in the Timeline Window to view the smoke at various stages of the animation.

Smoke generated in 3D Window
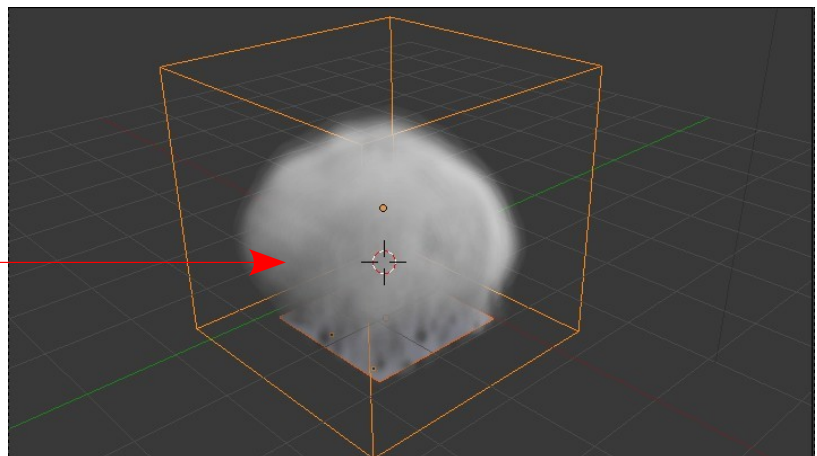
Note: On my computer, which isn't particularly up market, scrubbing the animation (Dragging the green line in the Timeline Window) doesn't work. Using the Up-Down Arrows on the keyboard to step through the animation in 10 frame increments doesn't work either. Using the Left-Right Arrows to step in single frame increments does work.

In essence this is the application of the Smoke Modifier but of course the effect can be modified. In the first instance in the Physics buttons – Smoke tab, ticking 'Initial Velocity' activates a multiplier which controls the smoke generation speed. There is a marked difference even with the value set at 1.
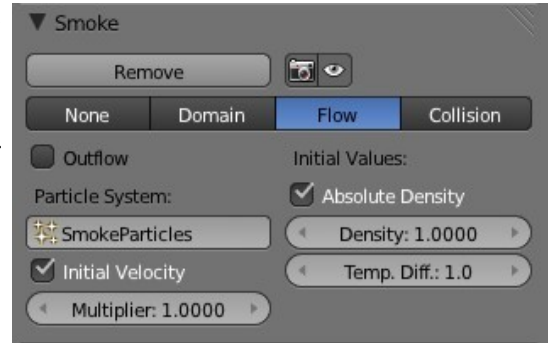
Other changes to the smoke generation may be made by settings in the emitters Particle System.

For example: In the Force Field Settings tab, selecting 'Vortex' from the drop down menu for 'Type 1' generates a swirling effect as the smoke is generated. Another example is changing the 'Normal' value to something like -3.000 in the Velocity tab with the emitter Plane located towards the top of the Domain. This produces a descending smoke effect.
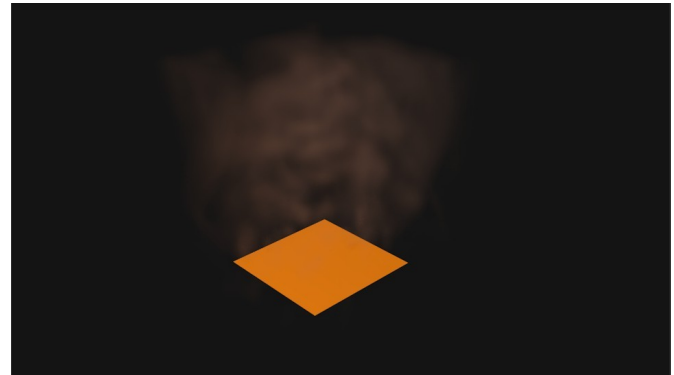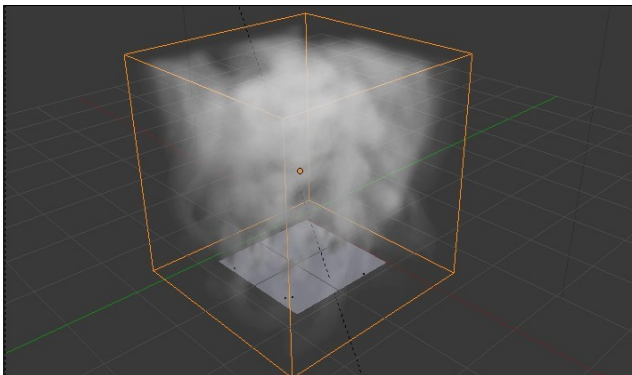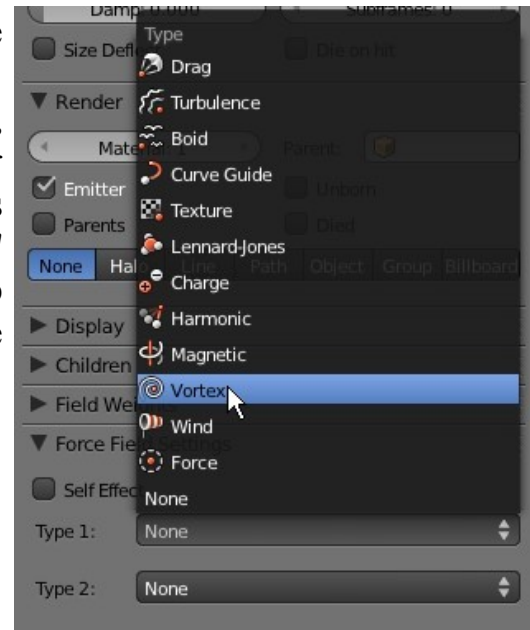
Experimentation will reveal many other effect variations

Rendering

Rendering at this point will result in just rendering an image of the Cube Domain . This issue can easily be resolved by working on the material and texture of the Domain cube. Select the Cube and go to the Material button . Change the material to 'Volume' .Set Density to 0.
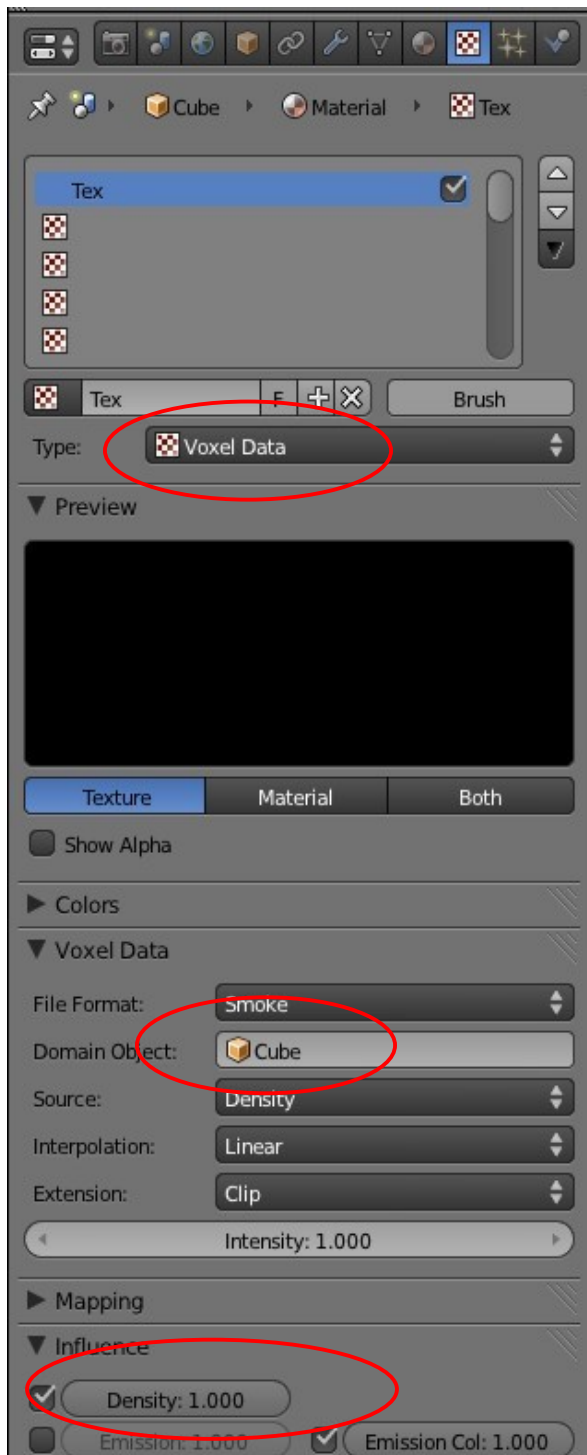
Material buttons →

← Texture buttons
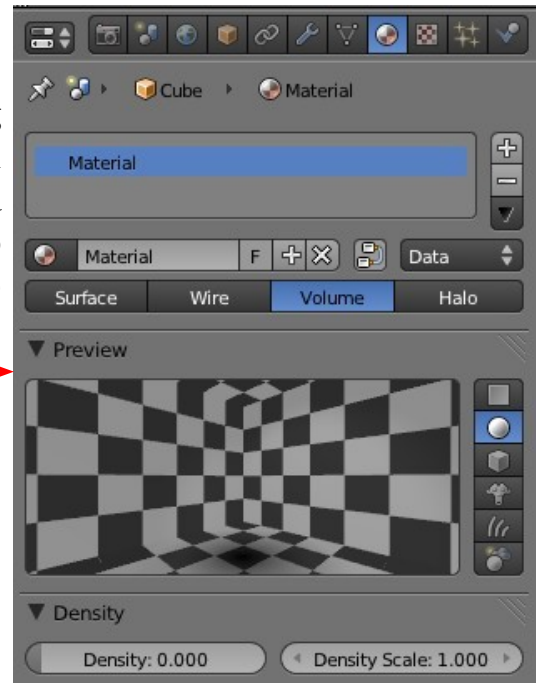
If you set the density to values larger than 0 the Domain cube will be filled with the material.

Next go to the Texture buttons and change the Texture type to 'Voxel Data'.

In the 'Voxel Data' tab, set the 'Domain Object' to 'Cube' by clicking in the Domain Object panel and selecting 'Cube'. The emitter is named 'Plane'.

In the Influence tab tick 'Density' and leave it at 1.000 (Emission Color should be automatically checked, too).

Now you should be able to render single frames. (Press F12 and Esc to cancel).

Tip: *To see the smoke more clearly* Under the world tab, chose a very dark color for the horizon. In the 3D Window add a Hemi Lamp, point it at the smoke and make the light color something bright.

Properties Window

Hemi Lamp
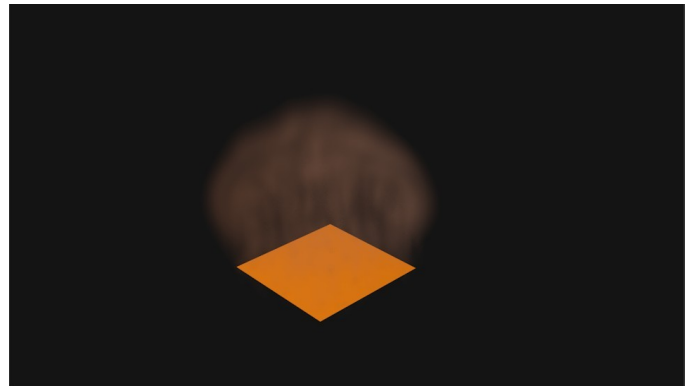
Rendered image with Hemi Lamp

Click on color bar to select the color

Soft Body Modifier

The Soft Bod Modifier in some respects is similar to the Cloth Modifier in that it allows the animation of deformation of a mesh object.

To demonstrate this Modifier use a UV Sphere positioned above a Plane. Scale the default Plane up four times and in Edit mode subdivide it four times.
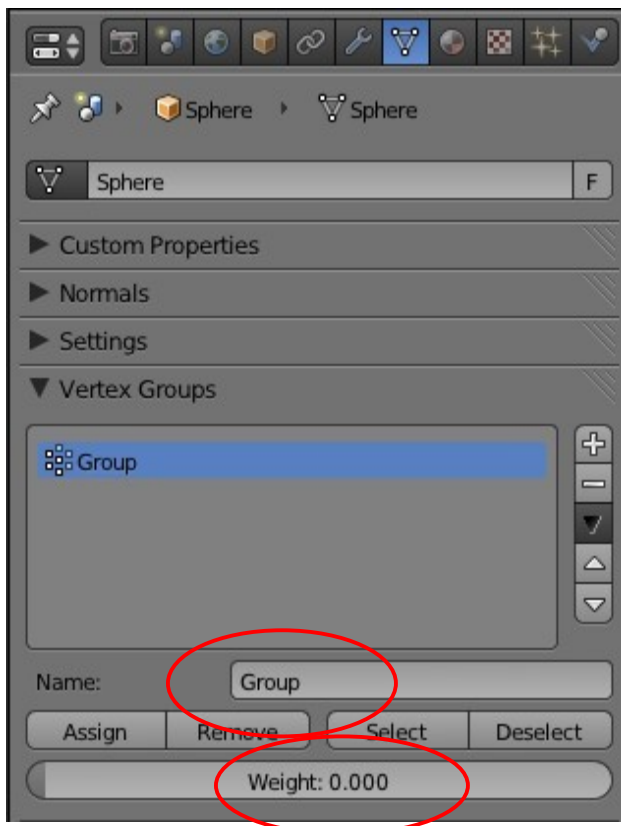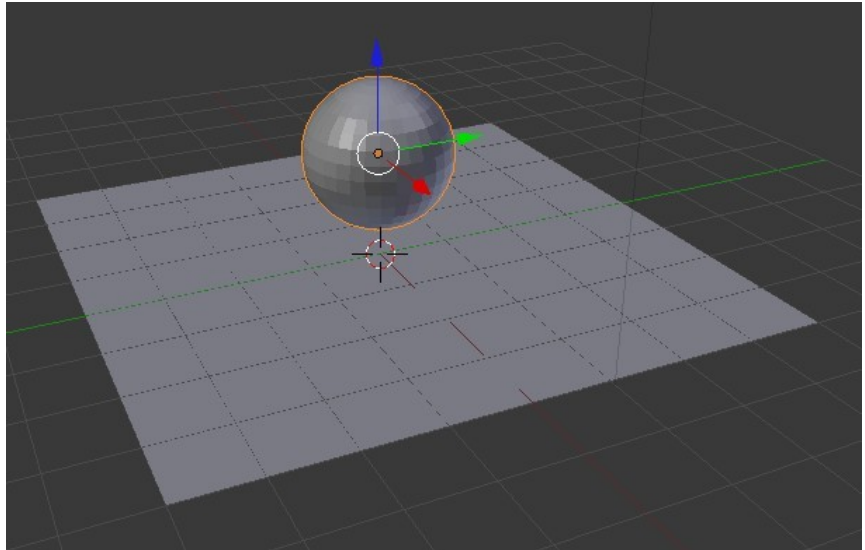
In the 3D Window select the UV Sphere, Tab into Edit mode and with all the vertices selected create a Vertex Group. (Properties Window – Object Data button – Vertex Group tab – Click on the Plus sign – Click 'Assign'). Set the 'Weight' value to 0.000 which means that the vertices will not be anchored and will be able to fall under the influence of the Gravity setting in the Scene settings.

Add a Soft Body modifier and in the Physics buttons – Soft Body Goal tab Vertex Group- enter 'Group'.

Physics Buttons
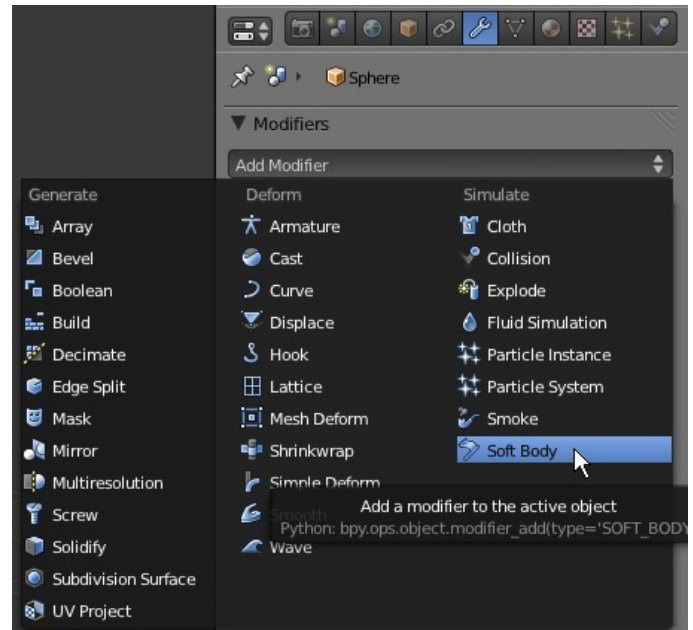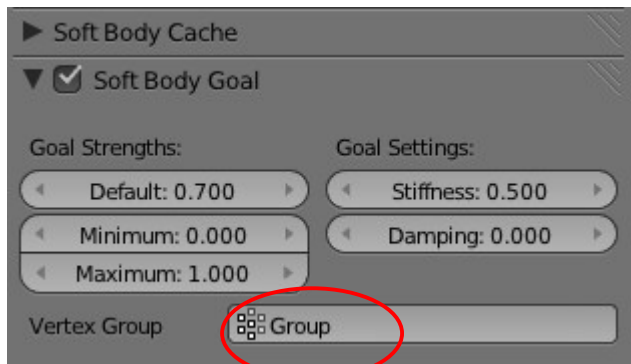
Pressing Alt + A in the 3D Window will play an animation of the Sphere falling through the Plane.

Deselect the Sphere and select the Plane. Add a Collision Modifier.
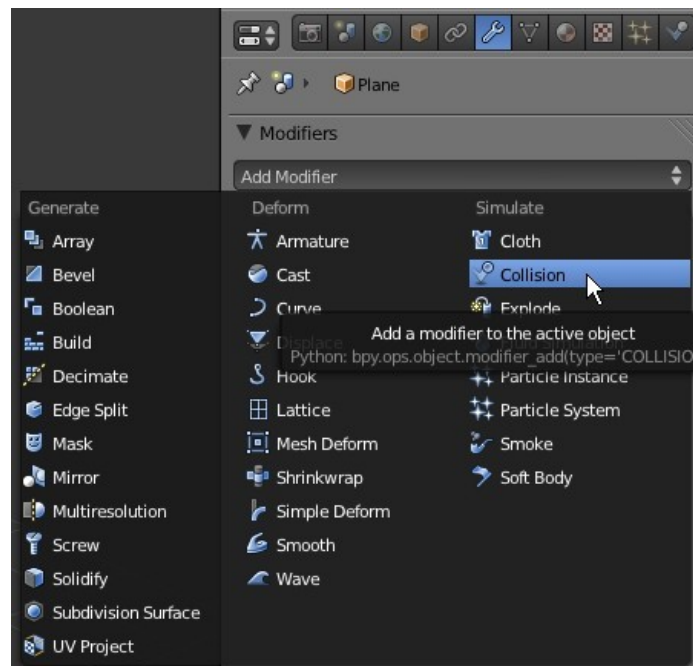
When the animation is played the Sphere now descends and deforms as it comes in contact with the Plane eventually becoming a flat blob on the surface of the Plane.
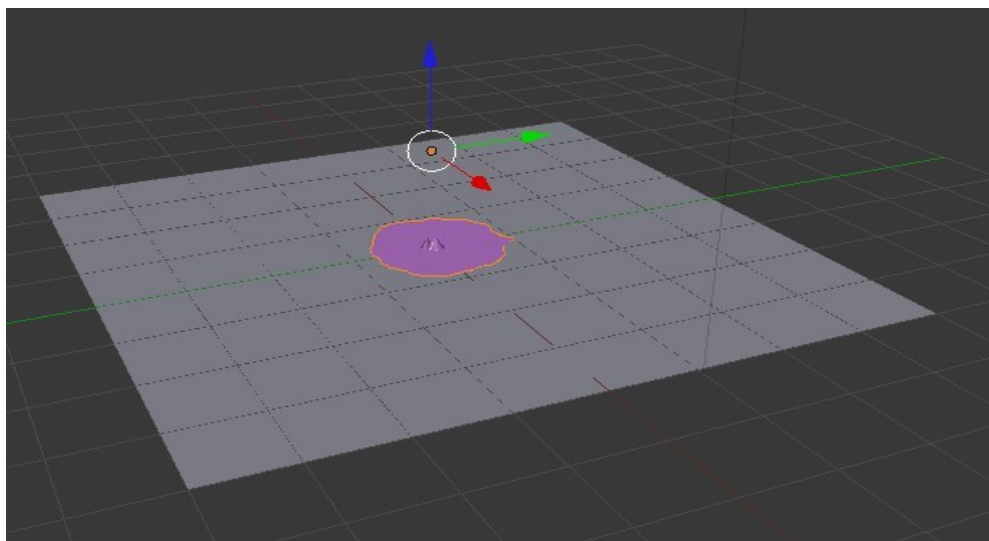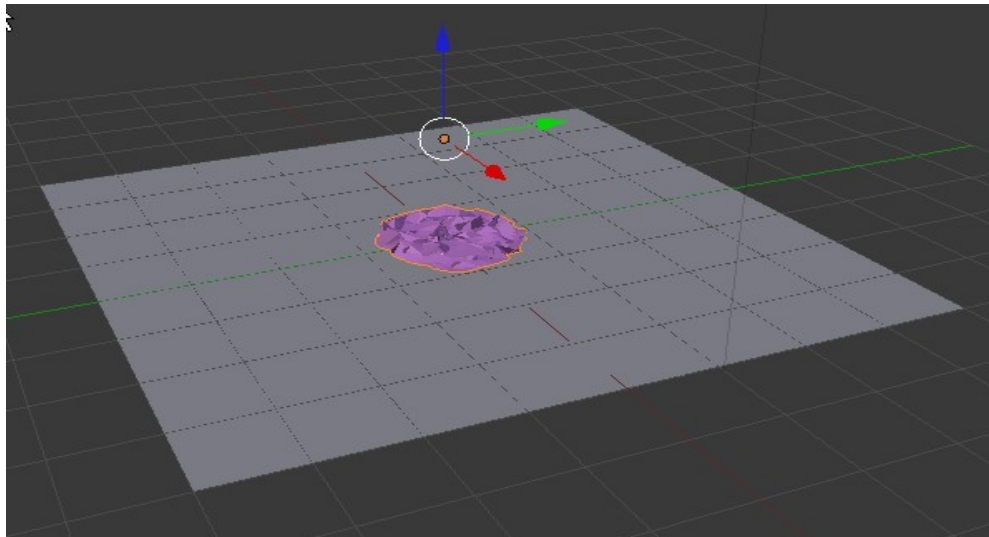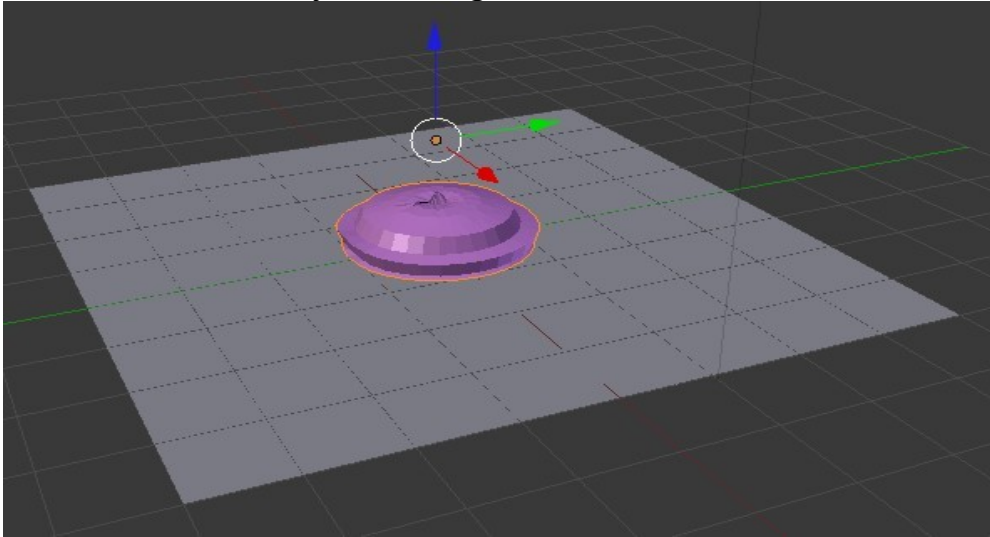
CH15- Particle Systems

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Particle Systems and Interactions

Overview.

This overview is intended as an introduction to the Particle Systems in Blender.

The first question that must be answered is, 'what are particles'? My dictionary tells me that a Particle is a minute portion, piece or amount. That's fine but when considering Blender, a particle is a small piece of what? For simplicity we will consider a particle to be a small dot on the computer screen. The dot may be displayed in a variety of ways but for now think of it as just a dot.

In Blender particles (dots) are emitted from an object and can be manipulated to produce varied effects . Particles can be used to simulate snow, fire, smoke, clouds, sparks and hair to name just a few. To produce particles an object selected in the scene must have a **Particle System** assigned to it. The emission of the particles is played as an animation and then rendered to produce the simulation effect. The best way to see how this is accomplished is to follow a few simple instructions and run a particle system.

Before setting up a Particle System we should establish a nomenclature so that we are able to understand the instructions that are given. Let's begin with the default Blender scene. The main Windows are outlined as follows.
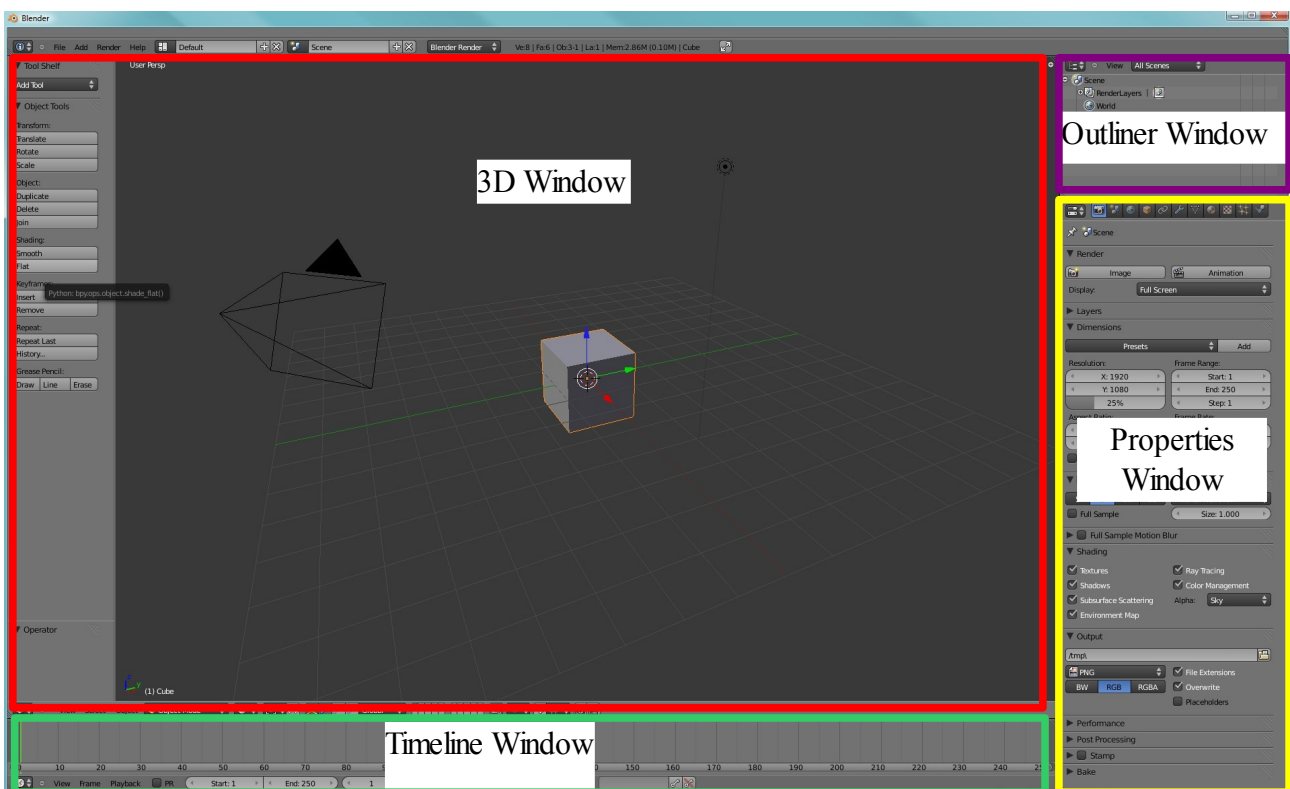
Blender Default Scene

Nomenclature

When referring to the **Properties Window – Particles buttons** panel the following nomenclature will be observed.
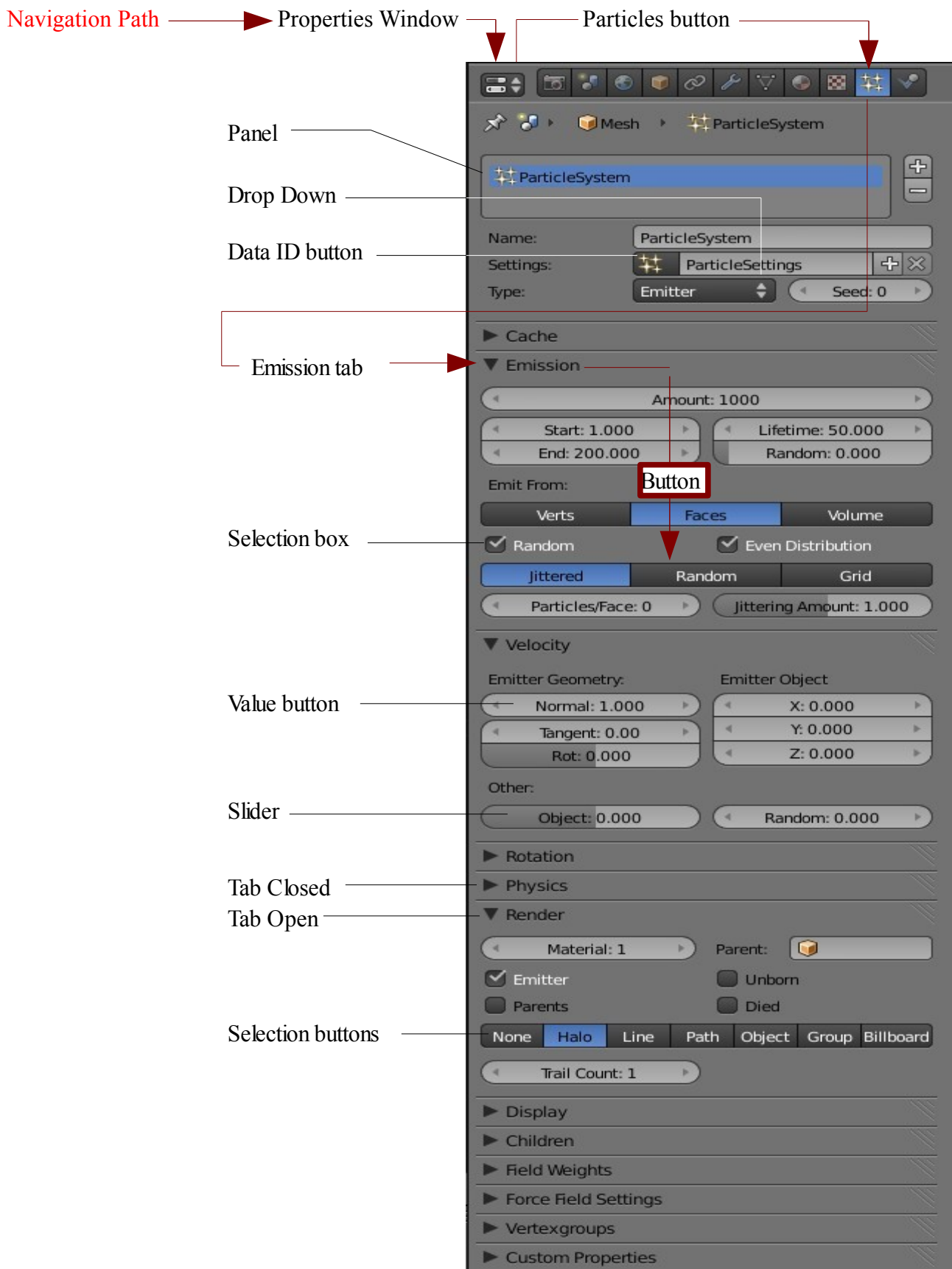
Setting up a Particle System

Open Blender and delete the default Cube object from the scene and then add a new UV Sphere. Leave the default values for the Sphere as they appear in the Properties Window. With the Sphere selected go to the Properties Window and click the Particles button. Click on the white plus sign next to the empty panel to 'Add a particle system'.

Properties Window

Particles button

Add Particle System
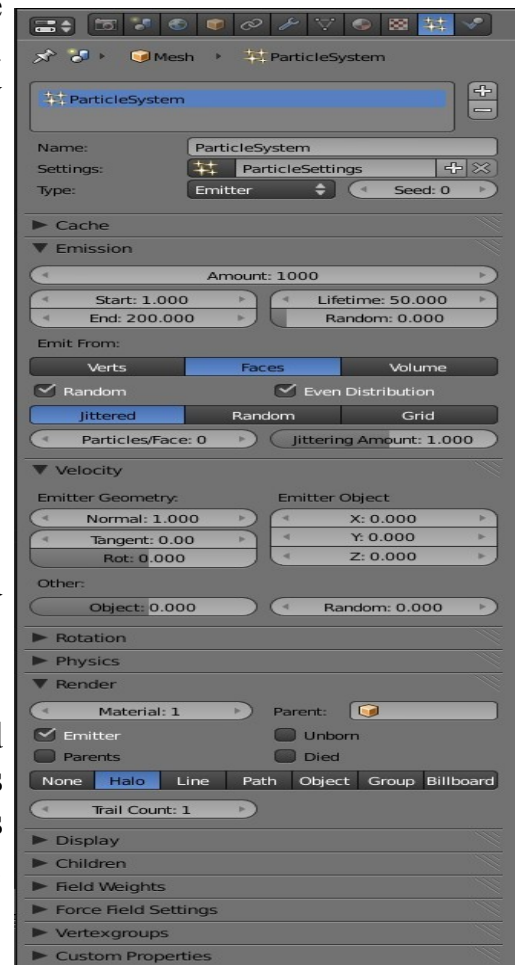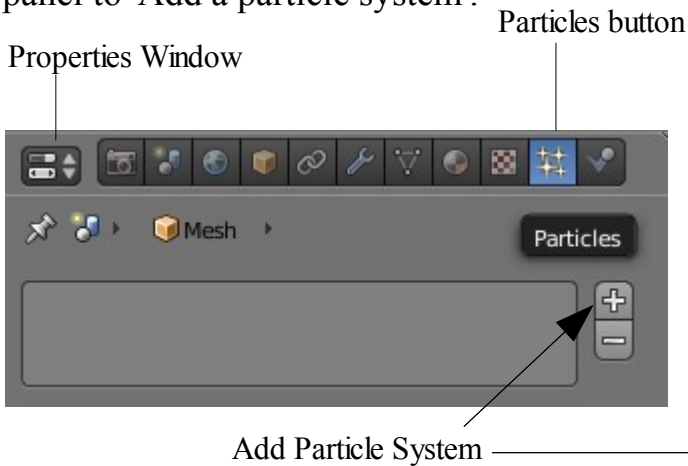
The window will display with an array of tabs and buttons which allow the set up of the system. This appears daunting to say the least but Blender has automatically created a system with default setting.

The first thing to note is the **Type: Emitter** right at the top of the Particle System panel. Type Emitter is what we will discuss to start with. Clicking on the panel where the word Emitter is displayed will open a drop down with the selection options Emitter and Hair. Type Hair is a separate system which will be discussed later.

With the cursor in the 3D Window press Alt + A to run an animation showing particles being generated. Note the Timeline Window is displayed across the bottom of the screen and will show a green line moving as the animation plays..

Particles emitted as orange squares as seen
in the 3D Window with the sphere selected
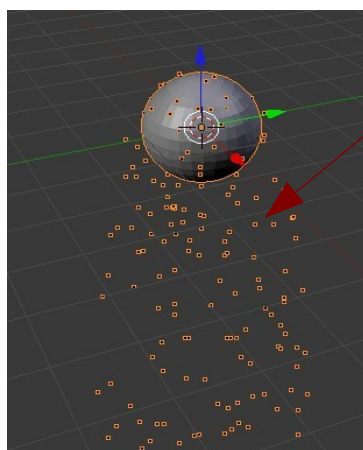
Rendered image at
frame 100
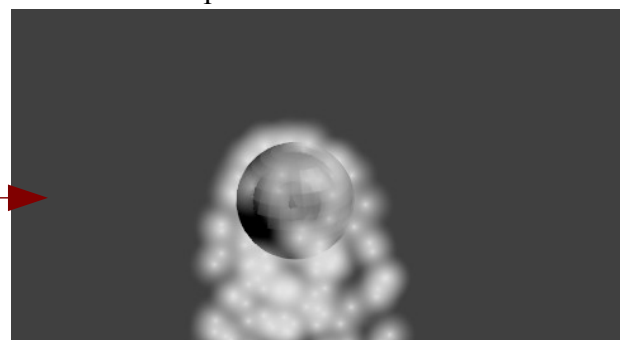
With the emitter object selected the animation will play showing particles as small orange squares being emitted from the UV Sphere and then falling towards the bottom of the screen. If the emitter object is not selected the particles show as small black dots. The animation will play for 250 frames then repeat itself. Press Esc to stop the animation. Using the Up – Down arrows on the keyboard or by dragging the green line in the Timeline, move the animation forward to say frame 100. The particles will now be displayed as they occur at frame 100. Render the scene (press F12). An image will be rendered showing the UV Sphere and the particles as halos (fuzzy balls of light merged together) cascading downwards. If the animation were to be rendered as a video you could play this in action.

Press Esc to cancel the image and return to the 3D Window.

Note that particles emit their own light therefore it is not necessary to have a lamp in the scene. If the default lamp is deleted from the scene the image rendered will show the halos but the emitter object will be black. The reason that the emitter is seen at all is because the render has a default grey background. If the background were black you would not see the emitter.

By default Blender renders an image at 25% of the 3D Window size. If you want something different go to the Properties Window – Render button and in the Dimensions tab – Resolution button change the percentage value (Drag the slider). You can also alter the X and Y values above the percentage slider to vary the aspect ratio of the image.

That in essence has demonstrated a particle system being applied. It is now time to progress and discover how to manipulate the system. The fun begins.

In the demonstration, the particles emitted from the sphere cascade downwards. This was to create reality in the scene by having a gravitational effect applied. We will now turn that effect off.

Scene button

Click to remove tick and turn gravity off
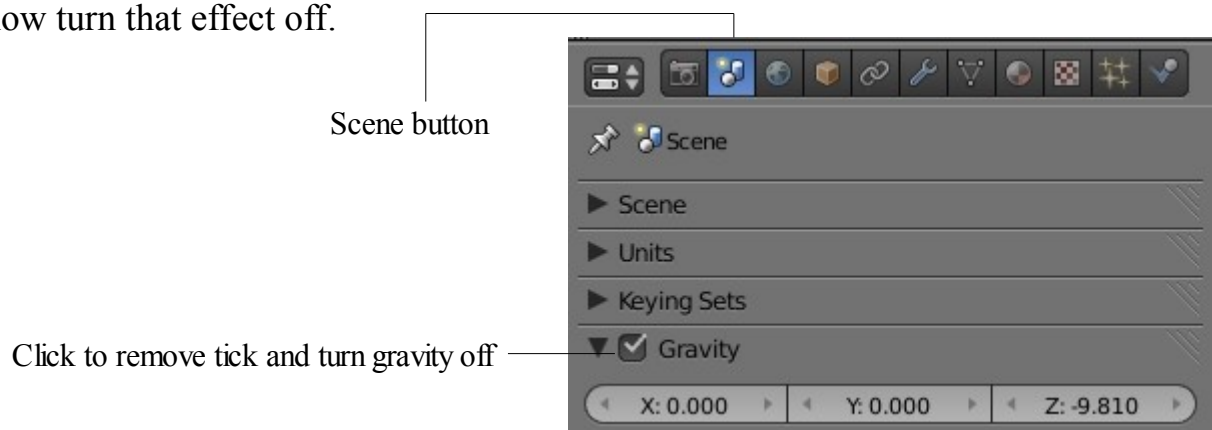
Go to the Properties Window – Scene button and remove the tick from the little box in the Gravity tab.

Set the animation in the Timeline back to frame 1 and replay the animation (Alt + A). This time the particles emitted from the UV Sphere disperse in all directions away from the sphere. Note that the particles seem to only move for a certain time and disappear before the end of the animation. Obviously there is something happening to cause this.
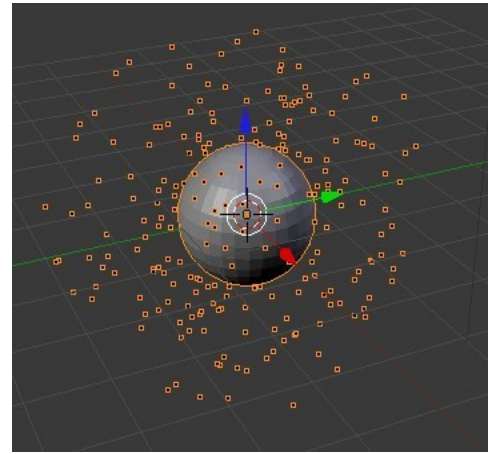
Take a look at the Properties Window with the Particles button activated and look at the Emission tab. You will see the following values:
Amount :1000, Start :1.000, End : 200.000 and Lifetime : 50.000. These values say that 1000 particles will be emitted starting at frame 1 and stopping at frame 200 but each particle will only be visible for 50 frames. Particles therefore disappear after being in existence for 50 frames.
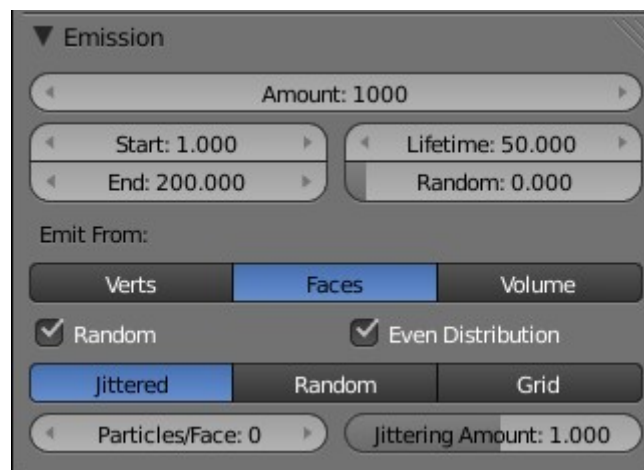
Also look at the Velocity tab and the Normal: 1.000 value. This says particles are being emitted at a speed of 1 unit per second normal to the surface of the sphere (at 90 degrees to the surface).
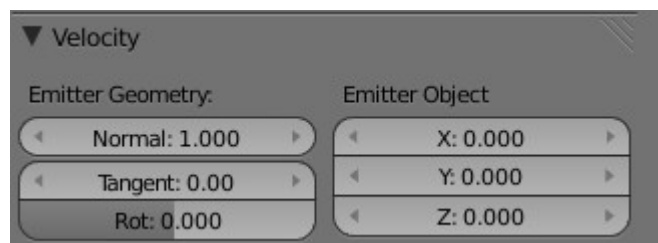
Increase the Lifetime value to 200 and replay the animation. Now particles are displayed for the whole 250 frame animation since particles emitted at frame 200 stay visible until frame 250 (50 frames).

Just to demonstrate another particle emission control feature, in the Velocity tab change the Emitter Geometry Normal value to 0.000 and the Emitter Object Y value

to 10.000. Replay the animation and see all the particles emitted move fairly rapidly along the Y axis of the scene. You have just told Blender to emit the particles along the Y axis at 10 units per second instead of emitting them at 1 unit per second at 90 degrees (Normal) to the a face on the surface of the sphere. Note that in the Emission tab 'Emit From Faces' is activated (Highlighted in Blue).
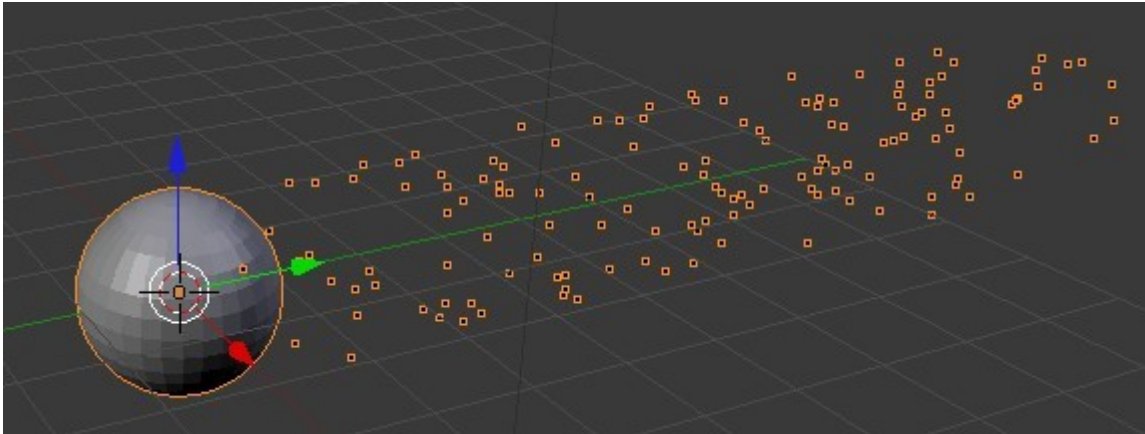
The forgoing has demonstrated how a particle system is instigated and can be controlled by values in the Particles buttons window. We will leave the buttons alone for the time being and come back later.

We will now have a look at some detail of where and how particles are emitted from an object. In the Properties Window – Particles buttons – Emission tab note the Emit From buttons, Verts (Vertices), Faces and Volume. The default value Faces is (Highlighted in blue).
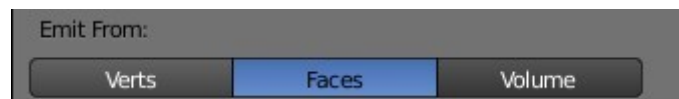
To see what this means start with a new Blender Scene and delete the default Cube. Add a Plain object and remove the 3D Manipulator Widget. Removing the Widget will let us see more clearly what is happening when particles are emitted. Untick the Gravity button in the Scene buttons. Add a particle system to the Plane. Press Alt + A and play the animation showing the particle generation.

You will see the particles being generated on the face of the Plane object. The Plane only has one Face. The particles are being generated at an initial velocity of 1 unit per second normal to the face of the plane (At 90 degrees to the surface). This is in accordance with the default values in the Velocity tab.
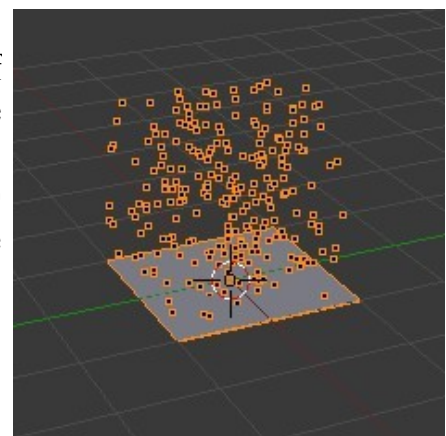
In the Emissions tab – Emit From buttons select Verts and replay the animation. You will now see the emission of particles from the four corners of the plane (4 vertices).

Selecting Faces or Verts depends on what you want to see in your final render.
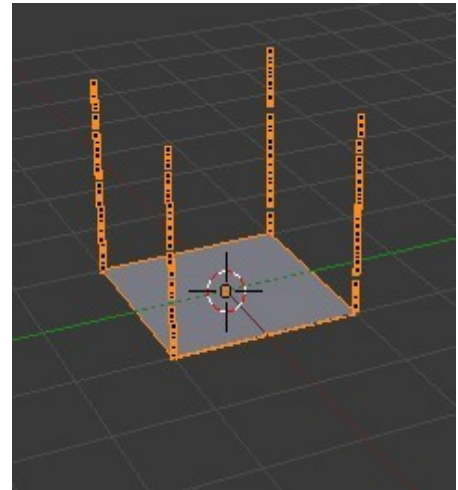
We will now have a look at a little more detail of particle generation. Start over with a new Blender scene and delete the default Cube object. We will now create a circular plane object to use in this example.
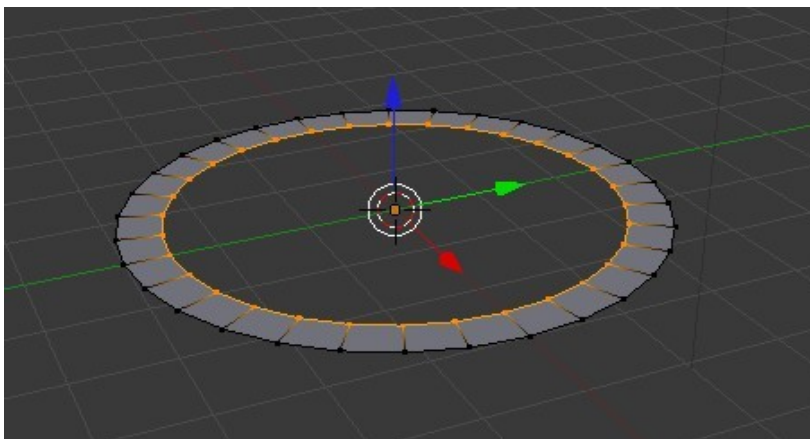
Outer vertices Extruded and Scaled down to form inner ring

Add a Circle object to the scene and scale it up 3 times. Go into edit mode and with all vertices selected press the E Key (Extrude) then click LMB followed by S Key (Scale) and move the mouse towards the center of the circle. With the E Key you have extruded (created a new set of vertices) and the S Key has allowed you to scale the set of new vertices. Change to object mode and add a particle system. Go to the Scene buttons and untick gravity. Play the animation.

You will see particles being generated but some are moving up and some are moving down. Note that the default Emission – Emit From value is 'Faces' and the Velocity – Emitter Geometry – Normal value is 1.000. We are therefore emitting particles from the faces of the object at 1 unit per second normal to the face. In modeling the circular plane object some faces have been assigned a negative normal value and some have been assigned a positive normal value , hence the
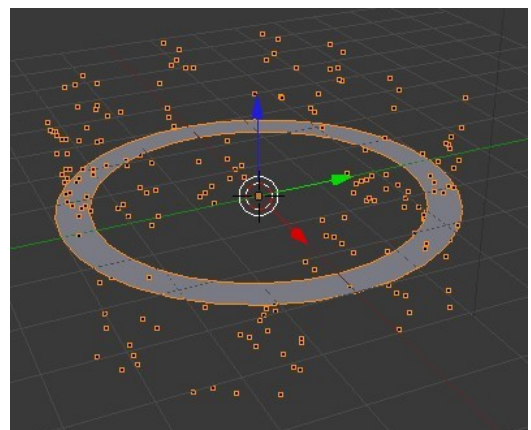
movement of the particles as seen in the animation. The normal values need to be recalculated to align them in the same direction.

To realign the normals go into edit mode and select all the vertices. With the cursor in the 3D Window, press Ctrl + N Key. Make Normals Consistent will display in the side panel at the lower LH corner of the screen.

Go back to object mode and replay the animation. All the particles will move in the same direction but not necessarily upwards. Note that if the normal value is changed to -1.000 (Minus one) the particles will move in the opposite direction. Set the normal value to move up.

OK let's have a close look at what is happening to the particles. If you look at the values in the Particles Emission tab you see that 1000 particles are being generated starting at frame 1, ending at frame 200 with a lifetime of 50 frames. You will also see Random and Even Distribution boxes ticked so the particles are being spread between the faces in a random order as they are generated. Random would appear to take precedence over Even Distribution. Note the value Jittered highlighted in blue. Jittered means that in any one face on the object particles appear in a random position.

Untick the Random box and play the animation. The particles are now generated from one face after the other around the circle plane object.

Increase the Lifetime value to 200 to make the particles display longer in the animation.

Note if the animation is played without the object being selected the particles will appear as small black dots instead of the little orange squares.

Cycling the animation in the Timeline to frame 200 produces a spiral array in the 3D Window which may be rendered as an image. You will however have to relocate the camera in the scene to render an image of the complete spiral.

Another feature worth mentioning at this time is the fact that by default Blender renders an image of a particle system which includes the emitter object. To render without the emitter object go to the Render tab and untick the Emitter box.
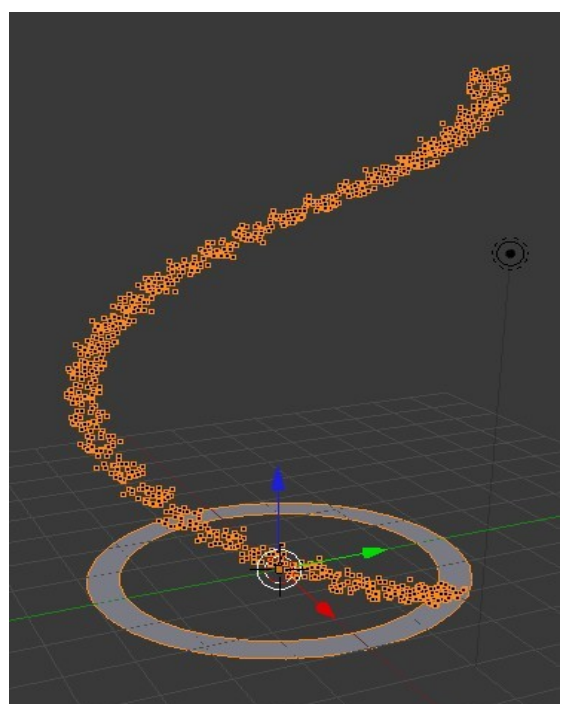
The spiral has been generated with Normal Velocity value of 1.000. If this value is deleted and still in the Velocity tab the Emitter Object Y value is set to 1.000 then when the animation is replayed the spiral will generate on the flat along the Y axis. This demonstrates that how the array of particles is generated is controlled by the values entered Velocity tab.
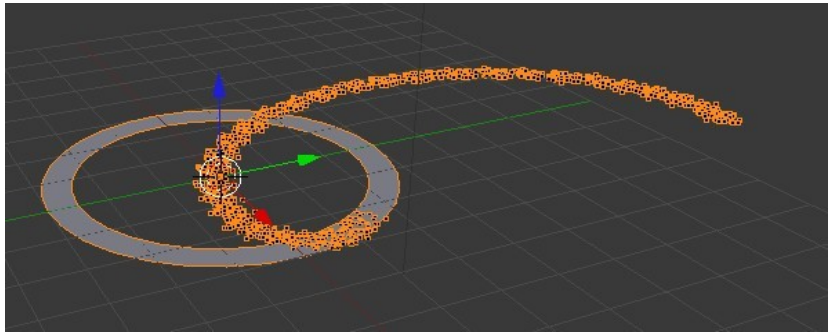
At this point we are attempting to only give an overview of particle generation and it is not intended that every function of the control buttons be detailed.

We will demonstrate two more features in this overview.

So far the particles that have been generated have been displayed as dots or little orange squares in the 3D Window and have been rendered as halos. In the Render tab you will a selection of render options. None, Halo, Line, Path, Object, Group, Billboard. We will have a look at the Object option. Go ahead and select it. Now reduce the number of particles in the Emission tab Amount to 32. Our plane circular ring object was created from a circle with 32 vertices therefore it has 32 faces. Reducing the particle amount to 32 gives us approximately one particle per face. This is approximate since at this point the generation of the particles follows an animation curve which accelerates and decelerates. Play the animation again to regenerate the particles then cycle through the animation and at frame 200 you will see 32 particles but they are not evenly spaced along the spiral. This is showing the influence of the acceleration change in the generation. We are only concerned with reducing the particle count just now.

Deselect the ring in the 3D Window. Add a UV Sphere object and note that it is called Mesh.001 (See lower LH corner of window). Deselect the sphere and reselect the ring. In the Particle button – Render tab look for the Dupli Object: box. Click in the box and in the drop down panel that displays select Mesh.001. The particles are now displayed in the 3D Window as tiny little spheres. Go to the Physics tab and increase the Size:value to increase the size of the tiny spheres in the 3D Window. Render to see an image of the spheres.
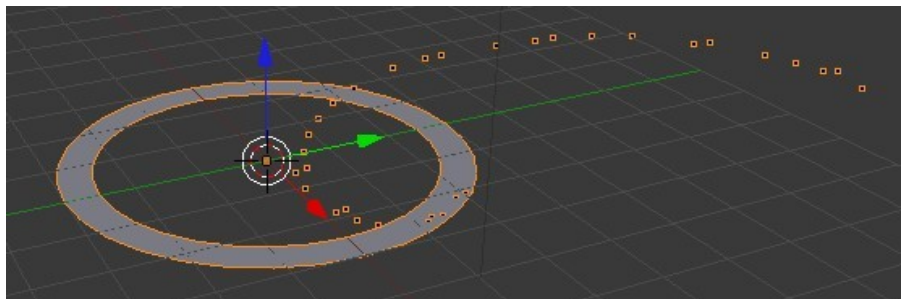
UV Sphere Added
Mesh.001
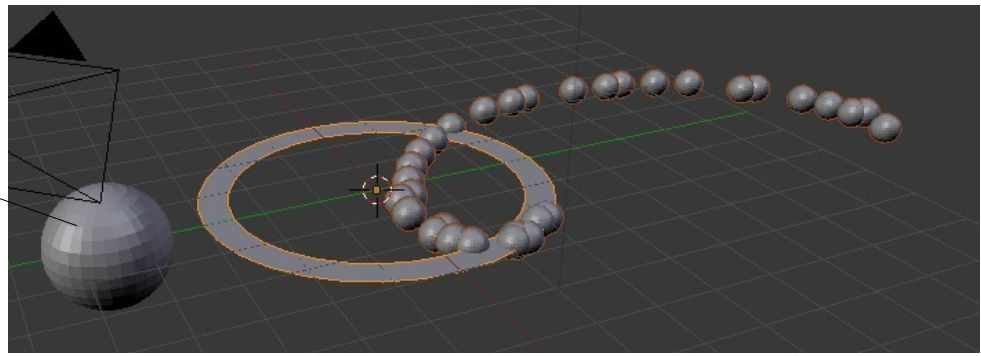
Up to now everything created and rendered has been the default dull grey color. Adding a new material color to the sphere we have just added will cause the array of spheres to display and render in that material color. Adding a material to the ring in the 3D Window will cause the particles with a halo value to render in that material color.
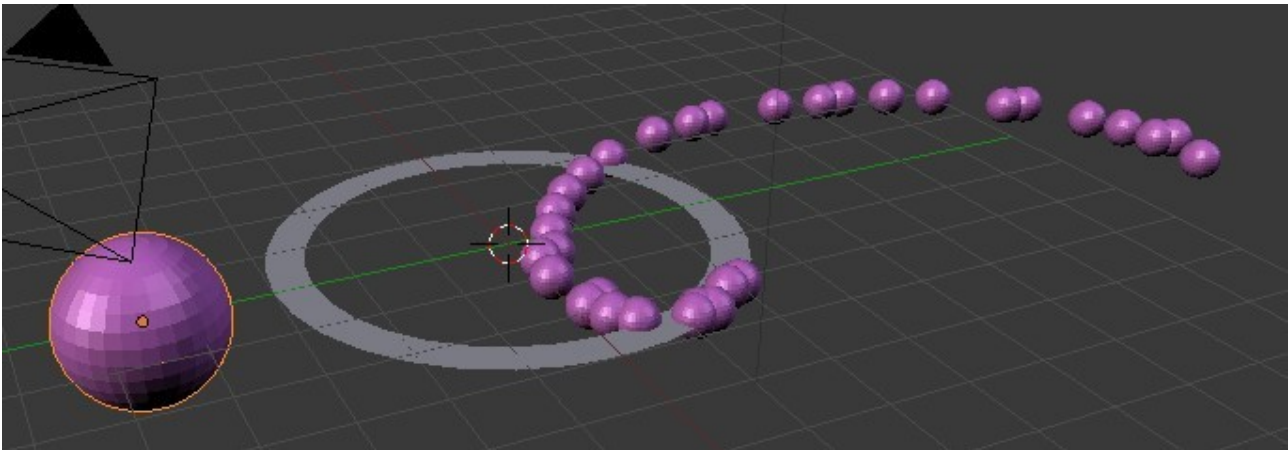
This demonstration of particle system applications has touched on the tip of the iceberg. We now require to make a detailed study of the Particle buttons window to ascertain the function of each tab and button and formulate the logic of particle systems interface. There are many excellent tutorials available to compliment this study but it is recommended that an understanding of the buttons be attained to allow the transition from an operator of the program to creative artist.

Particle Settings and Material Influence

We will continue the study of the Particle System by examining the Particle Settings and Material Influence and seeing how settings are entered to create effects. The possible effects that can be created are endless and only limited by the imagination. Particles can be deflected off other objects, be blown by the wind, be displayed before they are built and many more options. It would be impossible to demonstrate everything and only by experimentation and recording settings for future use will you become proficient.

Remember that a particular effect can be saved as a Blender file which can be imported into a scene in another Blender file. When you create something interesting its worth saving and recording for future use. Blender doesn't come prepacked with instant goodies so the objective should be for a Blender Artist to compile a library.

The Particle Setting are controlled by the Particles buttons which consist of a series of tabs housing buttons and sliders allowing values to be entered. As we have already seen Blender automatically created a Particle System when the Add button is pressed. What we do next is to modify that system to produce the particular effect that we require. The system is then saved to a cache to be used.

The tabs of the buttons window have a logic in setting up a Particles System so if each is examined and understood separately the overall picture will become evident. It is not intended to undertake that study here instead we will demonstrate some settings which produce examples.

Note: On the following diagram we have taken the liberty of labeling the first part of the Buttons Window as the Assignment tab. This part of the window is always open unlike the remainder of the tabs which are opened and closed by clicking on the triangles at the upper left hand corner of each tab.

Our Assignment tab controls what we do with a Particle System when we have created (modified the default) a system. We will therefore postpone the discussion of this tab until last.

Particles Buttons – Panel

Properties Window

Assignment tab
How particles are assigned
(The missing tab)

Cache closed Emission open
Click on triangle open/close

Cache tab
Saving the particle system

Emission tab
How particles are generated

Velocity tab
How fast and in what direction

Rotation tab
How particles rotate

Physics tab
Rules of animation
Rules of interaction

Render tab
How images and video display

Display tab
How particles display on screen

Children tab
Particles generate other particles

Field Weight tab
Values effecting Force Fields

Force Fields Settings tab
Modifiers effecting particles

Vertex groups tab
Where particles originate

Custom Properties tab

Cube ▶ ✦ ParticleSystem

✦ ParticleSystem

Name: ParticleSystem

Settings: ✦ ParticleSettings

Type: Emitter ⬍   ◀ Seed: 0 ▶

▶ Cache

▼ Emission

◀ Amount: 1000 ▶

◀ Start: 1.000 ▶   ◀ Lifetime: 50.000 ▶
◀ End: 200.000 ▶   Random: 0.000

Emit From:

| Verts | Faces | Volume |

☑ Random   ☑ Even Distribution

| Jittered | Random | Grid |

◀ Particles/Face: 0 ▶   Jittering Amount: 1.000

▶ Velocity

▶ Rotation

▶ Physics

▶ Render

▶ Display

▶ Children

▶ Field Weights

▶ Force Field Settings

▶ Vertexgroups

▶ Custom Properties

The Particle Buttons Panel

The Particle Buttons panel displays all the options relating to how particles are generated and displayed. To understand how we create specific effects using particles we will first require to look at some of the Buttons tabs.

Emission tab.

The Emission tab controls how particles are emitted.
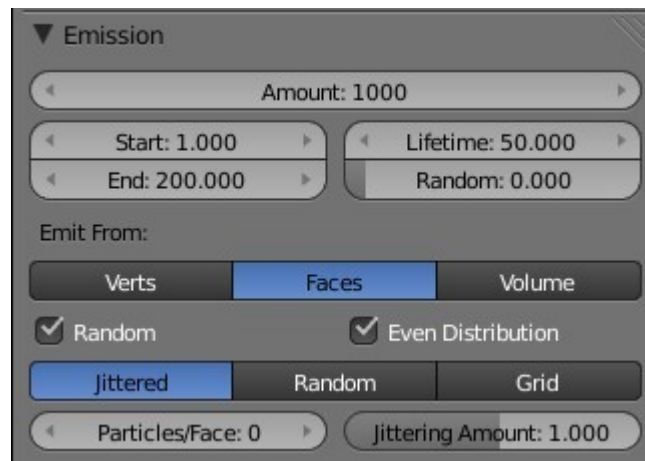
Amount: The number of particles emitted in the animation between the start and the end frame settings.

Start: The frame number in the animation where particles will start to be emitted.

End: The frame number in the animation where particle emission will stop.

Lifetime: How long each particle will be visible (number of frames) in the animation.

Random: Particles are emitted from Faces in a random order.

Emit From: Particles may be emitted from either Vertices, Faces or the Volume. Faces is selected in the screen-shot as indicated by the blue highlight.

The remainder of the options in the tab control the order of particle generation.

Random: Even Distribution: Jittered: Random: Grid: Particles/Face: Jittered Amount:. These options permutate depending on which of the Emit From options has been selected.
Experimentation and recording of results are required to establish combinations for specific application.

Velocity tab

The Velocity tab settings control how fast and in what direction particles are emitted from a mesh object.
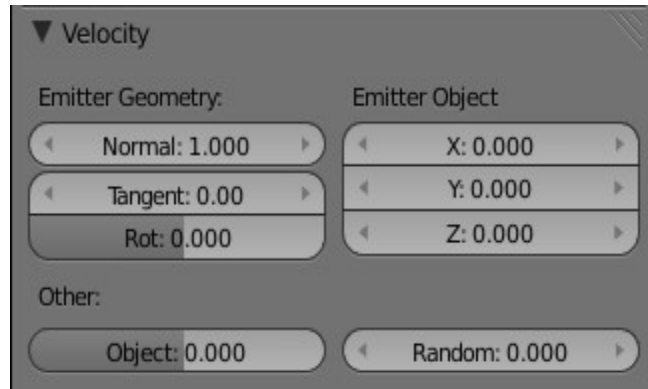
Emitter Geometry
    Normal: Velocity of particles normal (at 90 degrees) to the emitting surface
    Tangent: Velocity of the particles parallel to the surface.
    Rotation: Value rotates the direction of the surface tangent.

Emitter Object
    The velocity of particles along the X, Y & Z axes in the scene.

Note all values may be entered as positive or negative reversing direction.

Other:
    Object: The object gives the particles a starting speed and direction.
    Random: Gives the starting speed direction a random variation.

Note: The 'Other' values are best demonstrated with particles being displayed as objects. See: Render Tab.

Physics
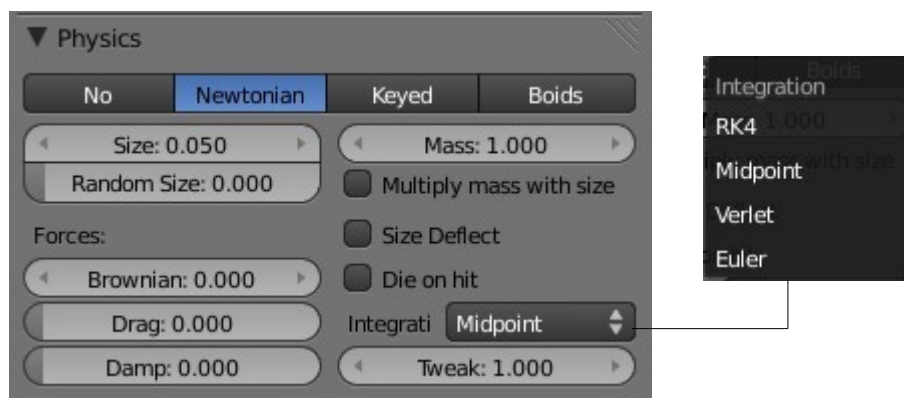
Physics determine the way particles move and interact with the world around them.

Note the selection bar at the top of the Physics tab with Newtonian highlighted in blue. Newtonian is the normal particle physics which we will consider at this time. The other options are:

No	Particles stick to their emitter for the whole lifetime.
Keyed	Allows particles to be directed from one emitter to another setting up a chain of particles moving from one place to the other.
Boids	Allows particles to be given rules of behavior which allow them to represent flocks, swarms, herds and schools of various kinds of animals.

Just for the moment the only setting we need concern ourselves with in the Newtonian system is the Size value which controls the size of the particles as seen in the 3D Window and as rendered in an image or movie.

Display

The display tab controls how particles are seen in the 3D Window. The options in this tab are useful when multiple particle systems are in play and it is desirable to distinguish between the particles in the different systems.

Lets work with our examples and begin by recapping starting a Particle System.

Starting a Particle System

Open Blender with its default scene containing a mesh Cube object. Delete the Cube and add a UV Sphere. Keep the segments and rings at 32. The number of segments and rings may be altered in the Tools Panel (T Key toggles hide/show) at the lower left of the screen.

With the Sphere selected in the 3D Window go to the Properties Window – Particles button and click the Add Particle System button (The white plus sign). The Particle System tabs display as shown in the previous Particle System Buttons diagram.

Blender has created a complete Particle System which we can modify to produce whatever effect we want.

Note the Timeline Window displayed across the bottom of the screen.
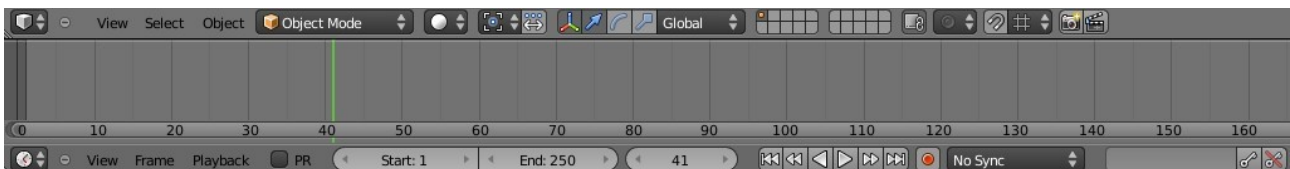
The timeline show a 250 frame animation window as seen by Start:1 and End:250. Note the green line positioned at frame number 41. You will see why in a moment.

With your cursor in the 3D Window and with the UV Sphere selected press Alt + A to play the animation of particles being generated. The particles emit from the surface of the Sphere in a random order and fall towards the bottom of the screen. The animation plays for 250 frames then repeats. Press Esc to cancel.

Click on the green line and drag it over to frame 41 to see the view <u>below.</u>

The particles behave in this manner since there is a gravitational force being applied. Have a look at the Properties Window – <u>Scene button</u> and note the tick in the Gravity box.

Gravity ticked ————————

Gravity Force -9.810
Earths Gravity
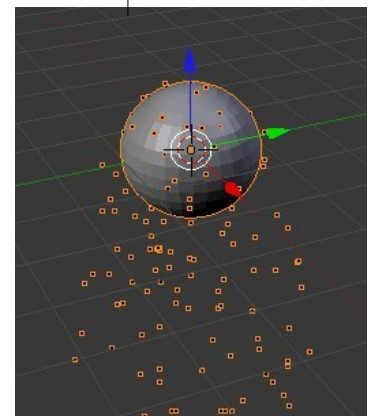
Click on the tick to remove it and play the animation again.
This time the particles emit from the sphere and float off into space. They still emit in a random order from the faces of the Sphere.

Look at the Emission tab and note the values inserted.
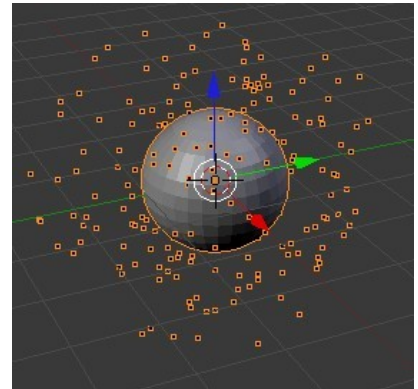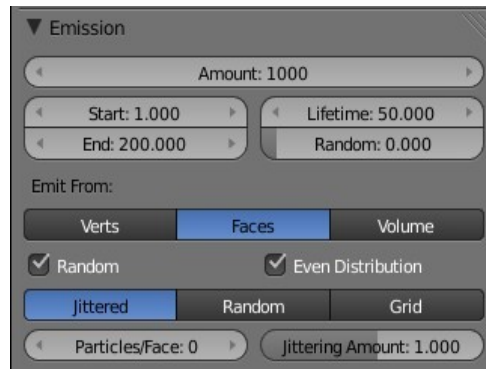
These values tell us that 1000 particles will be generated in the animation starting at frame 1 and ending at frame 200 during the animation. The animation is 250 frames. There is also a Lifetime value which tells us that when a particle is generated it remains visible for 50 frames. Therefore a particle generated at frame 200 will remain visible until frame 250.

Note the tick in the box labeled Random. This is giving the random order of generation of the particles. Click on the tick to remove it. Play the animation again. Esc to cancel. The 3D Window is in User Perspective view therefore it is difficult to see what has been achieved by removing the Random tick. Change the view to Top View (Num Pad 7) then to Front View (Num Pad 1). With the Timeline advanced to frame 41 you will see an ordered array of particles.
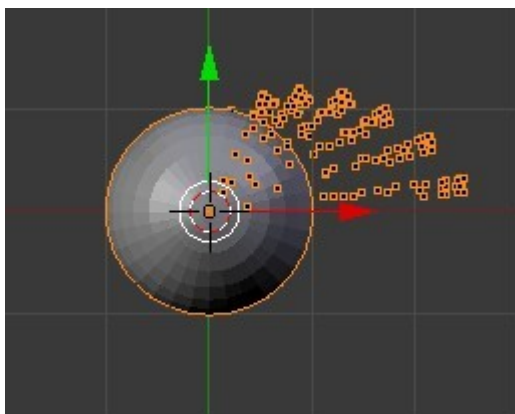
Top View
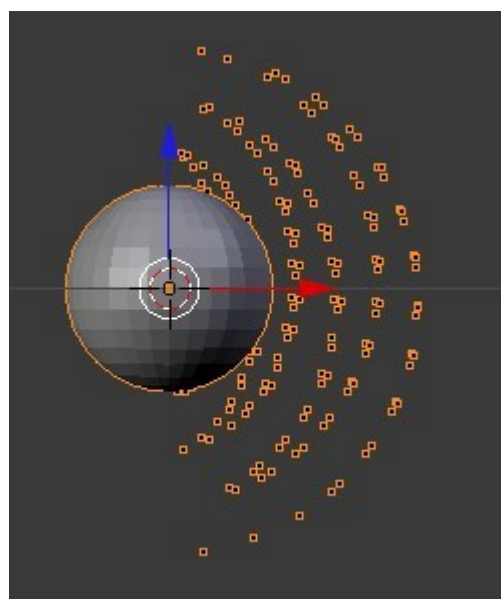
Front View

Material Influence on Particles

Particles emit their own light so it isn't necessary to have lamps in the scene when particles are rendered. To give particles color you have to add a material to the emitting object. We could render an image of frame 41 of what we have already created by pressing F12 on the keyboard. Go ahead and do it. What we get is a plain grey and white picture. Press Esc to cancel the image.
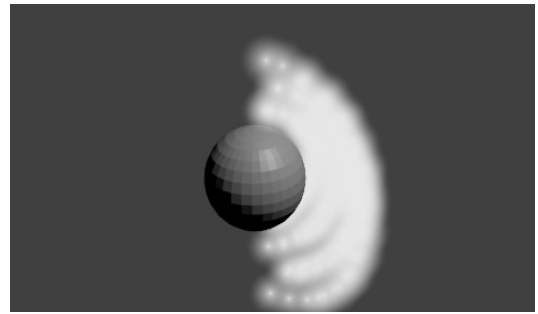
With the Sphere selected in the 3D Window go to the Properties Window – Material button. Press Add New to display the Button tabs and click on the Diffuse color bar to display the color picker. Select a color then render the image again.
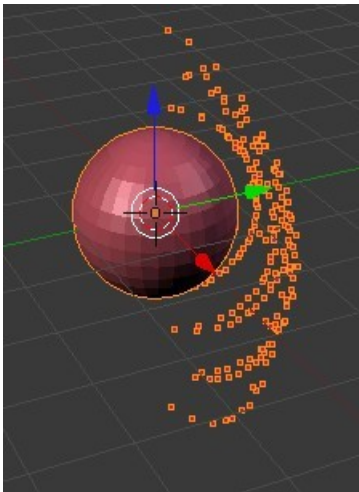
We see the emitter object (Sphere) and the particles rendered in the same color. To advance this subject a little further go to Particle buttons and find the Render tab.
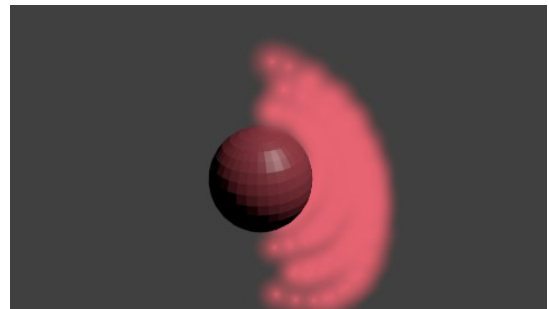
In the Render tab you will see Halo highlighted in blue. This is telling Blender to render the particles as halos. Since there are a considerable number of particles visible at frame 41 close together our rendered image shows us a colored blob.
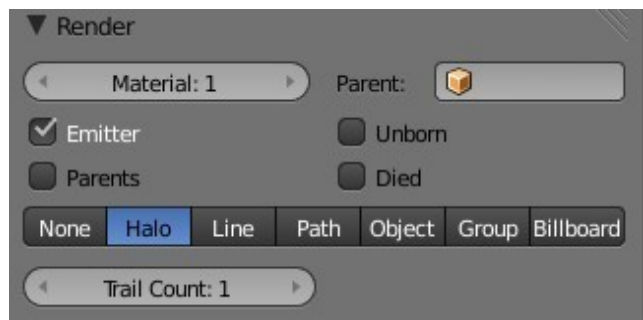
Note the tick in the Emitter box. This tells Blender to render the emitter object in the image. Click in the box to remove the tick. Go back to the Material buttons and find the Transparency tab. Click and add a tick in the Transparency box. Reduce the Alpha value to 0.050 and render again.

Now only the particles are rendered and they are transparent.

This has demonstrated some of the effects of materials on particles. There are many more combinations to play with.
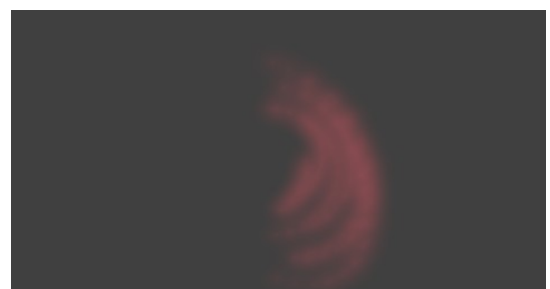
We will have a look at adding halo effects to particles and at the same time introduce a few more tricks to give you the feel for the the versatility of the Particle System.

Open a new Blender scene, delete the cube and add a Plane object. Leave the gravity setting in the Scene button ticked to maintain a gravity effect. With the Plane selected Go to the Property Window – Particle button and add a Particle System. In the Emission tab change the following, Amount: 61, Lifetime: 200. in the Velocity tab change Normal: 7.500 and Emitter Object Y: 0.990. At the bottom of the Velocity tab set Random approx 2.

We are decreasing the amount of particles so we are not flooding the scene but changing the lifetime makes the particles visible longer in the animation. We still have gravity working but with normal velocity at 7.500 the particles will project up a way before descending. Setting Emitter Object Y: 0.990 gives the particles a slight horizontal velocity along the Y axis making them move in an arc.

Now let's jazz the particles up a bit. With the Plane still selected go to the Material button.

Just above the Preview tab change to a Halo material. Click on the color bar and select a nice bright color (Yellow). Change the Halo size to 0.700, tick Rings and Stars.

Press Alt + A and run the animation. Esc to exit then cycle to animation to frame 41. if you select some other frame you wont see what I do. Render an image.
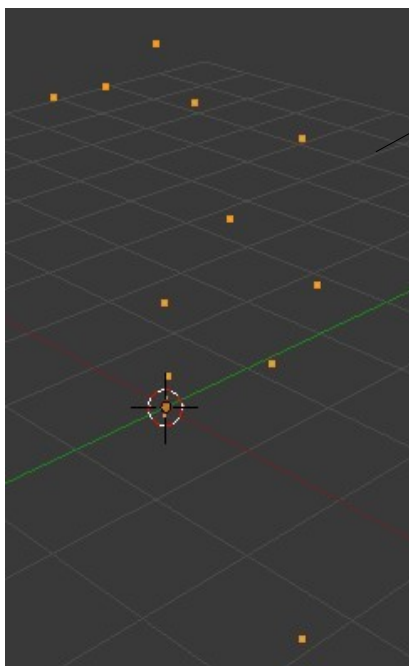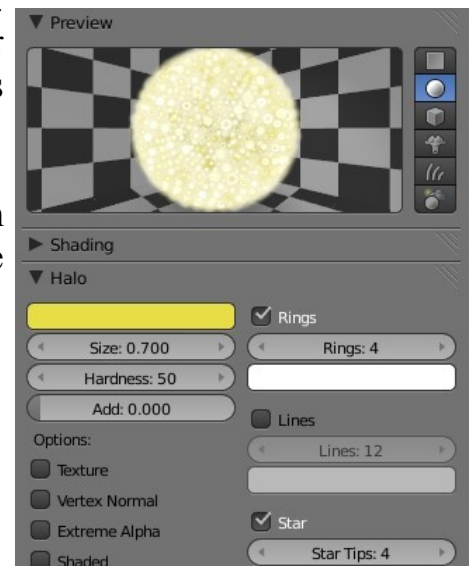
3D Window at Frame 41

Rendered Image
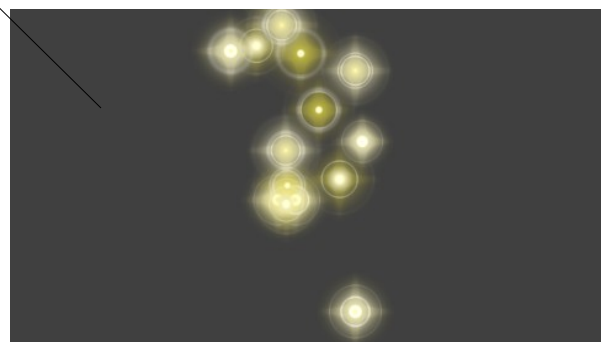
Experiment with Rings, Lines, Stars and Halo size. For example in Material untick Rings and Stars to change the particle render back to a plain halo. Set the Size to 4 to increase the halo size to something that fills the camera view. In the Shading tab decrease the Alpha value to 0.100 to give the halo a transparent look. This should produce something that looks like a cloud of smoke. If you place an object in the scene and position it where the particles are at frame 41 the object renders in the smoke cloud. There are many many combinations all producing different effects.
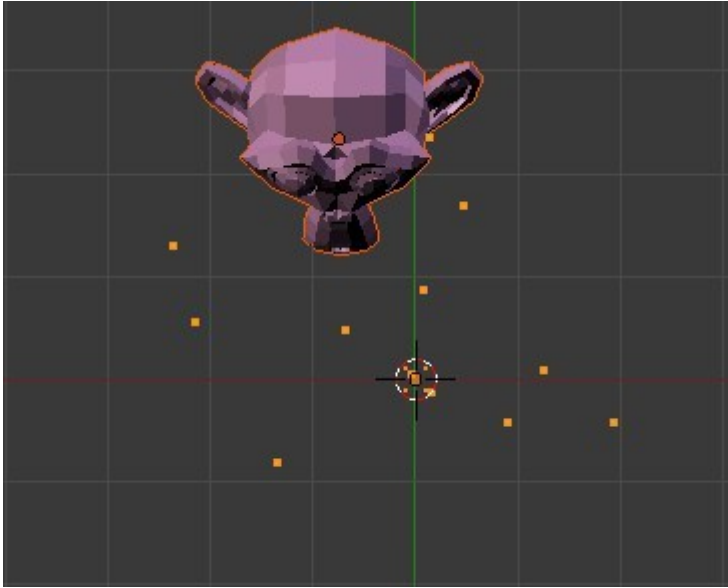
Monkey positioned behind Particles
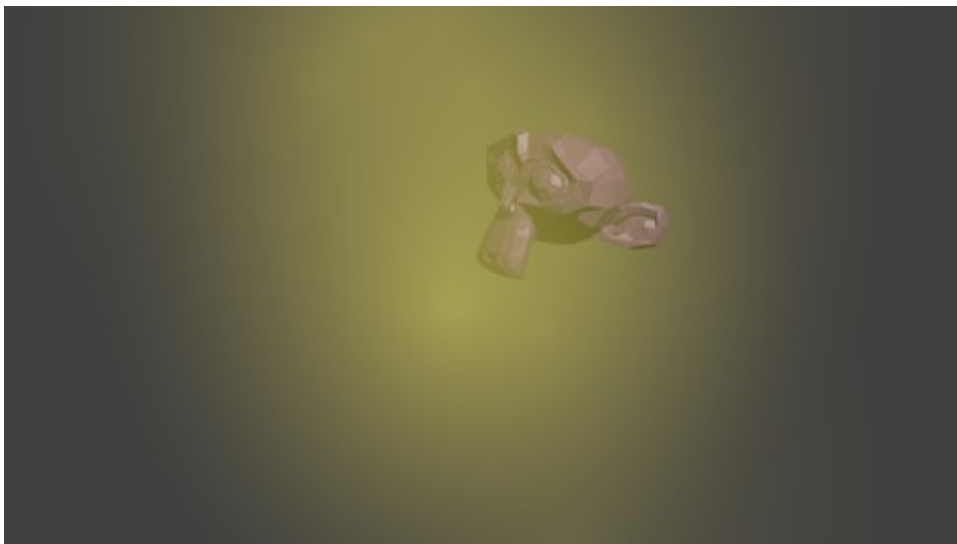
Rendered Image

Particle Interaction With Objects And Forces

Particles can interact with other objects and be affected by forces like wind. Particles can bounce off other objects and act like sparks or droplets. To show how these features work set up a scene with a Sphere positioned above a Plane as shown below. Don't forget to scale the Plane up.

With the Sphere selected go to the Properties Window – Particle button and Add a Particle System. In the Emission tab set the End value to 100 and in the Velocity tab set the Emitter Object Z: -3.000.
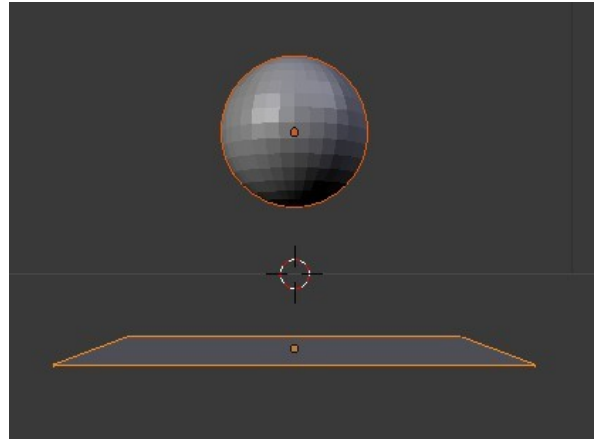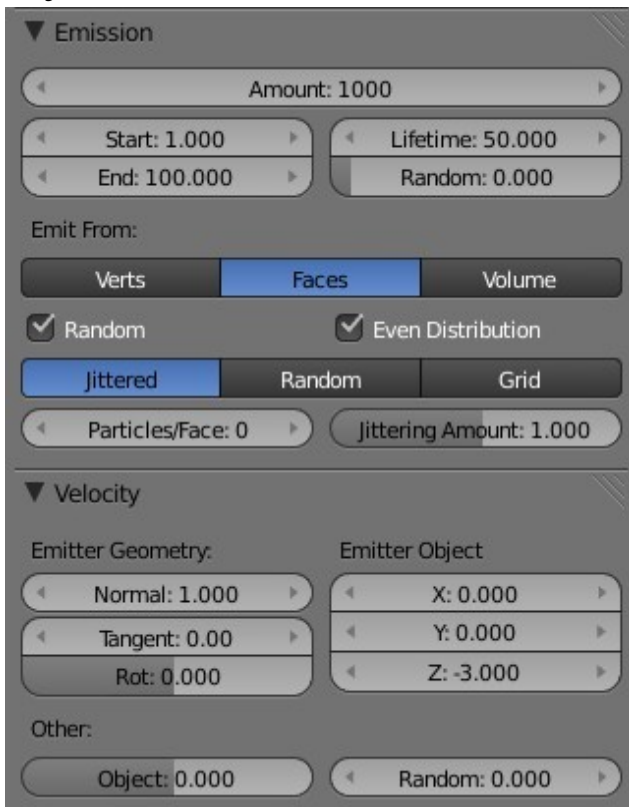
In the Properties Window – Scene button untick the Gravity box.

With your cursor in the 3D Window press Alt + A to play the animation of the particle generation. You will see the particles fall and pass through the Plane as below.
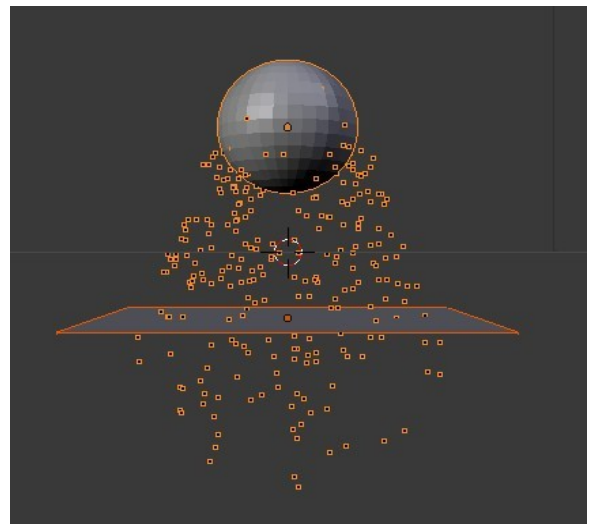
The next step is to stop the particles falling through the Plane.

Select the Plane and go to the Properties Window – Physics button.

Click on the triangle in the Collision tab and click on Add to activate a collision modifier to the Plane. Press Alt + A again to replay the animation. Remember you must be at frame 1 before you replay.

You will now see the particles bounce up from the surface of the Plane. (Tip: Shift select the Sphere and the Plane to better see the particles)/
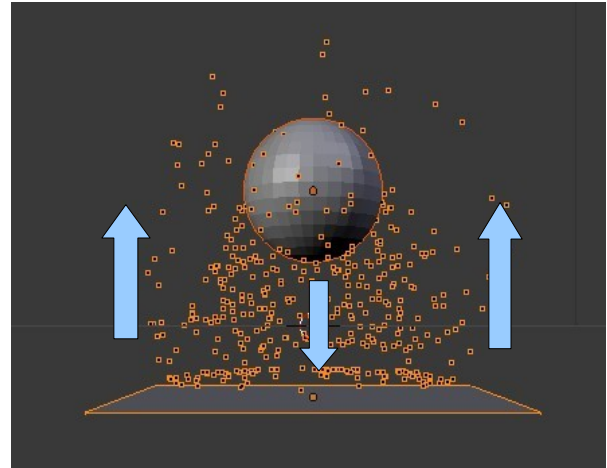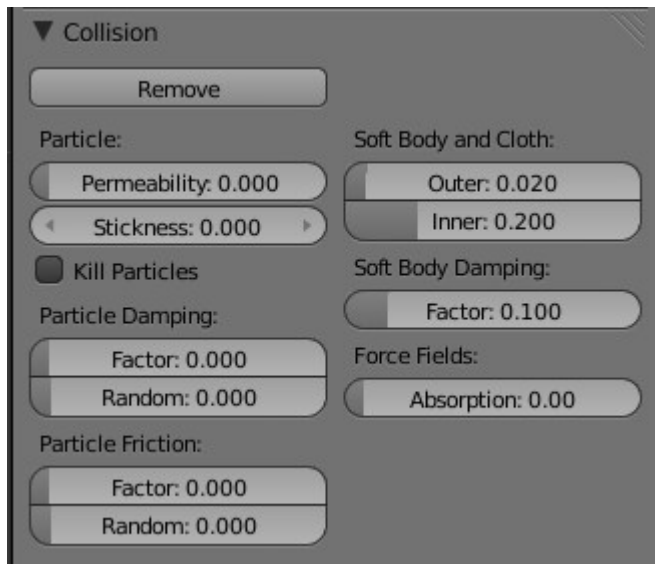
By increasing the Particle Damping factor in the Collision tab to 1.000 the particles will land on the Plane but no longer bounce.

By experimenting with other particle and collision settings and by applying materials with halos, line and stars you can simulate sparks bouncing with high quality results.

Wind

Blender allows particles to be influenced by a simulated wind force. To create a wind effect you have to place an object in the scene and assign a wind force to it. An object called an Empty is great for this since it doesn't render. Begin by opening a new scene and deleting the Cube replacing it with a UV Sphere. Add a Particle System to the sphere and leave the default settings. Add an Empty to the scene. Shift + A and select Empty. Position the Empty just below the Sphere off to one side as shown to the right.

The Sphere will emit particles which will fall downwards since the gravity effect is ticked in the Scene buttons
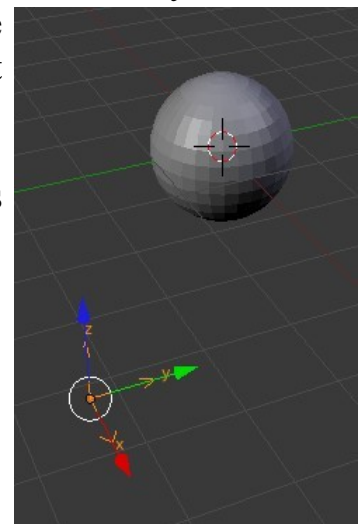
with the Empty selected in the 3D Window go to the Properties Window – Physics button and click on the drop down selection. Select Wind to display the Force Field type Wind settings. You will see the wind force field in the 3D Window attached to the Empty object.
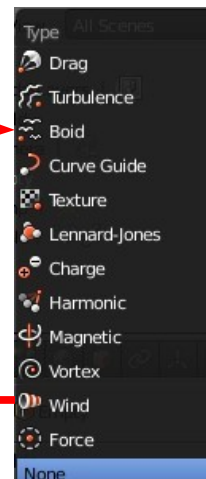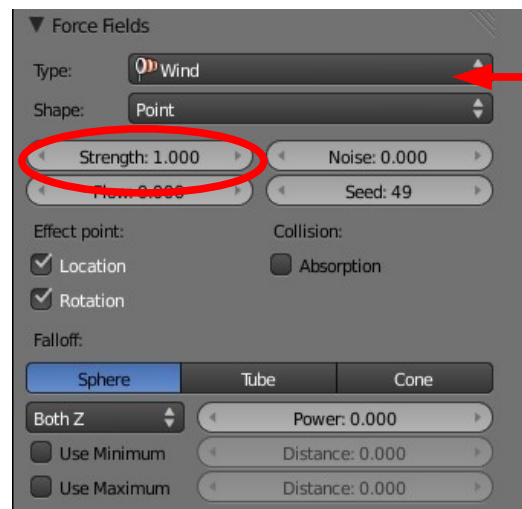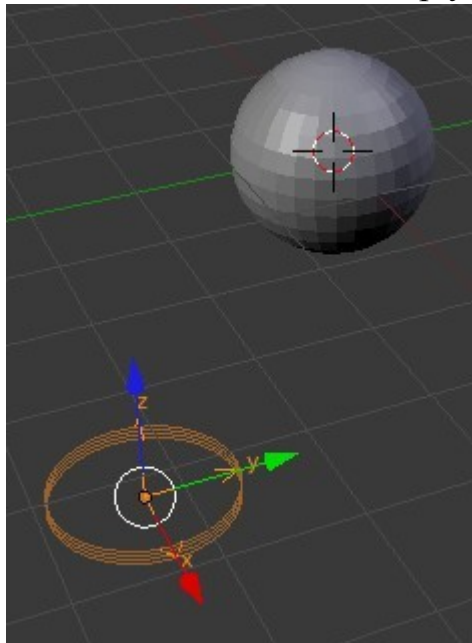
The Wind force is acting along the Z axis of the Empty object at strength 1.000. We want the wind to blow the particles falling from the sphere along the Global Y axis. With the Empty selected rotate it about the X axis so that the Empty local Z axis points in the same direction as the global Y axis.

Increase the Force Field Strength value to 10. Play the animation to see the Spheres particles being blown.

Global Y Axis

Particles blown along Global Y axis

Empty Wind Force rotated about X axis with Strength 10
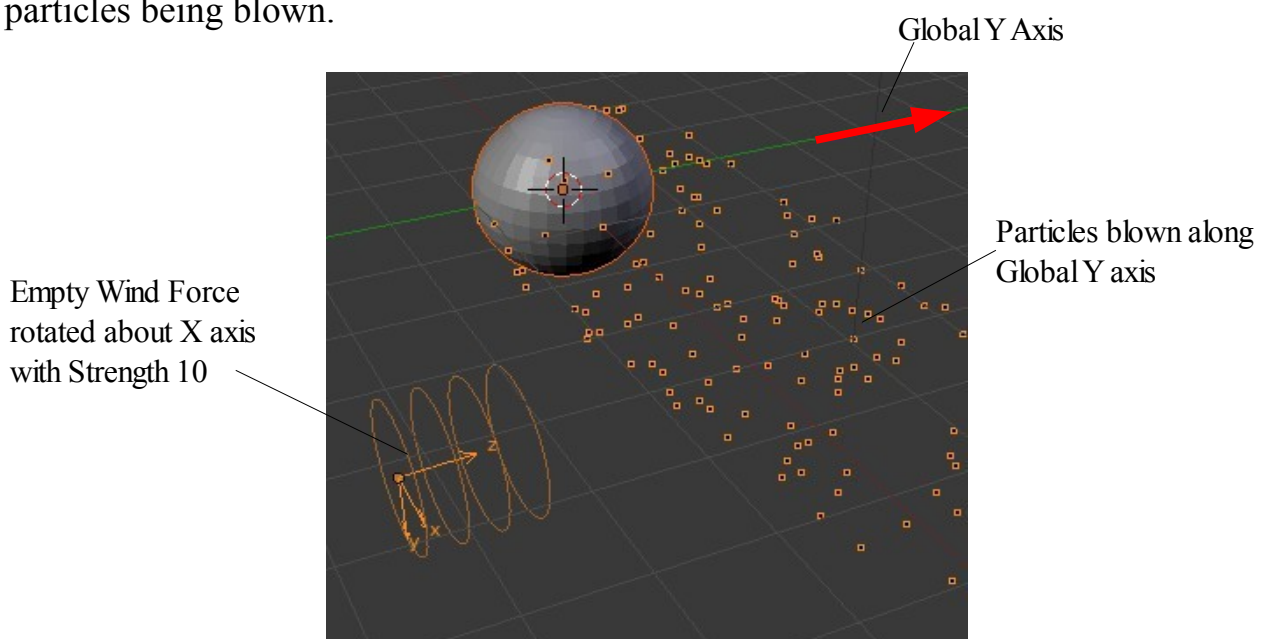
Wind strength is able to be animated which creates a realistic wind effect.

Sample Particle Settings

The following are some sample settings for various uses. Follow the settings carefully otherwise you will not get the results as demonstrated. Settings can be tweaked to produce whatever results you want and only by experimentation will you discover what can be achieved. Remember to record settings for future use when you discover something really neat.

Snow Effect

In a new scene delete the Cube and add a Plane. Scale the Plane up 5 times and subdivide the surface 4 times. Position the Plane at the top of the screen above the Camera out of camera view. The Plane is there to emit particles not to be included in the rendered image or movie.

Go to the Properties Window – Scene button and set Gravity Z: -0.210. This is a low value since we want our snow to float down gently. Remember though if there are other objects in the scene which are effected by gravity they will also float.

Add a Particle System to the Plane. In the Emission tab set Lifetime: 200 and in the Velocity tab set Normal: 0.010 and Random: 0.320. We want the particles to display for a fair while, not go careering off at a hundred miles an hour and have a random speed at start up.

In the Material button add a Material (White is appropriate) and set it as Halo. Set the halo size to 0.050 (Small snowflakes)

Run the animation to generate particles then advance the animation to about frame 230 and render an image.

Plane above Camera
out of view

Rendered Image
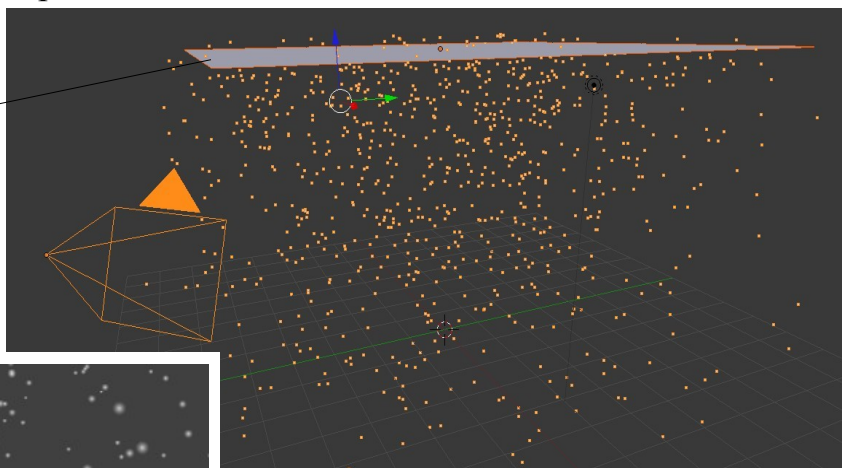
Animation as seen at Frame 230
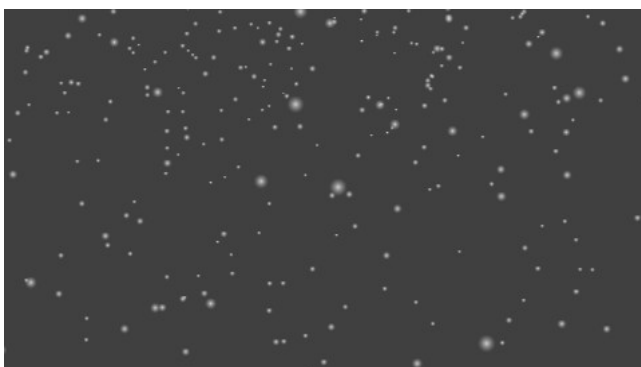
Snowflakes

Fire

In a new scene delete the Cube and add a UV Sphere. Add a material Halo type and make it a nice yellow or red color. Set the Halo size to 0.300.

In the Scene button untick the Gravity box.

Add a Particle System to the Sphere and in the Emission tab set Normal: 0.000. Set Emitter Object Z: 2.870

In the 3D Window move the Sphere down the Z axis a touch to position it at the bottom of the camera view.

Run the animation then cycle forward through the frames and render an image.
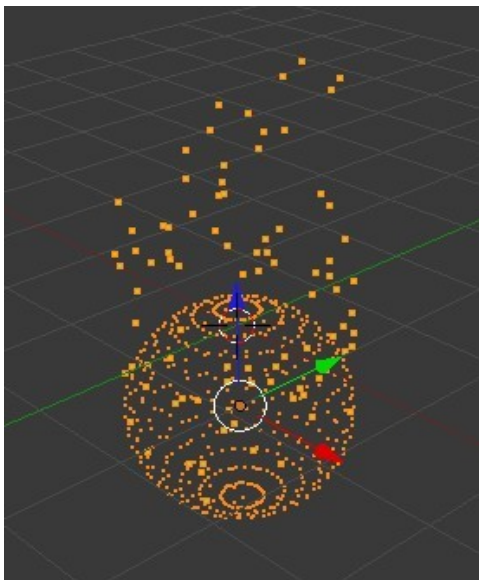
3D Window
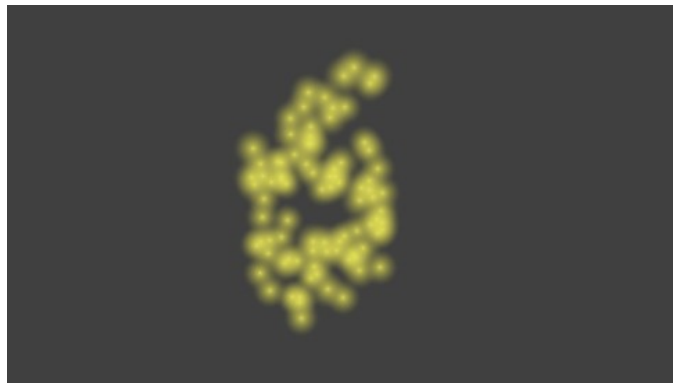
Rendered image

Simple Fireworks

New scene with UV Sphere scaled down.
Position Sphere at top of Camera view.
Material button – Add material- Halo type
Color – Yellow, Halo Size :1.000

Particle button – Add Particle System.
Emission – Lifetime: 100, Start: 50, End: 51
Velocity – Normal: 2.000

After animation run advance frame to 67.

Render tab – untick Emitter.

3D Window
Camera View

Rendered Image
Emitter Not Shown
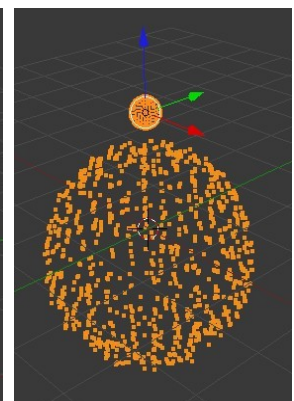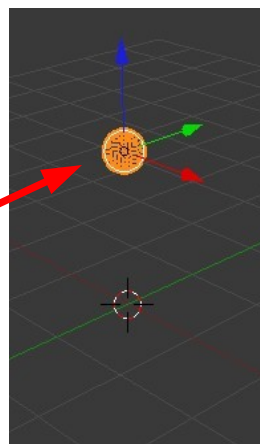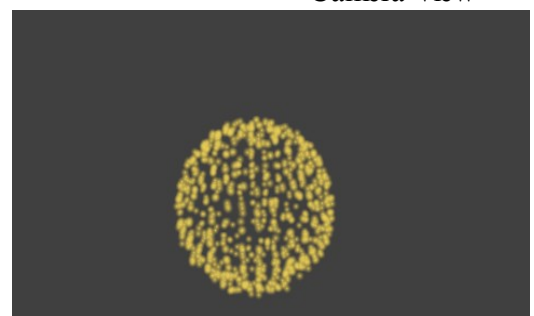
Keyed Particle Systems

So far we have looked at Particle Systems of Type: Emitter with Newtonian Physics. We will now consider type: Emitter with Keyed Physics which we call Keyed Particles.

Keyed Physics is a way of controlling the movement of particles by directing them from the original emitter object to a second object and on to a third and subsequent objects. The flow of particles may be used as an animation or used to create a static image.

The following procedure for setting up a Keyed system will demonstrate the principals involved.

Open a new scene in Blender and delete the default cube. Add three separate Plane objects and position them as shown in the diagram. A simple way to do this is to add one Plane then with the Plane selected press Shift + D to duplicate . the new Plane will be in Grab mode (White outline) so hit Y Key to confine movement to the Y axis and drag it to one side. Click mouse to exit Grab mode. Repeat the process to add a third Plane.

Note the first Plane was named 'Mesh' by Blender (see names at lower left of screen when selected). The second Plane is named 'Mesh.001 and the third 'Mesh.002. Arrange them in the 3D Window in order of name. It will help later on.
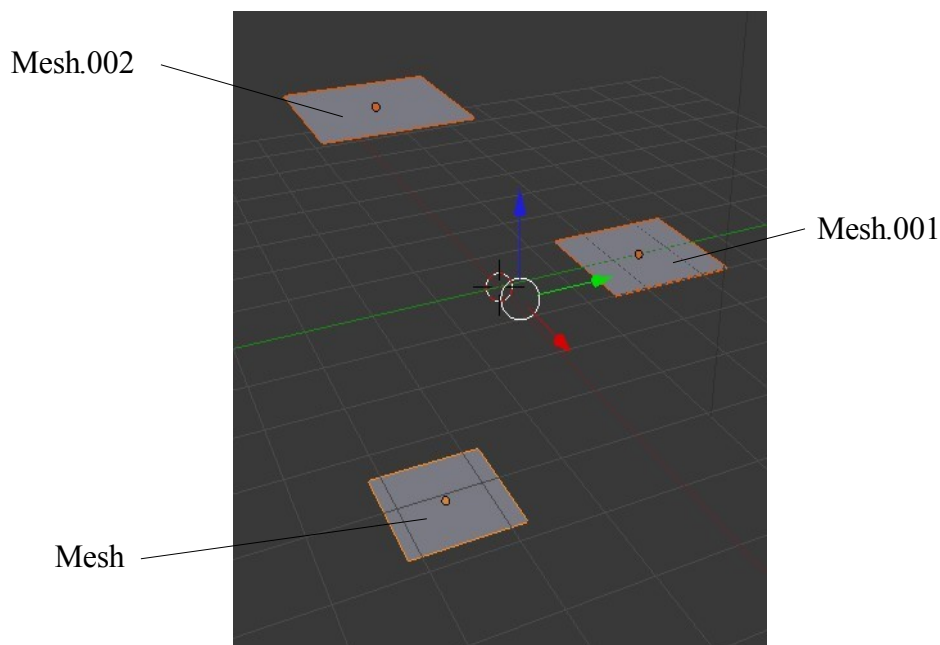
Just as an aside you could go to the Properties Window – Object data button and edit the name in the Name box at the top of the window. You could use any name you like say, 'Borris", 'Clive' and 'James'. Since they are all identical triplets it's probably best to stay with the 'Mesh' names.

Rename Object here if required
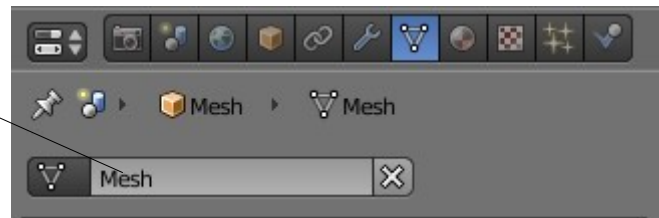
By the way the Planes have been arranged in a vertical stack with 'Mesh' at the bottom left, 'Mesh.001' middle right and 'Mesh.002' top left.

Select 'Mesh' and in the Properties Window – Particles buttons <u>click on the plus sign</u> to add a Particle System.
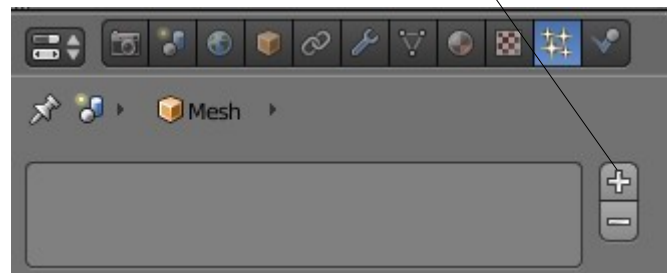
Go to the Physics tab and <u>select 'Keyed'.</u> <u>Click on the plus sign</u> next to the Keys panel to add a new Particle Target.

Blender enters this in the panel and names it 'Particle System'. Note the small panel with the little cube in it   just below the Keys panel. <u>Leave this empty</u> for the time being.
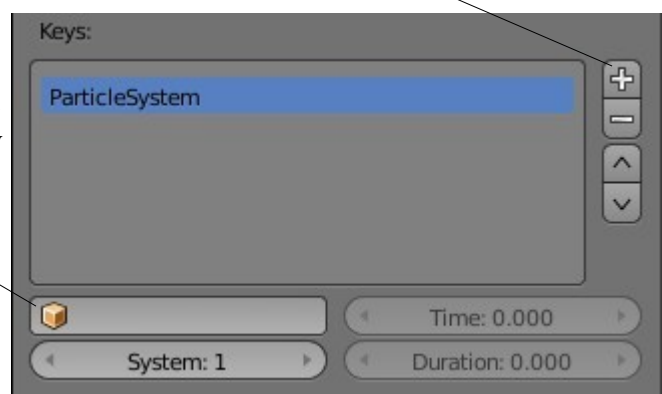
The Plane named 'Mesh' is going to be our Emitter.

Deselect 'Mesh' in the 3D Window and select 'Mesh.001'. Repeat the process to add a Keyed Particle System to 'Mesh.001'.

Tip for Newbies: When you select 'Mesh.001' all the buttons in the Particle buttons panel disappear if you happened to scroll down the buttons window with a few tabs expanded. Drag up the scroll bar at the right hand side of the window to reveal the plus sign to add a new system. Sound silly but it fooled me for a bit.

Select 'Mesh.002' and Add a Keyed Particle System to 'Mesh.002'.

Now go back and select 'Mesh'. In the Particles buttons - Physics tab click on the plus sign next to the Keys panel to add a new Particle Target. Blender enters Particle System again. Remember the small panel with the little cube in it. Click on the cube to display a drop down selection panel. Click on 'Mesh.001'. Blender changes the target to 'Mesh.001:ParticleSystem'

You are telling the particle target for 'Particle System that the target object is 'Mesh.001'.

Still with 'Mesh' selected in the 3D Window click on the plus sign next to the keys panel again. Again Blender enters 'ParticleSystem'. Click on the cube and select 'Mesh.002'.

We now have Particle targets named 'ParticleSystem', 'Mesh,001: ParticleSystem' and 'Mesh.002: ParticleSystem'.

This is simply telling particles emitted from 'Mesh' to go to 'Mesh.002' and then go on to 'Mesh.002'.

Hit Alt + A to see it happen.
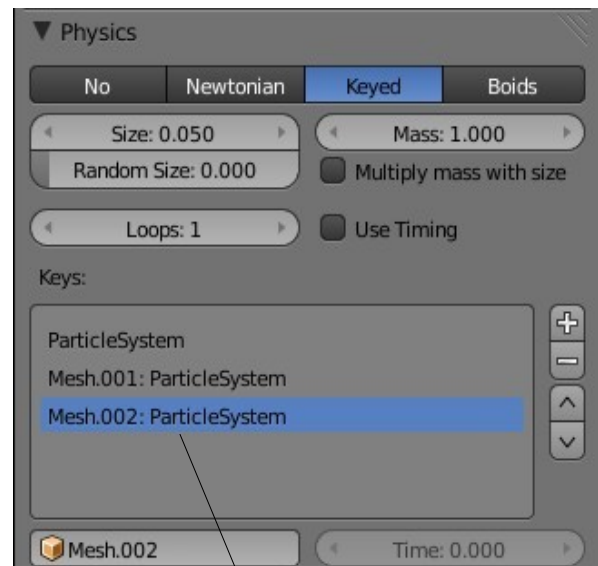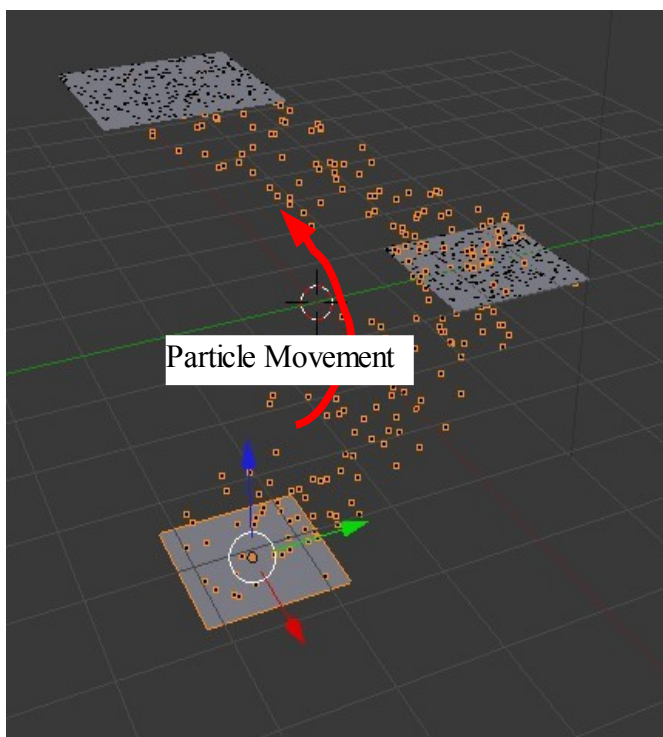
Particle Targets

Particles flow from one mesh to the other

Remember all the rules for number of particles, lifetime, start, end and normal velocity etc. apply.

Boids Particle Systems

Boids particle systems are used to simulate flocks, swarms,herds and schools of various kinds of animals or anything that acts with similar behavior. Boids particle systems are of Type: Emitter but have Boids Physics applied. Boids particles in one particle system can react to particles in another system or they can react to particles within their own system. Boids are given rules of behavior which are listed in a stack. The rules at the top of the stack take precedence over rules lower down in the stack but the stack is able to be rearranged once it is written.

Since only a certain amount of information is able to be evaluated if the memory capacity is exceeded rules lower down the stack are ignored.

The procedure for setting up Boids Particle Systems will be demonstrated with a few examples.

Example: A Flock of Birds

Remember we are sticking to basics so don't get too excited. Our particles will act like a flock of birds not look like birds.

Open a new Blender scene and stick with the default Cube. This will be our particle emitter. In the Properties Window – Particle buttons – Add a new Particle System.

Let's try a new innovation as far as instruction is concerned. Leave all buttons settings as default values except for the following. Change these values.

Emissions tab
      Amount: 30   We will have a small flock.
      Lifetime: 250   The default animation length in the Timeline.
Physics tab
      Select Boids Physics
Boids Brain tab
      Blender default rules are: 'Separate' and 'Flock'. With 'Separate' highlighted hit the minus sign to delete it. Click on the plus sign at the right hand side of the window to display a selection drop down for Boids Rules. Select ' Follow Leader'. With 'Follow Leader' highlighted click on the up arrow below the minus sign to move 'Follow Leader' to the top of the stack.

We have told the particles to follow the leader while flocking together. We will now give the particles a leader to follow.

Deselect the Cube in the 3D Window (A Key) and add an 'Empty'. An 'Empty' is a location point which can be animated to move in the scene but which does not render.

Grab the 'Empty' and move it to the side. Deselect the 'Empty' and select the 'Cube'. Go back to the Boids Brain tab and make sure 'Follow Leader' is highlighted. Below the stack window you will see a name box where you can rename the rule if you wish and below that an empty box with a little cube at the end. Click in this box and select 'Empty' from the drop down which displays.
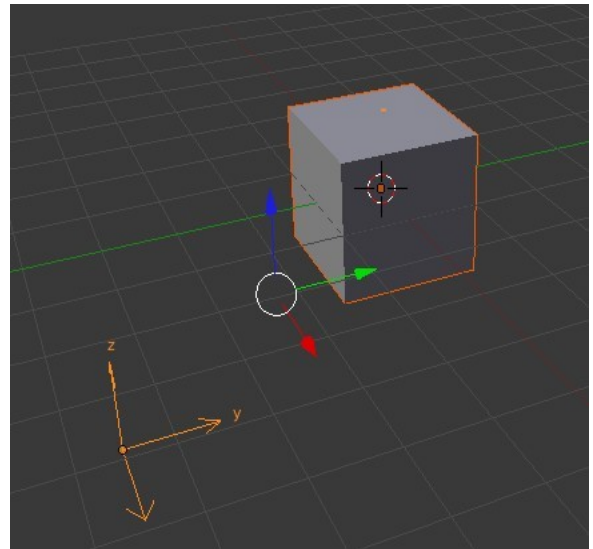
We have told the particles to follow the 'Empty'.

Animate the 'Empty' to move across the screen (See the section on animation).
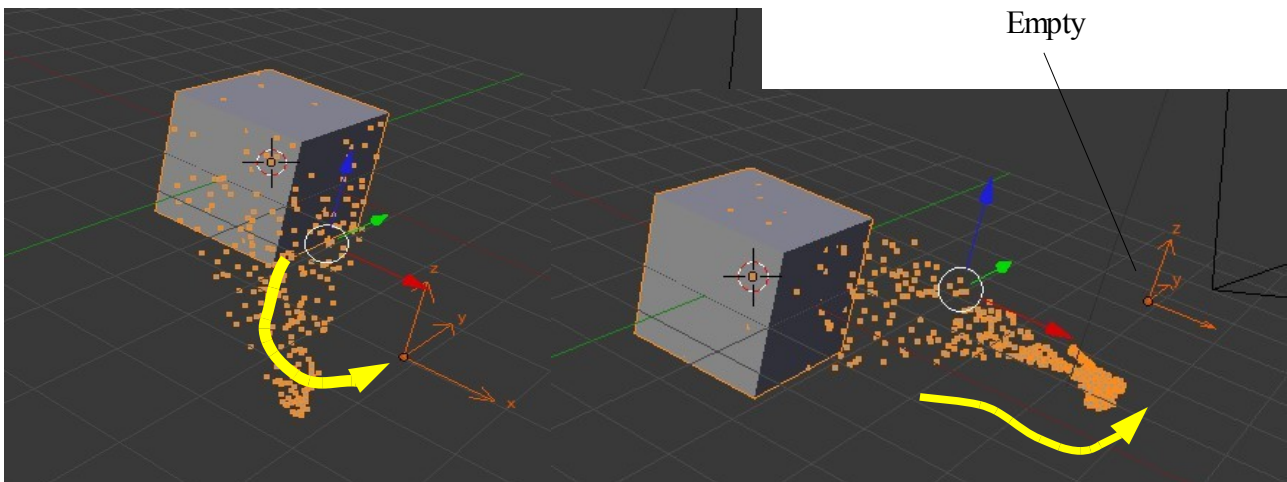
Particles emitted from Cube swarm and follow Empty as is moves

When the animation is played have the Cube selected in the 3D Window. Particles are emitted from the Cube, head towards the 'Empty' and attempt to follow it as it moves across the screen. Having the Cube selected displays the particles as little orange squares. If it isn't selected all you get are black dots which are hard to see.

Note: With a high particle amount Blender may crash due to overload when calculating data. This of course depends on the capability of your computer.

Example: Directing Movement

In this example we will demonstrate how to direct particles to move from one object to another.

Start a new scene and add a second Cube object. Note the default cube is named 'Cube' (see lower left of 3D Window) and the new Cube is named 'Mesh' that is if you added it by going Shift + A. If you duplicated the default Cube by Shift + D then it is named 'Cube.001'. Remember the names.

Position the Cubes as shown in the diagram scaling the new cube down.
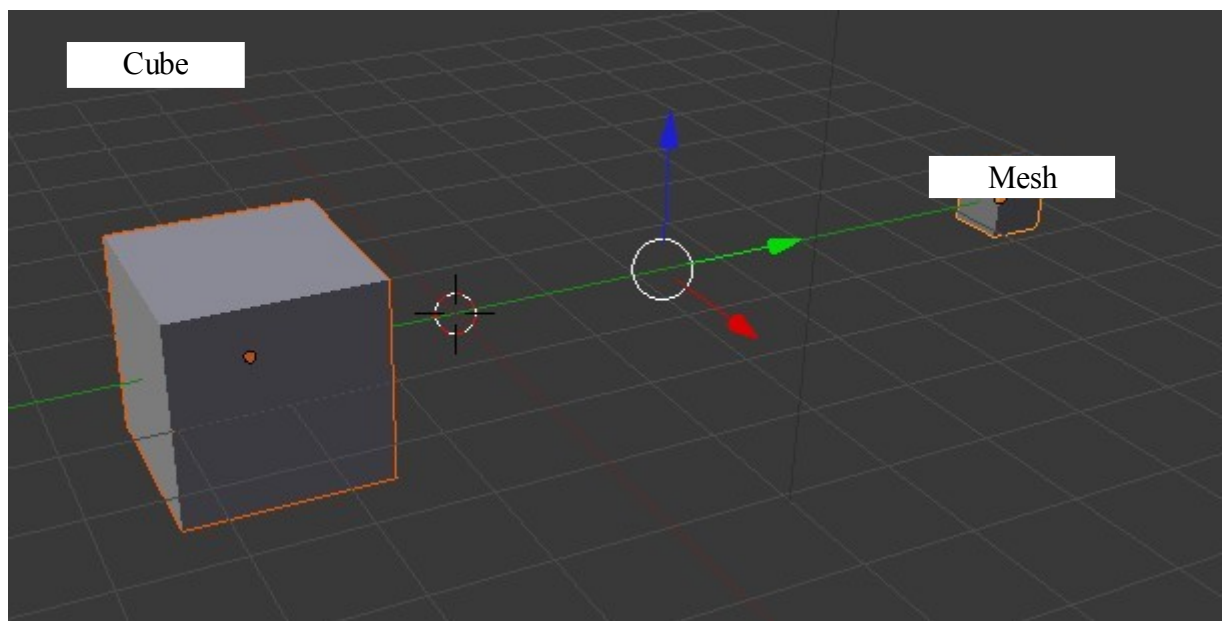
Select 'Cube' and add a particle system with Boids physics. In the emission tab reduce Amount to 10 and set Lifetime to 1500. We want to keep the number of particles low and have them visible for a fair amount of time in the animation.

Go to the Timeline Window and and set the animation at 1500 frames.

Let's display the particles in a different way. In the Display tab select Cross' and set the Draw Size to 10. You will see a biggish cross appear on the Cube.

Now for the Boids Brain tab. Remove 'separate' and 'Flock' and add 'Goal'. Click in the Object box below the rule window and select 'Mesh' or 'Cube.001' as the case may be. This tells the particles emitted from 'Cube' to go and find the target.

Play the animation to see the result.
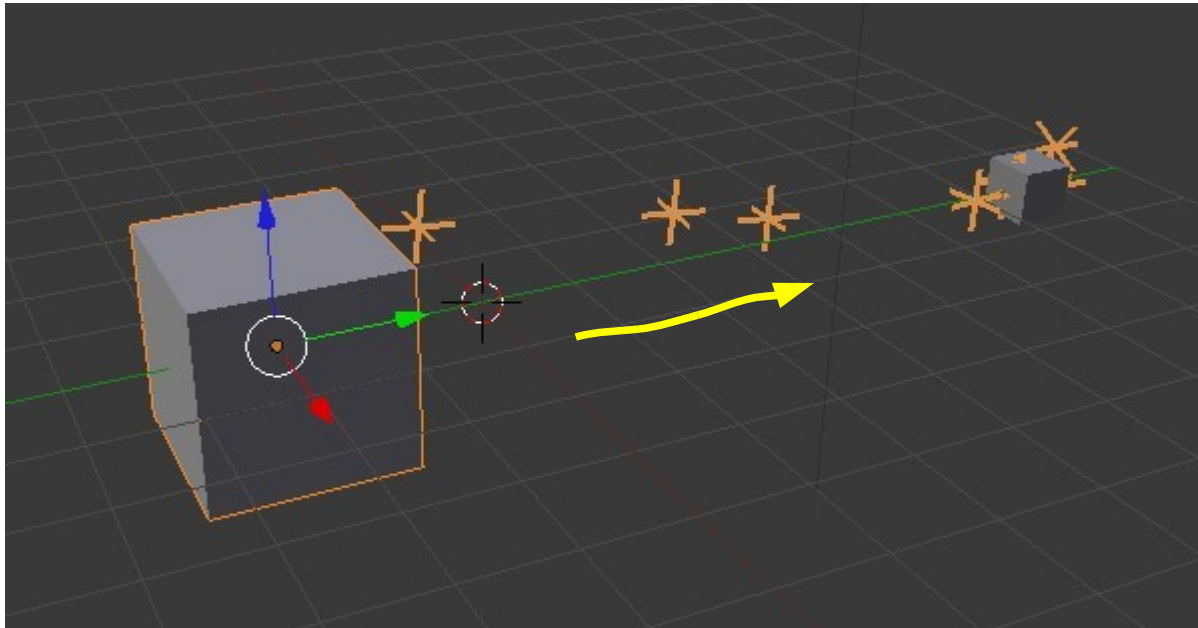
Crosses emitted from 'Cube' migrate across to and accumulate on the target. Remember the location of either or both of the cubes in the scene may be animated at the same time.

Example: Prey Predator Relationship

Boids particles will not only act like swarms or flocks in their movement they can also be made to react to one another. An example would be one flock of birds chasing off another flock.
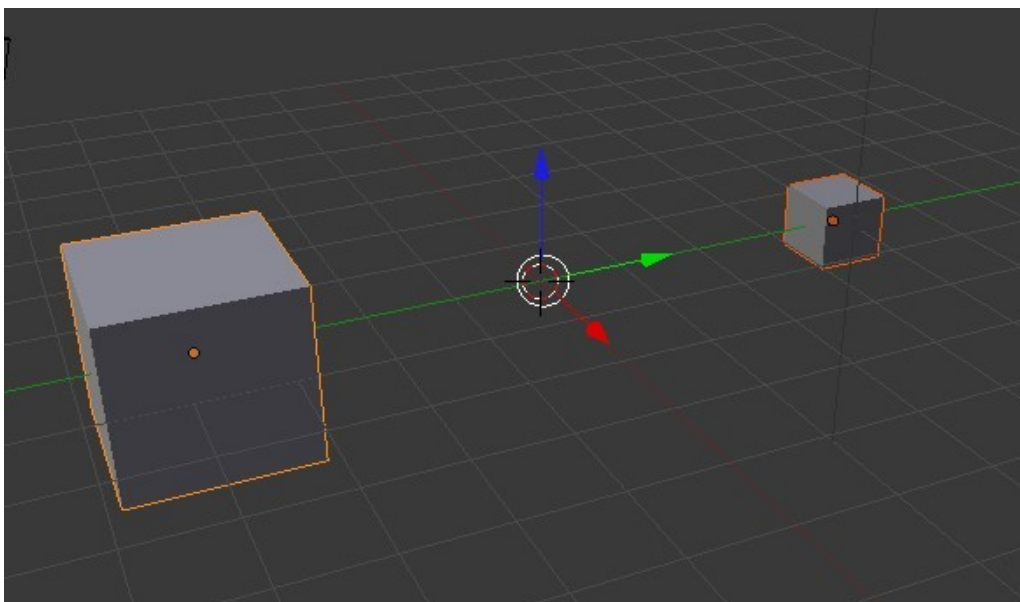
We will set up an example in a new Blender scene with two cubes as shown in the diagram. Make the larger cube 5x the smaller Predator Particles

Predator Particles
Select the small cube (Predator) in the 3D Window then in the Properties Window –
Particle buttons add a Particle System. Change the following settings:

Emission tab
        Amount: 100 (Observation: Larger number becomes the aggressor)
        Lifetime: 1500 (Allows particles to be visible for duration of the animation)
Display tab
        Select 'Point' and set Draw Size to 3.
Physics tab
        Select 'Boids'
        Size: 0.0300
        Max Air Speed: 7.000 (Gives an advantage over the slower Prey particles)
        Select: Enemy (Next to the 'Relations' panel click on the Plus sign)
Boids Brain tab
        The default Separate and Flock rules are applied. Add a Fight rule and move it
        to the top of the stack.

Prey Particles
Select the large cube (Prey) in the 3D Window and add a particle system.
Change these settings:

Emission tab
        Amount: 10
        Lifetime: 1500
Display tab
        Select 'Cross' and set Draw Size to 10.
Physics tab
        Select 'Boids'
        Size: 0.030
        Max Air Speed: 5.000 (Combined with size makes bigger and slower)
        Relations: Click the Plus sign (Invalid target displays) then click in the target
        selection box below the window (little cube) and select 'Cube'. Now 'Cube:
        ParticleSystem' displays in the window.
        Select 'Enemy'.
Boids Brain tab
        Repeat the same set up as the Predator system.

Go back to the Predator and repeat the 'Relations' setup this time selecting 'Cube.001'
as the target. (Note: You can not set up Relations until the other object has a particle
system)

Still in the Physics tab with the larger cube selected change to Newtonian Physics
then tick in the Die on hit box. Change back to Boids Physics.

Shift select both cubes in the 3D Window and play the animation to see the result. Selecting both cubes draws orange lines around the particles and makes them more visible.

Dot particles attacking Cross

The Cross particles emitted from the large cube are attacked by the swarm of small particles from the small cube. The Cross particles die when they are hit. By observation, on my machine, this is a hit and miss process and I am unable to define accurately at what frame a particular particle dies.
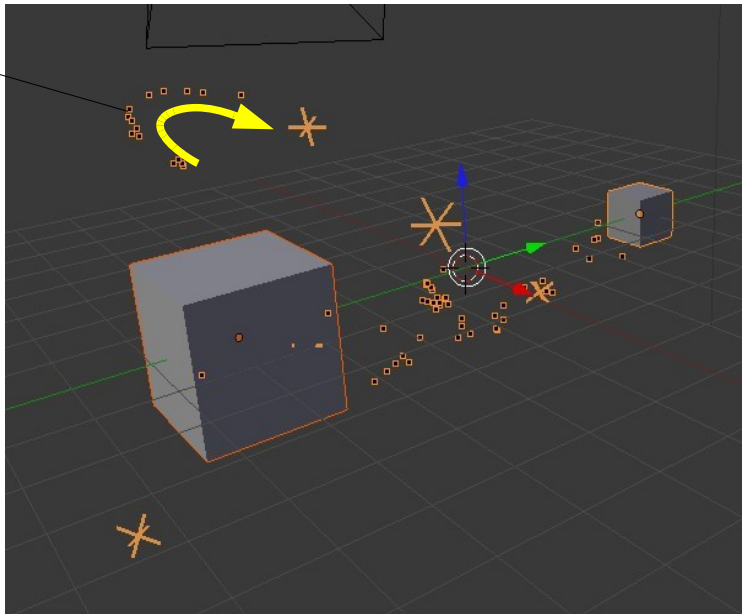
For simplicity we are showing only dots and crosses as seen in the 3D Window. A render could show anything you wish by choosing 'Object' in the Render tab and assigning a preconstructed mesh object. A complex single frame can take a while to render and a complex animation can take an eternity.

Example: Follow Terrain

Boids particles can be made to emulate herds following a terrain.

Set up a new Blender scene as shown in the diagram. The Cube object is the default Cube and will act as a target to which the particles will be directed. The other two objects in the scene are two Planes with one being scaled up and shaped to act as our terrain.

Mesh.001

Cube
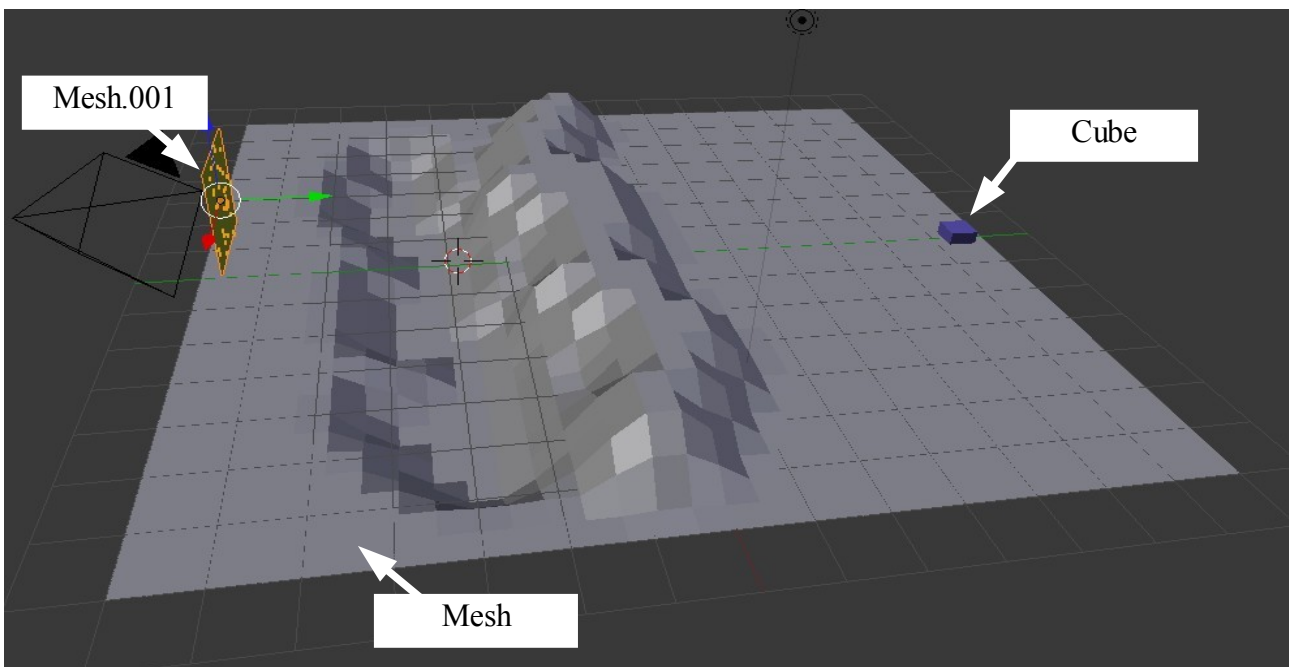
Mesh

With the scene assembled select the objects as listed and perform the following set up in the Properties Window:

Select Mesh.001 (The small plane rotated – The emitter)
> Add a Particle System with Boids Physics untick Allow Flight and tick Allow Land.
> In the Emission tab: Amount: 100, Lifetime: 1500 (Change the animation length in the Timeline to 1500 frames.
> In the Boid Brain window add a 'Goal' rule, move it to the top of the stack and select 'Cube' as the goal.

Select Mesh (The Terrain)
> In the Properties Window – Physics buttons – Collision tab – click Add.

The Cube (Target) requires no action other than to scale it down a bit.

Select 'Mesh.001 and play the animation.

The particles emitted follow the contour of the terrain as they move to the target.

Panel 1 (Particle System)

Cube ▸ ParticleSystem

ParticleSystem

Name: ParticleSystem
Settings: ParticleSettings
Type: Emitter   Seed: 0

▶ Cache

▼ Emission

Amount: 1000

Start: 1.000   Lifetime: 50.000
End: 200.000   Random: 0.000

Emit From:

| Verts | Faces | Volume |

☑ Random   ☑ Even Distribution

| Jittered | Random | Grid |

Particles/Face: 0   Jittering Amount: 1.000

▼ Velocity

Emitter Geometry: Emitter Object:
Normal: 1.000   X: 0.000
Tangent: 0.00   Y: 0.000
Rot: 0.000   Z: 0.000

Other:
Object: 0.000   Random: 0.000

▼ Rotation

Initial Rotation: ☐ Dynamic

Velocity   Phase: 0.000
Random: 0.000   Random: 0.000

Angular Velocity:

| None | Spin | Random |

0.000

Panel 2 (Physics)

▼ Physics

| No | Newtonian | Keyed | Boids |

Size: 0.050   Mass: 1.000
Random Size: 0.000   ☐ Multiply mass with size

☑ Allow Flight   ☐ Allow Land   ☐ Allow Climbing

Max Air Speed: 10.000   Max Land Speed: 5.000
Min Air Speed: 0.000   Jump Speed: 0.000
Max Air Acceleratio: 0.500 Max Land Accelerati: 0.500
Max Air Angular Vel: 0.500 Max Land Angular V: 0.500
Air Personal Spac: 1.000   Land Personal Sp: 1.000
Landing Smoothn: 3.000   Land Stick Force: 0.000

Battle: Misc:
Health: 1.000   Banking: 1.000
Strength: 0.100   Height: 1.000
Aggression: 2.000
Accuracy: 1.000
Range: 1.000

Relations:

▼ Boid Brain

Rule Eva Fuzzy   Rule Fuzzines: 0.500

Separate
Flock

Separate

Panel 3 (Display)

▼ Display

| None | Rendered | Point | Circle | Cross | Axis |

Display: 100   Draw Size: 0

☐ Size   ☑ Use material color
☐ Velocity
☐ Number
☐ Health

▶ Children

▼ Field Weights

Effector Group:

Gravity: 1.000   All: 1.000

Force: 1.000   Harmonic: 1.000
Vortex: 1.000   Charge: 1.000
Magnetic: 1.000   Lennard-Jones: 1.000
Wind: 1.000   Turbulence: 1.000
Curve Guide: 1.000   Drag: 1.000
Texture: 1.000   Boid: 1.000

▼ Force Field Settings

☐ Self Effect

Type 1:   None

Type 2:   None

Hair Particles

The previous pages describing particles have introduced particles of Type: Emitter with Physics types No, Newtonian, Keyed and Boids. We will now take a look at particles Type: Hair, where particles are rendered as strands and may be edited in the 3D Window. Hair type particles may be used to represent such things as grass and fur as well as hair or anything which has a surface with fibrous strands.

We will perform a quick demonstration to show what is meant by Hair Particles.

In the 3D Window delete the default Cube object and add a Plane. Zoom in a bit.

Click to Add Particle System

With the Plane selected go to the Properties Window – Particle button and click on the plus sign to add a Particle System. At the top of the Particles window click on the drop down where it displays Type: Emitter and select Hair. The Plane in the 3D Window will show long strands sticking up from the surface of the plane. Go to the Velocity tab and decrease the Normal:1.000 value and you will see the length of the strands shorten. We have a Hairy Plane.

Reduce Normal to Shorten Hair
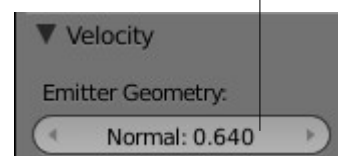
That just shows you what Hair Particles look like in essence.

Let us proceed with something a little more exciting. Start a new Blender scene, delete the Cube and add a Monkey. The monkey head always loads looking upwards. Put him with the top of his head pointing up. R Key – X Key – 90 – Press 'Enter'. That means **R**otate about the **X** axis **90** degrees.

If we just go ahead and add a Hair particle system we will get a hairy headed monkey with hair sticking out all over everything. We know a lot of our friends look like this but let's try for a more clean cut look with some hair on the head and a beard.

Press the Num Pad 7 key to get into top view looking down on monkey's head. We will designate where we want the hair to grow by selecting a bunch of vertices. This bunch is called a Vertex Group. Tab into Edit Mode, zoom in so you can see what you are doing and in the 3D Window header click on the <u>Limit selection To Visible</u> button.

Press the A key to deselect all vertices then go ahead and select a group on the top of monkey's head. You can do this by Shift + Right Click individual verts, B Key and Left Click to drag a box to select or C Key and Left Clk to drag the circle to select (Scroll MMB to change circle size and press Esc to cancel when selection finished).

Plan view of Monkey Head with
vertices selected
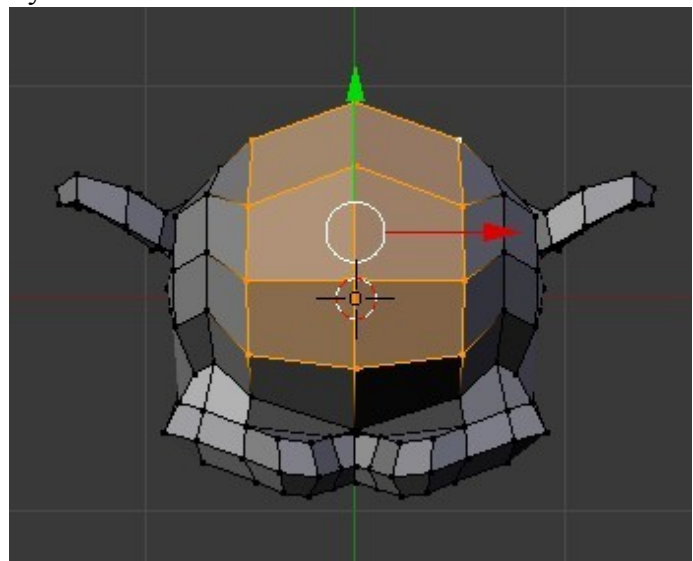
Leave the vertices selected and in the Properties Window click on the Object data button. In the Vertex groups tab <u>click on the plus sign</u> to add a Vertex Group.
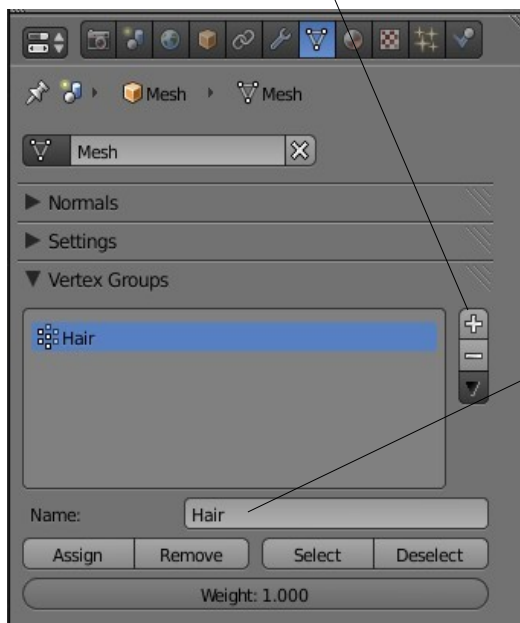
Group renamed Hair

In the name box click on Group and delete it (Blender names every new vertex group 'Group'). Type in 'Hair' and press enter to rename the group. You will note that the group highlighted in blue in the window changes.

Remember we still have our vertices selected. Now in the Vertex group tab just below 'Name' click on the Assign button. This assigns the selected vertices to the Vertex group named 'Hair'.

So far we have a head and we have nominated an area on the head by selecting a group of vertices. We do not have hair.

Go to the Particles button and click on the plus sign to add a particle system.

Change Type: Emitter to Hair. What! Nothing happened? That's because we are in edit mode. Note Blender has named the particle system 'Particle System'.
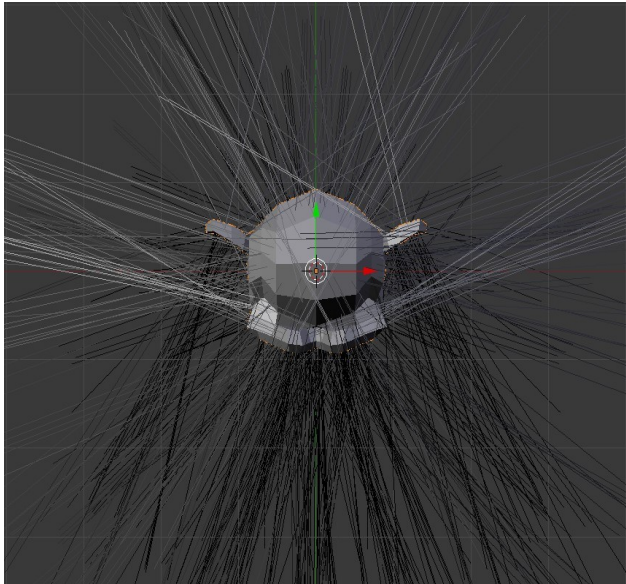
Plenty of Hair
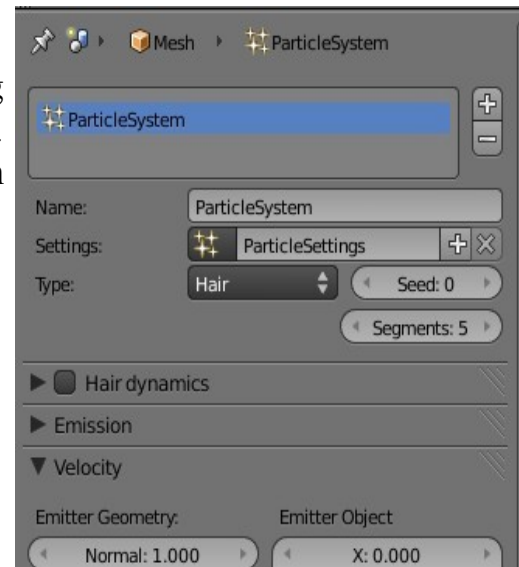
Tab to Object mode in the 3D Window and Yay! plenty of hair. In fact we have hair everywhere. Long hair all over the place just like our friends we mentioned earlier. We will correct this look. To start with in the Velocity tab decrease the Normal value until the hair strands look reasonable say about 0.270. Next, still in the Particles buttons, go down to the Vertexgroups tab and in the box next to Density click and select 'Hair'.

We now have hair only on the area we selected. Press Num Pad 3 to get a side on view. What a scrawny bunch of hair. That's not so impressive.
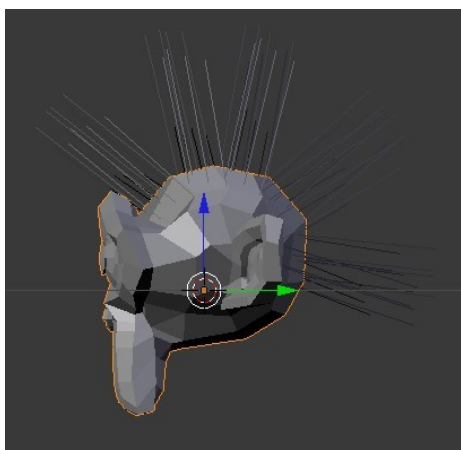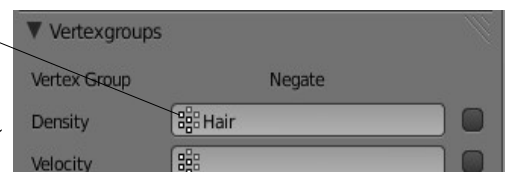
To fix the scrawny look go to the Children tab and click on Particles. Wow! Now we have a bushy sticky out sort of mowhawkey hairdo. Well you would if you selected the same vertices as I did. It still probably looks like your friends.
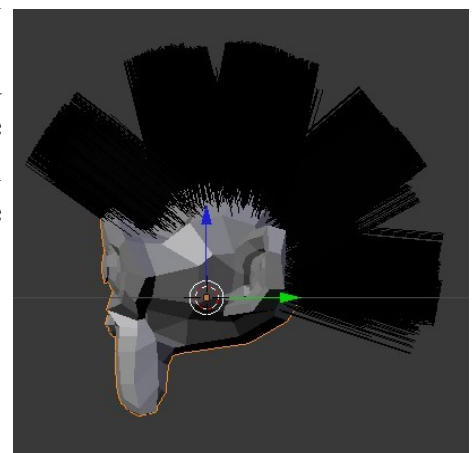
We will continue on and add a beard as promised. Does your friend have a beard?

To make proceedings interesting but hopefully not difficult to understand we will vary the procedure just a little. We previously selected a bunch of vertices then created a Vertex Group and named it then assigned the selected vertices to the group.

Lets create a new Vertex Group first this time. With Monkey selected in Object mode in the 3D Window go to the Object data button in the Properties Window and in Vertex group tab <u>click on the plus sign to add a new Vertex group.</u>

Blender again names the new group 'Group'. Rename this to 'Beard' as we did before for Hair.

Now we need to select the vertices to assign to the new group. We could use the procedures as outlined previously but lets do it a different way.
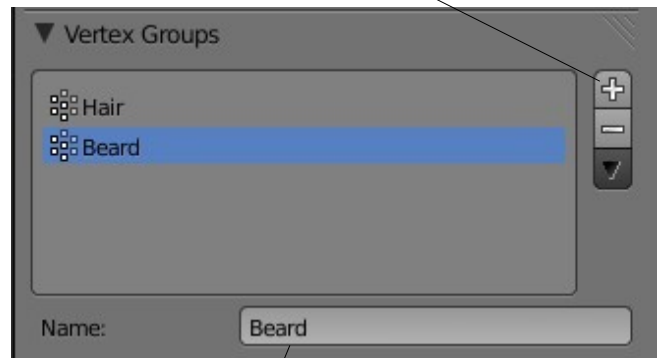
Group renamed Beard
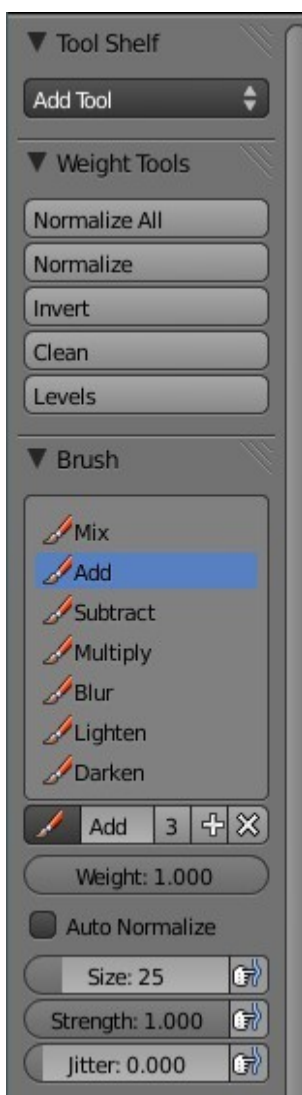
First Tab into Edit Mode and deselect all vertices.

In the 3D Window header change to Weigh Paint mode. Our monkey turns blue in the 3D Window. This is showing that no vertices are selected. Note 'Beard' is highlighted in blue in the Vertexgroups tab in the Object data buttons. Click on 'Hair'. If you look closely in amongst all that black hair (Rotate the view) you will see red scalp. This is showing the area previously selected by selecting individual vertices. Tab to Edit mode and click on Select in the Vertexgroup tab and you see the vertices that were painted. Press the A Key in the 3D Window to deselect. Click on 'Beard' again in the Vertexgroup tab, Object data buttons.

Now look at the tools panel at the left hand side of the screen.

See the Brush tab and click on 'Add' go below this and drag the Strength slider all the way to the right to Strength:1.000. In the 3D Window drag the circle that appears as the mouse curser over the monkey's chin.

You will see the color change as you drag. Keep dragging until the chin is all red which means that you have selected this area as the new Vertex Group for the Beard. Tab to Edit Mode, make sure all vertices are deselected, then in the Vertexgroup tab click on 'Add' to assign the painted vertices to the Beard Vertexgroup. Click on 'Select' to see them.

Go to the Particles buttons and add a new Particle System. Note Blender names this system 'Particle System 2'. Select Type: Hair, decrease the Normal value in the Velocity tab, go down to the Vertexgroups tab and click in the density box selecting 'Beard'. We now have scrawny hair on the monkeys chin. Go to the Children tab and click Particles for a real hairy guy just like your friend.
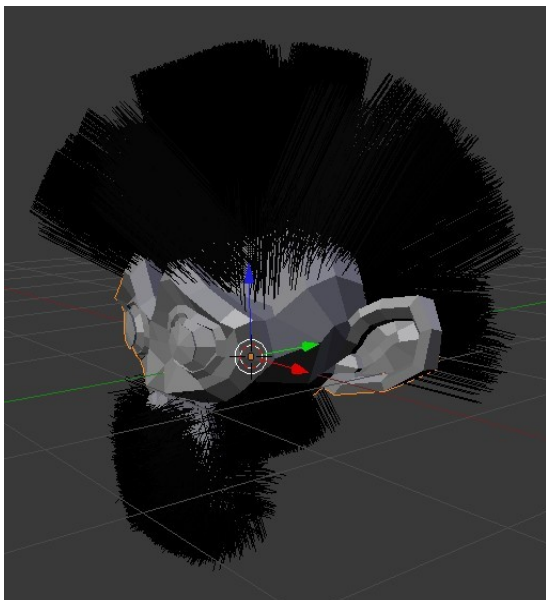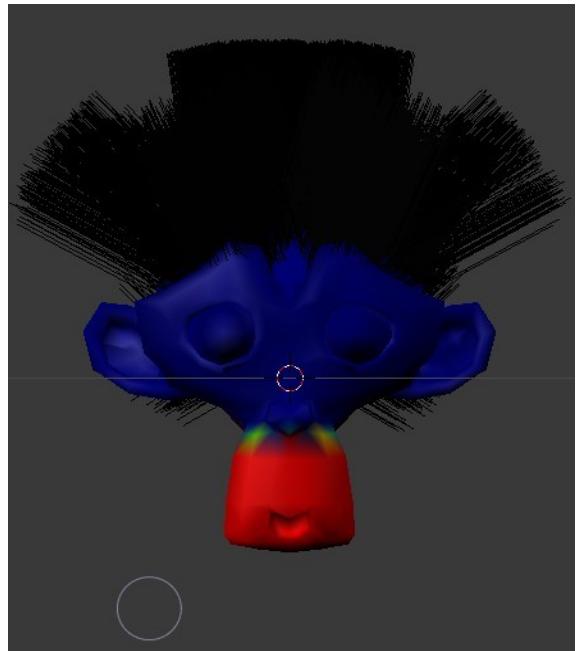
It doesn't matter in which order you do it the procedure is the same. Select vertices defining area, create Vertex Group, assign vertices to Vertex Group, create Hair Particle System and assign it to the Vertex group.

A grey monkey with black beard and hair in the 3D Window is fine but in a render isn't all that exciting. Let's jazz it up a bit.

Select monkey in Object mode in the 3D Window. Go to the Materials button in the Properties Window. Click on 'New' to add a material. Click in the Diffuse color bar and select a diffuse color for the monkey with the color picker that displays. To start with this will be applied to everything monkey, skin, hair and beard.

At the top of the Material buttons window note 'Material' highlighted in blue and just below that 'Material' again. The blue highlighted 'Material' is a material slot and the lower 'Material' is a material datablock.

Click to display Color Picker
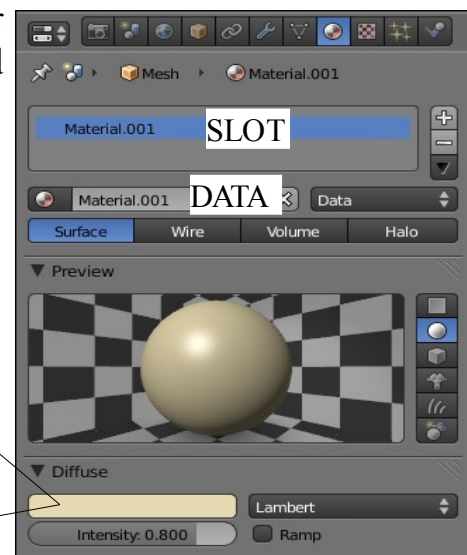
To understand this see the section on Material Datablocks but if you haven't read that or can't quiet remember what it was all about just follow on.

Color Added
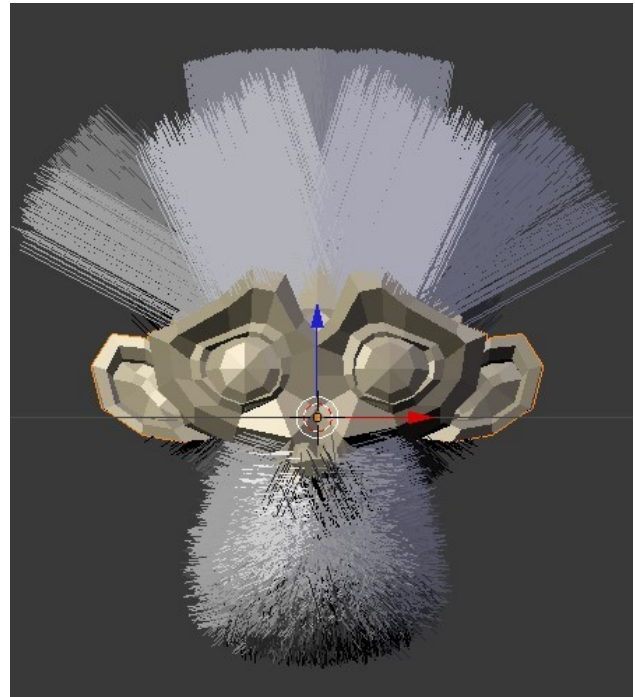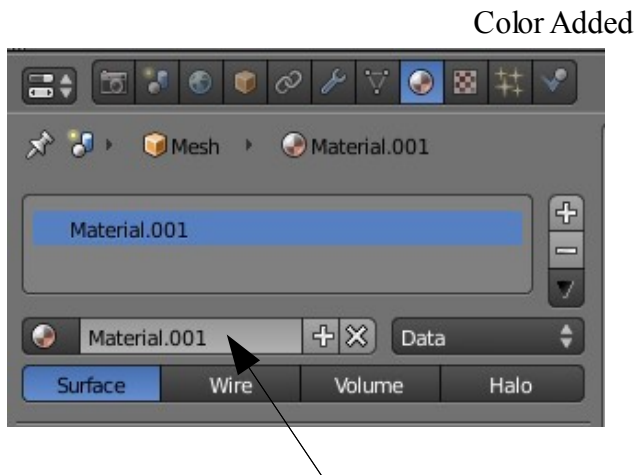
In the <u>Material buttons unique datablock ID name</u> click on 'Material', delete and rename it 'Skin'. Click on the plus sign to add a new slot. Note the number 2 appears next to the ID name. Click on the 2 to make single user then as before rename it 'Hair'. Repeat the process again and rename 'Beard'. You will now have three slots. Remember 1 is Skin, 2 is Hair and 3 is Fur. You just have to remember the order number or write it on the back of your hand.

There are now three material slots each with a separate datablock. At the moment they are all the same color which is what we originally chose. Click on slot Hair and Beard in turn and choose colors.

Go to the Particles button and at the top you will see Particle System and Particle System 2. Remember the first is the Hair PS and the second is the Fur PS. Select 'Particle System' (Hair) and in the render tab Material button click on the little triangle at the RHS until you get Material:2 (Hair). Now do the same for 'Particle System 2' selecting material:3 (Beard).

Weird beard and weird hair but its pretty.

Just to introduce you to some more fun stuff with hair go to Particle mode in the 3D Window and play around with the Brush tools. Somewhere about two thirds the way down the tools panel there is a X Mirror switch which lets you comb or add or whatever on both sides of the model at once.

Note: Select the Particle System in the Particle System Buttons Window. When a particle system is selected in Particle Mode the 3D Window shows the particles (Hair) without children. Use the Brush Tools then switch to Object Mode to see the effect.
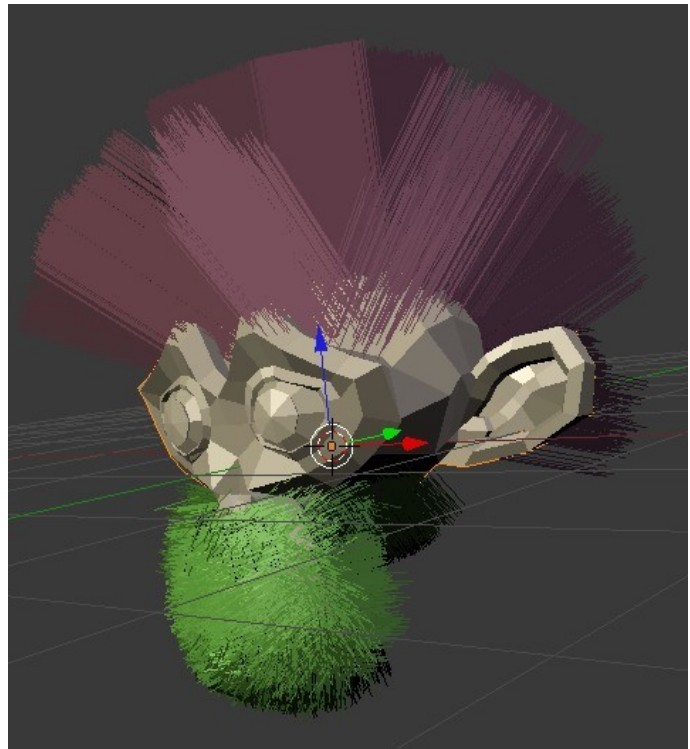
As allays there is much much more to play with in Blender. Try the Hair tutorials at http://www.blendercookie.com

A Final Note On Hair Particles

Adding hair to an object can add an awful lot of vertices which when rendering can take an awful lot of time and may even cause your computer to stall out. If you are not doing anything serious and have a slow machine to start with keep the number of strands low.

Assignment Tab

When a particle system is first added to a scene by clicking on the white cross '**Add Particles System'** Blender introduces a block of data to the scene which comprises a default particle system. Blender names this datablock 'ParticleSettings' as seen in the Settings panel. The datablock named 'ParticleSettings' is automatically linked to the default particle system which is named 'ParticleSystem'. 'ParticleSystem' is placed in the Assignment Panel where it is assigned to an object in the 3D Window.

This analogy may be viewed in the following diagram. There is no **Assignment tab** or **Assignment Panel** as such but for the purpose of this discussion we will consider the area marked in magenta as the **Assignment tab** and the panel displaying 'ParticleSystem' highlighted in blue as the **Assignment Panel.**
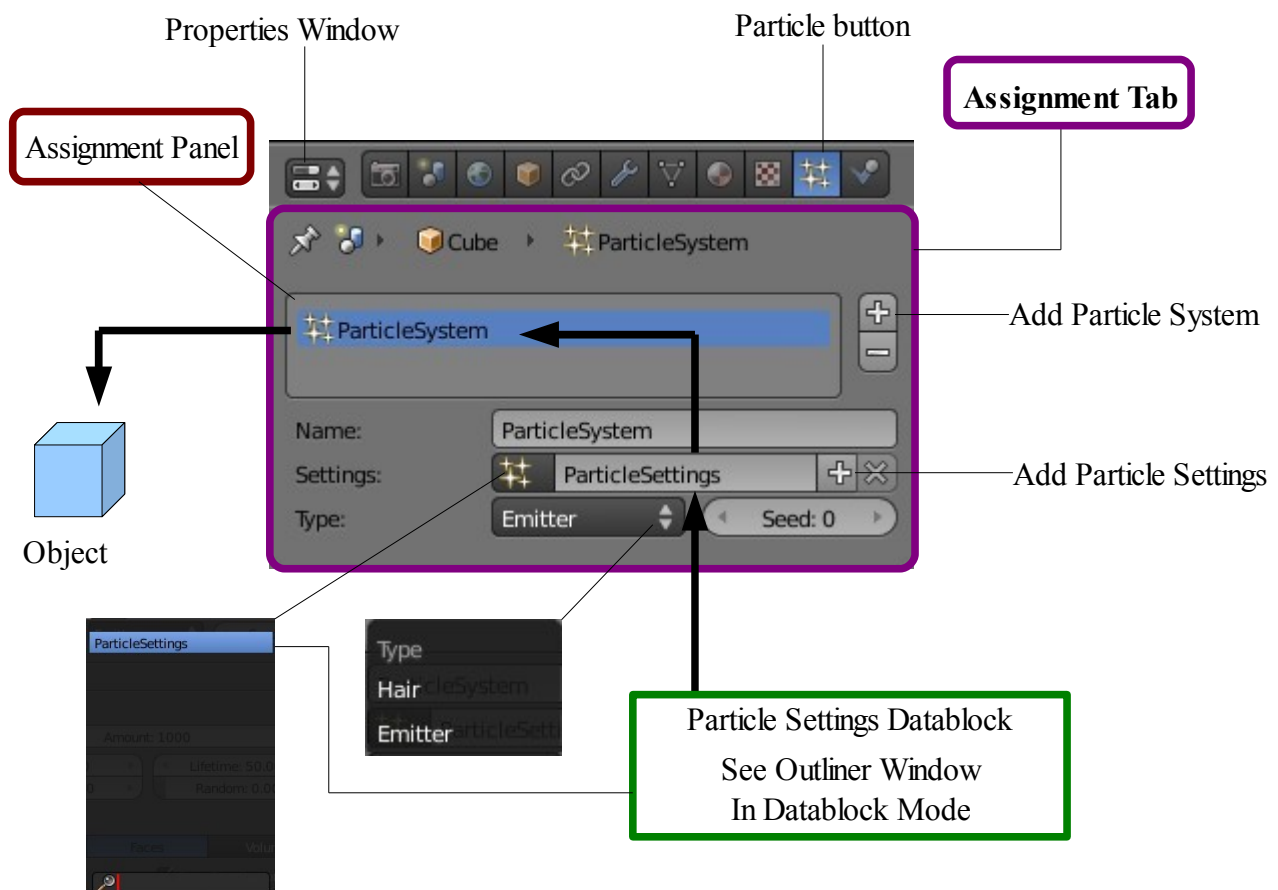
The analogy may not be strictly correct in accordance with the program structure but it is used to describe the logic of the graphical user interface.

The information in the Particle Settings datablock may be altered by changing settings in the Particle Buttons tabs of the particle systems buttons window to create varied effects.

Datablocks with all of their settings may be viewed in the Outliner Window in Datablock Mode.

In the assignment tab there is a **Type** drop down button which displays the options Emitter and Hair. Type Emitter is the default selection which means that with the particle system assigned to an object in the scene that object becomes the emitter of the particles. In either case the object becomes an emitter with a particle system assigned. Hair type may be viewed as a specialised static emitter which will be described later in the section.

Note that the name 'ParticleSettings' and the name 'ParticleSystems' may be renamed by clicking in the panels deleting the name and retyping a new name. This is useful when there are multiple objects, datablocks and particle systems.

Multiple objects in the 3D Window can each have a different particle system assigned. Each object may have more than one particle system.

When a new particle system datablock is added to the scene Blender creates a new name for the datablock. The default ParticleSettings datablock is named 'ParticleSettings' as previously stated. When a second datablock is added it is named 'ParticleSettings.001, a third would be named 'ParticleSettings.002 etc. Renaming datablocks to something more relevant to objects in the scene would be an advantage. When new datablocks are created they are stored in a cache for reuse by other particle systems (See the Outliner Window – Datablock Mode).

When a new particle system is added to the scene Blender assigns that system to the object that is selected in the 3D Window. If no objects are selected the new particle system is assigned to the last object that was introduced to the scene.

Particle systems added to a scene initially have the default ParticleSettings datablock linked and a new name applied as described above. At this point the datablock settings may be altered to create a new unique datablock or a previously created datablock may be selected and linked to the new particle system. Clicking on the icon in front of the ParticleSettings panel reveals a drop down showing the cache mentioned above with datablocks for selection.

The foregoing statements may seem confusing and not easily related to what has been labeled the Assignment Tab. The following exercise will attempt to clarify the statements and at the same time demonstrate the application of particle systems in practical terms.

Practical Exercise

Open a new scene in Blender and delete the cube from the 3D Window. Add three separate Plane objects and position them at the center of the scene so that in camera view they are all visible and an image containing all three may be rendered.
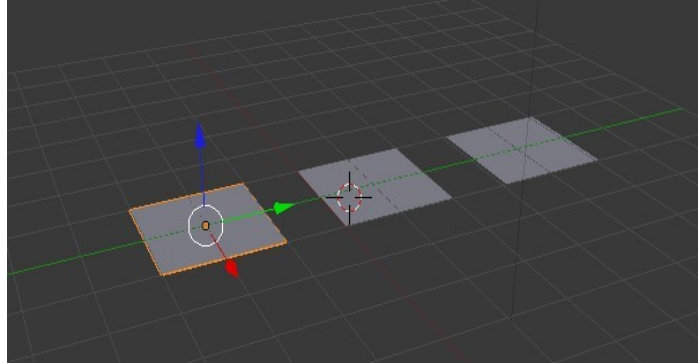
Add a diffuse material color to each of the Planes. We will make them Red, Green and Blue. The colors do not have to be accurate.
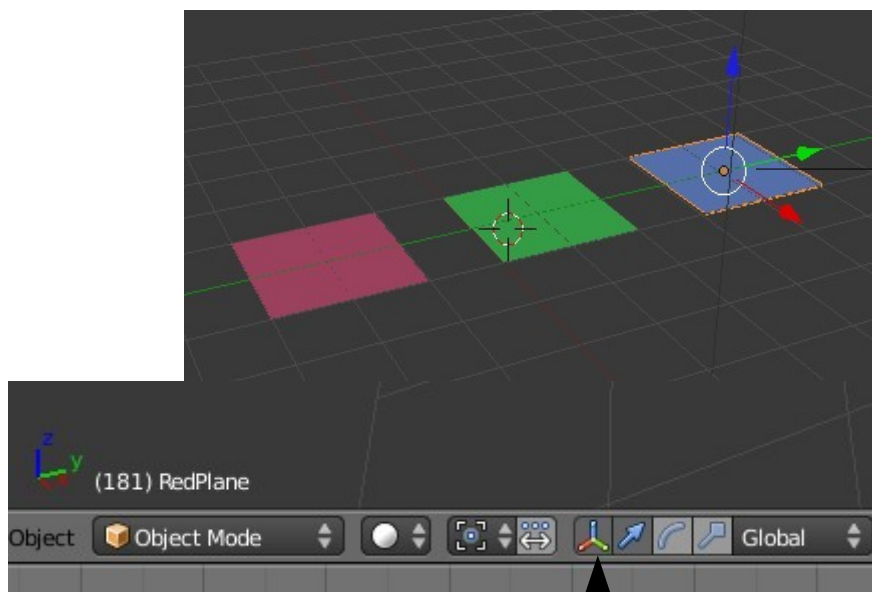
Click in 3D Window
Header to turn Widget off

Turn off the Gravity setting from the Scene buttons and turn off the 3D manipulator Widget in the 3D Window.

Click to untick and remove Gravity
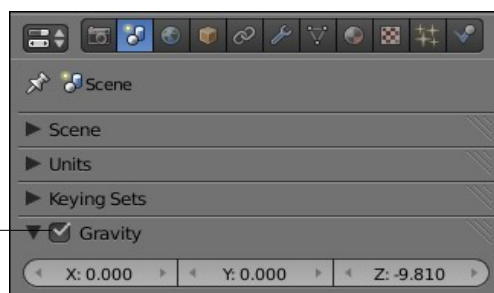
At this time the three Plane objects have been named by Blender as Mesh, Mesh.001 and Mesh.002 as seen in the lower left hand corner of the 3D Window as each is selected. This naming is not all that relevant to what we have in the scene so we will rename the objects.

Object Name

Lower Left Corner of 3D Window
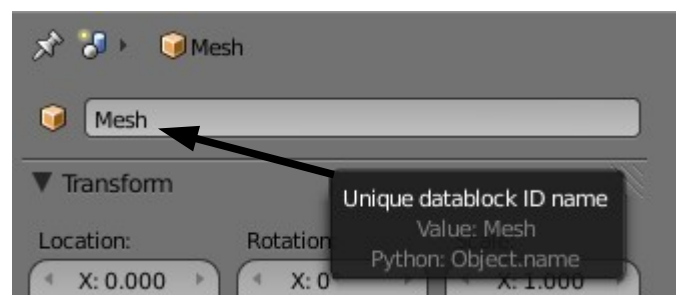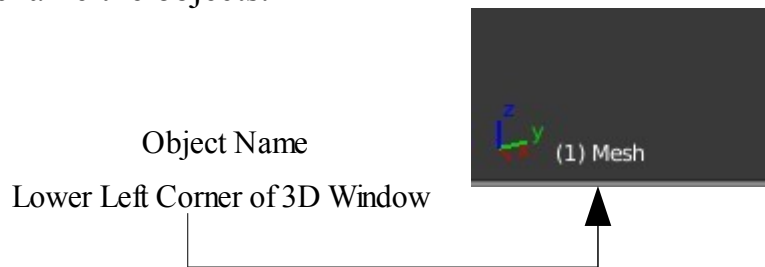
In the 3D Window select the red plane. Go to the Properties Window - Object button. At the top of the buttons window you will see 'Mesh' in the Unique Datablock ID Name panel. Click on the name to highlight it, hit delete and type in 'RedPlane'. Press Enter. Select the green plane in in the 3D Window and rename it 'GreenPlane' and then similarly for the blue plane.

Particles button

Click on the Cross to add a Particle System

Change Lifetime from 50 to 200
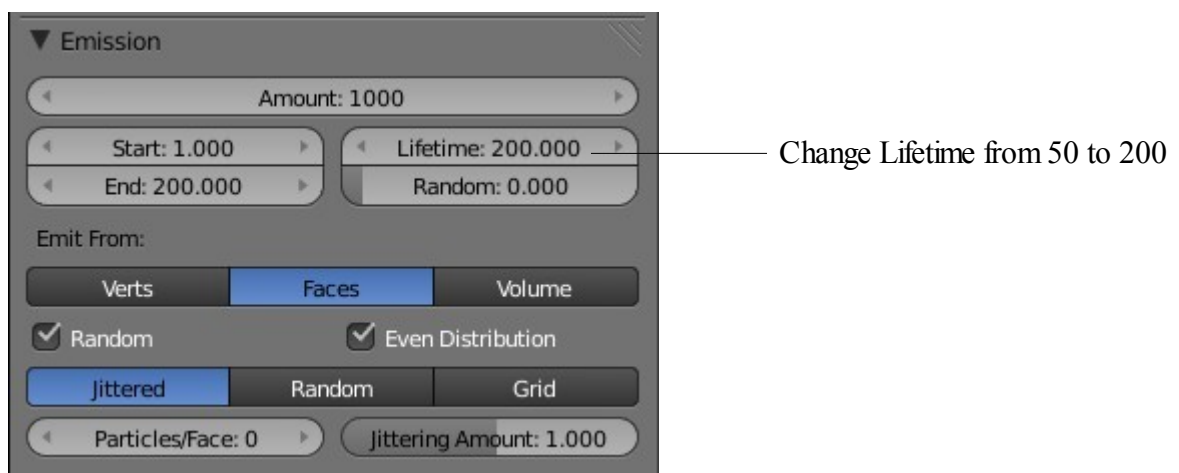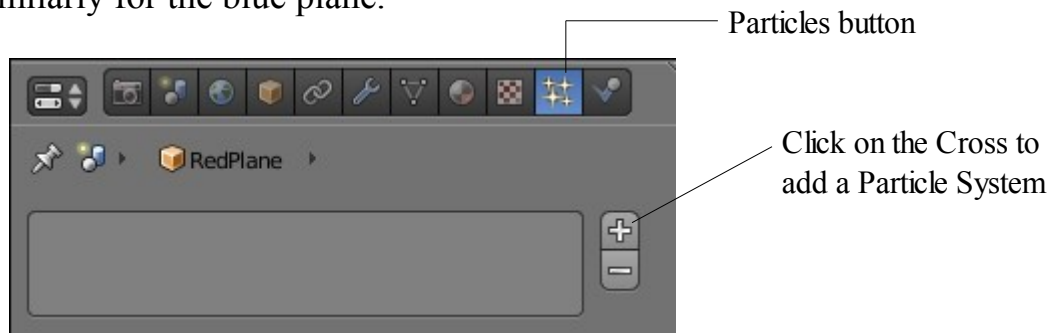
We will now add particle systems to the planes. Select the red plane and in the Properties Window click on the Particles button. Click on the white cross to add a particle system. The particle system panel displays with all the Tabs and buttons for controlling the settings and has been set up with default values. Leave all the values as set except for the Lifetime value in the Emission tab. Change this from the default 50 frames to 200 frames. This will give us a better view of particles being generated.

Do the same for the other two planes and in addition change the Amount value in the Emissions tab to 100 for the green plane and 10 for the blue plane.

Shift select all three planes in the 3D Window hit Alt + A to play the animation of particles being generated. Cycle through the animation in the Timeline Window to about frame 180 and observe the particles. Red plane 1000 particles, green plane 100 particles blue plane 10 particles. We have three different planes with three different particle systems.
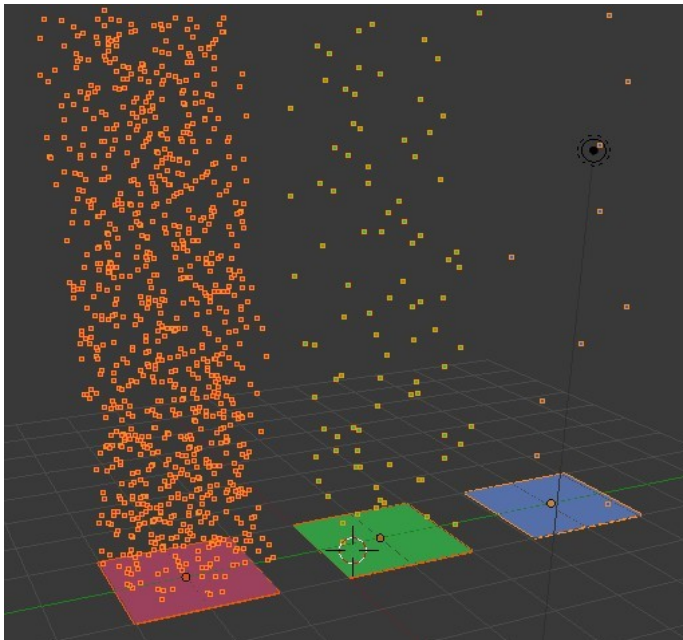
The number of particles emitted from each plane object show the different systems.

Now in the 3D Window select each plane separately and note in the Properties Window – Particles buttons – Assignment tab, the names that display in the Name panel and the Settings panel.
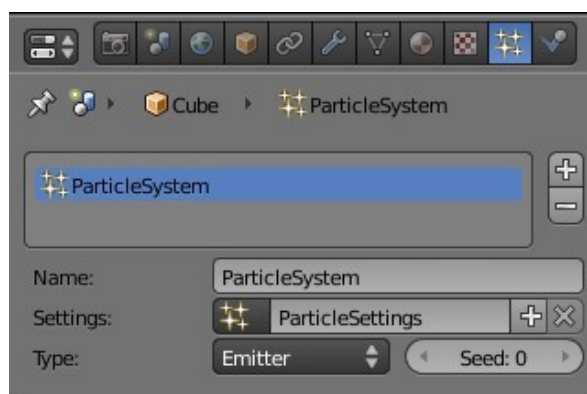
Red Plane:	Name: ParticleSystem	Settings: ParticleSettings
Green Plane:	Name: ParticleSystem	Settings: ParticleSettings.001
Blue Plane:	Name: ParticleSystem	Settings: ParticleSettings.002

We previously stated that we have three separate particle systems but now we see three names all being **ParticleSystem** but each one has a different settings name.

Probably a good idea to do some renaming. Change the names to the following.

Click in name panel to highlight the name – Hit Delete – Retype the new name.

Red Plane:	Name: RedPSystem	Settings: RedPSettings
Green Plane:	Name: GreenPSystem	Settings: GreenPSettings
Blue plane:	Name: BluePSystem	Settings: BluePSettings

We should be able to see where we are now.

To continue, in the 3D Window select the green plane. We are going to reassign some settings. In the Properties Window – Particles button – Assignment tab, next to Settings click on the button just in front of the name panel. The thing that looks like four tiny stars in a box. The drop down that displays has the names of the three Particle Settings Datablocks.
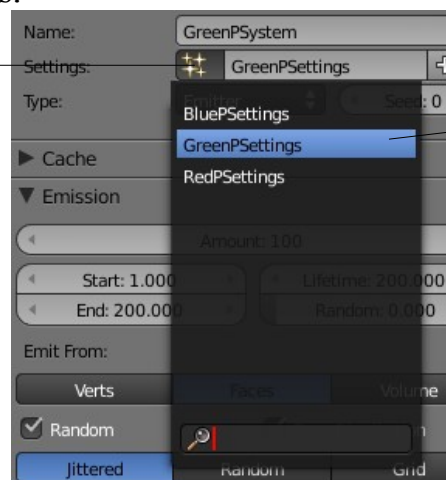
Whenever a new group of particle settings are created Blender puts them into a cache for reuse. You can see these datablocks in the Outliner Window in Datablock Mode.

The green plane is selected so in the datablock drop down click on BluePSettings. We now have the BluePSettings assigned to the GreenPSystem. If you replay the particle generation animation the green and blue planes generate the same number of particles. Note that in the settings panel a number 2 has appeared. This tells us that BluePSettings is being used by two systems. The color of the particles is controlled by the color of the Plane object. The number of particles emitted is set by the ParticleSystem Settings.
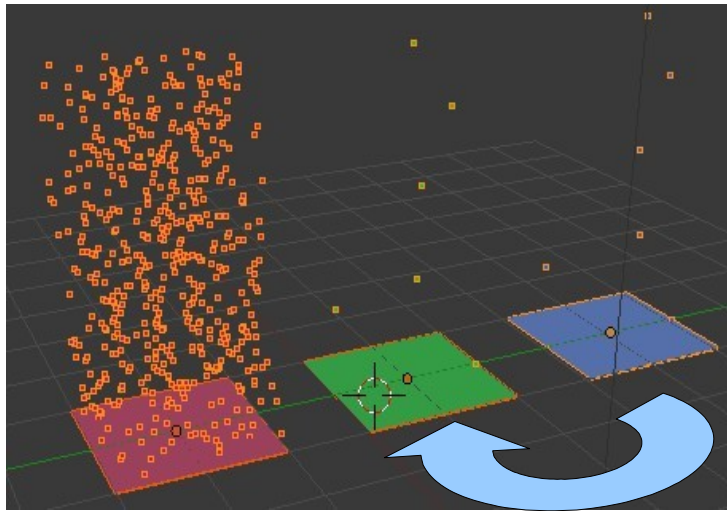
Suggestion: Shift select all three planes when replaying the animation to make the particles visible in the 3D Window. If a plane is not selected the particles appear as tiny little dots.

We have demonstrated that you can select any datablock of settings and assign it to any particle system.

Continue by clicking on the number 2. This makes the datablock a single user. Blender does this by leaving the original as it is and creating a new datablock. The new datablock is however identical to the original. You see that the settings name is now BluePSettings.001. Lets change some data in this new datablock.
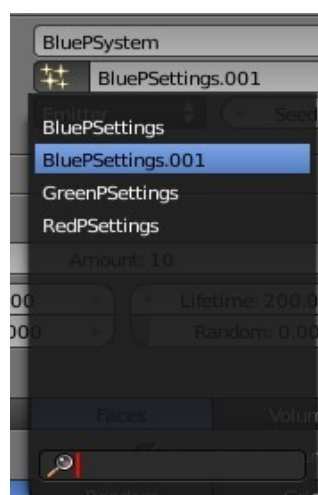
Find the Render tab in the Particle buttons window (Scroll down a bit). In the bar containing the render type selection, that is None, Halo, Line, Path, Object, Group, Billboard click on Object.

Click on Object

In the 3D Window add a UV Sphere to the scene and give it a yellow color (or any color). Note Blender has named the sphere 'Mesh'. Make sure it is off to one side in the scene away from the planes.

Reselect the green plane in the 3D Window and then go back to the Particles button on the Properties Window. Check that you still have GreenPSystem and BluePSettings.001. Now go back to the Render tab for BluePSettings.001 and where it says Dupli Object: click on the little cube icon and then click on Mesh in the drop down. We are telling Blender to display and render the particles as spheres.
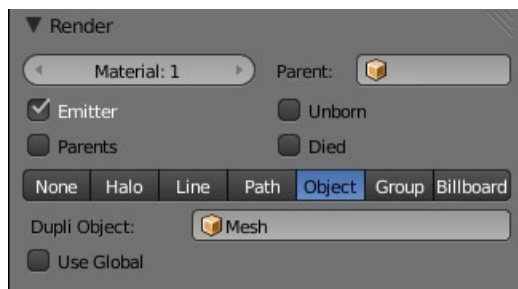
Scroll up to the Physics tab and slightly increase the Size value. You will see a sphere appear on the green plane. Play the particle generation animation and you see yellow spheres being generated.

Sphere object named Mesh
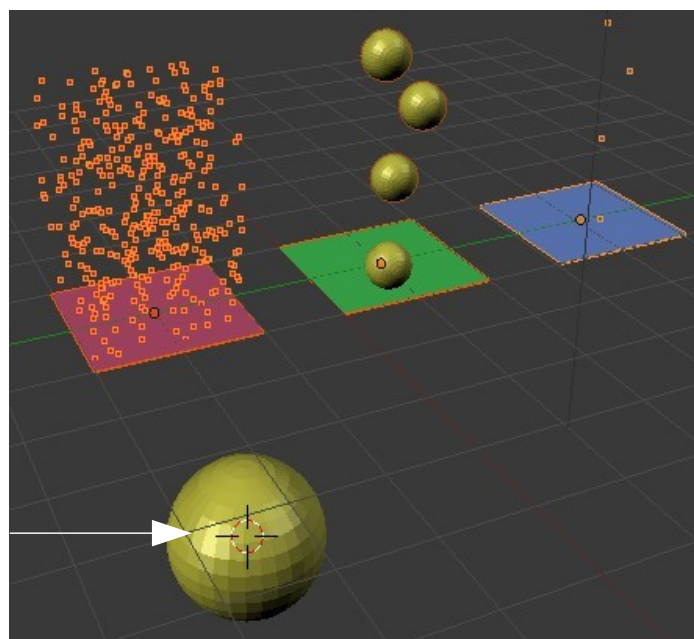
There is still more to play with.

With the green plane selected in the Properties Window – Particles buttons – Assignment tab click on the Add Particle System cross. You will see a new particle system highlighted in blue named ParticleSystem2 with particle settings name ParticleSettings. This has created a new particle system.

Original default ParticleSettings
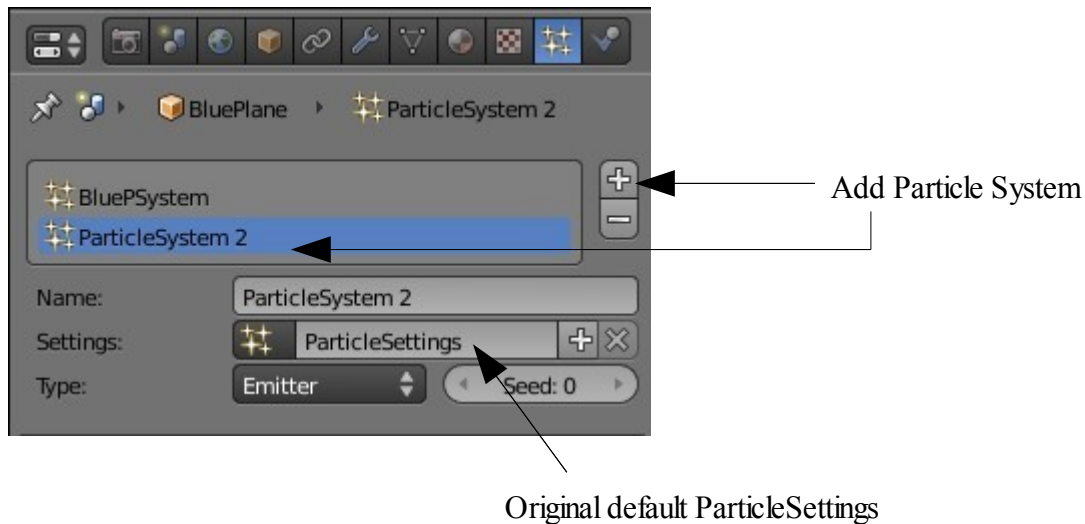
With the green plane selected in the 3D Window play the animation again. The green plane now emits yellow spheres and original particles together. The original particles only display for a short while since on particle settings named **ParticleSettings** the Lifetime value is 50 frames.
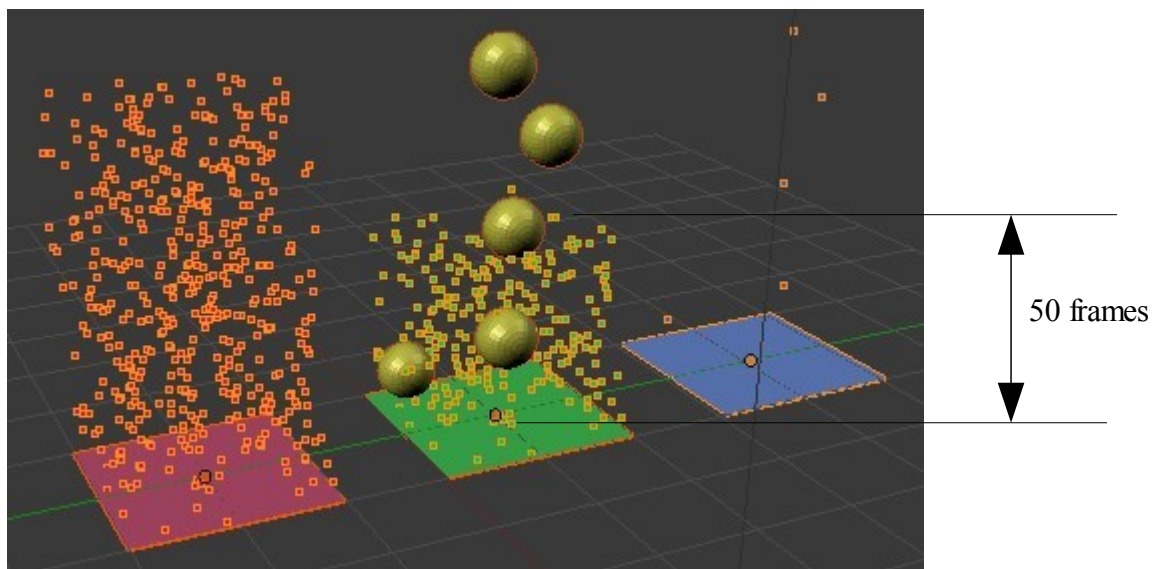
We have two separate particle systems with separate settings datablocks assigned to the same object.
The best way to get the hang of all this is play, play and more play.

CH16- Child Parent Relationships

01-Child-Parent

02-Child of Constraint

Return to Contents

Child Parent Relationships

Child parent relationships are used where there are several parts connected together which are required to move independently. Examples are a robot arm or a humanoid limb. The components of the arm move but are connected to the body. An arm raises and the hand waves in the process. The concept of a child parent relationship is where a hand is a child of a forearm and the forearm is a child of biceps and the bicep is a child of the body. They are all linked together but move separately in their own way.

We will demonstrate the application of this in Blender by connecting several scaled cubes together. Start with the default Blender scene,. Scale the Cube as shown then Tab to edit mode and shift the vertices positioning the center towards one end. Duplicate the scaled Cube twice (Shift + D x 2).
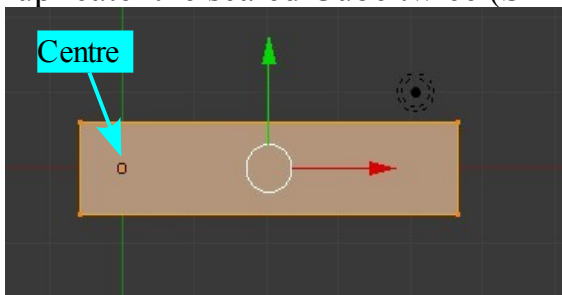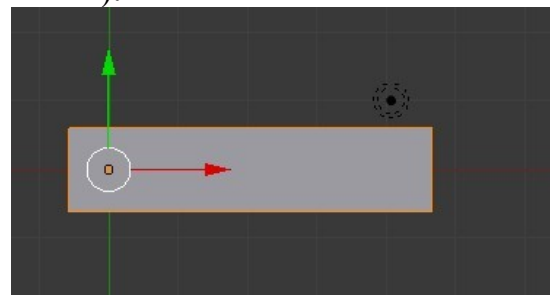
Edit Mode   Object Mode

Note: In the diagrams a separate Cube has been added to the Scene instead of duplicating. This has allowed different Material colors to be applied. If you duplicate an object you also duplicate its Material and the objects are all the same color.
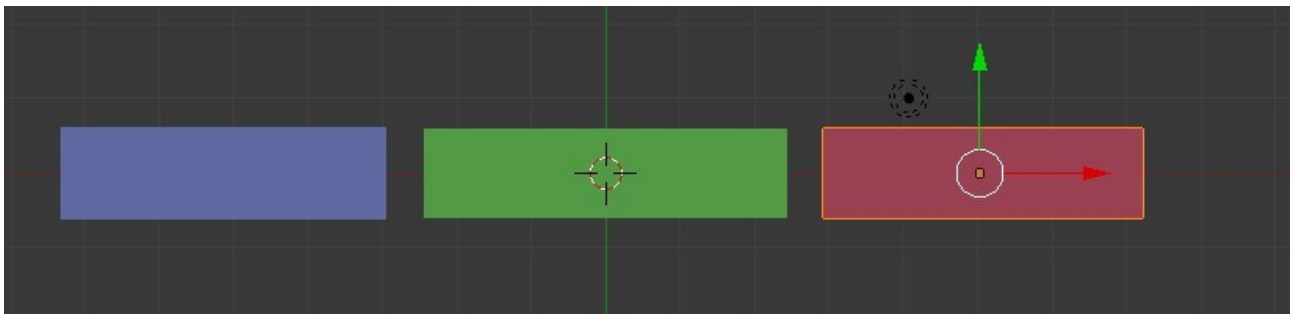
Shift each Cube and overlap the ends.
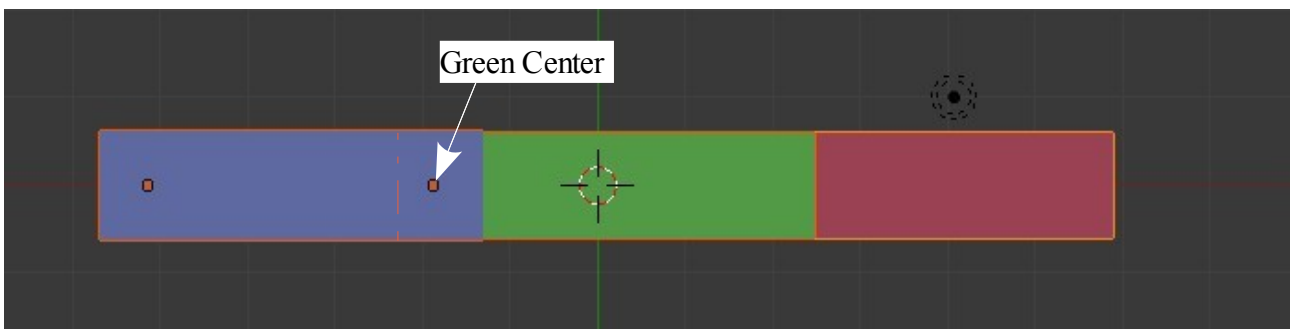
Create the Child Parent Relationship by first selecting the red cube then shift select the green cube then press Ctrl + P and select 'Object' in the 'Set Parent To' panel that displays. Deselect then repeat the process for the green and blue cubes. The first object selected is always the child of the second object selected. Therefore in the diagram red is the child of green which in turn is the child of blue.
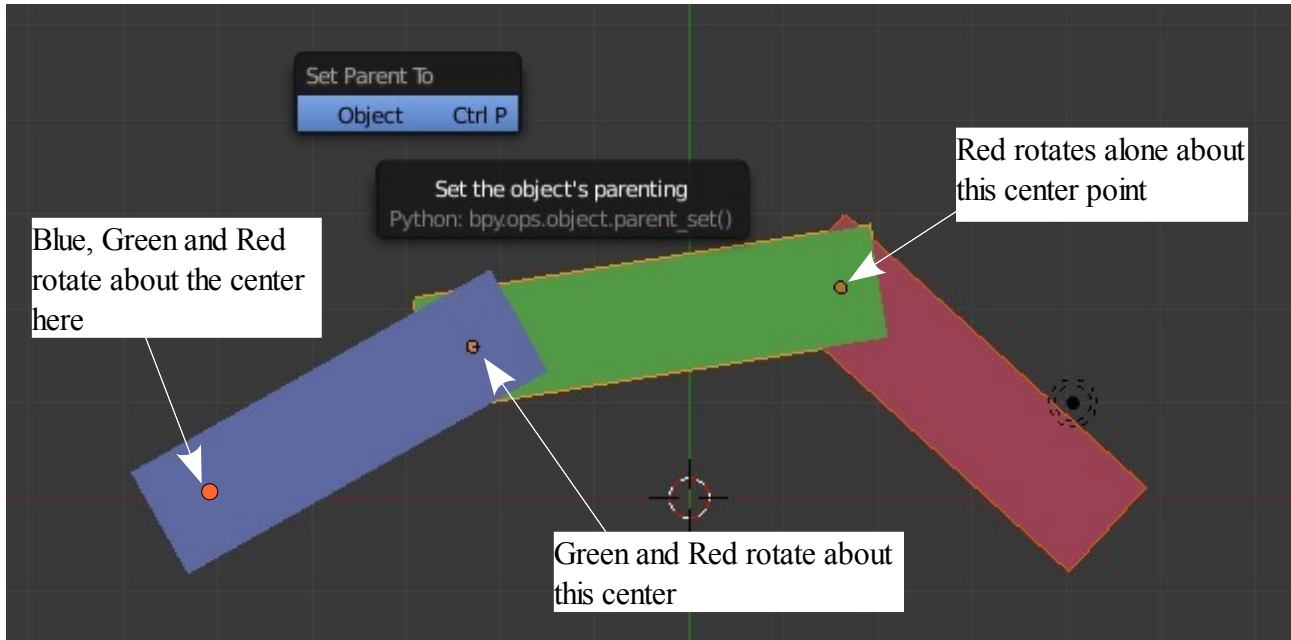
To see the relationship in action select red and rotate. Select green and rotate and red will follow. Select blue and rotate and both red and green will follow.

You can child parent any object to another in Blender. A Camera can be parented to another object so that when the object moves the Camera moves with it. For example you could place a Camera inside a model of an aircraft cockpit and create simulation of what the pilot would see. A useful technique it to parent a Camera to an Empty.

Child of Constraint

Note: There is another method of creating a Child Parent relationship which is to add a 'Child of' constraint to the child object. This is discussed in the section on Constraints.

CH17- Constraints

01-Introduction

02-Constraint Stack

03-Transform

04-Tracking

05-Relationships

06-Duplicating on Curves

07-Extruding on Curves

Introduction

Constraints are object features that define spatial relationships between objects. They are the standard method for controlling characters among all 3D animation packages that still implement a more traditional approach to digital character animation. In Blender, constraints can be associated with object. Note however that not all constraints work with all objects.

Constraints are associated with an object by selecting the object in the 3D Window then In the Properties Window – Constraint buttons clicking on 'Add Constraint' and selecting the constraint from the drop down menu that displays.

Click to select Constraint
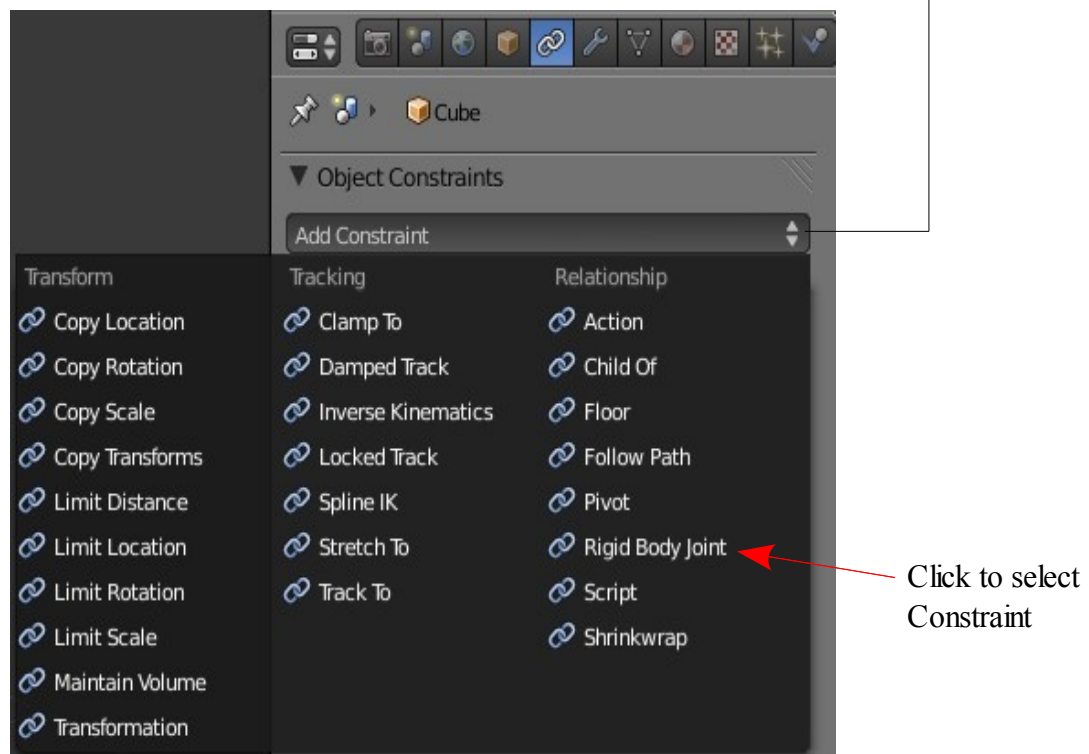
The following pages in this section contain a brief description of constraint functions. Most constraints are self explanatory therefore a detailed explanation will only be given for a few common constraints or where it is not self evident.

The general method of application of constraints is to select the Object in the 3D Window then in the Properties Window – Constraint button - Click on 'Add Constraint' and select the appropriate constraint. In many cases a control object will be required to make the constraint function. There are control values to be inserted to regulate the function.

Constraint Stack

It should be noted that in some cases it is appropriate to apply more than one Constraint to an object. When this is done the Constraints are placed in a stack in order of priority. The priority can be changed by moving a Constraint up or down in the stack.

Track To and Locked Track Constraints in a Stack.

Enter Target Object
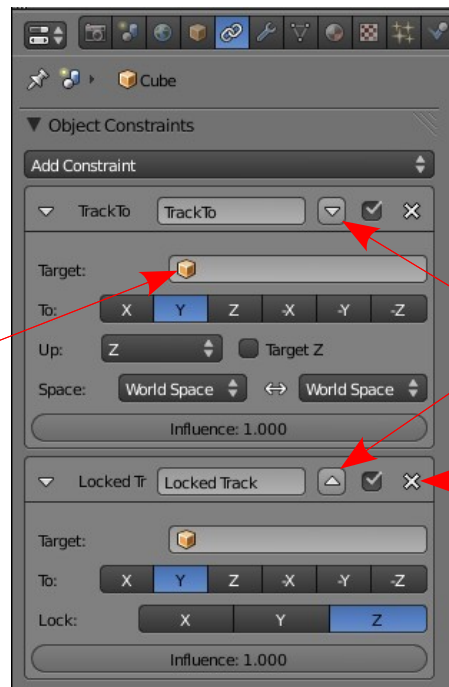
Click to move up or down in the stack.

Click to remove constraint

Transform Constraints

Copy Location

Forces the Object with the Constraint added to take up the location of the Target Object.

Copy Rotation

Forces the Object with Constraint added to copy the rotation of the Target Object. When the Target rotates the Object rotates.

Copy Scale.

Forces the object with the Constraint added to copy the Scale of the target Object

Copy Transformation

Similar to Copy Location.

Limit Distance

Constrains the Object to remain within a set distance from the Target Object. The distance is a spherical field surrounding the Target. The Object is constrained within the spherical field or outside the field.

Limit Location

Constrains the Objects location between a minimum and maximum distance on a specific axis. The distance is relative to either the World center or a Parented Object.

Limit Rotation

Constrains an Objects rotation about a specific axis between limits.

Limit Scale

Constrains the scale of an object between limits on a specified axis.

Maintain Volume

Constrains the dimensions of a side on a specified axis.

e.g.   Default Cube Vol: 1   Dim x = 2, y = 2, z = 2
       Scale Vol to 4 with
       axis y constrained   Dim x = 4, y = 2, z = 4

Transformation

To be advised.

Tracking Constraints

Clamp To

Clamps or locks the position of the Object to a Target Curve.

Damped track

Constrains one local axis of the Object to always point towards the Target Object.
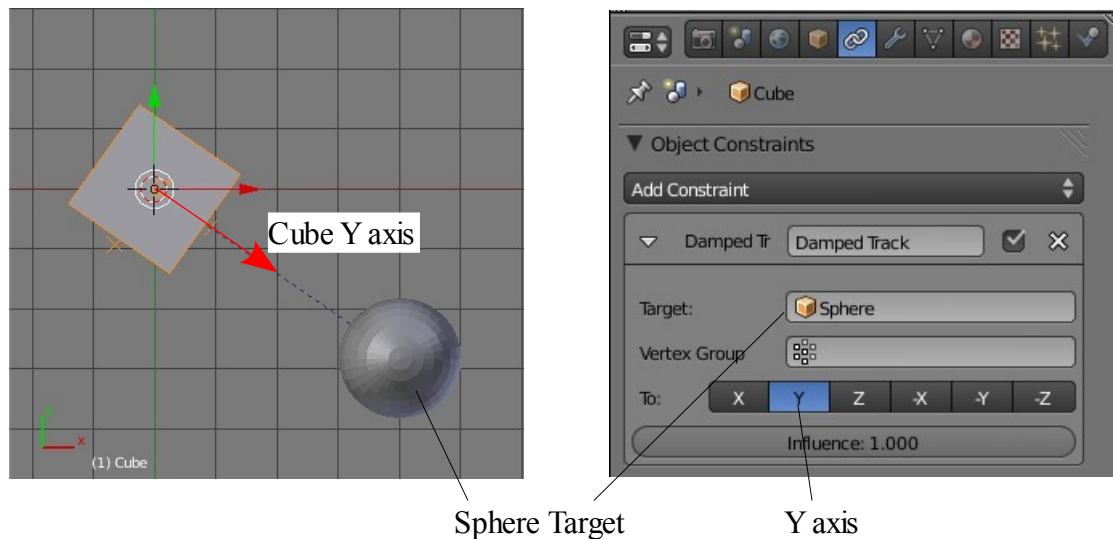
Cube Y axis constrained to always point towards the Sphere

Inverse Kinematics

Can only be applied to Bones. See Armatures section.

Locked track

Similar to damped track with more axis control.

Spline IK

can only be applied to Bones. See Armatures section.

Stretch To

Stretches the Object towards the Target Object or compresses the Object away from the target Object.

Track To

   Causes the Object to always point towards the Target Object no matter where either the Object or the target is positioned.

   Example: Tracking a Camera to follow an Object that is animated to move.

   Start with the default blender Scene in Top View (Num Pad 7 + Num Pad 5). Select the Camera and press Alt + R to clear the rotation and align the Camera axis with the World axis.
   Go to the Properties Window – Object Constraint button – Click 'Add Constraint' and select 'Track To'.
   Enter the Cube as the Target Object.
   Set Axis To = -Z and Axis Up = Y to orientate the camera in the World.

   The Camera will now point at the Cube when the Camera or the Cube is moved and during an animation playback.

Track To constraint added to Camera ——————

Cube as Target Object ——————
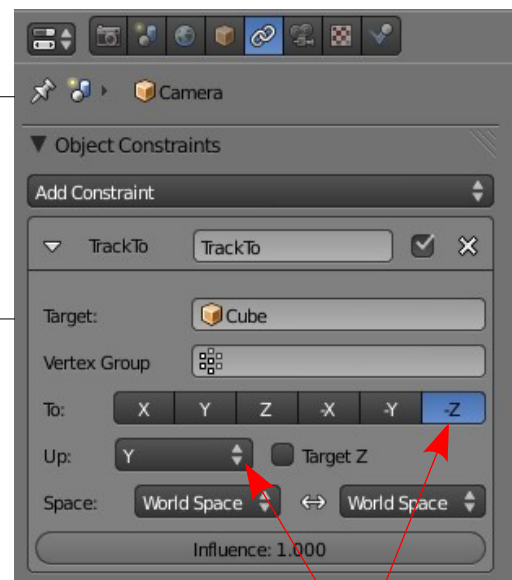
Axis Values

Camera Orientated to Point at Cube
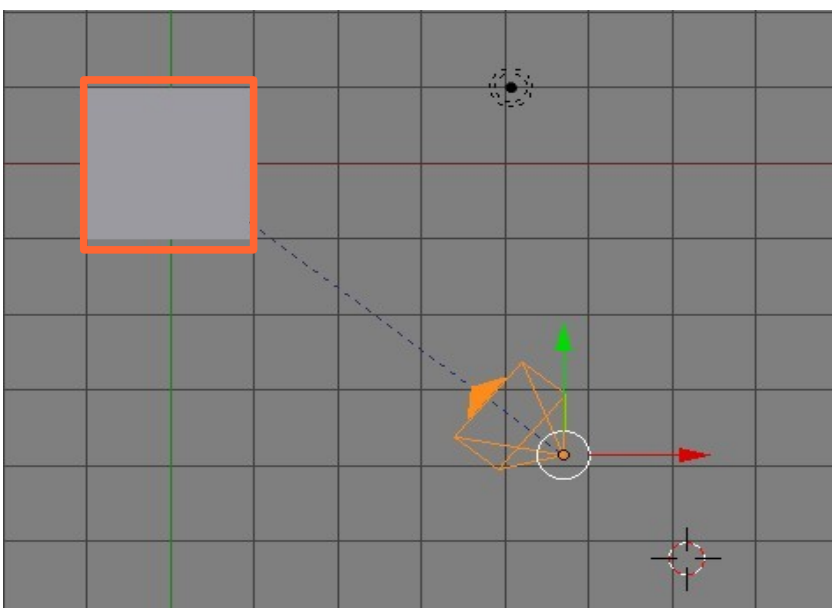
Relationship Constraints

Action
To be advised

Child Of
see Child Parent Relationships

Floor
Allows the Target Object to obstruct the movement of the Object.

Example: A sphere animated to descend in a scene will not pass through a Plane that has been set as a target Object.

Follow Path
Causes the Object to be animated to follow a Curve Path nominated as the Target. This constraint also has the feature to Follow Curve which means that the Object will rotate and bank as it follows the Curve.

This constraint can also be employed to duplicate objects along a curve path.
See : Constraints and Curves – Follow Path.

Pivot
Causes the Object to leapfrog to the opposite side of the Target Object along an axis between the Object and the target centers. The location can be offset either side if the axis by inserting offset values.

Rigid Body
to be advised.

Shrinkwrap
To be advised.

Duplicate Object Along Curve

The Follow Path constraint can be used to duplicate an Object along a Curve.

Example:
Start with the default scene with the Cube Object selected. Add a Bezier Curve to the scene and shape it in edit mode. Select the Cube and scale the cube down (very small). In the Properties Window – Object Constraint button– Press 'Add Constraint – select 'Follow Path'.

In the Constraint panel set the Target Object as 'Curve'.
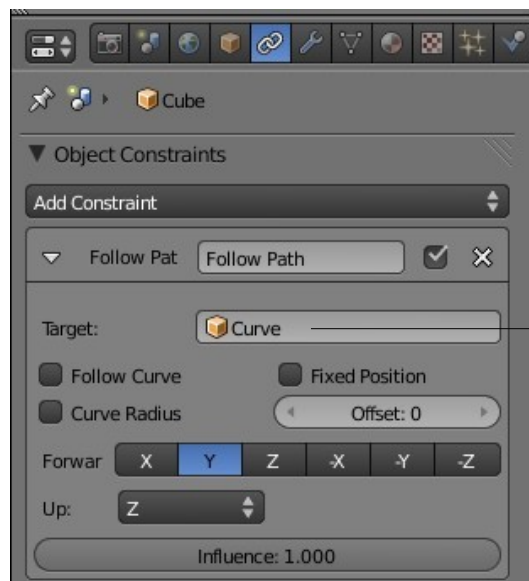
Target Object

In the Properties Window – Object button – Relations tab – Parent – add 'Curve'.
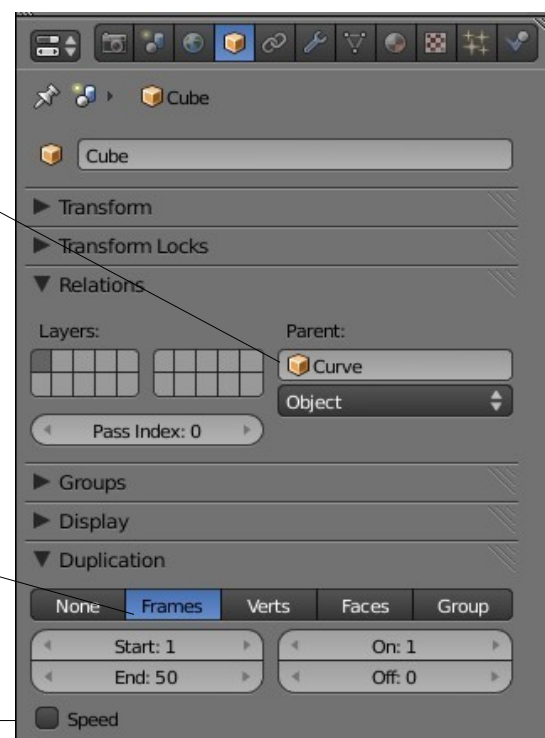
In the Duplications tab select 'Frames'.

Untick 'Speed'.
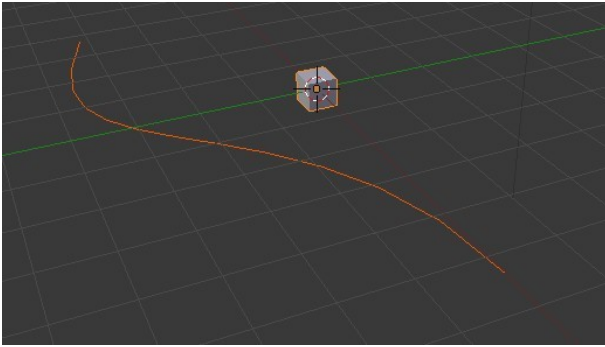
Default Scene with Cube and Bezier Curve
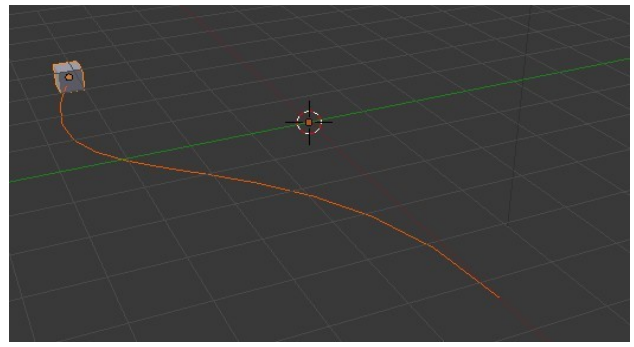
Target Object Added in Constraint Panel
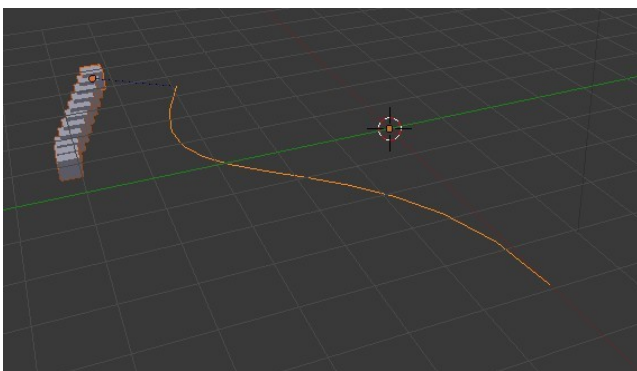
Curve added to Parent panel and 'Frames' selected in the Duplication tab. You may have to scale and reposition the Cube at this point. The view shows the Cube duplicated at 10 Frames.
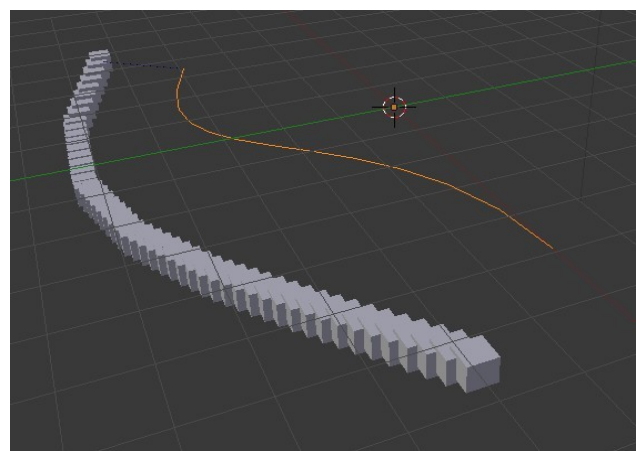
Cube duplicated at 50 frames

Extrude Along Curve

A shape can be extruded along a curve to produce a shape.

Example:

Start with the default Blender Scene and delete the Cube Object. Add a Bezier Curve and scale it up along the X axis. For simplicity put the window into Top View (Num Pad 7 + Num Pad 5). The Curve may be scaled and shaped in Edit mode to produce a shape for your extrusion to follow.

Deselect the curve and add a Bezier or Nurbs Circle. The circle may be shaped in edit mode to produce a cross section shape for your extrusion.

Scale the Circle way down.
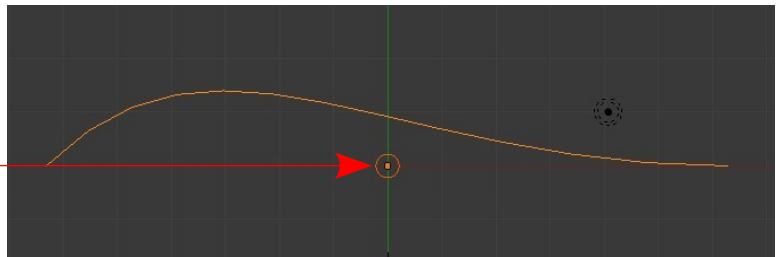
Deselect the Circle and select the Curve.

Rotate the Circle standing it up perpendicular to the Curve (R Key + y + 90 – Enter).

In the Properties Window – Object data button – Geometry tab enter 'Curve Circle' in the Bevel Object data panel.
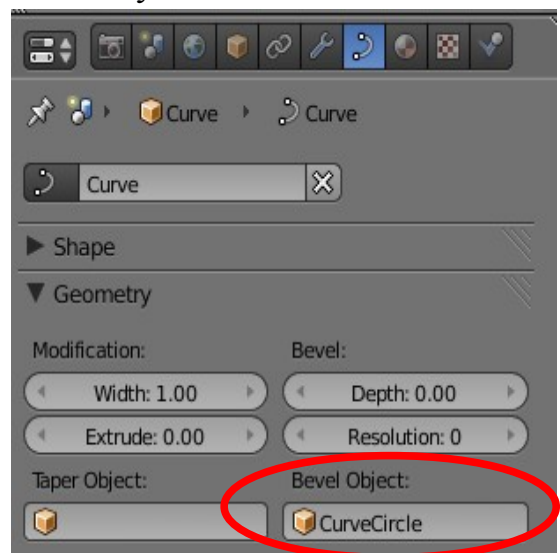
Adjust the scale as required.
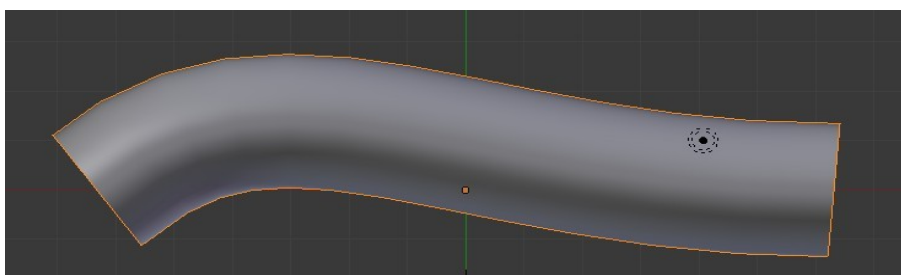
CH18- Armatures

01- Adding an Armature

02-Single Bone Armature

03-Armature Display Types

04-Multibone Armatures

05-Deforming a Mesh

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Armatures

My dictionary defines 'Armature' as being a protective covering but in Blender the term appears to have a different meaning altogether. In Blender, 'Armature' refers to an Object type which is used to deform a mesh. Think of your finger and the skin covering it and the bones inside. The skin would be the mesh and the bones are the 'Armature'. When the bone moves the skin moves with it. Obviously the analogy is not quiet correct but it give you the idea.

Adding an Armature to the Scene

To begin the instruction on Armatures start with the default Blender scene, delete the Cube object and add an Armature object (Shift + A Key – Armature – Single Bone). Zoom in (Num Pad Plus Key) and press Num Pad 1 then Num Pad 5 to get the front elevation Orthographic view.

Single Bone Armature

What you see is a single bone Armature. Armatures can and usually do, comprise multiple bones but before we complicate anything we should have an understanding of bone manipulation.

The default single bone Armature is, by default, displayed in what is termed type 'Octahedral'. I would suggest this description is due to the object having eight surfaces. It appears as two four sided pyramids conjoined at the base with spheres at the apexes. Note: Although the Armature is an object in Blender it is not a MESH OBJECT. It's shape can not be edited other than scaling it larger or smaller. It can be rotated and translated. It has a centre like any other object which may be repositioned but for use in a multi bone armature it is best to maintain the centre at the apex of the lower (smaller) pyramid in the centre of the sphere. With the Manipulation Widget turned on the Widget is positioned at the centre.

Manipulation Widget
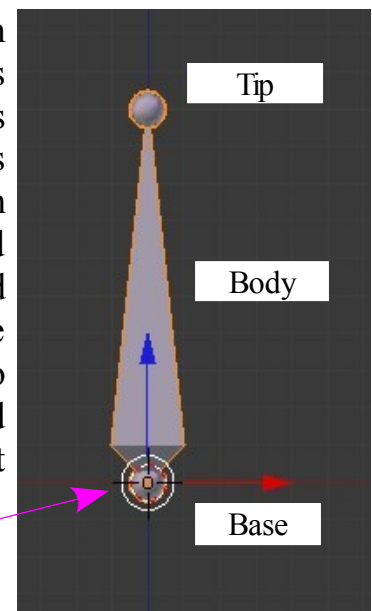
Single Bone Armature
In Object Mode

For the purpose of the demonstration we will name parts of the Armature, Tip, Body and Base .

Armature Display Types

OK! The default display type is 'Octahedral' but there are three alternative display types. These are 'Stick', B-Bone' and 'Envelope'. (With the Armature bone selected see the Properties Window – Object data button – Display tab). Which display type is used depends on what you are doing with the Armature. We will not go into the different uses at this time but since the basic function of an Armature is to deform a mesh object we need to understand how this happens.
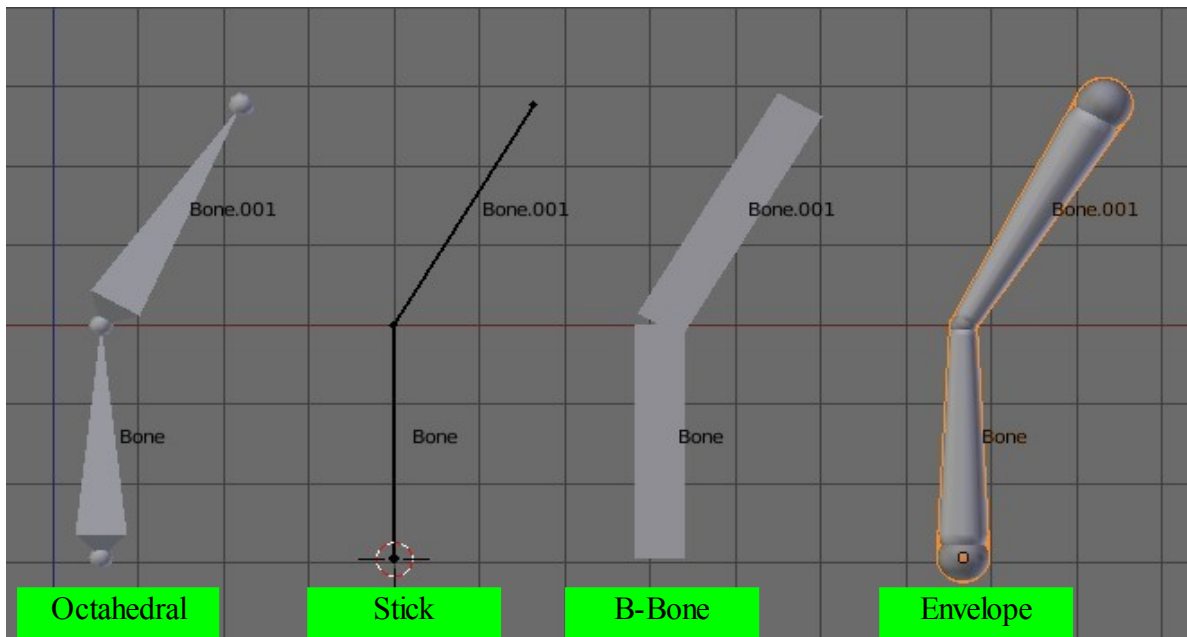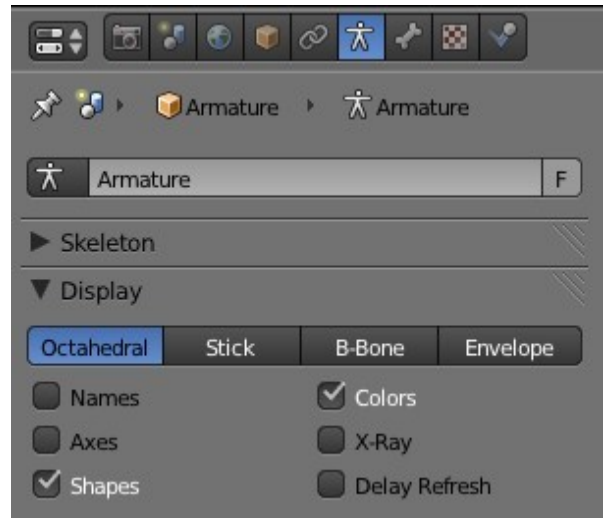
Basic Procedure

The basic procedure in deforming a mesh object with an Armature is to apply an Armature Modifier to the object and then in the modifier name the Armature that will do the deformation. You are probably shaking your head trying to come to grips with that. Don't worry we will run you through a demonstration in a while but it doesn't matter which Armature display type is used each Armature has a field of influence in which mesh vertices must reside in order to be influenced.

The last statement is not exactly true but for the time being pretend that it is.

Change the Armature display type to 'Envelope'. Now you will have something like a cylinder with a sphere at each end. Tab into Edit mode. Now you see the field of influence surrounding the Armature. You can only see this in Envelope display type in edit mode. In **Edit mode** you can select the whole Armature or the spheres at either end separately then scale. This has the effect of reshaping the field of influence to encompass vertices in a mesh.

Widget

Widget

Field of Influence
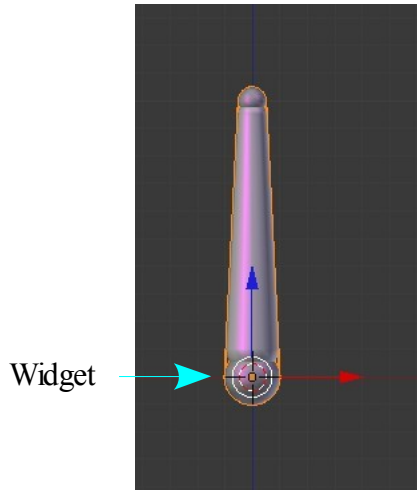
Envelope – Object Mode
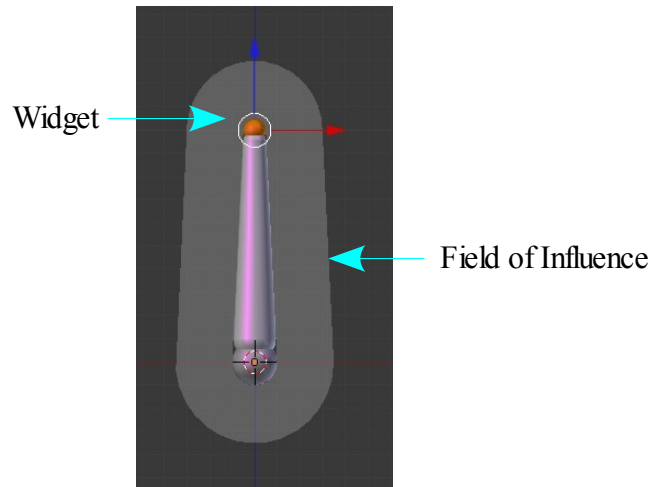
Envelope – Edit Mode

Just file these snippets of information in the memory bank for the time being and go back to the default single bone Armature in display type 'Octahedral' in **Object mode** .

Widget Off – Sphere Orange

Tab into Edit mode. Now the widget is located at the Tip which is showing that the Tip of the Armature is selected. Turn the widget off and you see the sphere at the Tip is orange. Having the widget on just makes it easier to see for demonstration purposes. With the widget on you can translate the Tip in the 3D Window which also changes the length of the Armature. The rotate and scale functions of the widget have no affect.

Edit Mode

Extruding Multi Bone Armatures

Turn the widget off but leave the Tip selected. Now press E Key (extrude) and drag the mouse. You will see a new bone being extruded from the Tip. Select the Root – E Key (Extrude) -drag the mouse and a new bone is extruded from the Root. Select the Tip of either new bone and repeat the process creating a multi bone Armature. Select the Root and extrude another bone.

New Bone Extruded

New Bone Extruded from the Root
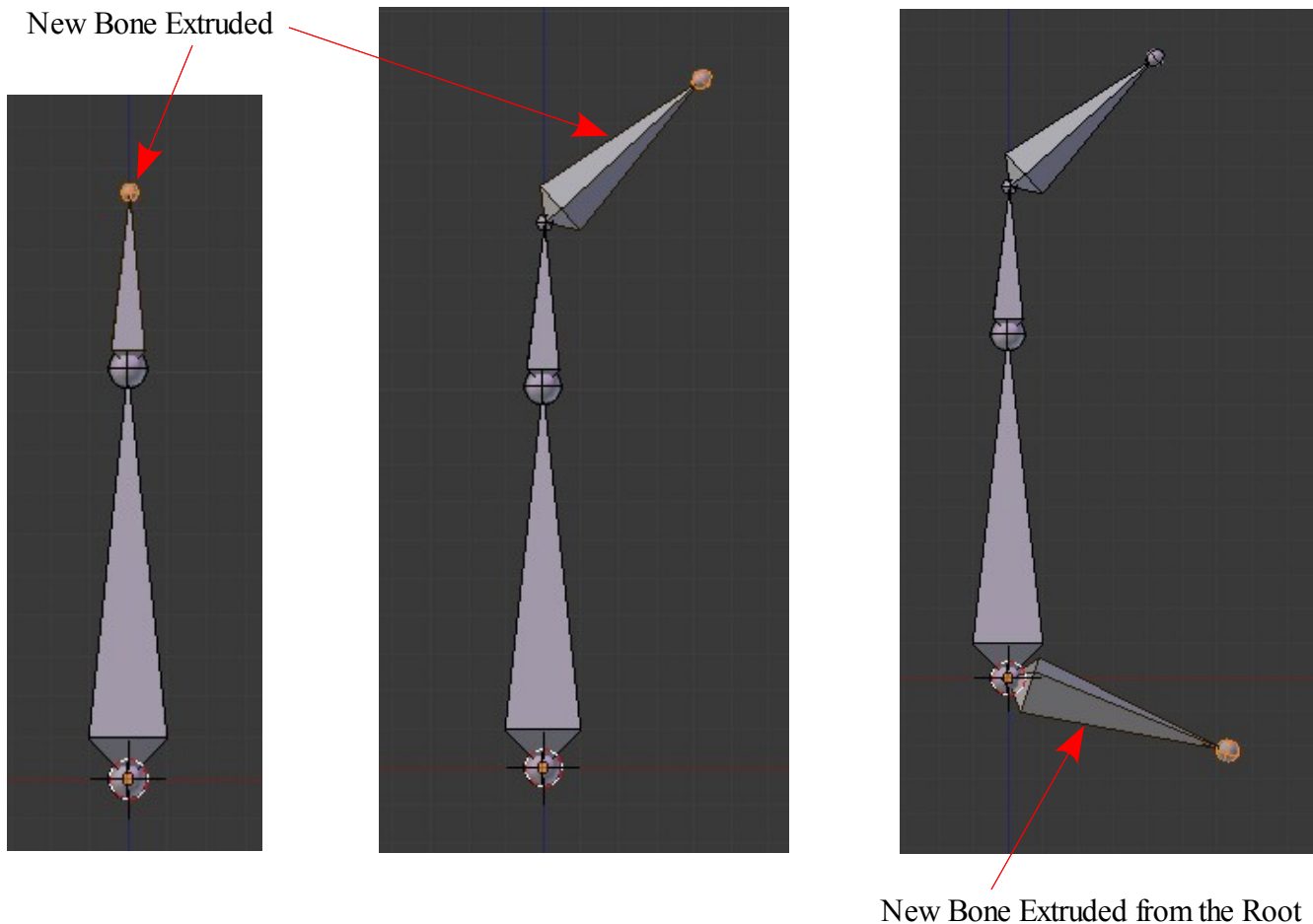
Deforming a Mesh

So far we have demonstrated the very basics of what an Armature is and how to expand a single bone into a multi bone Armature. It's time to see how to deform a mesh. To demonstrate the 'Armature' principal in Blender we will make something akin to a finger on your hand and make it deform with an 'Armature'.

Start with the default Blender Scene and delete the Cube. Add a Mesh Circle.

In the Tool Shelf (Panel at LHS of 3d Window – Lower Left) reduce the number of vertices from 32 to 8. When creating a mesh for use with Armatures use as few vertices

as possible. A high number of vertices will give you a better surface look and a better render but too many vertices will slow down the computer considerably in an animation. This is the reason for reducing the number of verticals in the Circle.

Note: When you add a Primitive to a scene it is in Object mode and the tool panel at the lower left of the screen provides the facility to edit the size and vertex count. Once you tab to Edit mode the tool panel no longer has this feature.

Tab into edit mode. Extrude the Circle on the Z axis and scale some of the segments to create a simple mesh as shown in the diagram. The finger will only have two parts with a joint in the middle. The vertices close together in the middle of the mesh are where the joint will be. They act like a concertina hose on a vacuum cleaner allowing the mesh to bend.

Vertices Scaled In

Vertices Scaled In

Place 3D Cursor Here

Edit Mode   Object Mode
Front View – Num Pad 1
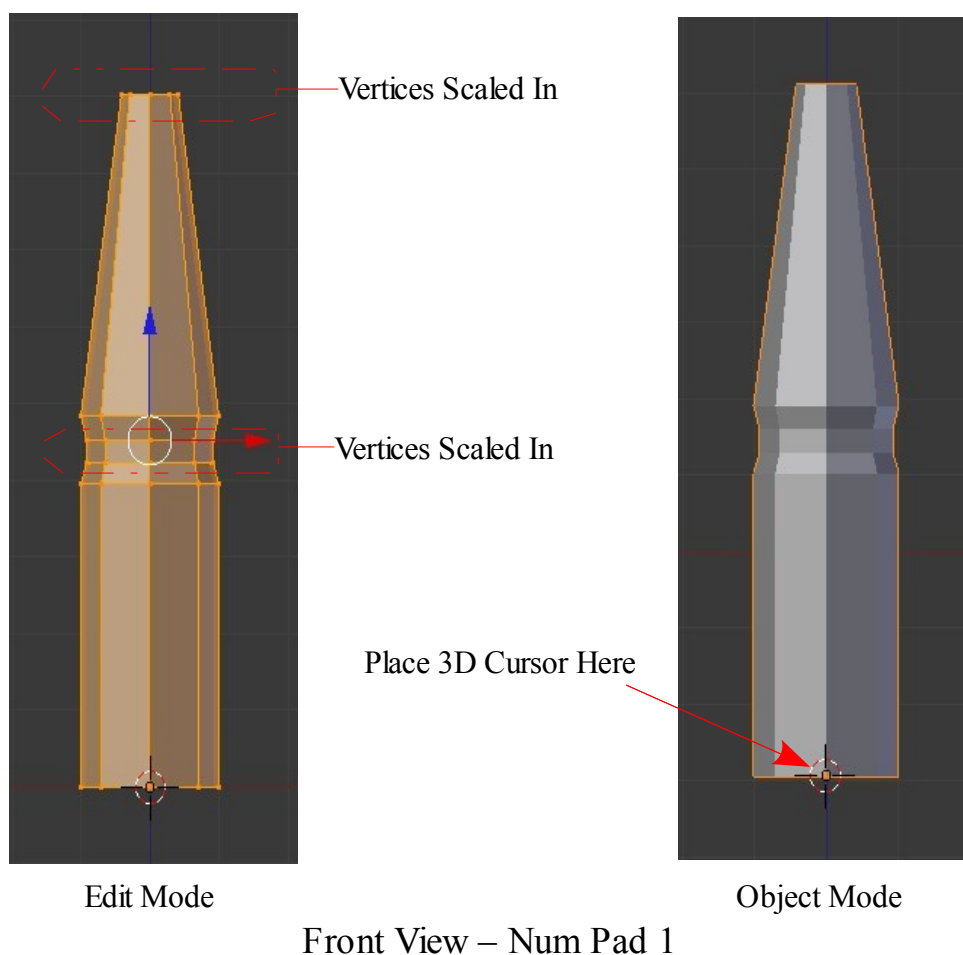
With the mesh selected tab into Object mode and place the 3D Cursor as shown.
Note: For the purpose of the demonstration leave the default Circle object with the default radius of 1.000 Blender grid units. If the circle is scaled the Finger mesh vertices may fall outside the Armatures field of influence resulting in some unexpected results.

Deselect the mesh Finger (A Key).

Add a single bone Armature as previously described. Since the cursor was placed at the base of the finger on the centreline you will probably not see the Armature.

Go to the Properties Window – Object Data button – display tab and tick X-Ray. This makes the Armature visible in Object mode -Solid display.

It actually makes the Armature display on top of the Mesh.
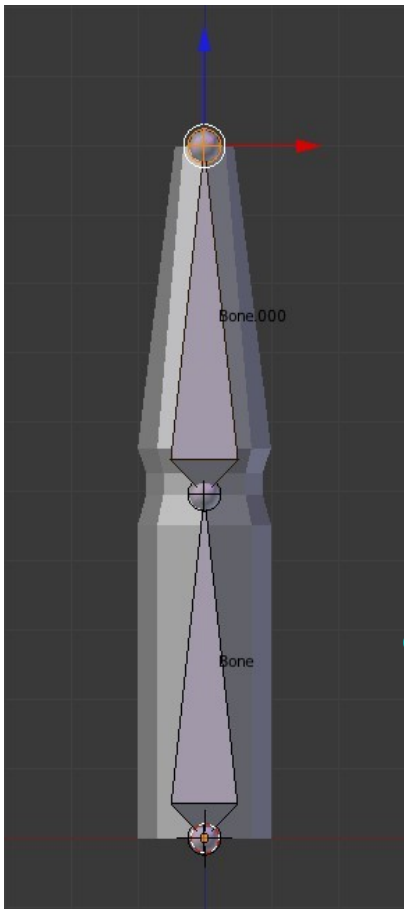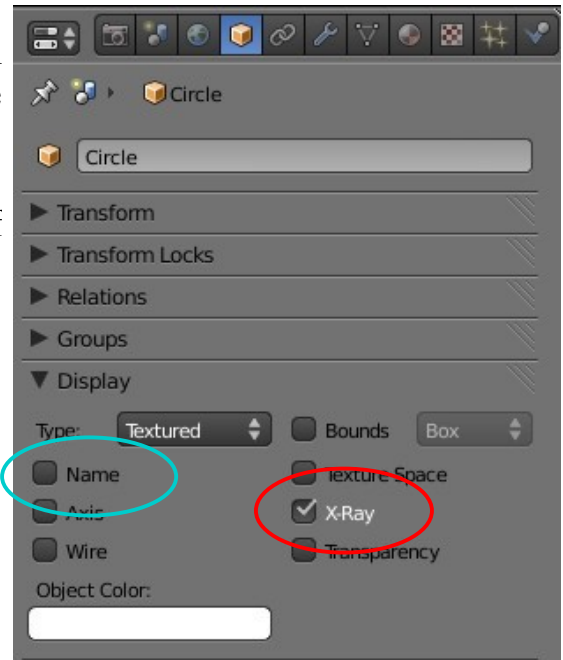
With the Armature selected – Tab to Edit mode.
Select the top end of the Bone (Tip) and drag it up to the middle of the bend point of the Finger.
Press the E Key and extrude the bone (Creates a second bone) up to the top of the mesh Finger.

In the Properties window – **Object data** – Display tab – tick 'Names' to show the names of the bones in the 3D Window. The names will be 'Bone' and 'Bone.000'.

Press A Key to deselect the Armature bones – **Remain in Object mode**.

Alternative Method for Creating a Multi Bone Armature

There is an alternative method for creating a multi bone Armature.

With a single bone Armature added, tab to Edit mode and drag the tip up to the top of the finger. Make sure you have the body of the bone selected (Right click on the body).

Go to the Tool Shelf at the left of the screen and click on 'Subdivide'. Successive clicks will subdivide the bone and create a multi bone Armature.
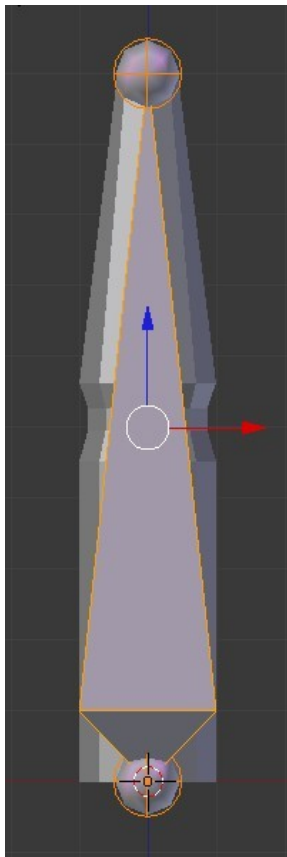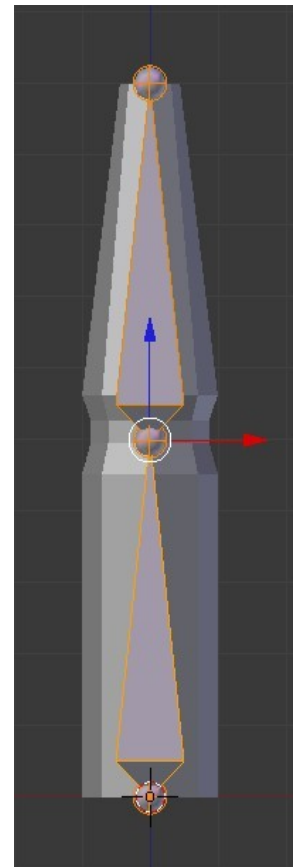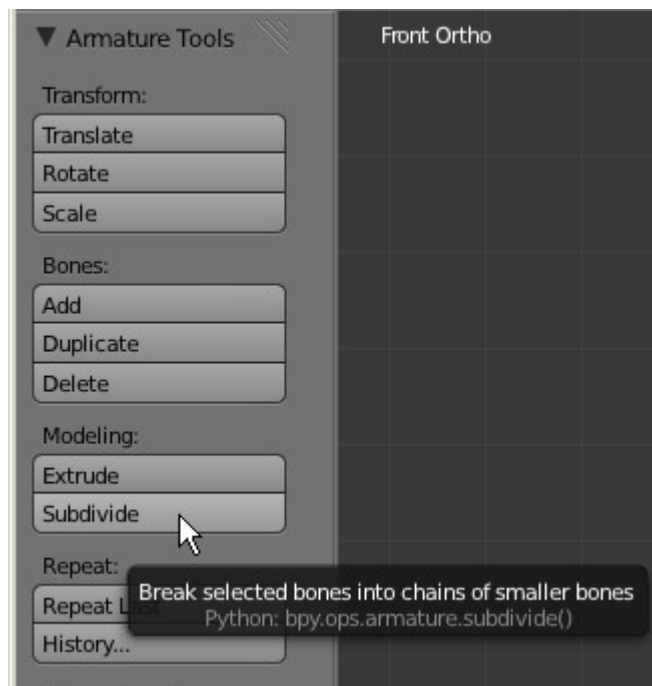
Single Bone   Multi Bone

Armature Modifier

We will now add an Armature Modifier to the Finger Mesh Object.

Deselect the Armature.

Select the Finger (Right Click). In the Properties Window – Modifier button – click 'Add Modifier' and select 'Armature.
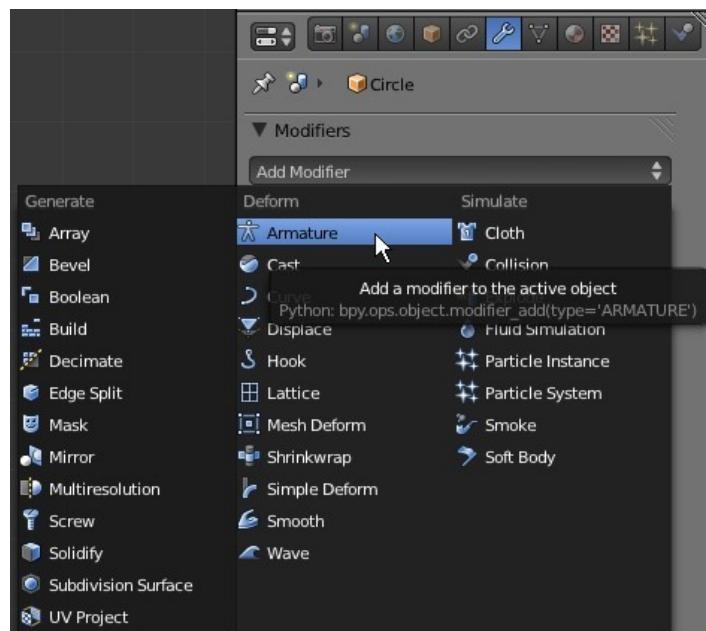
Click in the Modifiers 'Object' panel and select 'Armature' (Blender named your Armature, 'Armature').
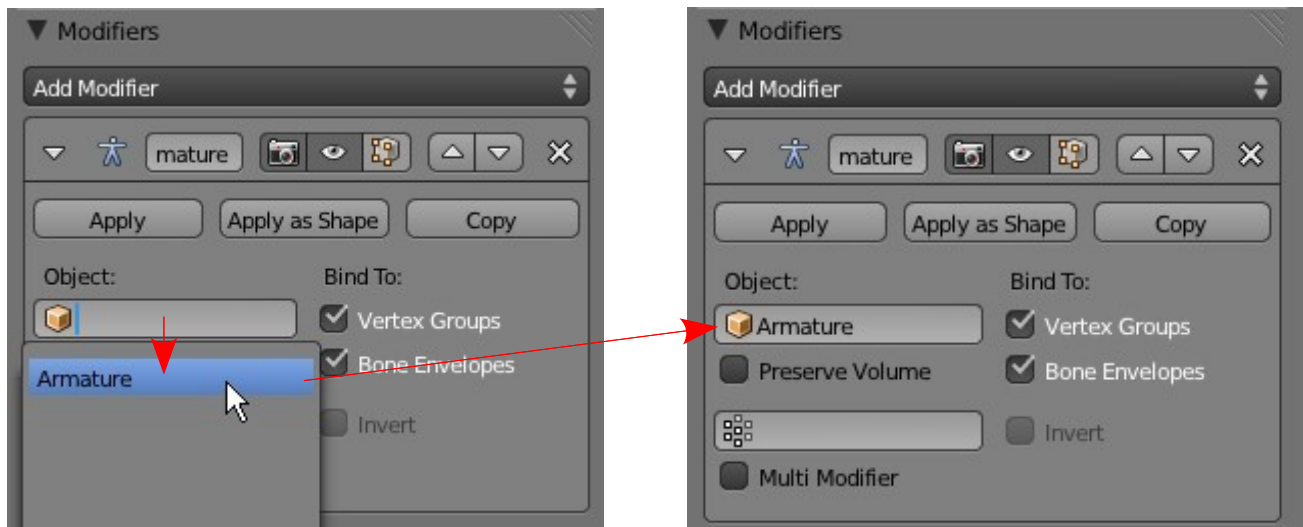
It is time to test the deformation process.

In the 3d Window deselect the Finger and select the Armature. Depending on how you positioned the Armature in the Finger you may have difficulty selecting. If this is the case go to the Outliner Window at the upper right of the screen and right click on 'Armature' in the display.
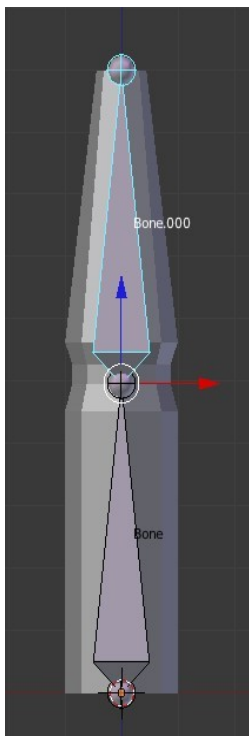
With the Armature selected change from Object Mode to Pose Mode in the 3D Window header. Bone.000 should be highlighted in blue. R Key and rotate the bone. The top of the finger rotates with the bone.
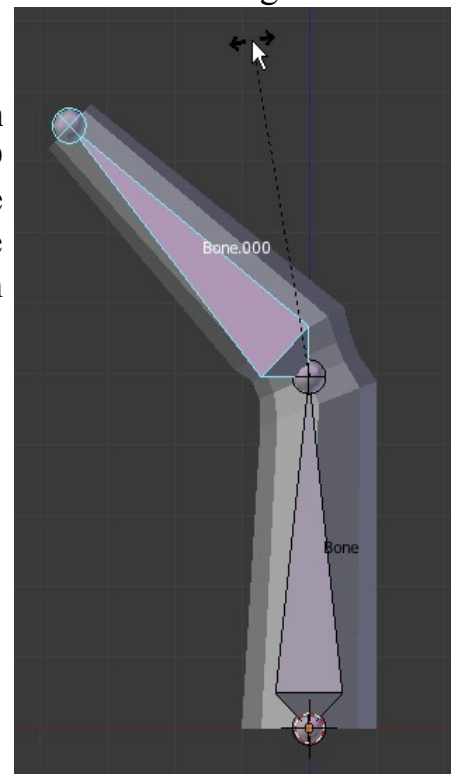
Select a bone and S Key (scale).

Change the Armature to Envelope display.
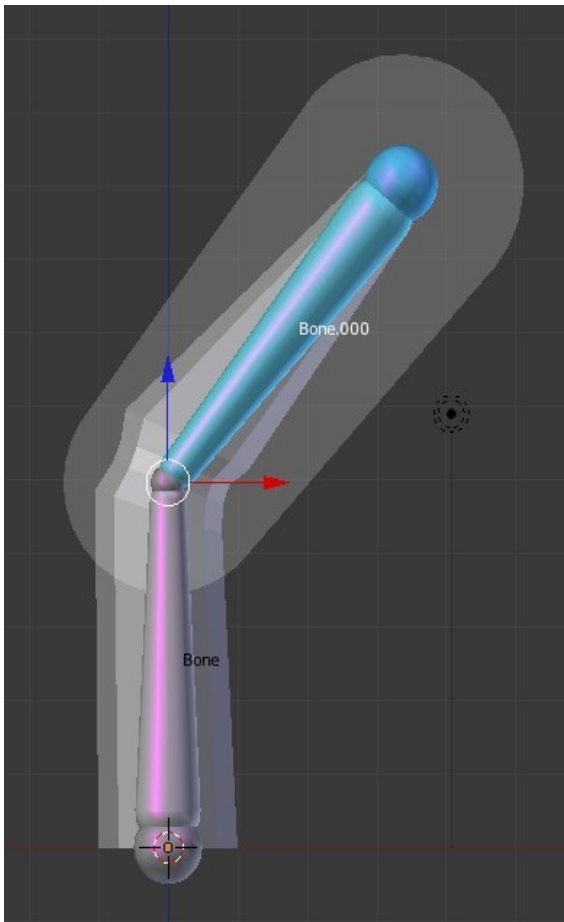
Envelope display with Bone.000
scaled down showing the field of
influence reduced.
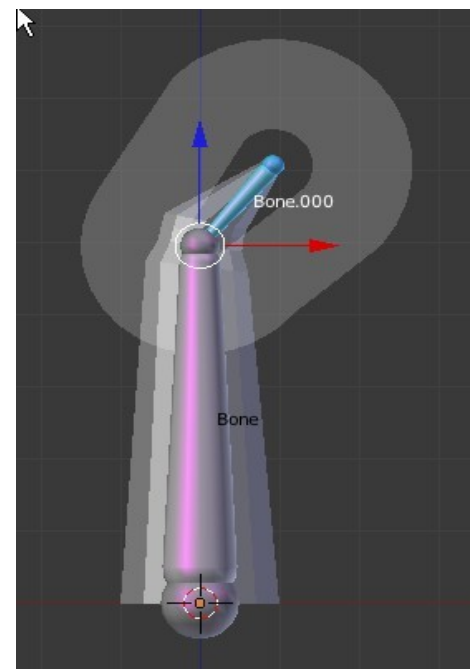
The foregoing has demonstrated how to deform a mesh object using Armatures and the Armature Modifier. The ultimate use of Armatures is in character animation which involves rigging a mesh (The character) with a multi boned Armature and then animating the movement of the Armature simulating the characters movement.

Rigging a character can be a tedious and sometimes complicated process. Blender has a ready made humanoid Armature rig secreted away in the User Preference Window.

Humanoid Armature

In the user Preference Window click on 'Add Ons' at the top of the Window. In the panel at the LHS click 'Rigging' and you will have a single line entry named 'Rigging Rigify'. Tick the little box at the end of the line.

Go back to the 3D Window and press Shift + A Key. Select 'Armature' and you will see that 'Human (Meta-Rig)' has been added to the selection options. Click on the new entry and a multi boned humanoid Armature is introduced to the scene. On my computer it is entered rather small. If this is the same for you zoom in or scale the rig up. Pan the window around and have a good look at the rig. If you go into 'Pose Mode' and select individual bones you will be able to move them about creating different poses.
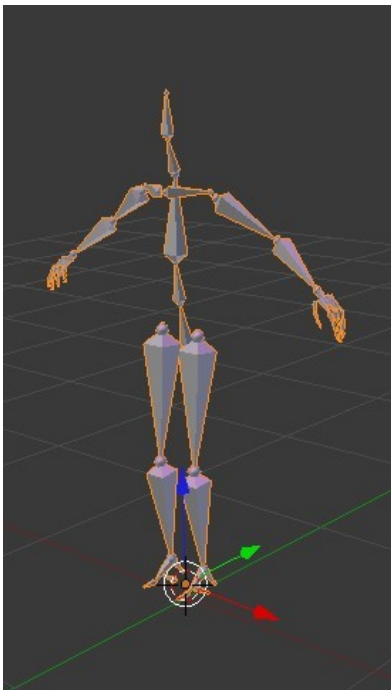
Object Mode
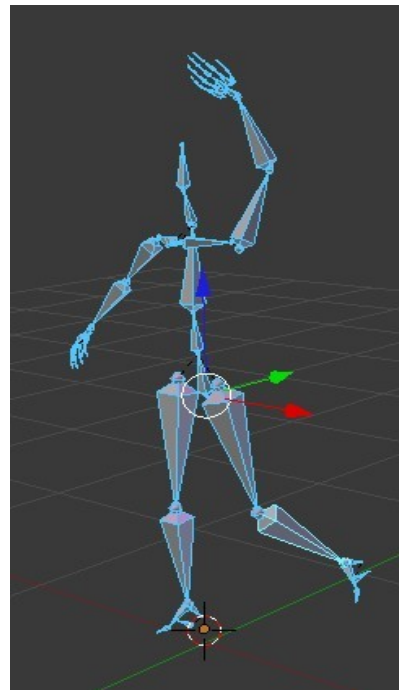
Pose Mode

It may be a little ambitious at this stage to construct a model of a human figure and rig it for animation. Of course you could use the 'Make Human' program (http://www.makehuman.org/) to create a figure then import it into Blender and rig for animation but unless you have a reasonable computer you may be disappointed. Make Human models have a pretty high vertex count so there is a lot of stuff to move about in an animation. You will also have to go find a rigging tutorial on the internet and stud this topic in detail. What we have covered so far is the very very basics.

While on the subject of Armatures we will demonstrate a few more basics.

Disconnected Bones

You may have noticed that in the humanoid Armature some of the bones appear to be disconnected. They are separated from adjoining bones.

To demonstrate how this occurs this follow this procedure.

In a new scene add single bone Armature. Tab into edit mode, select the Tip and extrude another bone. Select the Body of the new bone then, in the Properties Window – Bone button – Relations tab untick 'Connected'.
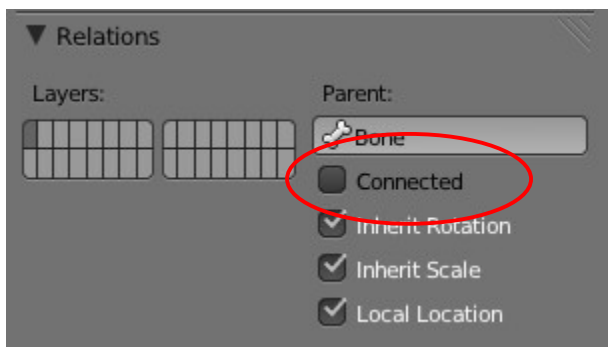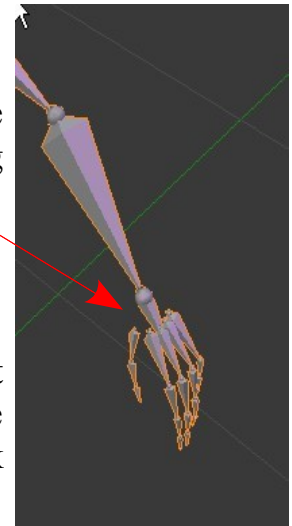
Bone repositioned but remains part of the Armature
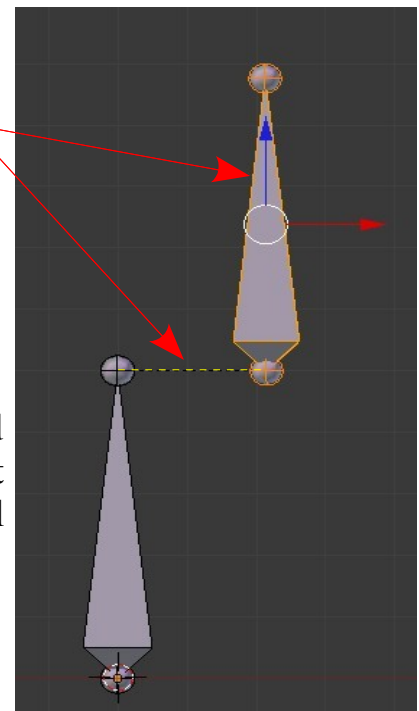
The new bone may now be translated (G Key grab) and repositioned away from the original bone. It remains as part of the Armature. If 'Connected' is re-ticked the new bone will be repositioned with its base connected to the original bone.

In the previous examples of deforming a mesh with an Armature, the mesh vertices were required to be located within the field of influence of the Armature. An alternative to this is to manually nominate which vertices will be affected by the armature. There are basically two methods which are:

1. Select and assign vertices to a Vertex Group and nominate the control Armature bone.

2. Perform this same operation using Blender's Weight Paint tool.
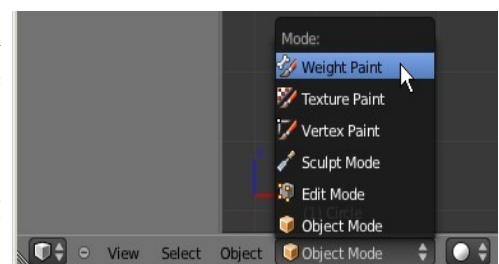
Method 1. Manually Assign Vertices.

In a new scene construct a Finger as previously described. Add a two Bone Armature as before but position it as shown in the diagram to the right.

Select the Armature and in the Properties Window – Object data button – Display tab tick 'Names' to show the bones named 'Bone' and 'Bone.000'. Deselect the Armature.

Select the Finger and tab into Edit Mode – A Key deselect the vertices.

In the Properties Window – Object Data button – Vertex group tab click the plus sign to add a new Vertex Group. A Vertex Group is added and named 'Group'.
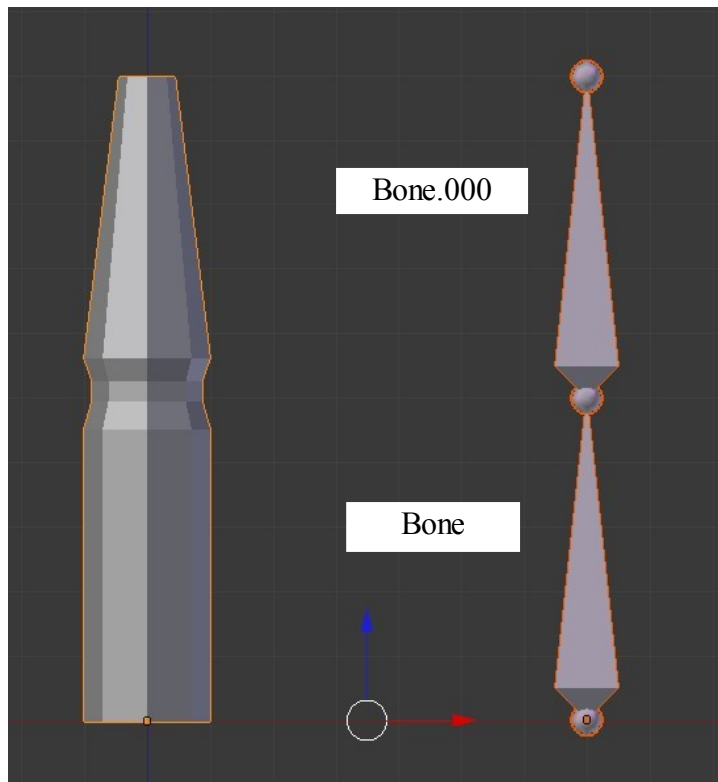
The aim here is to select vertices and add them to the Vertex Group. The movement of the group is to be controlled by a bone in the Armature.

By renaming 'Group' to 'Bone.000' the Vertex Group will automatically controlled by the bone named 'Bone.000'. Groups and bones may be renamed to whatever you want but for a group to be controlled by a bone the names must be identical.

In the 3D Window select the vertices in the upper part of the Finger (B Key – drag rectangle).

Make sure you have the 'Select Only Visible' button turned off in the 3D Window header or you will only be selecting the front vertices of the Finger.

Select Only Visible Button
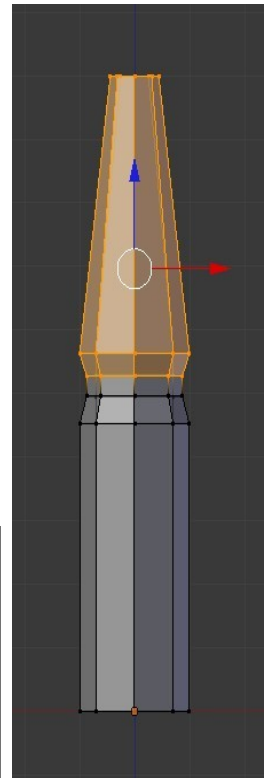
In the Vertex Group tab click 'Assign' to assign the selected vertices to the group. Check out the assignment by alternately clicking on 'Deselect' and 'Select' in the tab.
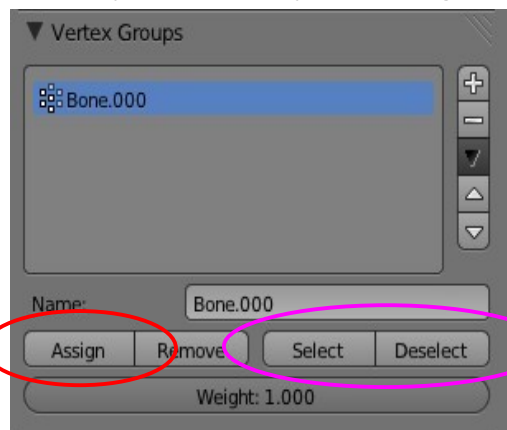
Tab into Object Mode and A Key deselect the Finger.

▼ Vertex Groups

Bone.000

Name: Bone.000
Assign | Remove | Select | Deselect
Weight: 1.000
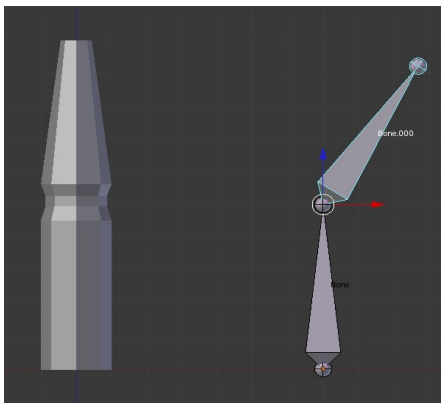
Select the Armature and go into Pose Mode. Select 'Bone.000' and R Key rotate.

Nothing happens! Why? We haven't applied an Armature Modifier to the Finger.

Circle

▼ Modifiers

Add Modifier

Generate	Deform	Simulate
Array	Armature	Cloth
Bevel	Cast	Collision
Boolean	Curve	Add a modifier to the active object
Build	Python: bpy.ops.object.modifier_add(type='AR
Decimate	Displace	Fluid Simulation
Edge Split	Hook	Particle Instance
Mask	Lattice	Particle System
Mirror	Mesh Deform	Smoke
Multiresolution	Shrinkwrap	Soft Body
Screw	Simple Deform	
Solidify	Smooth	
Subdivision Surface	Wave	
UV Project		

Go back and select the Finger and in the Properties Window – Modifiers button click 'Add Modifier' and select 'Armature'. In the Armature Object panel click and select 'Armature'.
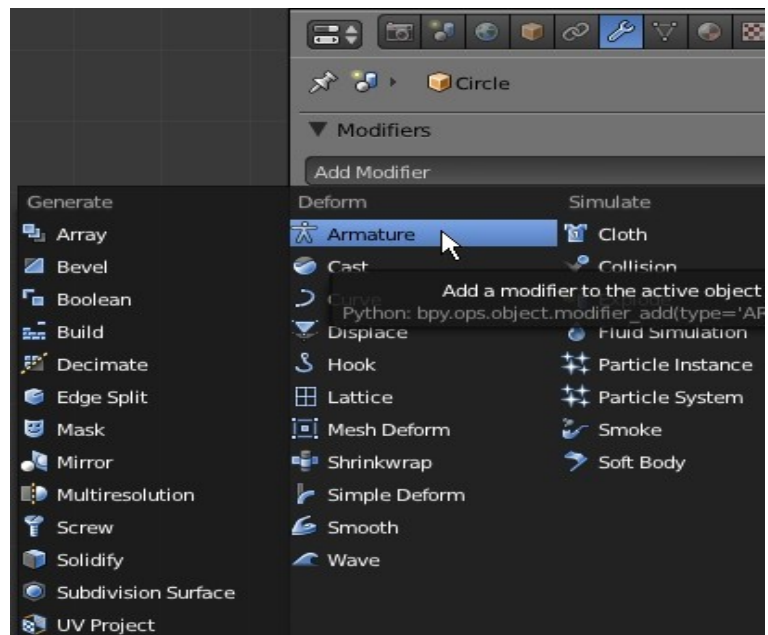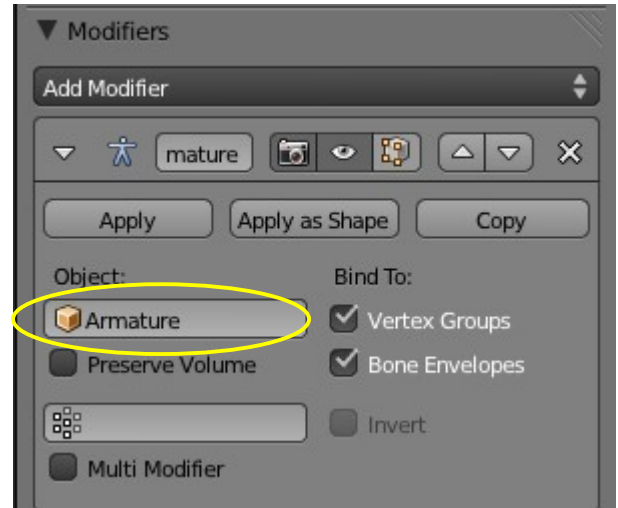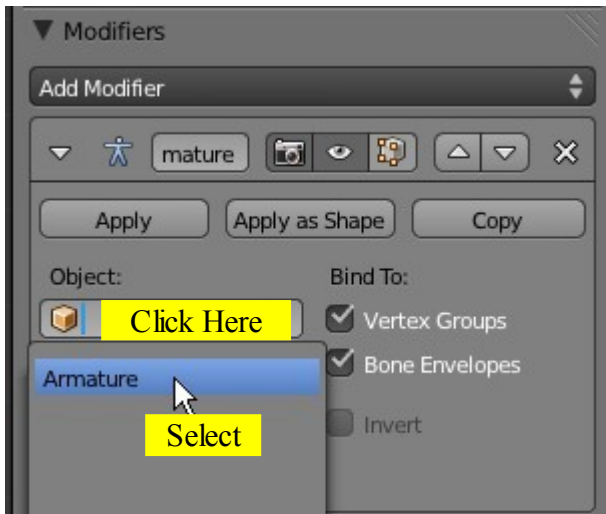
Deselect the Finger and select the Armature in Pose Mode. Select 'Bone.000' and rotate it. The upper part of the Finger will now deform as the bone is rotated.
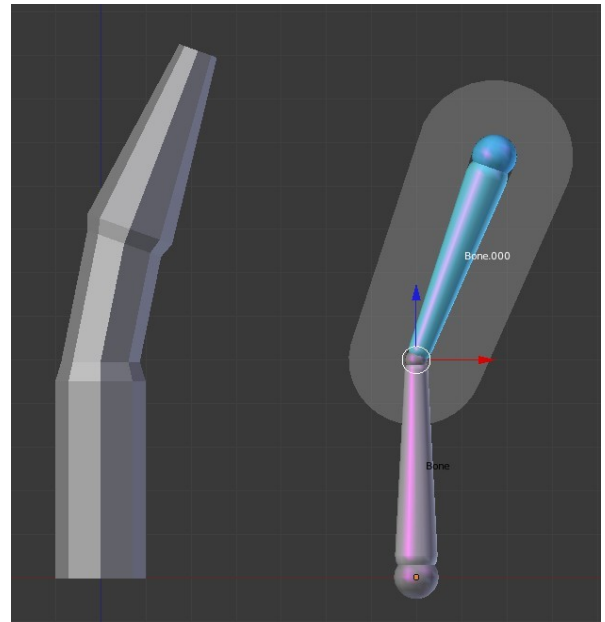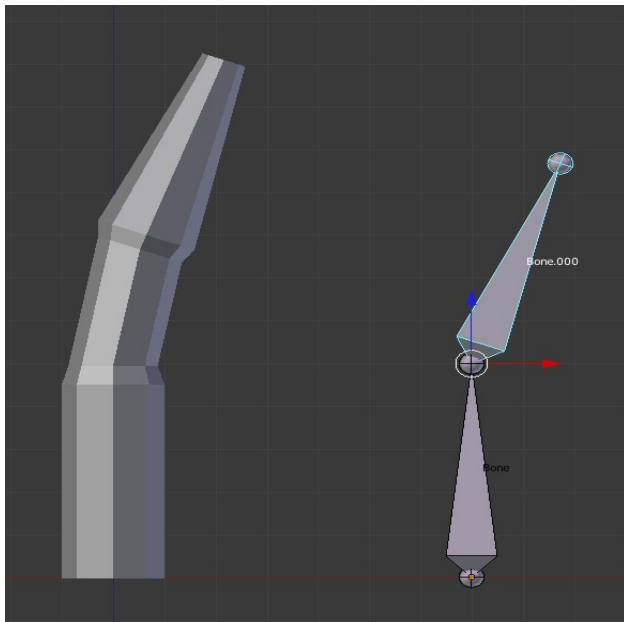
Since the Armature is located well away from the Finger the field of influence of the Armature is not in force.

Method 2. Weight Paint.

Instead of selecting vertices, Blender has a painting method which selects and assigns vertices to a Group, automatically linking them to an Armature bone.

The paint method provides for a graduated weight to be given to vertices which dictates how much influence the Armature bone will have over the deformation of the mesh.

Set up a new scene the same as Method 1.

Select the Finger in Object Mode and In the Properties Window add an Armature Modifier. Don't forget to enter 'Armature' in the 'Object' panel.

Select the Armature and enter Pose Mode.

In the properties Window – Object Data button – Display tab tick 'Names' to display the bone names. They should be 'Bone' and 'Bone.000' as before.
Select 'Bone.000'.

Leave 'Bone.000' selected and right click the Finger to select it. With the Finger selected go to the 3D Window header and change from Object Mode to Weight Paint Mode. The Finger displays in blue. Blue denotes that no vertices are selected.

Paint Circle Size

Strength Slider

Bone.000
Selected
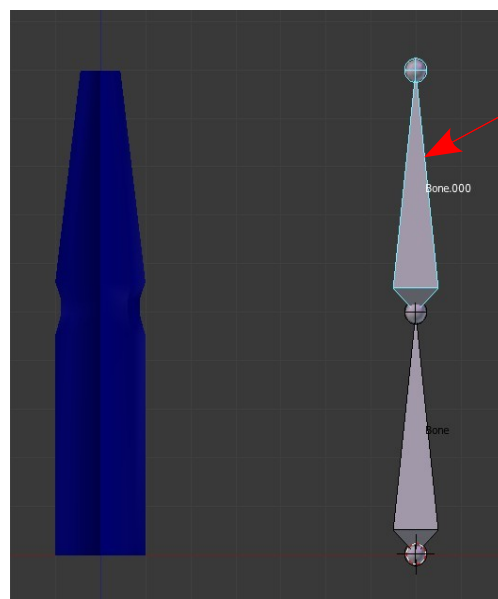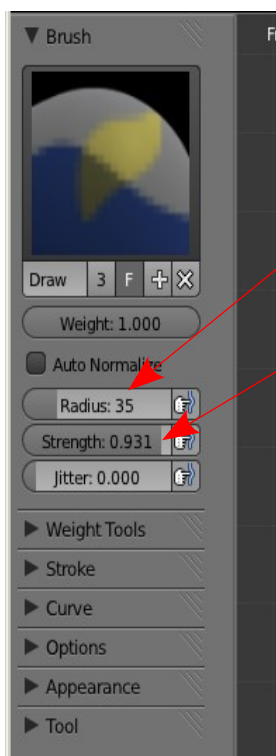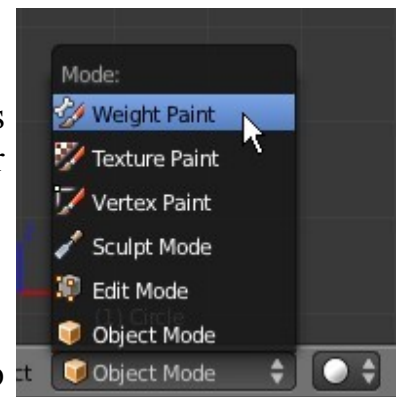
In the panel at the left hand side of the window drag the 'Strength' Slider up to '0.9000'. We are about to paint over the Finger mesh selecting vertices and by setting the strength to a high value we are telling Blender that the selected vertices are to be rigorously controlled by "Bone.000'. Remember we had 'Bone.000' selected when we clicked on the Finger.

In Weight Paint Mode the cursor in the 3D Window has a circle attached. The size of the circle is the size of the paint tool. This can be altered in the panel at the left.
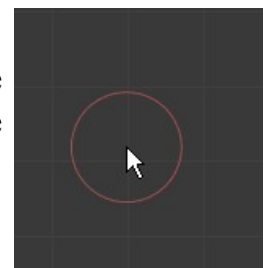
We want the upper part of the Finger to be transformed by 'Bone.000'. Click, hold and drag the cursor circle over the top part of the Finger. The part of the Finger painted turns red. Red indicates a rigorous control. Altering the 'Strength ' value changes the control strength and will display as some other colour.

Painting only selects vertices on the visible surface of the mesh. You have to turn the mesh around and paint the back side to select the whole top part of the Finger (Pan the 3D View around).

Having painted the Finger, note that in the Properties Window – Object data button – Vertex Group tab a Vertex group has been created and named 'Bone.000'.
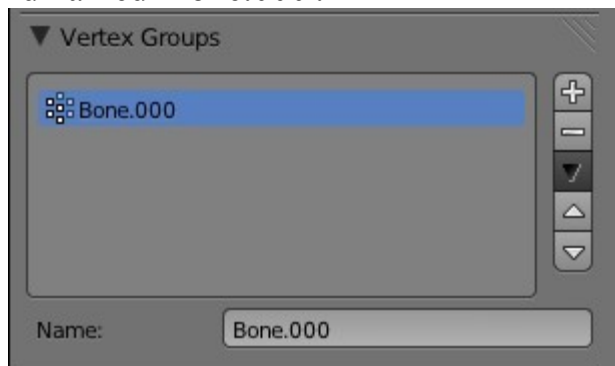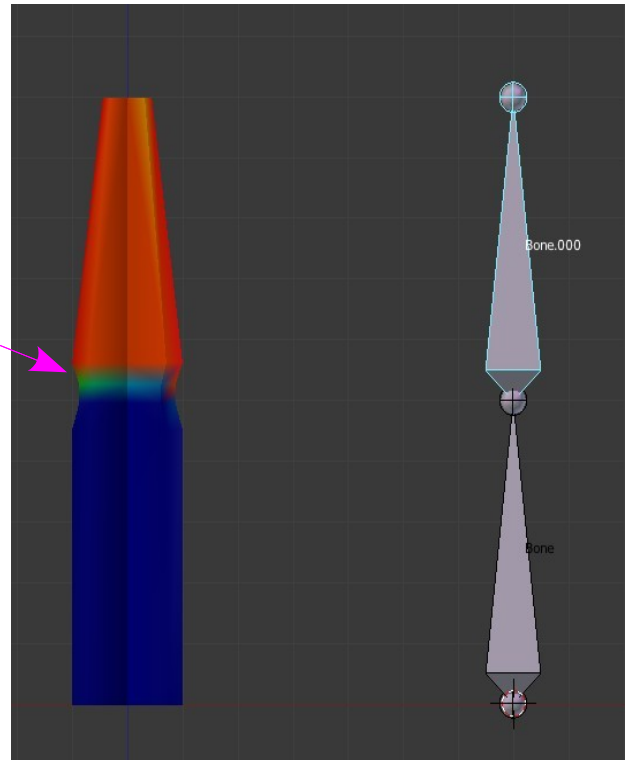
Selecting the 'Armature Bone.000' in Pose Mode and translating it will move the top part of the Finger.
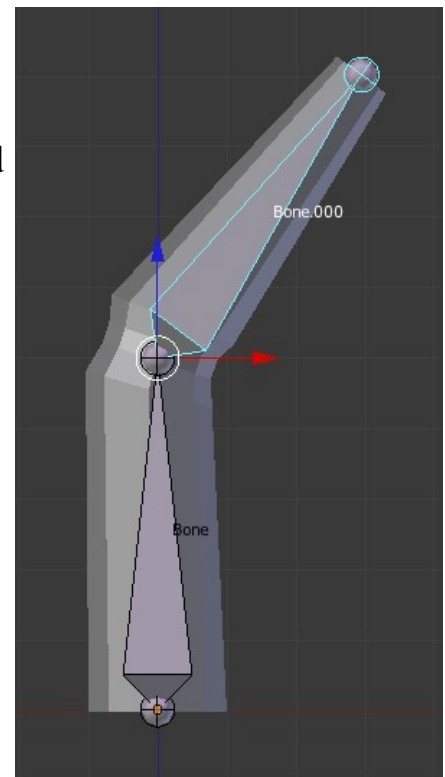
Vertex Groups or Field of Influence

Having described the deformation of a mesh by employing Vertex Groups and Field of Influence the question arises as to which is being employed when the Armature is located inside the mesh.

Look at the following example with our two bone Armature sitting inside the Finger.

If we follow the preceding examples either selecting vertices or Weight Painting, thus assigning vertices to a Vertex Group. It is unclear whether the Vertex group or the Field of Influence is controlling the deformation of the mesh.

If the Armature is moved away from the mesh posing the bone will still cause a deformation therefore the vertex group is in control. But when the Armature is inside the mesh, is it the Field of Influence or the Vertex Group?

Follow this example to clarify this dilemma.

Select only the vertices at the tip of the Finger and assign them to a Vertex Group.

Make sure you have added an Armature Modifier to the Finger and have assigned 'Armature' in the Object panel.
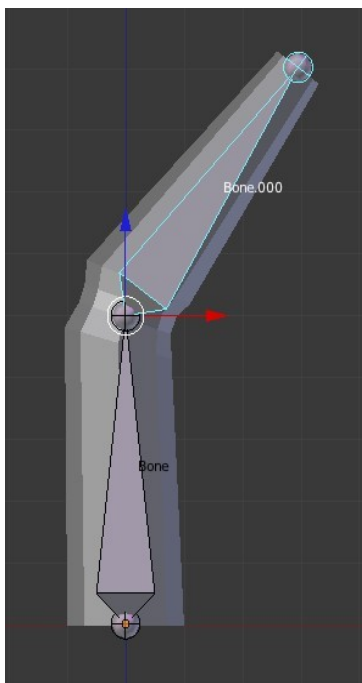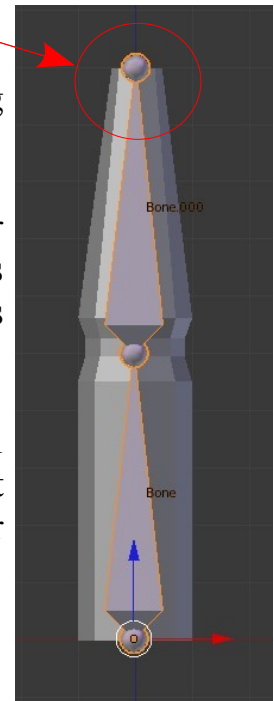
Rotate 'Bone.000' in Pose Mode and the the whole top of the Finger deforms. Place the Armature in Object Mode and move it away from the Finger. Rotate the bone again and only the tip of the finger deforms. This only proves that both the Vertex Group and the Field of Influence are active.
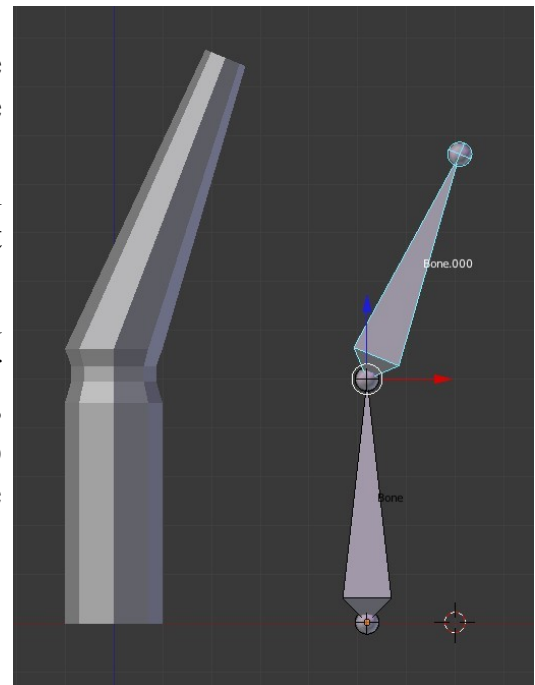
Place the Armature back inside the Finger.

Select the Finger and take a look at the Armature Modifier. Under the heading 'Bind To' there are the two boxes labelled 'Vertex Group' and 'Bone Envelope'.

Untick 'Bone Envelope'. Rotating the bone now only deforms the tip of the Finger. Obviously you have turned the field of influence off. So here lies the control for selecting either the Field of Influence or the Vertex Group.
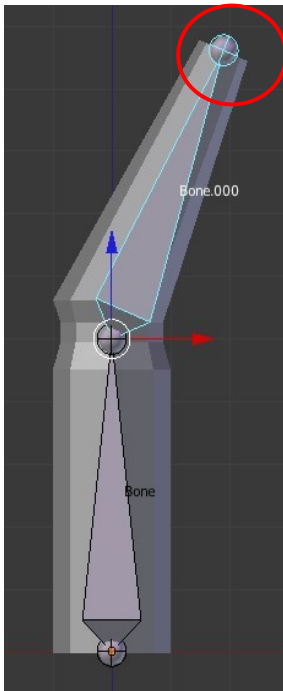
Tip Only Moved
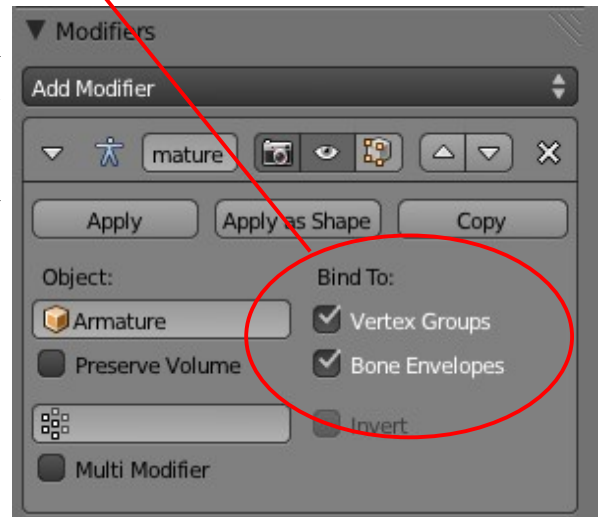
Another way of negating the field of influence is to set the 'Distance' and 'Weight' values to 0.000 in the Properties Window – Bone button – Deform tab.

In the Properties Window – Object Data button – Skeleton tab, under 'Deform', there are also boxes ticked and labelled 'Vertex Group' and 'Bone Envelope'. Ticking or unticking these seems to have no effect.
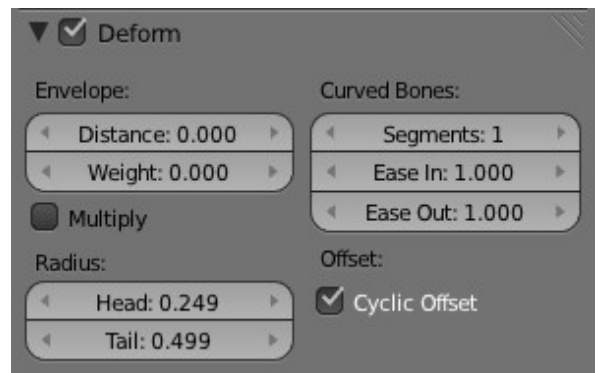
This discourse has rambled on and still only the basics have been covered in this topic. Again you will have to go to the internet and search for tutorials to become proficient.

Before you go we will point out that Armatures can have Constraints applied. For example the IK Constraint.

The IK Constraints

The IK Solver Constraint is a wonderful tool for animators. IK stands for Inverse Kinematics which is the opposite to FK, Forward Kinematics. Both IK and FK are ways of controlling the posing and animation of a chain of bones. With FK you have to rotate the chain of bones one by one to pose it for animation. This is a tedious process but gives full control. With IK, dragging the end will result in the chain following the selected bone.

An example would be to create a chain of bones as shown here.
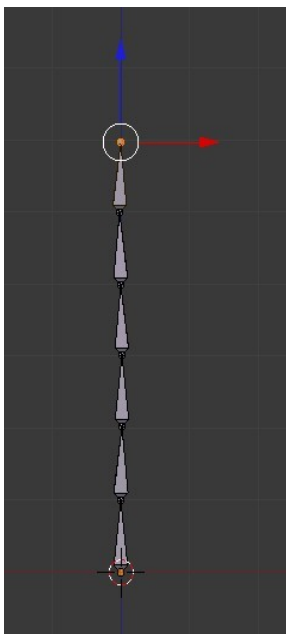
Pose Mode Last Bone Selected

With the chain (Armature) selected go into Pose Mode. Select the last bone in the chain and in the Properties Window – Bone Constraints button and click on 'Add Constraint'. Select 'Inverse Kinematics'. In the 3D Window, in Pose Mode, with the end bone still selected G Key (grab) and move the bone.
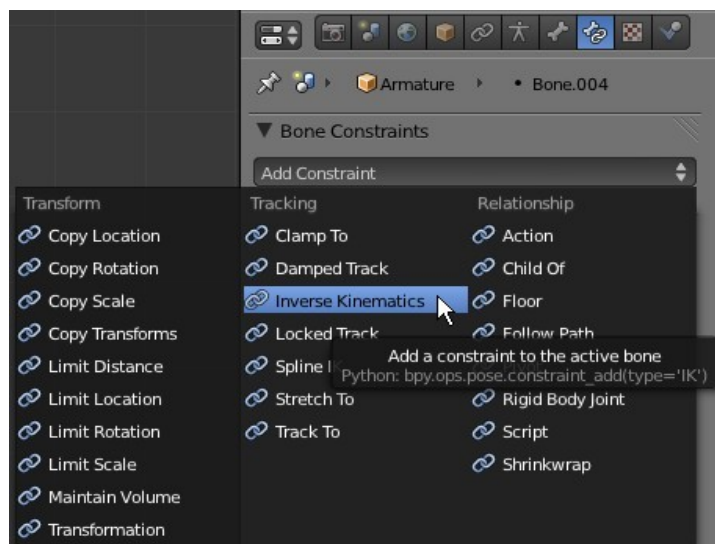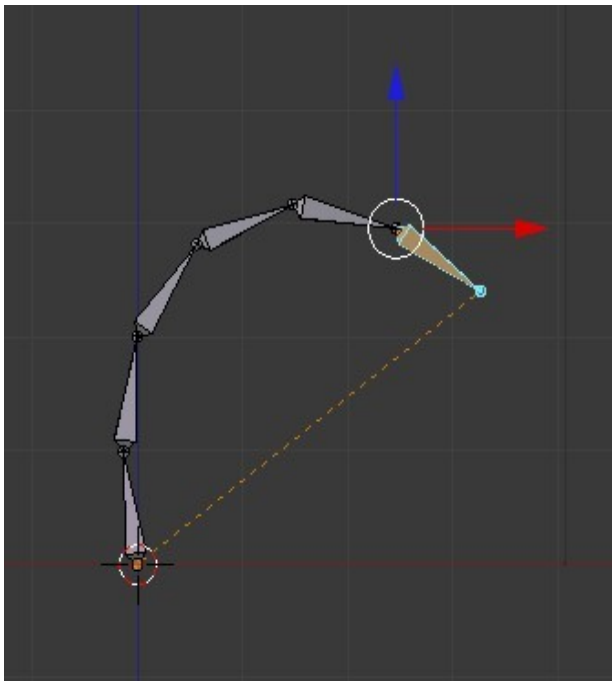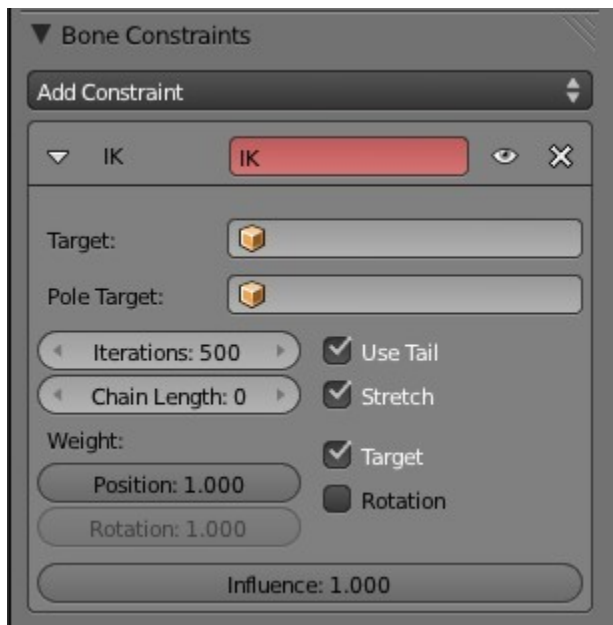
Even in this single constraint there are plenty of settings to play with. Again finding a good tutorial will do wonders in proficiency.

CH19- Relative Shapes Keys

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Shapes Keys and Action Editor

Shapes Keys and Action Editors provide an easy method of animating shapes and objects. Both Editors are located in the Dope Sheet Window. The Shapes Key Editor allows you to control the animation of vertices or groups of vertices while the Action Editor allows you to set up an animation of an Objects movement and scale.

To demonstrate both methods we will use a simple Plane Object with only four vertices.

Start with the default Blender scene, delete the Cube and add a Plane. Go into Top View (Num Pad 7 + Num Pad 5). Zoom in on the view (Num Pad +).

Split the 3D Window into two windows and change one to the Dope Sheet Window.

Shapes Key Editor

In the Dope Sheet Window click on the drop down mode selection and select 'Shapes Key Editor'. With the Editor selected the window has now become an animation timeline.

Select the Plane in the 3D Widow.

In the Properties Window – Object data buttons – Shapes Keys tab click on the plus sign The tab expands showing a 'Basis Key' inserted. Click on the plus sign again and 'Key1" will be added. Note that in the Dope Sheet Shapes Key Window 'Key1' is also displayed (Upper LH side of window).
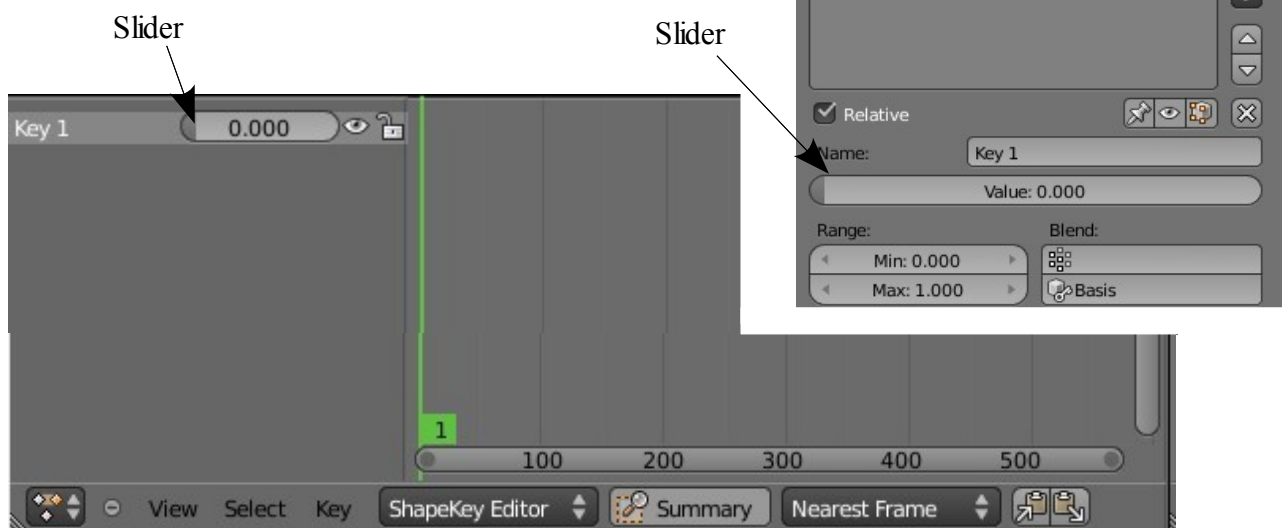
Dope Sheet Shapes Key Window

With the cursor in the 3D Window Tab to Edit mode. Deselect all vertices (A Key).

Now select one of the vertices and drag it (G Key drag mouse). Tab to Object mode.

The plane reverts to its original shape.
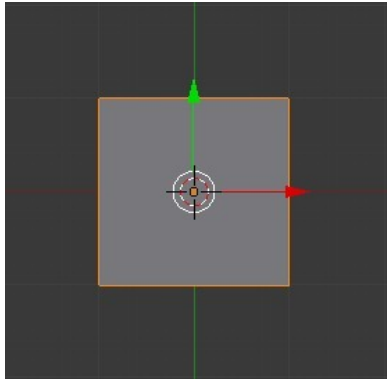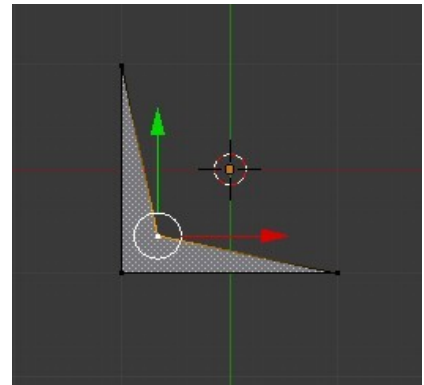
Edit Mode with Vertice Moved

Object Mode
Origional Shape

In the Properties Window – Shapes Key tab – Changing the 'Value' by moving the slider changes the shape of the Plane in the 3D Window. You can also change the shape by moving the slider next to 'Key1' in the Dope Sheet Shapes key Editor.

In the Properties Window – Shapes Key tab click on the plus sign again to add 'Key2'.
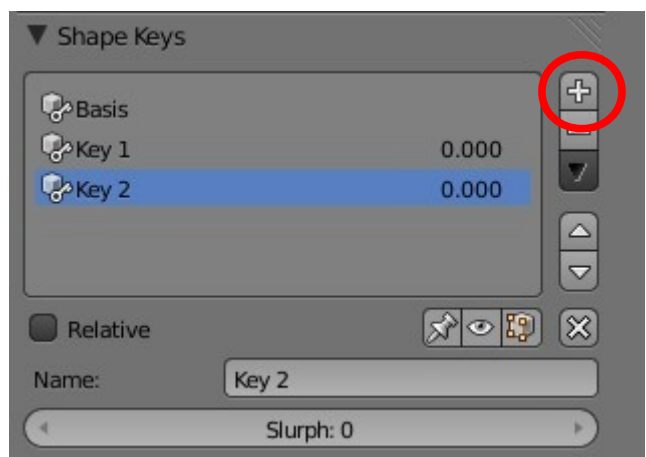
 In the 3D Window Tab to edit mode select another vertice and move it somewhere. Tab back to object mode. Key2 has been added to the Shapes Key Editor.

Shape Key Editor – Key2 Added
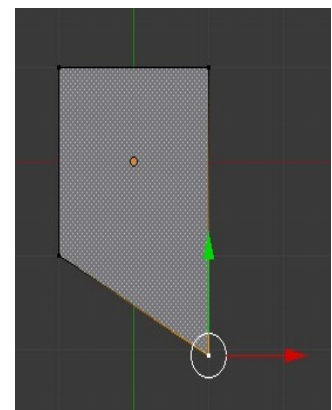
Edit Mode
Vertice Moved

In the Shapes Key Editor
click on Key1 then Shift
click on Key2. This has
selected both keys as
indicate by the white
highlight of the names.
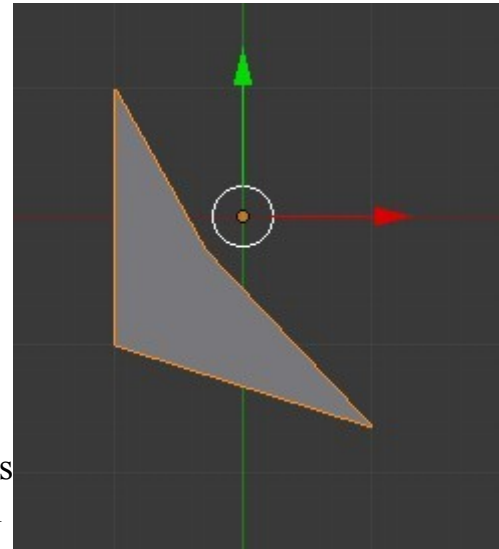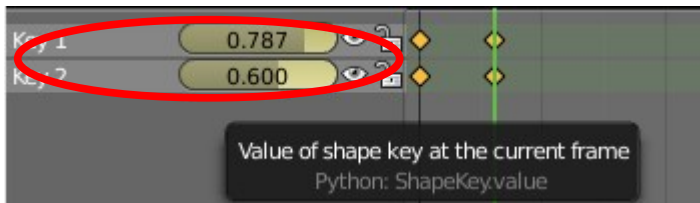
Move each slider to see the Plane change shape in
the 3D Window then return each slider to the 0.000
position. Moving the sliders has inserted key
locations in the timeline of the Shapes Key Editor as
indicated by the orange diamond shapes. Press 'I
Key' and select 'Only Selected Channels'. This inserts
Keyframes in the animation timeline. Drag the green
line to a new frame, move the Key sliders and press
'I Key' again selecting 'Only Selected Channels'. New Keyframes are inserted. Scrub
the timeline (Drag the green line) to see the animation. You can also press Alt + A
with the cursor in the 3D Window to play the animation.

Action Editor

To demonstrate the Action Editor begin with the same set up as use for the Shapes
Editor except this time select 'Action Editor' mode in the Dope Sheet Window.

Select the Plane in the 3D Window in Object mode and insert a keyframe (I Key)
type 'LocRotScale.
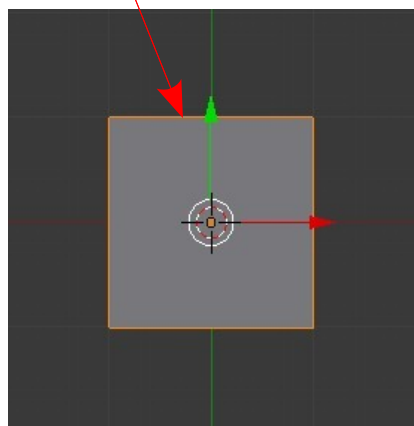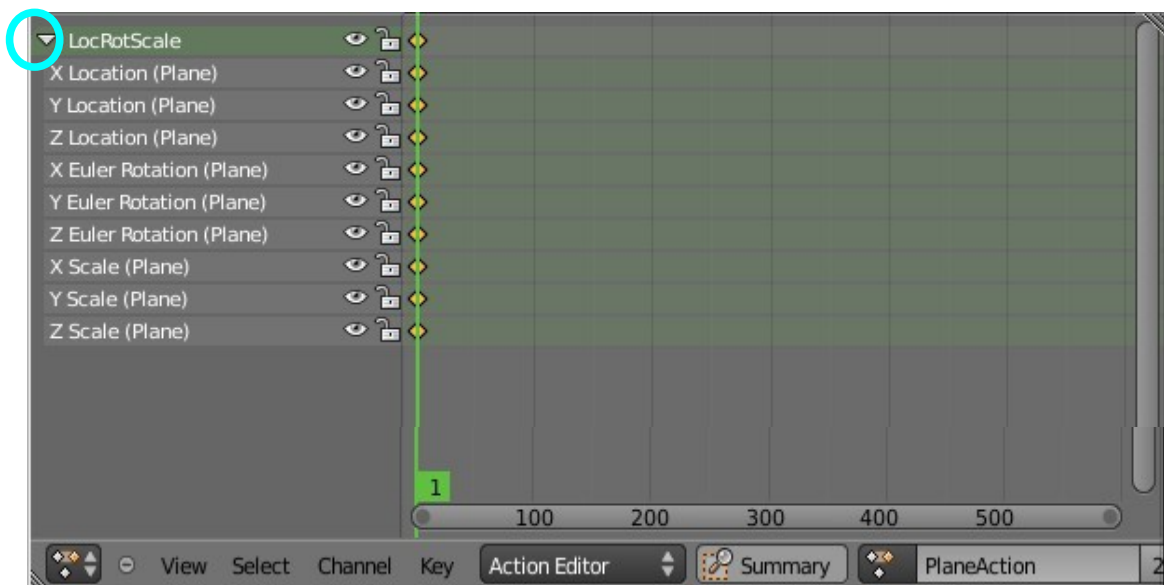
In the Dope Sheet Action Editor you will see the keyframe displayed in the upper LHS of the window. Clicking on the little triangle in front of the LocRotScale expands the keyframe to show the individual components.

In the Action Editor Window header click on 'View' and tick 'Show Sliders'. There will now be value sliders in each component of the keyframe. By moving the sliders you can manipulate the Plane in the 3D Window.

Inserting Keyframes (I Key) with each change of frame produces an animation. As previously you can scrub the animation or Alt + A play the animation.

X Location Slider set 2.000 in Action Editor

Plane Moved 2.000 in 3D Window
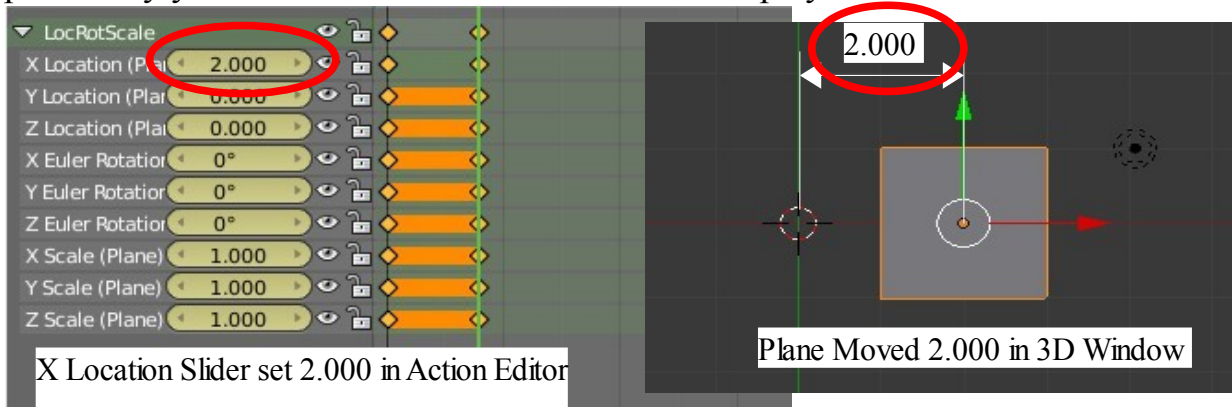
CH20- Fluid Simulation

01-Fluid Simulation

02-Basic Setup

03-Domain Object Setup

04-Fluid Object Setup

05-Inflow Object Setup

06-Obstacle Object Setup - Trough

07-Obstacle Object Setup – Cup

08-Outflow Object Setup

09-Fluid Simulation – Particles

10-Fluid Simulation - Control

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Fluid Simulation

Fluid Simulation Physics provides a means of simulating fluid flow. In this discussion we will consider two scenarios.

The first scenario is animating a volume of fluid such as a droplet of water or larger single volume which is initially suspended in space and allowed to drop into a container or on to a surface.

The second scenario is animating a stream of fluid such as fluid running from a tap or out of a container in a controlled flow. This scenario will recap on the first scenario.

For detailed procedure see Blender Wiki PDF Pages 1059 to 1071 obtainable at http://www.letworyinteractive.com. (Note: These pages refer to Blender 2.49)

Basic Setup fore Fluid Simulation (First Scenario)

Blender 3D Window scene.

This setup represents a basic scene constructed for a fluid simulation. As with all blender scenes there must be a light to provide illumination and a camera before anything can be rendered.
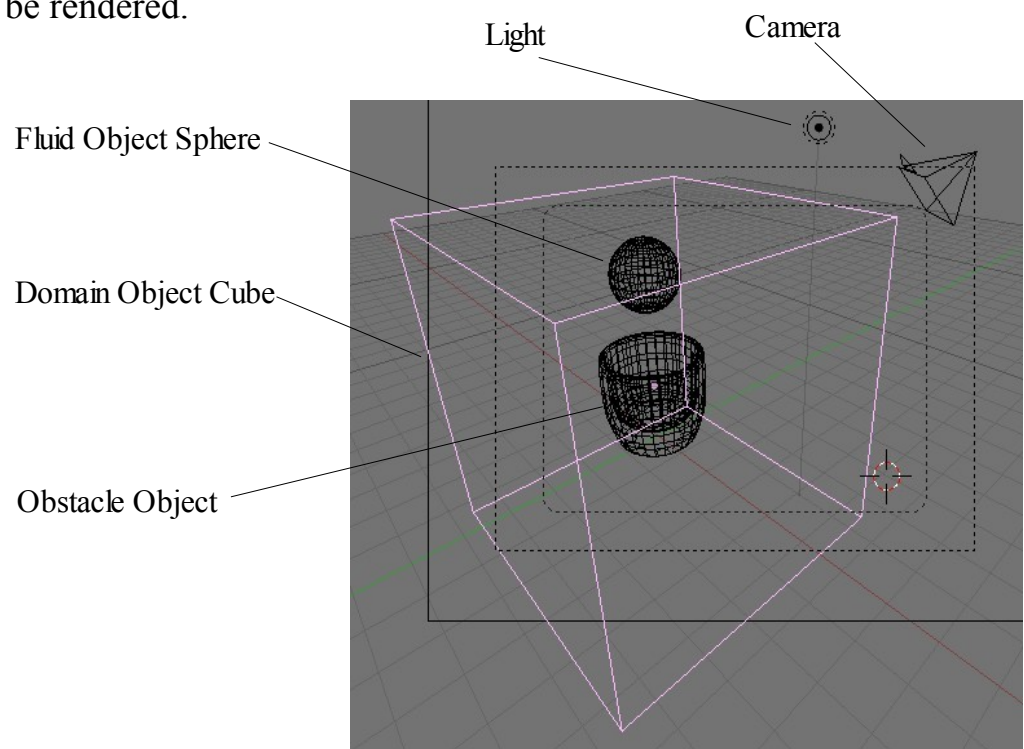
The scene has been constructed with:

> Fluid Object – Sphere – Default Sphere 32 segments and Rings. Domain Cube – default Cube scaled up x 4.
>
> Obstacle Object – Cup – Extruded from a Circle (See next page).

In the scene a volume of liquid (Fluid Object) suspended in space, it will be released and then dropped into a Cup (Obstacle Object). The falling fluid (Fluid Simulation) takes place within the confines of the Domain. The domain is a segment of space defined by a cubic volume (The Cube).

There must be a Domain for a simulation to take place and all Objects participating in the simulation must be within the Domain. Any Object partially outside of the Domain will not function.

In this simulation the fluid is represented by a Sphere positioned somewhere towards the top of the Domain and immediately above the Cup. The size of the Sphere relative to the Domain and to other objects within the Domain determines the volume of the fluid. A large sphere relative to the Domain and the Cup produces a large fluid volume.

The Cup is an obstacle which obstructs the movement of the Fluid. In this example the Fluid is simply falling in space until it is obstructed by the Cup. If the Cup did not exist the Fluid would fall until it reached the bottom of the Domain and then come to rest as if enclosed in a transparent rectangular container which is defined by the shape of the Domain.

With the objects placed in the scene nothing will happen until all the Objects have values assigned. This sets up the simulation.

Domain Object Set Up

In this example the Domain is a Cube which has been scaled to enclose the Sphere (Fluid Object) and the Cup (Obstacle Object). To assign fluid simulation values to the Domain first **select the Cube in the 3D View**.

Go to the Properties Window -Physics button – Fluid tab. Click 'Add New' to display the Fluid tab properties. Select 'Domain' from the Type drop down selection menu.

The Fluid Domain settings panel displays.
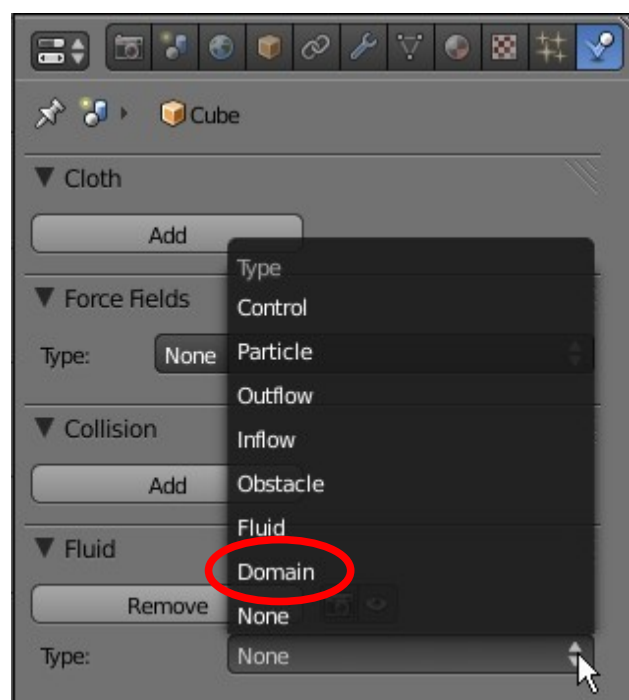
Selecting the Cube in the 3D Window applies the Domain characteristics to the Cube and displays Domain options. Three further tabs can be opened.
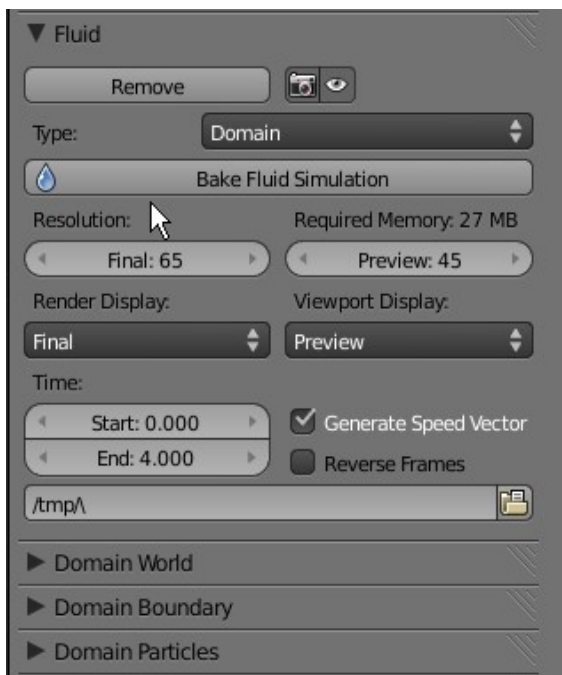
Domain Settings Panel

Three additional tabs
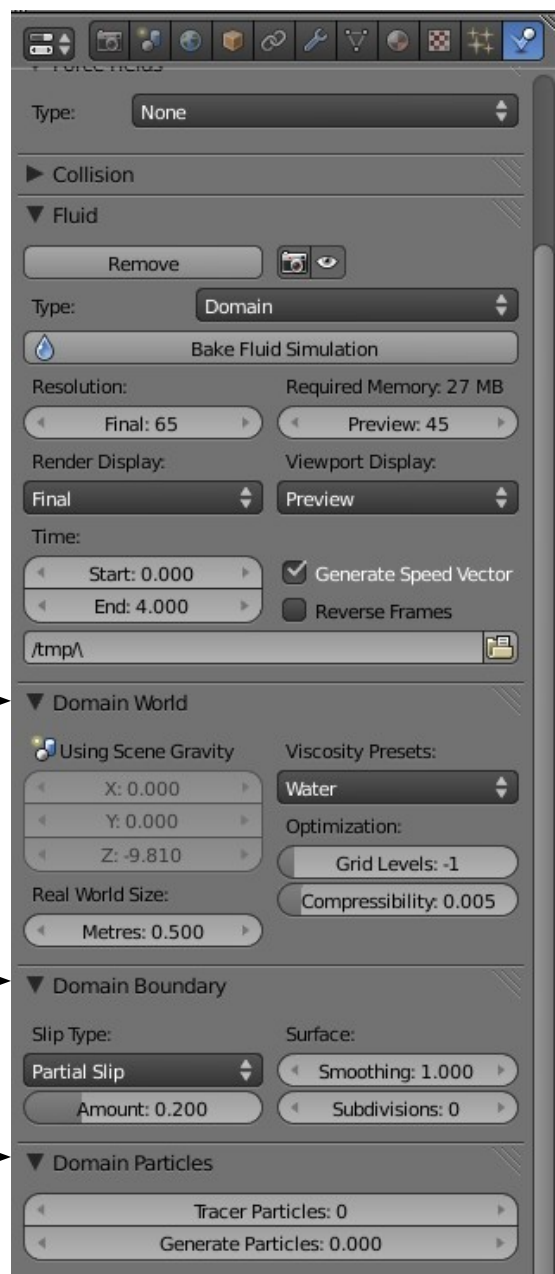
In discussing this first example of fluid simulation default values will be used with the exception that in the 'Time' settings the 'End' value will be changed to 0.03.

The default time settings are Start and End times default values. Start: 0.0 End: 4.0

Changing the End value to 0.30 is done to reduce the Bake time to something reasonable for a demonstration.

Baking is similar to rendering images for an animated movie. Baking is the process of simulating a fluid flow and can take a considerable time depending on the complexity of the simulation set up .

When baking Blender looks at the Start and End times set in the Fluid tab, calculates the time period, then computes how the volume of fluid would react to the environment during that time. In our example the time period is 0.30 seconds (Start:0.00 End:0.30).

The Start and End time values have nothing to do with how many frames will be produced in the animation of the fluid flow but instead are concerned with the physical force and the fluid viscosity. In other words how the fluid will react to its environment in the given time period.

In the Properties Window-Render button-Dimensions tab the default animation length is set at 250 frames (Frame Range Start:1 End:250) and will display at 24 frames per second. The animation Frame Range is also displayed in the Timeline Window. These values produces an animation of appx.10 seconds. The behavior of the volume of water in this example over 0.30 seconds will be spread over the animation time of 10 seconds. Imagine dumping a cup of water and observing its action over 0.30 seconds then stretching that behavior over 10 seconds. A slow motion effect will result.

A 0.30 second bake takes a considerable time a 4.00 second bake will take forever.

A 0.30 second bake will suffice to demonstrate simulating a fluid flow even though it does not produce a real time animation.

What is real time animation? Real time animation with respect to fluid flow is an animation which shows precisely how the fluid reacts in real time as apposed to our slow motion effect. If you want real time, set the Time Start and End values in the Fluid tab to match the length of the animation. For example with the default animation of 250 frames at 24 frames per second equaling approx 10 seconds you would set the Fluid tab Time values to give a 10 second period. Be warned: Make the Bake process coincide with your summer vacation. You will have a long wait while you Bake your cake. You may as well go on holidays.

Varying the Start and End time of the fluid action therefore affects how the behavior

of the fluid is seen in the final animation. For now leave all the values in the standard Domain tab set per the defaults except for the End Time setting.

One last point in the Domain settings for now. Note the directory name at the bottom of the Fluid tab. This gives the location where the Bake files will be saved. The default location is /tmp/\ but you may change this to whatever you wish. We have already noted that Baking takes a long time and with that comes a terrible lot of files. If a simulation is rebaked the files are overwritten but after messing about with some trial and error in the learning process you will still accumulate a whole swag of files. The best way to clean them out is to delete the 'tmp folder and replace it with a new one. In Windows 'Windows Explorer' is a good place to do this.

Fluid Object Setup -Reference: process Step 2- blender Wiki PDF P1060.

In this example the fluid is represented by a Sphere which has been placed in the Domain immediately above the Cup.

The size of the Sphere relative to the Domain and the Cup determines the volume of the fluid in the simulation. Big Sphere big volume. Small Sphere small volume. For the demonstration make sure the Sphere is smaller than the Cup otherwise you will have some mopping up to do.

Select the Sphere in the 3D Window. Go to the Properties Window – Physics button – Fluid tab. Click 'Add' and in the selection dropdown select Type 'Fluid'.
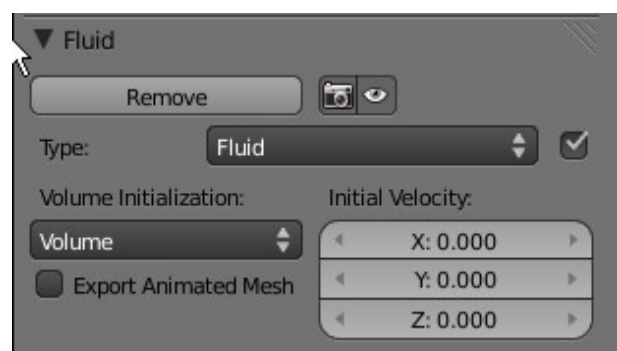
You can leave the settings as they are but it is worth noting that the Initial Velocity values will give your fluid a kick start in whatever direction you set.

Obstacle Object Setup

Reference: Process step 2 – blender Wiki PDF Manual P1060

In this example the Obstacle to the fluid flow will be the Cup.

With the Cup selected in the 3D Window go to the Properties Window – Physics button – Fluids tab. Click 'Add' and select Type Obstacle.

With all the objects required for the simulation having settings assigned the Fluid Simulation Setup is now complete and ready to be BAKED.
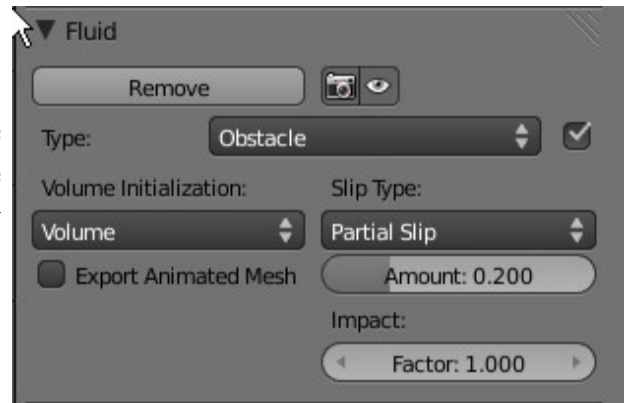
Baking   See Blender Wiki PDF Manual P 1062

In the 3D Window in wireframe mode select the Domain cube. The domain properties tab will be displayed with the values that were previously set.

Make note that Baking a simulation can take a long time depending on the complexity of the simulation, the resolution, the length of the animation and the speed of the computer. For the purposes of this example, where the default values have been used, set the length of the animation to 50 frames in the animation Timeline Window. At a display rate of 25 frames per second this will produce an animation lasting 2 seconds.

Go back to the Properties Window – Physics button – Fluid tab.

With the Domain Object selected (The Cube) in the 3D Window click on the 'Bake Fluid Simulation' button.

The Bake progress can be observed at the top of the 3D Window in the Fluid Simulation progress bar. The bar only appears when you bake and will be located in the Information Window header adjacent to 'Blender Render'. If you want to cancel a Bake click on the cross next to the bar.

The Bake takes a considerable time. It is akin to creating an image for each frame of an animation so be prepared to sit back and wait a while

In this example the BAKE should take about 30 seconds.

Note what happens in the 3D Window. The Domain seems to disappear changing into a blob which attaches itself to the Sphere Fluid Object.

The blob then descends, deforming as it goes and splashes into the Cup.
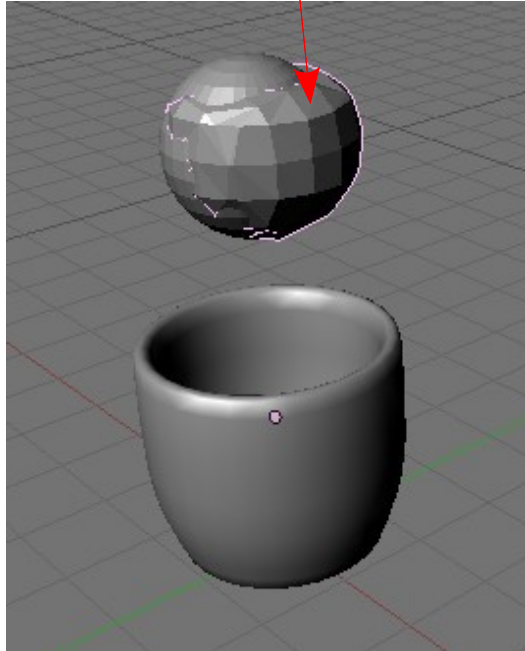
The progress of the BAKE can be observed in the header bar of the Information Window. If the BAKE is not performing as expected it can be terminated by pressing the Esc Key or the cancel button (Cross) in the header and settings can be adjusted to correct the action. To rebake the simulation select the Domain (Which is now the blob attached to the sphere) and press BAKE again in the Domain properties tab.

When the BAKE is completed change to solid mode and press Alt + A to view the animation of the simulation.

When a simulation is BAKED it is similar to rendering files for an animation sequence. Files are created and saved to a folder on the computers hard drive. Blender Wiki PDF Manual P1062 briefly describes this operation. The path to the folder where the BAKED files are saved can be seen in the Domain Fluid tab. (Yes I know I'm repeating myself)

Change Time: End: to 0.300

Baked files located here

Click to open file browser window to change Bake destination folder

The folder for the storage of BAKE files can be changed to any folder you wish by clicking on the file browser icon and navigating to a folder in the file browser window.

See the navigation section CH02-Navigate and Save.

If the BAKE is executed without altering the Path the BAKE will be saved in the default tmp folder.

When a simulation is BAKED without altering the destination folder any existing BAKE is overwritten. To delete a BAKE, select the storage folder and delete the files or shred the folder.

Basic Set Up for Fluid Simulation (Scenario Two)

Blender 3D Window Scene

The setup in the view below is a basic scene configuration to demonstrate a fluid simulation in accordance with scenario two. The camera and light are not shown in the screenshot but they must exist in the scene.
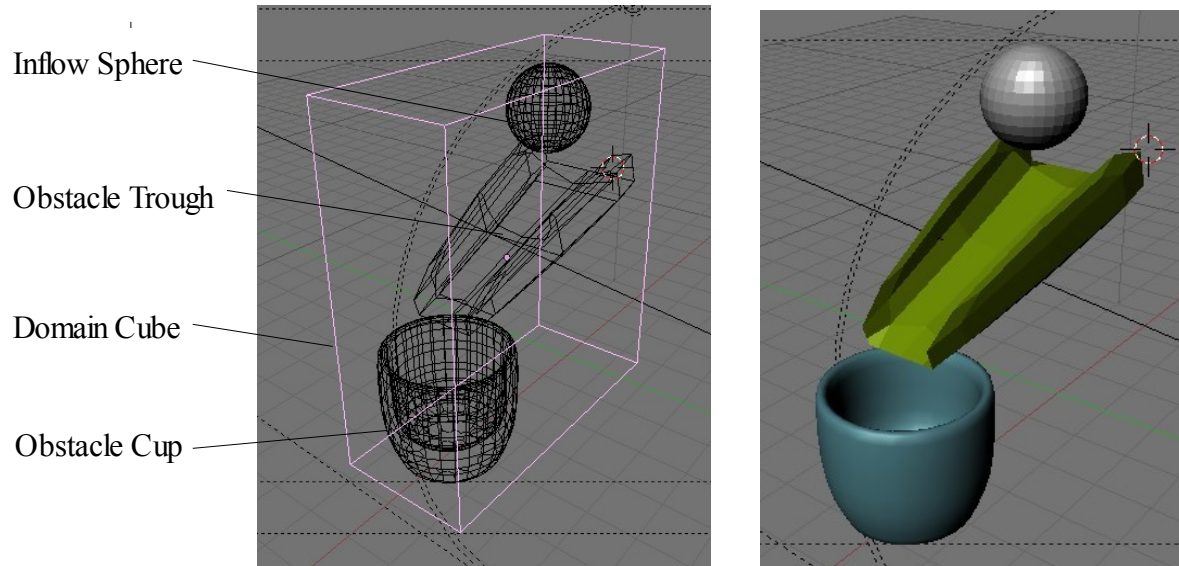
In this scenario the fluid will flow in a stream from the Inflow Object Sphere down the Obstacle Object Trough into the Obstacle Object Cup. All Objects participating in the simulation must be within the confines of the Domain.
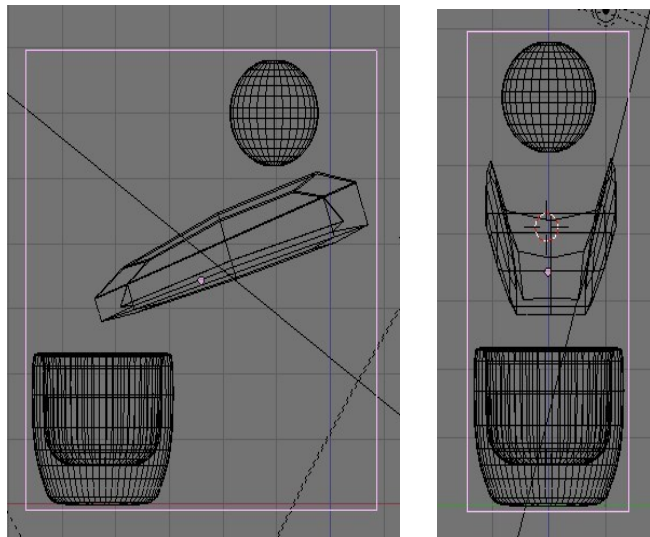
Domain Object Setup

The Domain cube has been scaled to confine the participating Objects in a restricted volume of space. The procedure for assigning the Cube as Domain and setting values is identical to that of scenario one with the exception that the End Time value has been changed to 8.00 in the Standard settings and the 'Real World Size' has been set as 0.180 in the Domain World tab.

In setting up a fluid simulation the length of the final animation in real time and the physical size of the scene in real terms must be considered. The Blender scene viewed on the computer screen is seen in Blender units and an animation is measured in the number of frames viewed at a set frame rate.
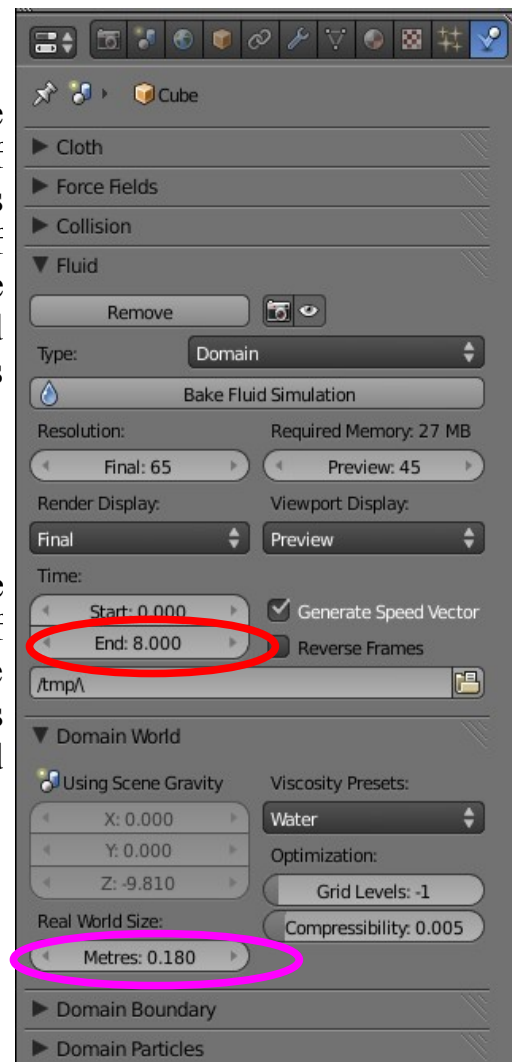
In this simulation the animation will be 200 frames long viewed at 24 frames per second as seen in the Properties Window–Render button–Dimensions tab.

200 frames at 24 frames per second produces an animation of approx. 8 seconds duration.

Setting Start at 0.00 and End at 8.00 in the Fluid tab computes the action of the fluid over an 8 second time period i.e. over the length of the animation. This produces a real time animation. If for example the End value was set at 4.00 seconds then how the fluid behaved in 4.00 seconds would be spread over the 8.00 seconds of animation.
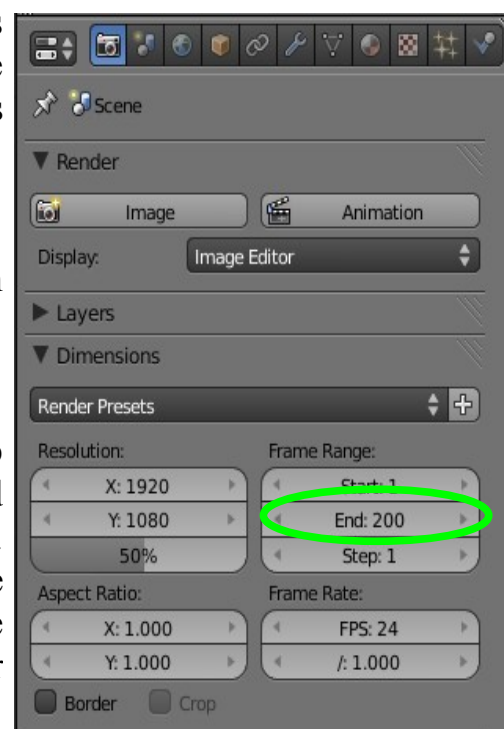
In regard to the size of the scene consider that the diameter of the cup is something like 8 or 9 centimeters and the horizontal length of the trough extending past the edge of the cup is also 8 or 9 centimeters. Taking the maximum we then require a Domain length of 18 centimeters. Thus the Real_World_Size is set at 0.180 (0.180 M = 18 cm) which is the longest side of the Domain.

Fluid Objects Setup

In this scenario there is no Fluid Object instead we use an Inflow Object which provides a continuous flow of fluid.

Inflow Object Setup

Make particular note of the scale of the Inflow object relative to the Obstacle Objects. The scale of the Inflow Object determines the physical volume of the fluid in the scene. If the Inflow Object is too large the volume of fluid will spill over the sides of the trough and cup.

With the Inflow Object selected in the 3D Window go to The Properties Window-Physics button-Fluid tab .

Since the Domain Object has been previously set the Fluid options in the Field tab should already be available. Select Inflow to display the Inflow options.
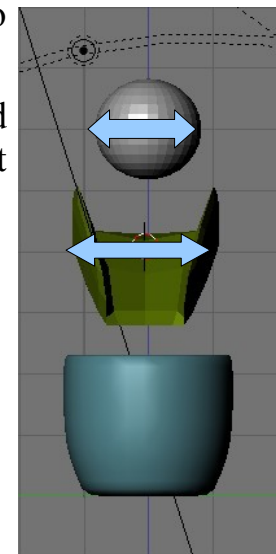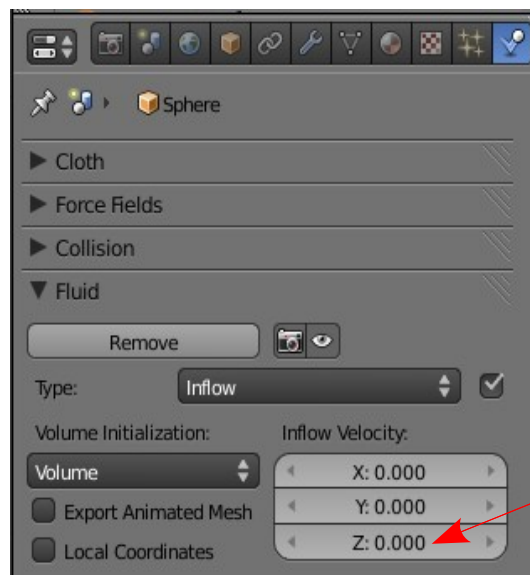
Set Z: 0.20

To give the fluid a small amount of momentum set the Z initial velocity at 0.20

In doing this the fluid is moving before the acceleration due to gravity take hold. Leaving the Z velocity at zero produces a rather sluggish Fluid flow.

Obstacle Object Trough Setup ➤

Make particular note of the construction of the Trough. It has been modeled by extruding and scaling a cube into a rectangular U-shape and then rotating to provide an incline and positioned below the Inflow object and above the Cup. After modeling a Subserf Modifier has been applied. Without the modifier the Fluid tends to break through the Trough surface.

With the Trough constructed select it in the 3D Window then go to the Fluid tab and select Obstacle. Set the Volume Init value to Shell and the Boundary type to Free. Volume Init & Shell initializes a thin layer for all faces of the mesh preventing fluid breakthrough. Foundry type Free allows fluid movement along the obstacle. For other options see Blender Wiki PDF P1065.

Obstacle Object Cup Setup ➤

The model of the Cup is identical to that used in the first scenario.
Set the value options the same as for the Trough Obstacle Object.
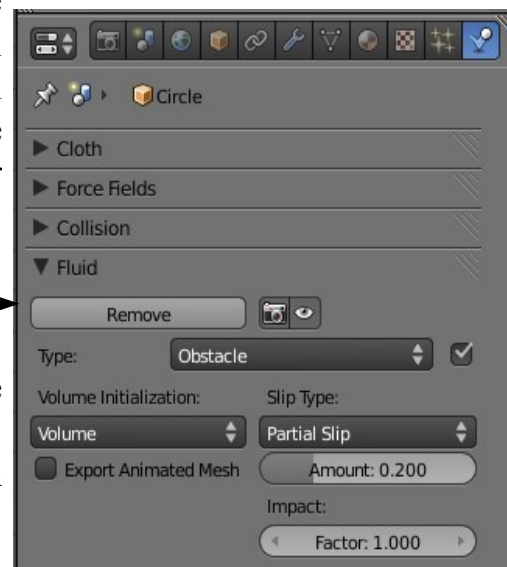
All objects included in the simulation have been assigned and the process can be BAKED. Follow the procedure as outlined in the first scenario.
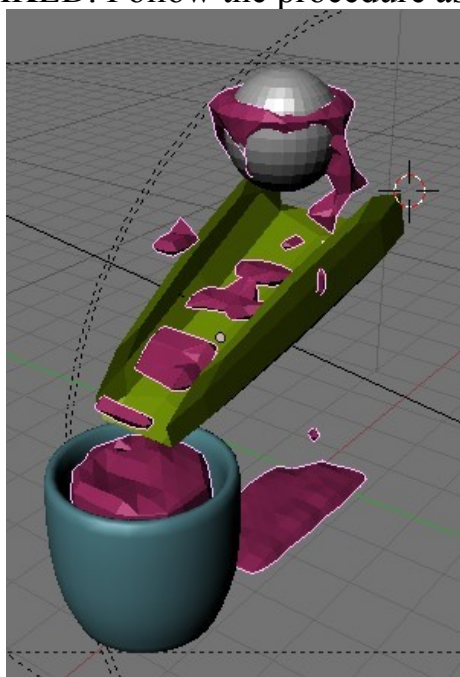
Frame 100 ⬅

Frame 200 ➡
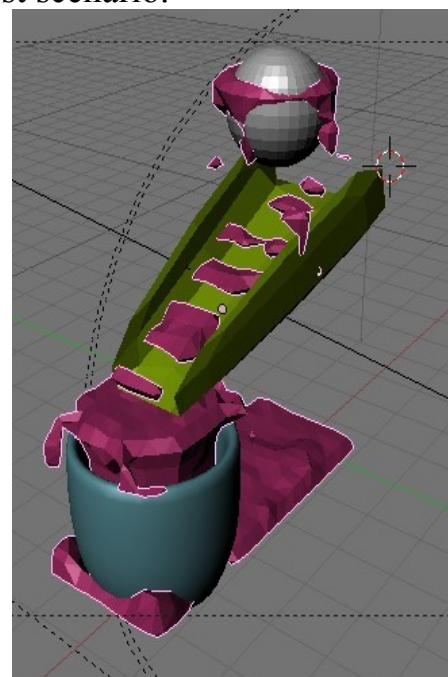
Outflow Object

An Outflow object is used to limit the build up of fluid to a certain level within the confines of the Domain.

Outflow object

Limit of fluid level
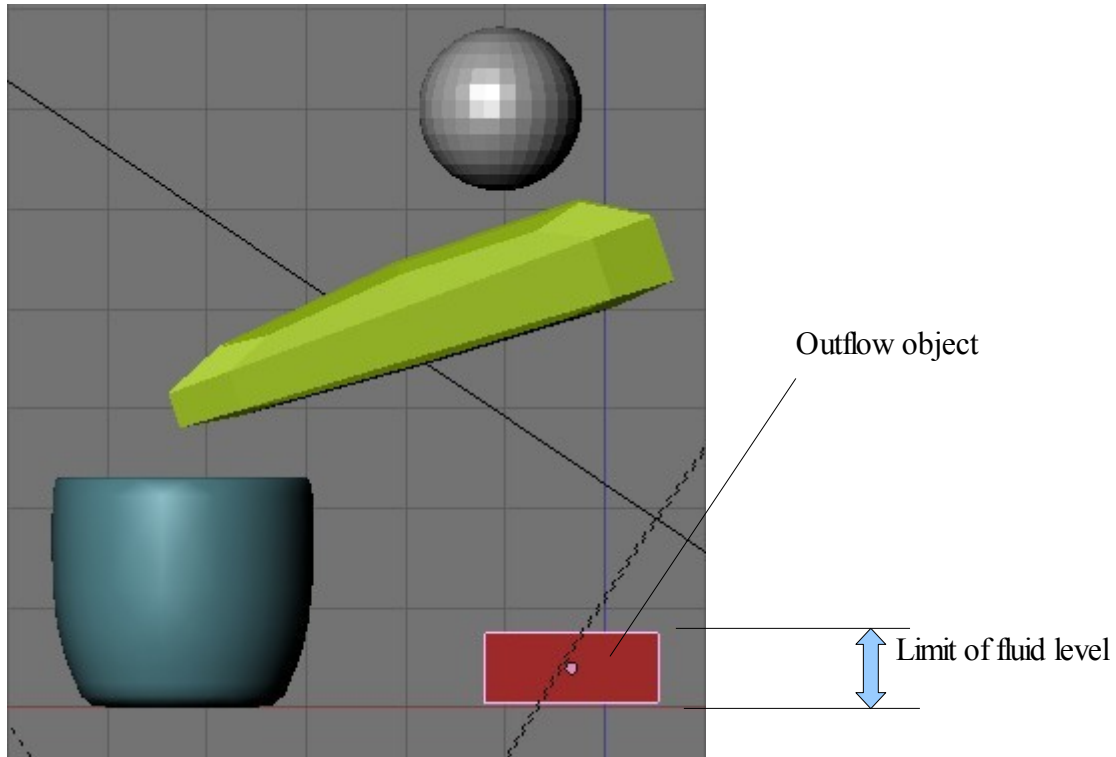
Outflow Object settings tab.

The outflow would be used if it was intended that the fluid overflowed from the Cup and you only wanted the fluid level in the Domain to reach a certain level.
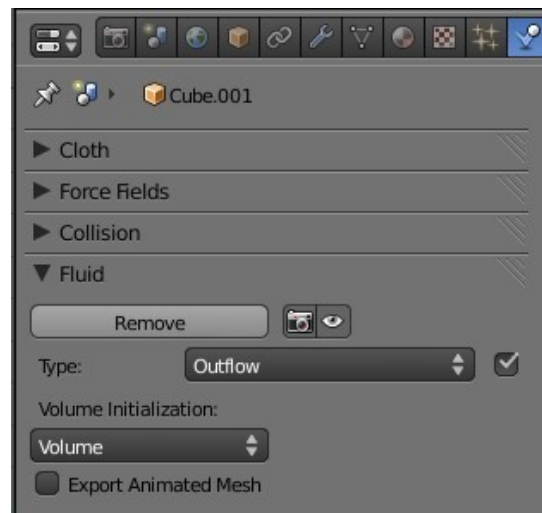
Fluid Simulation – Particles

So far Domain, Obstacle, Inflow and Outflow Objects have been considered. Now consider the application of Particle Objects.

Note : Blender Wiki states that only Tracer Particle Objects are supported at this time.

Start with the fluid system as set up for the second scenario.

Add a Sphere to the scene and position it within the confines of the Domain as shown.
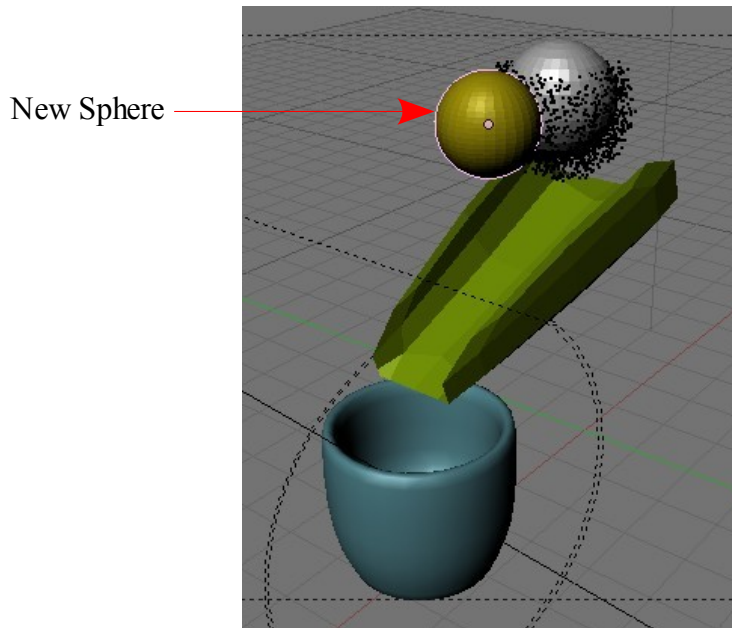
New Sphere

With the Sphere selected in the 3D Window go to: Properties Window–Physics Button–select Fluid – select Type Particle – Tick 'Tracer'
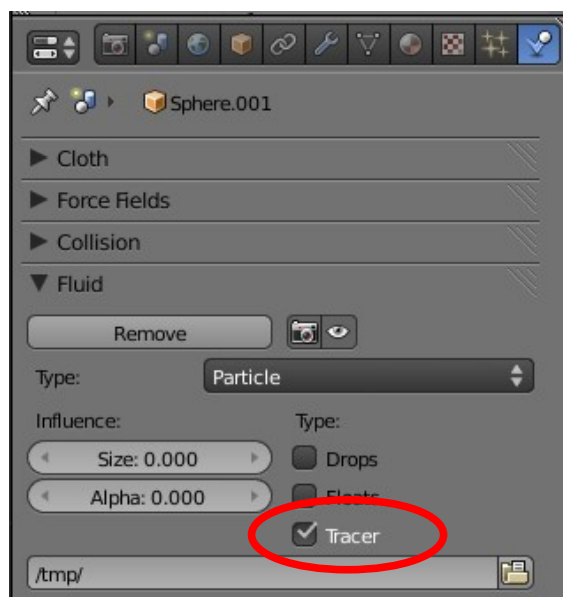
In the 3D Window select the Domain which is now the blob attached to the side of the Inflow Sphere Object.

Go to the Fluid tab. Set tracer Particles to 3000 and Generate Particles to 1.000. Setting these values instructs the system to generate 3000 particles over the length of the animation and turns the generation on to normal (0=off, 1=normal, >1=more).
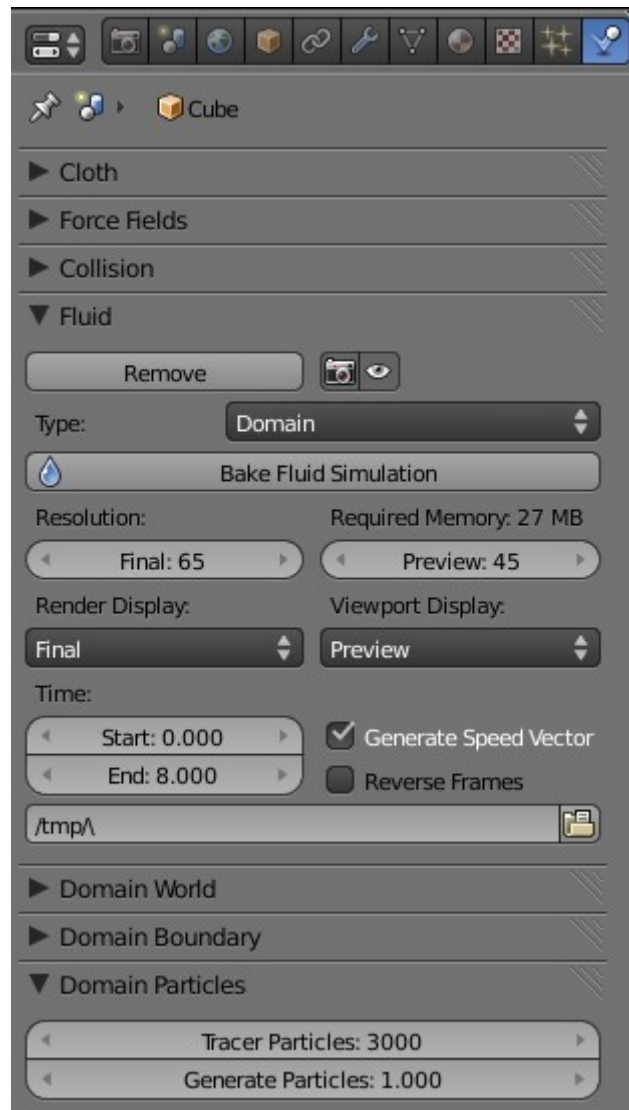
In the Domain Particle tab option window click on 'Bake Fluid Simulation"

The system will now REBAKE the simulation taking as long as it did the first time. Notice that as well as the fluid being generated there are black dots distributed randomly amongst the fluid. These dots are the particles and when rendered will show as halos.
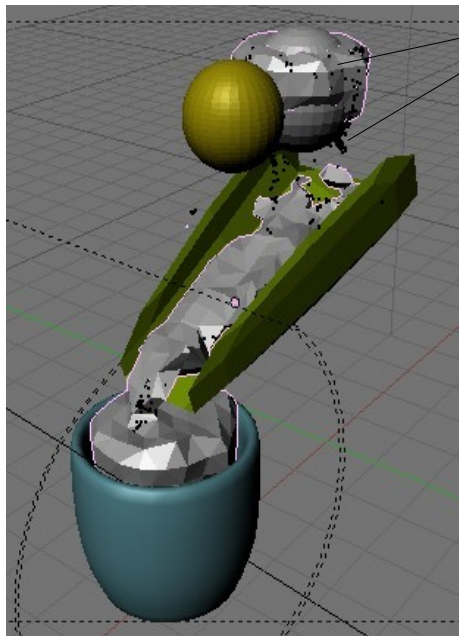
Particles show as black dots

Move Domain to level 2. Select Domain in 3D Window- M-Key -click level 2 then OK

Particles can be better seen with the Domain moved to level 2
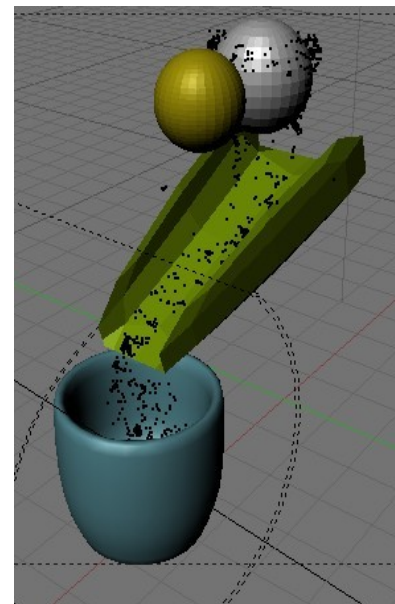
When the scene is rendered the particles display as halos. In the following view material color has been added and also a spotlight.
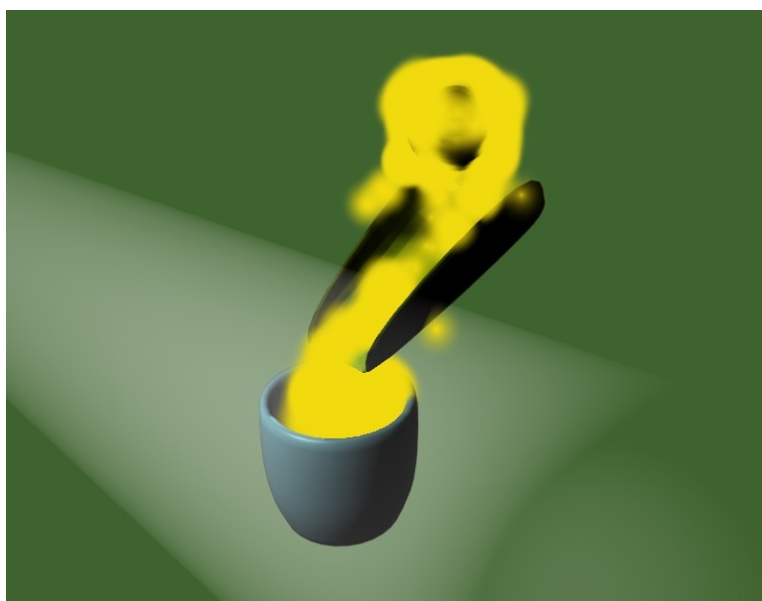
Note: The Domain has been left on level 2 therefore only the particle halos render.

Fluid Simulation – Control

Besides Domain, Fluid, Obstacle, Inflow and Particle Objects there is also the Control Object. Control Objects are placed in the scene within the Domain to influence the flow of Fluid.
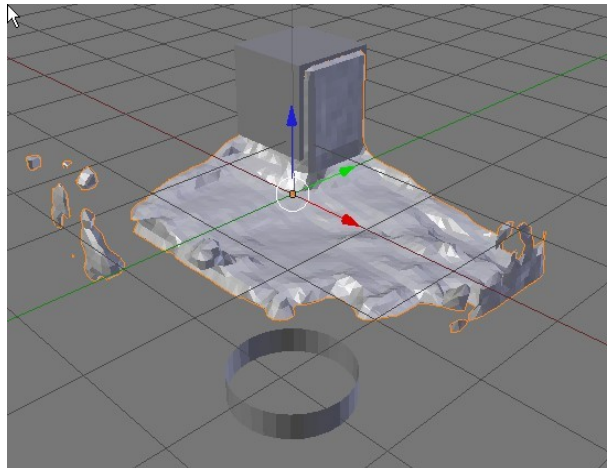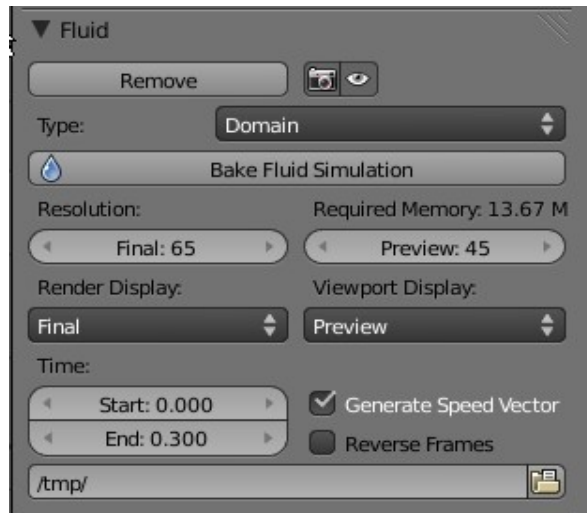
Scene at Frame 110 without Control
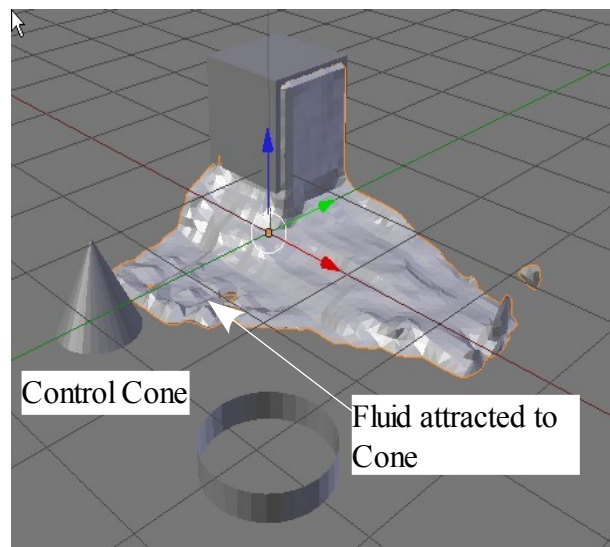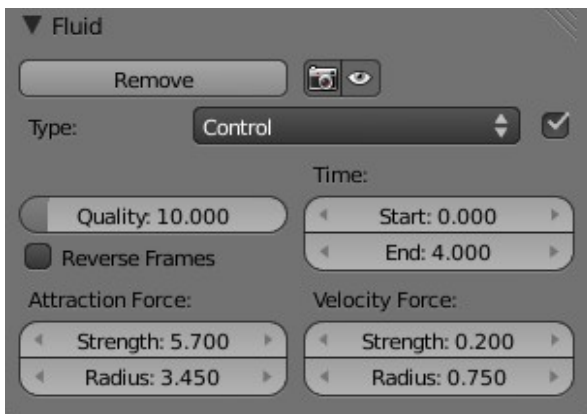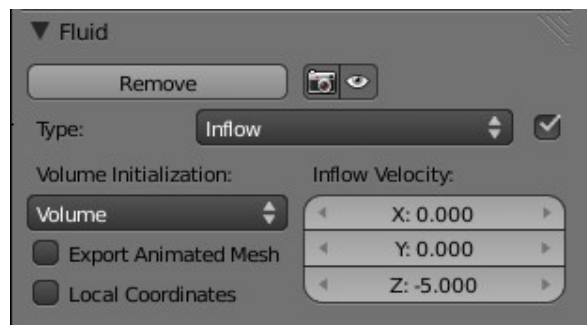
Scene at Frame 110 with Control

Control Cone

Fluid attracted to Cone

The Scene contains:
Domain Cube scaled x and y times 2
Inflow Cube
Outflow Extruded Circle
Control Cone

Settings shown at LHS

CH21- Nodes

01-Nodes

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Nodes

The Blender node system allows the creation of materials and textures for application to objects and the output of data effecting the rendered image or movie.

In Blender every button, value slider, pop-up menue, tick box etc. provides the user a means of entering data which effects the programs output display. Nodes do exactly the same thing. They are graphical displays where data can be entered. The displays can be arranged and linked togeather in combinations providing an array of options.

Nodes are accesed using the Node Editor Window

Start a new Blender scene and leave the default Cube object selected. Change the 3D Window to the Node Editor Window. The window will display as a blank window.
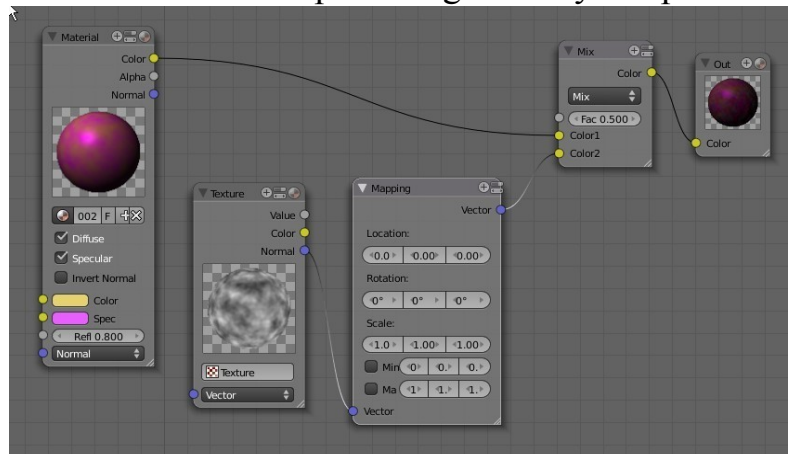
Nodes

Blender Nodes are arranged in three catagories. Material Nodes, Texture Nodes and Composite Nodes. Each category can be selected in the windows header.
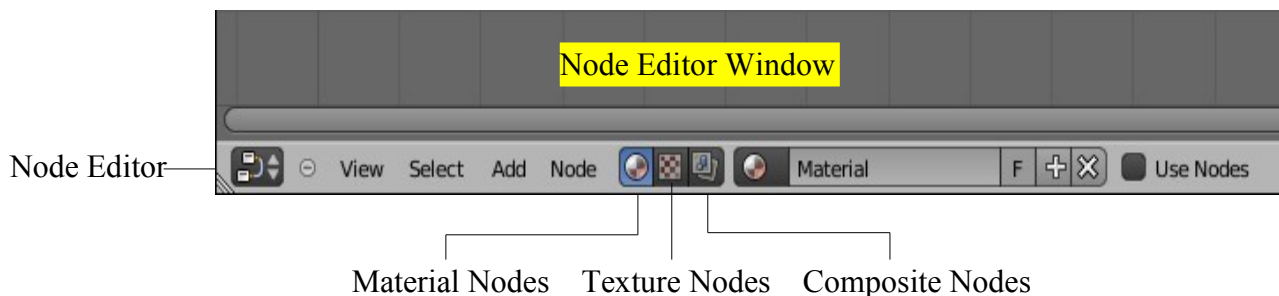
Material Nodes allow the creation of materials, Texture Nodes allow the creation of Textures while Composite Nodes provide a means of assembling and enhancing images or movies.

Before attempting to use Nodes for any specific task it is esential to know how to add, arrange and link nodes. The first step is to open the Node Editor Window.

By default the Material Node category is selected, so to demonstrate the process of using Nodes we will start with this category. Make sure an object is selected in the 3D Window and that a Material has been assigned. If you use the default Blender scene the default Cube object is selected and in the Properties Window – Material buttons the Preview panel shows a grey sphere. The sphere is showing the default color of the default materaial named 'Material' which is applied to the Cube.

The Node Editor can not be activated unless a material has been applied to the selected object in the 3D Window.

Properties Window

Material in Slot applied to Cube object

Material named 'Material' selected

Default Material Color
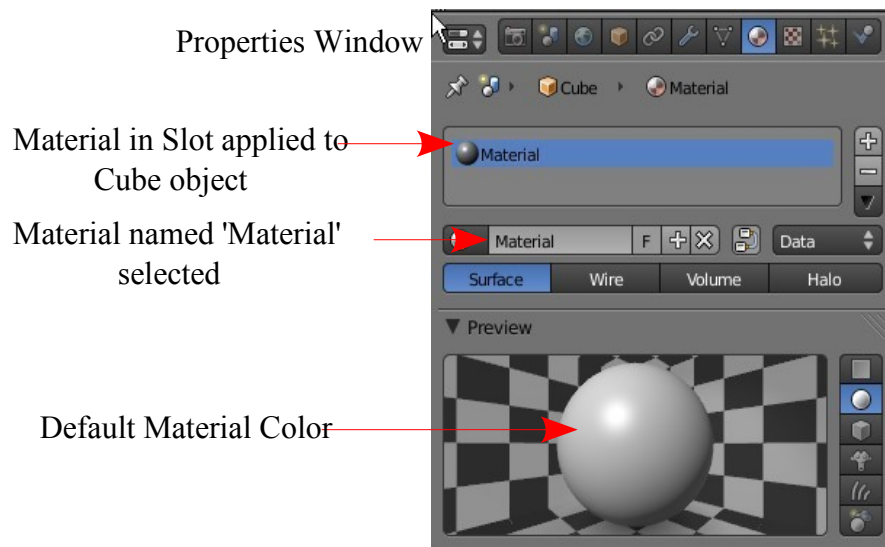
In the Node Editor Window header tick the 'Use Nodes' box. Two Nodes will display in the window. The nodes are 'Material' and 'Output'.
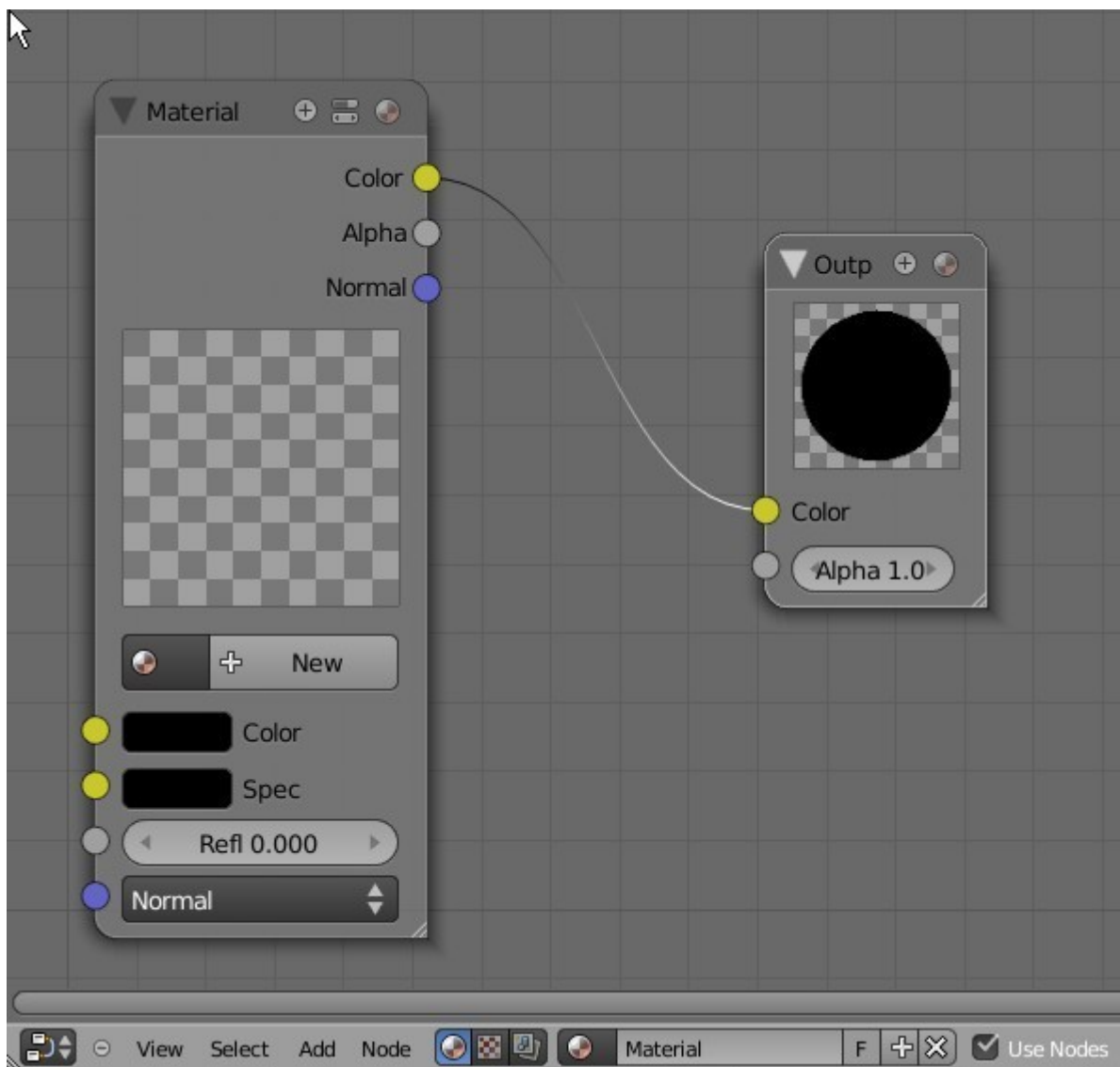
Note that the sphere in the Materials button -Preview panel is now a black circle which what is showing on the Output Node. Your Output Node is probably showing 'Outp' in its header.

Resize a Node

Click and hold on the little cross hatched triangle in the lower RH corner of the node and drag your mouse to resize the node panel. You shold now see 'Output' in the header.

Expand and Collapse Nodes

Besides changing the size of a node they can also be expanded and collapsed to save space on the screen. Look at the 'Material' node header. There is a pluss sign in a circle, an icon like the Properties Window icon and a sphere like the Materials button icon. Clicking on either of these icons will toggle expand and collapse of the node in different ways. Click and experiment to determin the difference. Node systems can become very complex so it is very handy to be able to minimize the size of the nodes. To toggle expand/collapse node entirely click on the white triangle at the LHS of the header.

Default Material Node
New Clicked
Plus Sign Clicked
Bars Clicked
Sphere Clicked
White Triangle Clicked
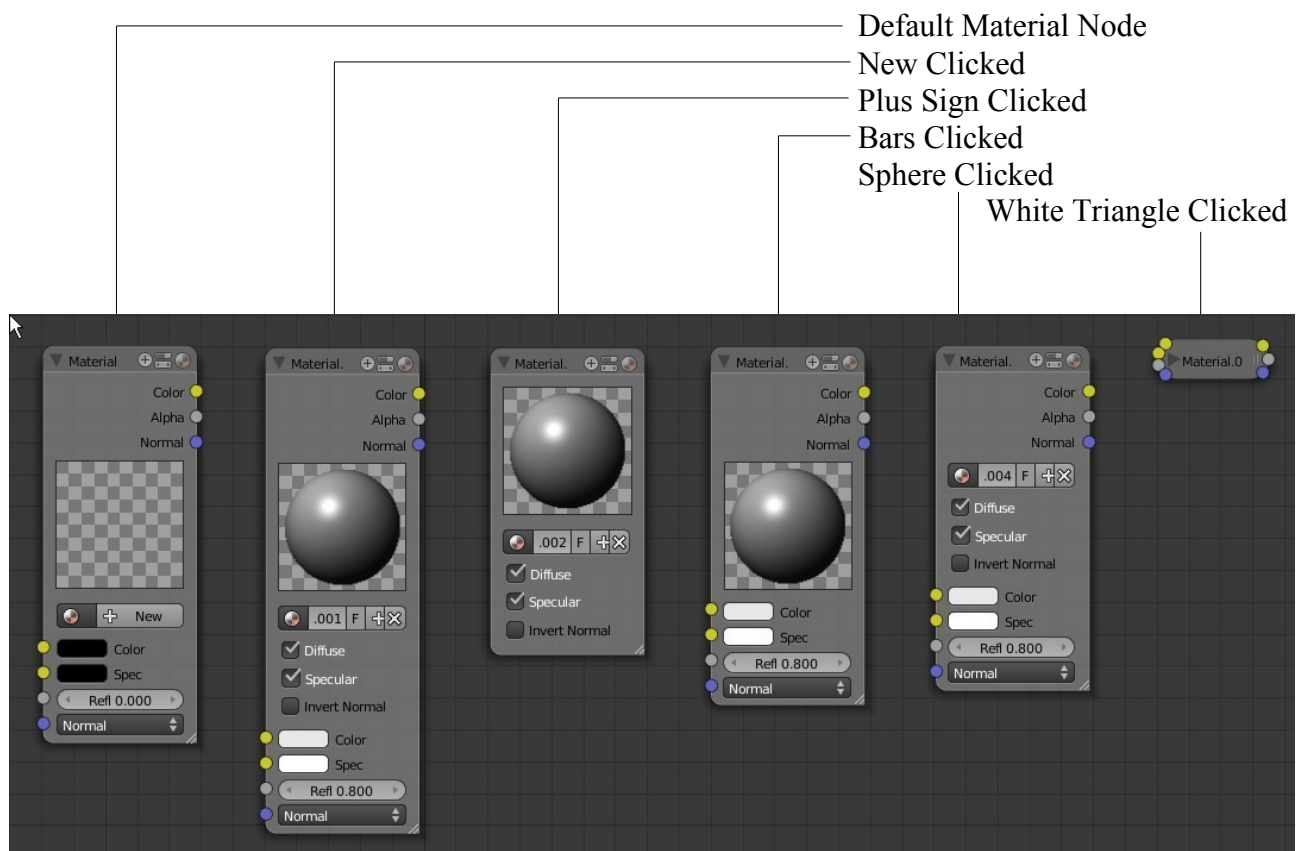
Moving and Arranging Nodes

Click and hold anywhere in the node panel and drag the mouse will move the node .

Zoom Window

Scrolling the mouse wheeel or pressing the Num Pad Plus/Minus Keys will zoom in and out in the Node editor Window. Click and hold MMB will pan the window.

Connecting and Unconnecting Nodes

You will see that the 'Material' node is connected to the 'Output' node by a curved line between the two yellow 'Color' sockets. Click and hold on the 'Output' node yellow socket and drag your mouse away from the socket. Release the hold and you will have disconnected the nodes. The connecting line dissapears. Click and hold on the 'Material' node yellow socket and drag the mouse to the 'Output' node yellow socket realease hold to connect the nodes.

In general sockets should be connected yellow to yellow, grey to grey and blue to blue.
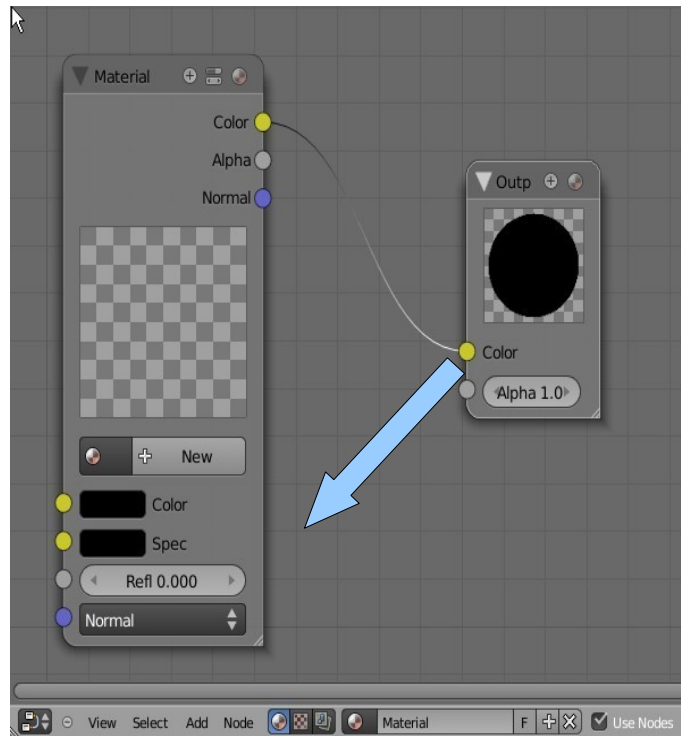
Node Groups

Several nodes amy be grouped together. Again this is a way of saving space on the screen since the group is able to be expanded and collapsed.

To group nodes press B Key and drag a rectangle around the nodes you wish to group then press Ctrl + G . Selecting the group and pressing Alt + G ungroups the selection. Pressing 'Tab' toggles Expand/Collapse of the group.

Grouping nodes provides a means of saving a particular node combination and thus the means of creating an effect and then appending this for use in other Blender files. In this way you can build a library of node combinations for reuse.
Once a node group is created you can select it and then add, remove, link and unlink and move nodes around within the group. In other words you can edit the group.

When you have finished editing a group press 'Tab' to collapse it the 'A Key' to deselect it. You can now add more nodes to the screen.

Naming Node Groups

Its all very well having a library of node groups but if they are all named
'NodeGroup', 'NodeGroup.001', 'NodeGroup.002' etc. which is the names Blender
applies then it would be difficult to destinguish their use in the future. You may wish
to change the names to something more meaningfull.

You change the node group name in the Outliner Window. Blenders default scene
opens with an Outliner Window in the upper RH side of the screen but this is an
abriddged version of the full window. Divide one of your larger windows in two and
change one part to the Outliner Window. It should display in Datablock mode
showing entries for everything in your scene.
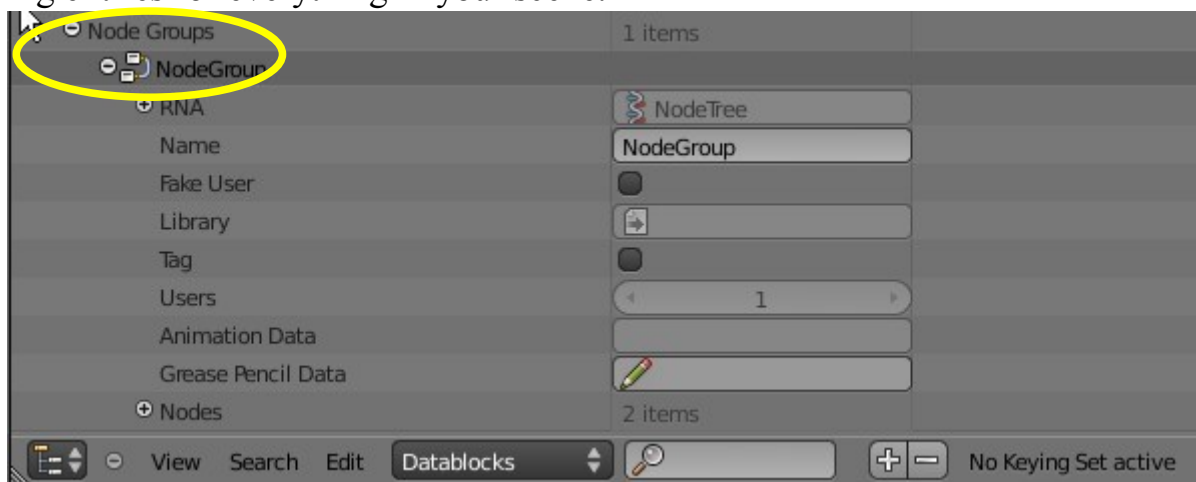
Scrole down and find 'Node Groups'. If you have just created a node group you will
find it as a sub entry. Expand the sub entry and you can change the name of the group
in the 'Name' panel. A namechange here will be reflected in the Node editor Window.

Getting Started

Way back before all the diversion about adding, naming, moving and linking nodes
we made the statement that by default Blender opens the Node Editor Window with
the Material Node mode selected. We will therfore continue with a discussion on
Material Nodes.

Material Nodes

Material Nodes allow the creation of Materials and just like adding any material once
it is created in Blender it is saved for future use in the Blender file. You use an object
which is selected in the 3D Window in conjunction with the Node Editor when
dealing with Material Nodes.

We will work through a simple exercise and create a material using nodes.

Start with the default Blender scene with the default Cube object selected. The cube

will have the default material applied as seen in the Properties Window – material buttons. The material displays the default grey color.

At this point it is worth having a look at what we have in terms of material.

Look at the Properties Window – Material buttons. The Preview tab shows a sphere with the grey color, a material named 'Material' is selected and assigned to the Material Slot. The Material Slot is linked to the selected Cube object in the 3D Window which renders as the grey color.
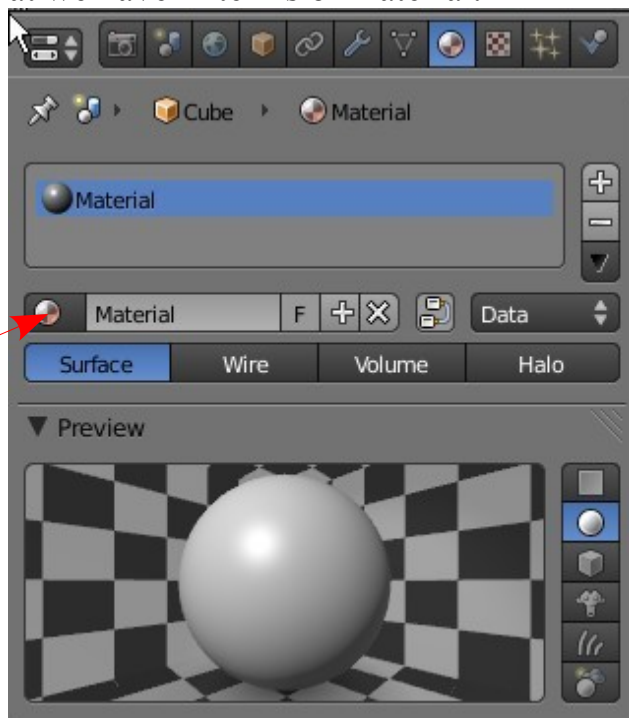
Clicking on the 'Browse ID data" button shows the material cache with only the material named 'Material' stored.

What is a Material?

A material in Blender is a bunch of data which tells the program to display the surface of an object in a certain way, i.e. grey in color (Diffuse color), reflecting a certain color under a light source (Specular color), having bumps, spots etc. etc.

The data is grouped together in a block, a Data Block.

Datablocks

If you change the 3D Window to the Outliner Window in Datablocks mode you will see the Materials Datablock as one of the entries. Click on the pluss sign next to 'Materials' to see the Datablock for the material named 'Material'. Click on the pluss sign next to 'Material' to expand the datablock and see all the materail data .
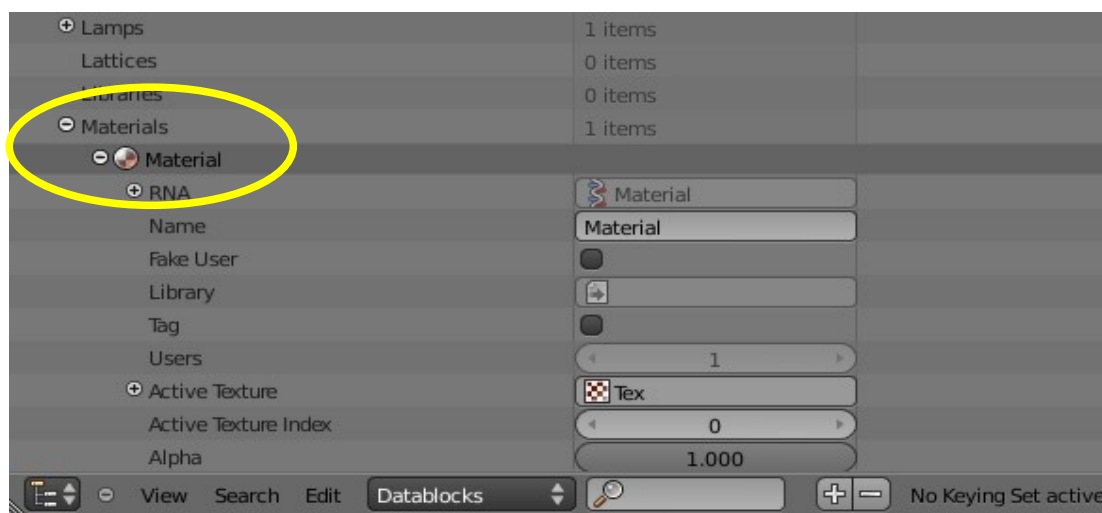
Note that Blenders default screen arrangement has an Outliner Window in the upper RH side of the screen. This window is an abridged version of the full Outliner Window.

Its worth mentioning here that you can change the name of the material in the name slot in the datablock. Just click in the slot, delete and retype a new name. The name change will be reflected in the Properties Window Materials buttons. This is very usefull when creating multiple materials. Blender starts with a default name which is 'Material' then adds 'Material.001', 'Material.002', 'Material.003' etc.etc. which are not very meaningfull or descriptive.

OK! we know what a material is and where the data for the material can be found. Change the Outliner Window to the 3D Window to get us back to square one. Make sure the Cube is selected and make note that Blender has assigned the material named 'Material' to the Cube. Material nodes will not work unless a material has been assigned to the selected object.

Change the 3D Window to the Node Editor Window. You will get a blank window.

At the start of this section we said that Nodes were accesed through the Node Editor Window. By default Material Nodes mode is selected but to activate the Nodes you must tick the 'Use Nodes' box in the window header.

Ticking 'Use Nodes' introduces two Material Nodes to the window, 'Material' and 'Output'. The nodes are connected together via the Color sockets, yellow to yellow. The Material node shows a blank checkerboard preview panel, the Output node shows a black circle and in the Properties Window – Material buttons Preview tab you see the same black circle.

If you click on the 'Browse ID data' button you will see that the default material named 'Material' is still the only thing in the cache and note that 'Material is still shown selected and in the Material Slot. If you render an image (F12) however all you get is a black profile of the Cube.

Activating 'Use Nodes' has taken over the render process and at this stage we have not created any new material.

In the Material Node click on 'New'. The Material Node expands and the Color and Spec color selection bars show white. If you click on the 'Color' bar you will see RGB values 0.800 (grey) and the 'Spec' bar shows RGB 1.000 (white). This is why you see grey spheres in all the preview windows. Render an image (F12) and you see a grey cube. The Cube is selected in the 3D Window.

Note that in the Materials buttons 'Material' is still showing as selected and in the material Slot. Click on the 'Browse ID data' button and you will see two materials,

'Material' and 'Material.001'. Clicking on 'New' in the material Node has created a new material but as allways Blender creates a new material identical to the last material selected which in this case was our old friend 'Material'. Since 'Material' and 'material.001' are identical you can only render a grey Cube.

Click on the the color selection bar in the Material node and pick a new color. All the previews display the new color. In the 3D Window the Cube is still grey.

Note that in the Material Node the name of the material is showing 'Material.001'. This shows that the node is editing 'Material.001. Untick 'Use Nodes' in the header.

Go to the Material buttons in the Properties Window and in the 'Browse ID data' button drop down select Material.001. This places Material.001 in the material slot and assignes it to the Cube in the 3D Window. The Cube will display the color you chose.

Tip: Untick 'Use Nodes' before selecting the new material in the 'Browse ID data' dropdown.

There you have it, the very basics of using Material Nodes but of corse there is much much more.
Clicking on 'Add' in the Node editor Window header reveals a pop up selection menue with seven categories of node types. Each category has indavidual Node type options. It is not possible to demonstrate all of the possible node combinations but the following examples should give you the idea. Remember when you have created a node arrangement which produces a desired result, create a Node Group and save the .blend file for future use. The Node Group can be appended to any new Blender scene and applied to any object in the scene. It is therefore possible to create a single .blend file containing many Node Groups for future appending.

Example 1.
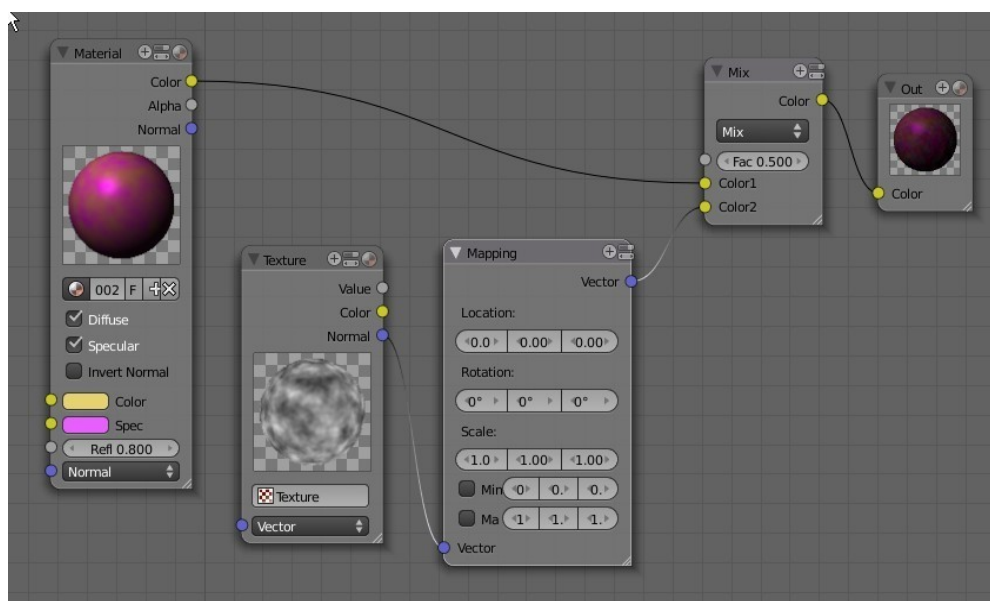
Example 1 shows Material Color mixed with Texture which has Map settings applied. The new material has been applied to a sphere which has been scaled down along the Z axis to create a disk.

Rendered Image
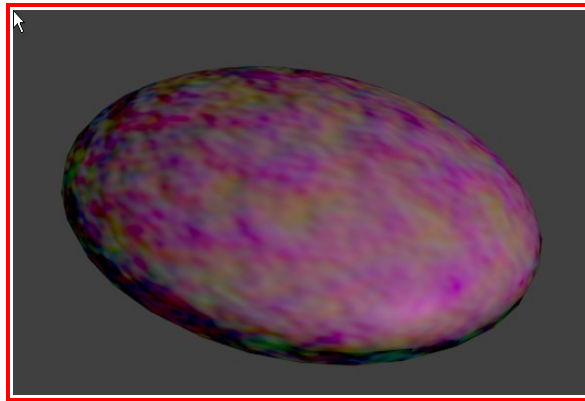
Example 2

Example 2 shows another variation on example 1
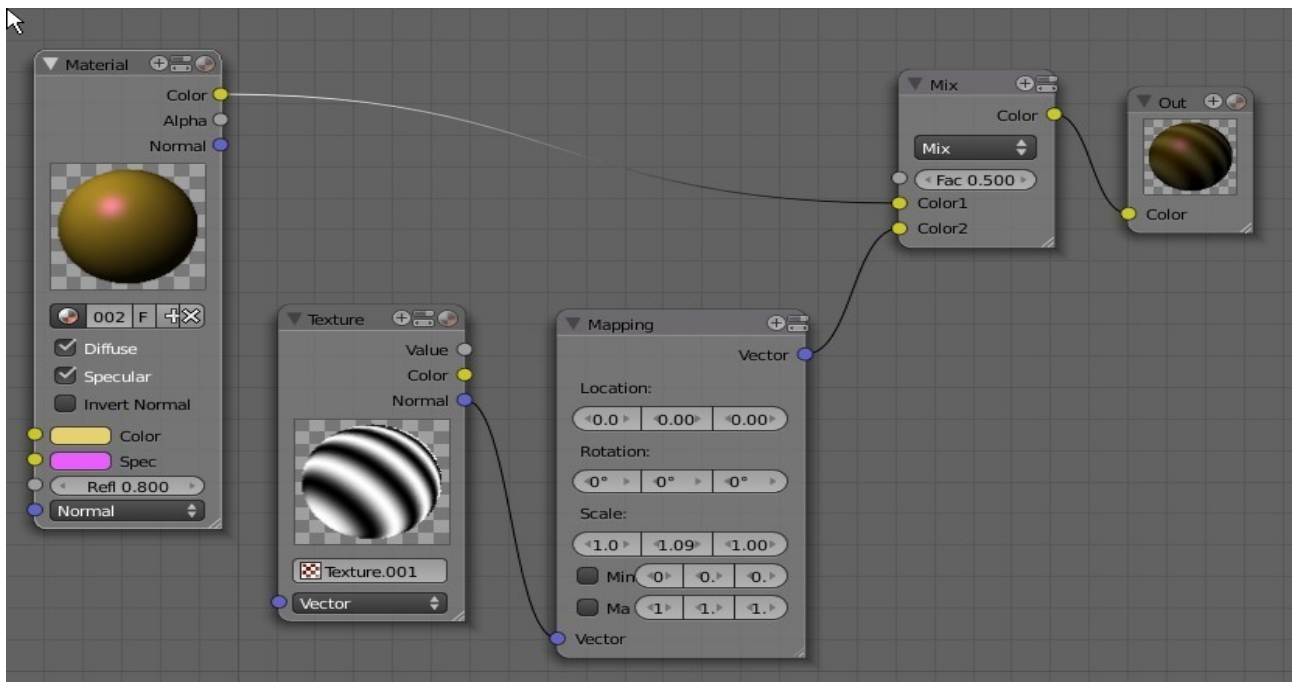
Rendered Image
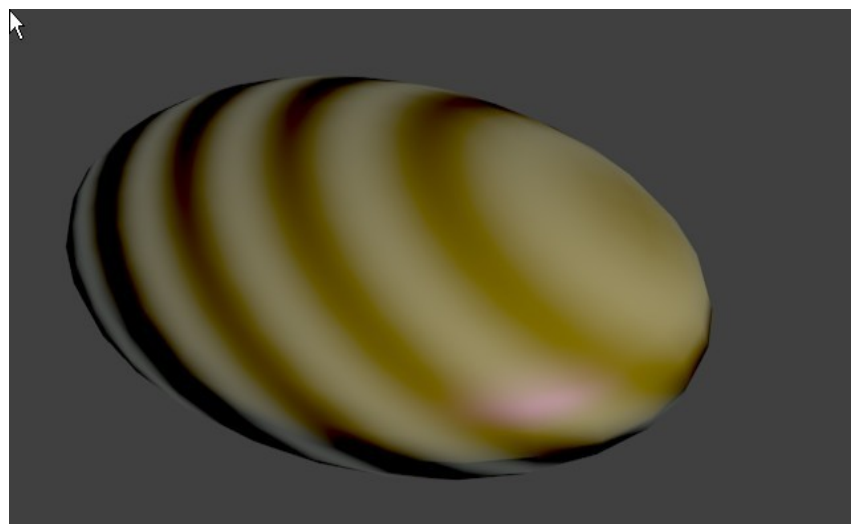
Example 3

This example shows two RGB inputs mixed to a Color and then having a Color Ramp applied
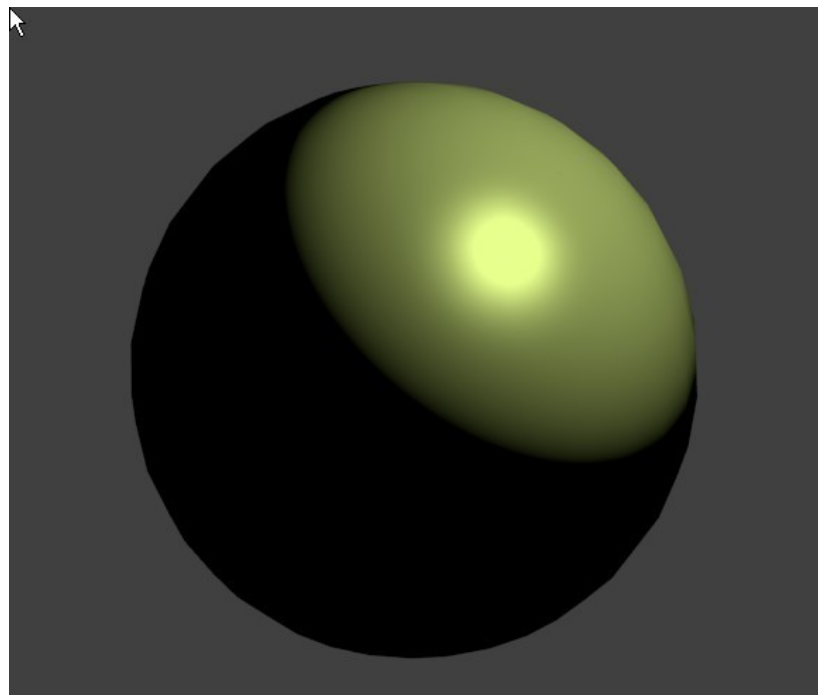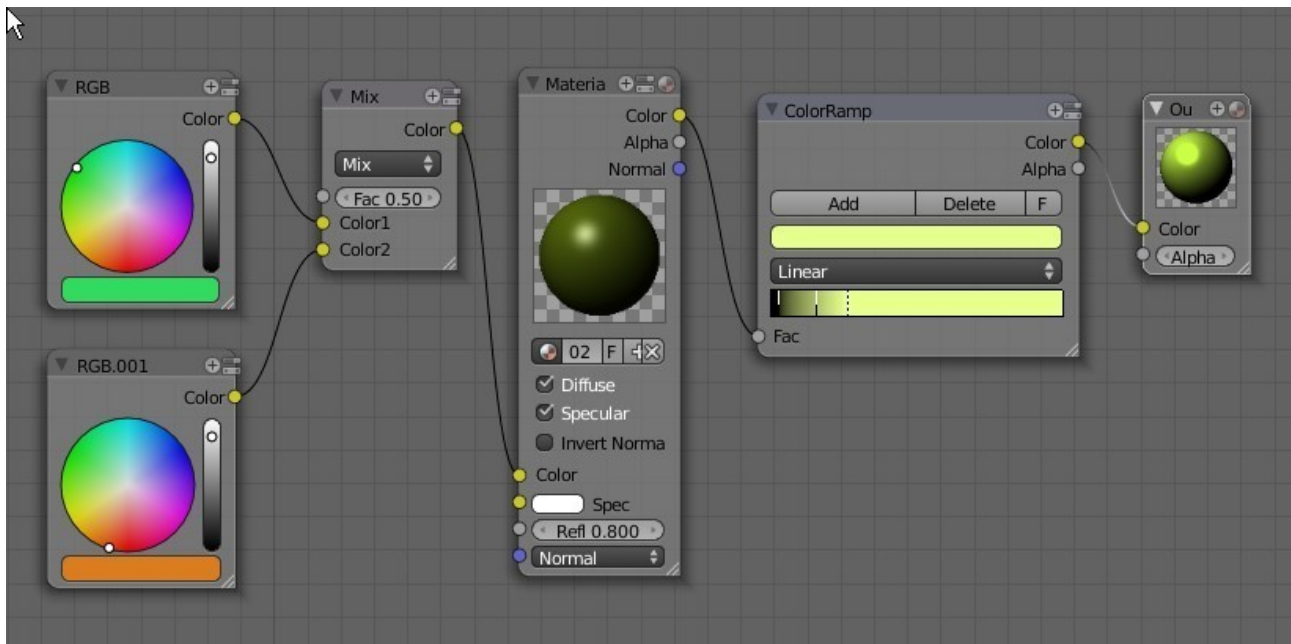
Rendered Image

Note that the three examples shown so far simply create a material and apply it to a selected object in the 3D Window. The default settings for the Lamp and Camera are used with no other influence.

Example 4

Example 4 demonstrates the use of Material Nodes in combination with other objects in the scene.

The objective here is to create a simple graduated Material.

First we have to set up the scene as shown.
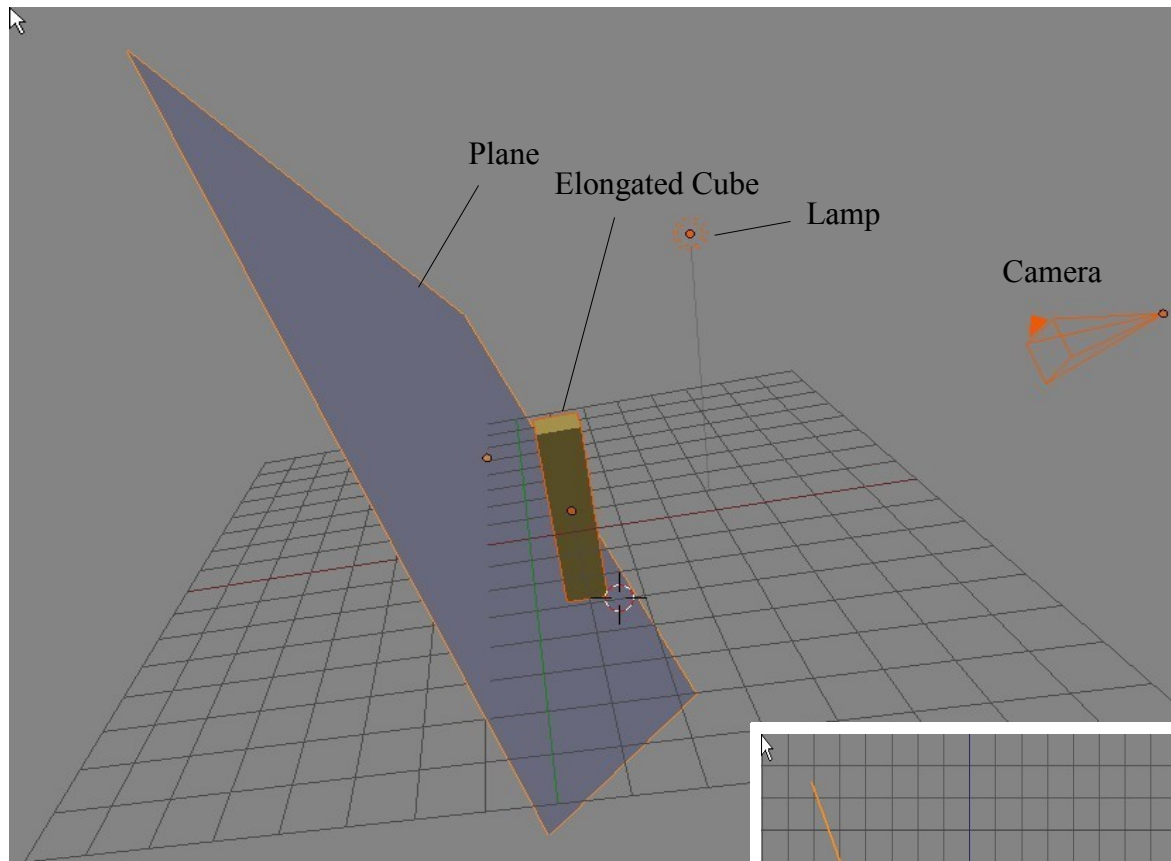
The default Cube has been elongated into a vertical column. A simple Plane object has been added to the scene, scaled up and positioned behind the elongated cube forming a backdrop in the camera view.

Important: Make sure the Lamp is positioned on the camera side of the Plane.
Select the Plane in the 3D Window and assign the default material to it in the Properties Window – Material buttons. Add a marble texture.

Deselect the Plane then select the elongated Cube.
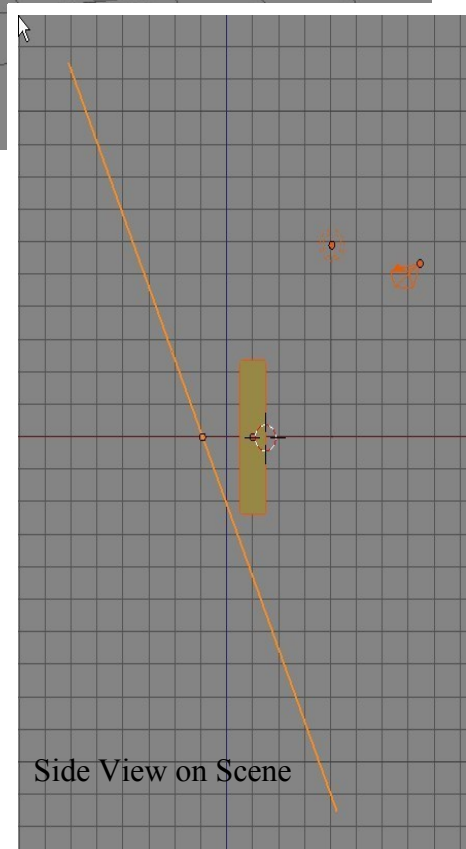
In the Properties Window – Material buttons – Diffuse tab pick a diffuse color and in the Specular tab pick a specular color. In the transparency tab tick transparency,turn the Alpha value to 0.000 and set the IOR value to 1.2. still in the transparency tab click 'Raytrace'.

In the Properties Window – Render buttons Shading tab untick 'Shadows'.

The Diffuse and Specular colors can be anything you want. Obviously Transparency makes the Cube transparent with Alpha at 0.000 it is fully transparent. The IOR value is an angular index of refraction for raytraced refraction. Value 1.200 is something like glass. Raytracing clicks you up a knotch when it comes to rendering an image. Only by experimenting with different values will you understand how to achieve the outcome you want.

Make sure the Cube is selected in the 3d Window and then in the Node Editor Window – Material Nodes mode, tick 'Use Nodes' and set up the following arrangement.
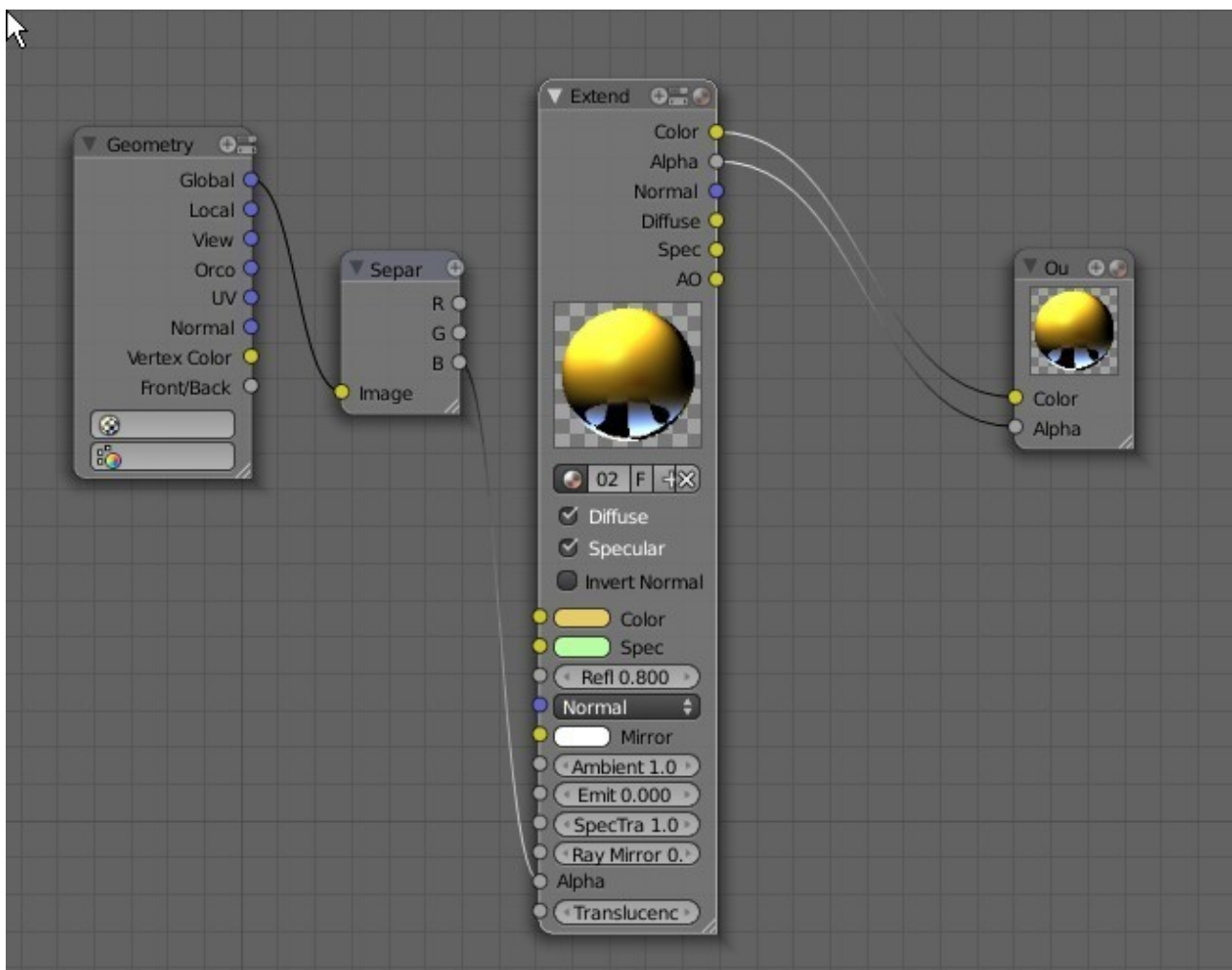
Note: The 'Separ' node in the diagram is actually 'Separate RGB', the 'Extend' is 'Extended material' and 'Ou' is 'Output'. Increase the size of the nodes to see the full names.

Note also all the unconnected sockets on the Extended material node. The rule here is that an uconnected input socket will relay the value in it's adjacent panel to the output. If an input node is connected then that node overides the value. Fore example Refl 0.800 is the value used since there is no input connected to the socket.

Its worth remembering that in any scene the Lamp or number of Lamps, the type of Lamp and the enrgy settings and color of Lamp light can have a dramatic effect on the rendered image.

Something else to note in this example is that the rule of connecting like colored sockets has been broken. The blue Global socket on the Geometry node is connected to the yellow Image socket on the Separate RGB node.

'Separate RGB' means saparate the red, green, and blue values. Geometry – Global would suggest that it is intended to do the saparation using global coordinates but the Global output coordinate value is connected to an Image input?!?!

What is happening?

'Geometry' – 'Global' is saying use global coordinates. 'Saparate RGB' is being used to saparate the coordinates which are vector values. RGB in this case represents XYZ coordinate values which are fed to the Alpha value in the 'Extended Material' node. B corisponds to the Z value, the vertical coordinate. We are applying the material to a vertical cube column. The value is fed into the Alpha socket on the 'Extended Material' node which is the value that controls transparency so the combination is telling Blender to apply the Diffuse color and the transparency to the elongated cube on the Z axis.

We have raytracing applied and we have given the elongated cube the charisteristics of glass. The cube is therefore refracting the light reflected from the bckdrop in the scene (The Plane)

The rendered image shows the application.

This example shows how you can mix and match nodes , lamp settings and objects in the scene to produce stunning efects.
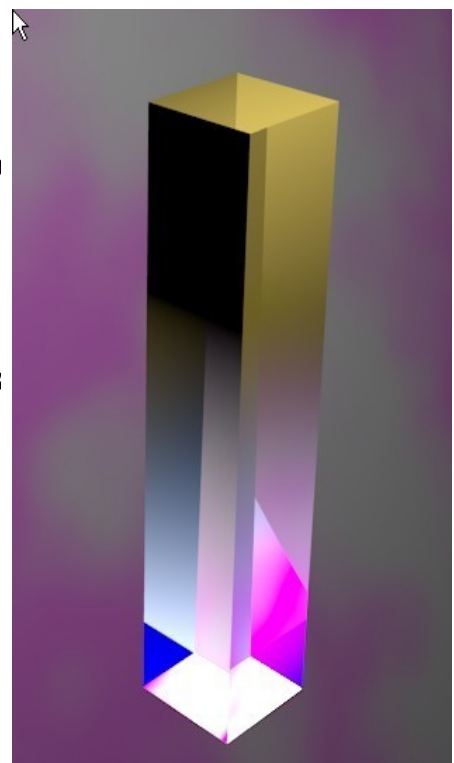
Texture Nodes

Texture Nodes allow you to create textures and apply them to a selected object in the 3D Window

As far as adding nodes to the Node Editor and manipulating them and connecting the process is the same as for Material Nodes however activating the Node Editor in Texture mode is slightly different.

Start a new Blender scene and delete the default Cube object. Add a simple Plane object and scale it up a bit. A Plane will provide a nice flat surface on which to place the texture. In the Properties Window – Material buttons click 'New' to add the default Material. As with Material Nodes, Texture Nodes can not be activated unless a material has been applied to the selected object.

Change the 3D Window to Node editor. Note that the Material Node option in the header is selected by default. Change this to Texture Node mode. Click on 'New'. This is the same as clicking on 'New' in the Properties Window – Texture buttons. Now tick 'Use Nodes'.
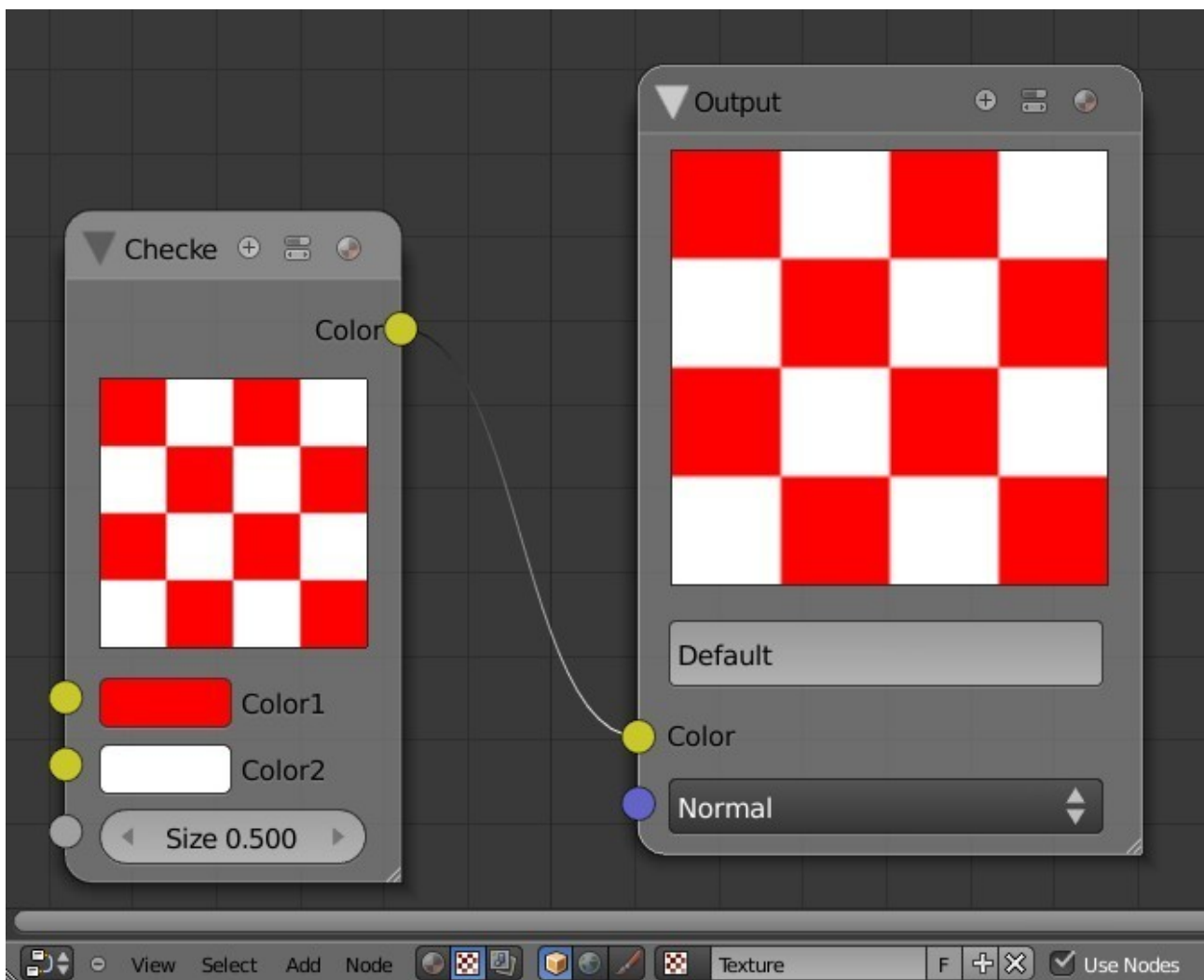
Two nodes appear in the Editor Window, Checker and Output. In all Texture node arrangements there must be an Output node.

If you render an image (F12) you will see the Checker texture applied to the Plane object which is selected in the 3D Window.
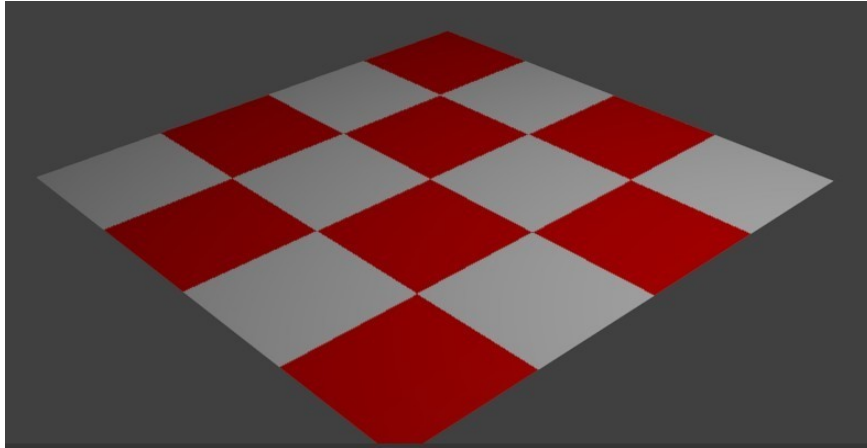
In the Properties Window – Texture buttons you will see that a texture named 'Texture' is selected and placed in the Texture Slot. Click on the 'Browse ID data' button and see that there are two textures in the cache. 'Tex' and 'Texture'. 'Texture' is the new texture you have just created using Nodes and 'Tex' is Blenders hidden default texture datablock. As with everything else in blender entering data for a new material or texture is in fact modifying something that pre exists.

At this stage you have 'Use Nodes' active so the Node editor is applying the new texture to the object. If you untick 'Use Nodes' a render will only show the Plane object as having the default grey Material color.

In the Properties Window – Texture buttons click on the 'F' next to 'Texture' to save the texture datablock. A 2 appears indicating that there are two users of the data. Click on the 2 to make single user. The 2 dissapears and if you look in the cache (Click Browse ID data) you will see Tex, Tex.001 and Texture. Tex and Tex.001 just render a grey Plane while Texture displays the nodes in the Node Editor. You still have to tick 'Use Nodes' to render the checker texture to the object.

The foregoing is an observation and at this point no explanation can be offered for the the procedure.

This has demonstrated the basic application of texture Nodes. There are many combinations of node arrangements which will produce many many textures. The following examples will show simple arrangements.

Note that complicated node arrangements consume computer power and unless you are working on a powerfull machine rendering an image will take forever or just never happen.

Example 1
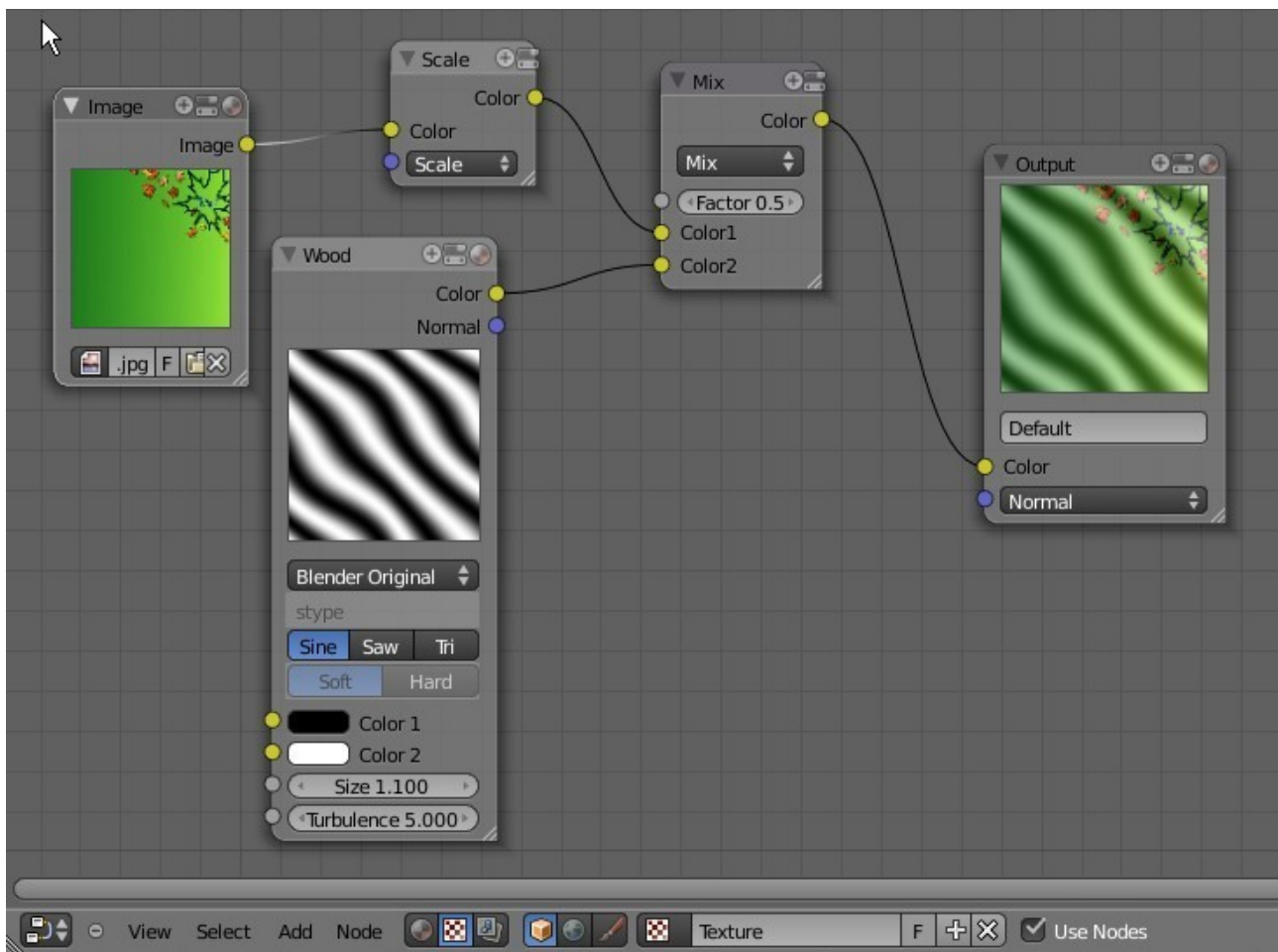
In this example an image has been loaded into the Image Node andmixed with a Wood Texture Node. The scale node resizes the image. The texture created is mapped on to a Sphere object selected in the 3D Window

Image loaded into the Image Node
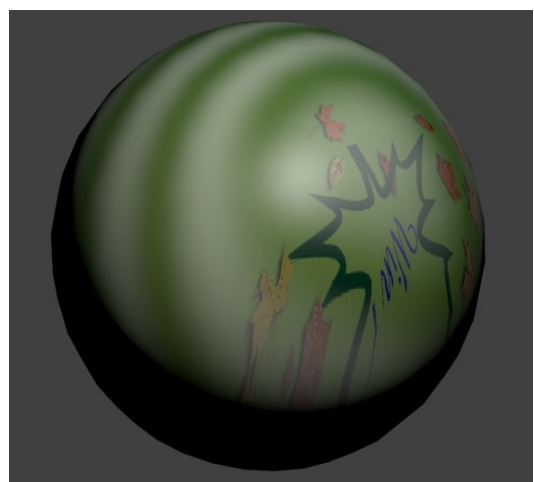
Rendered Image

Example 2
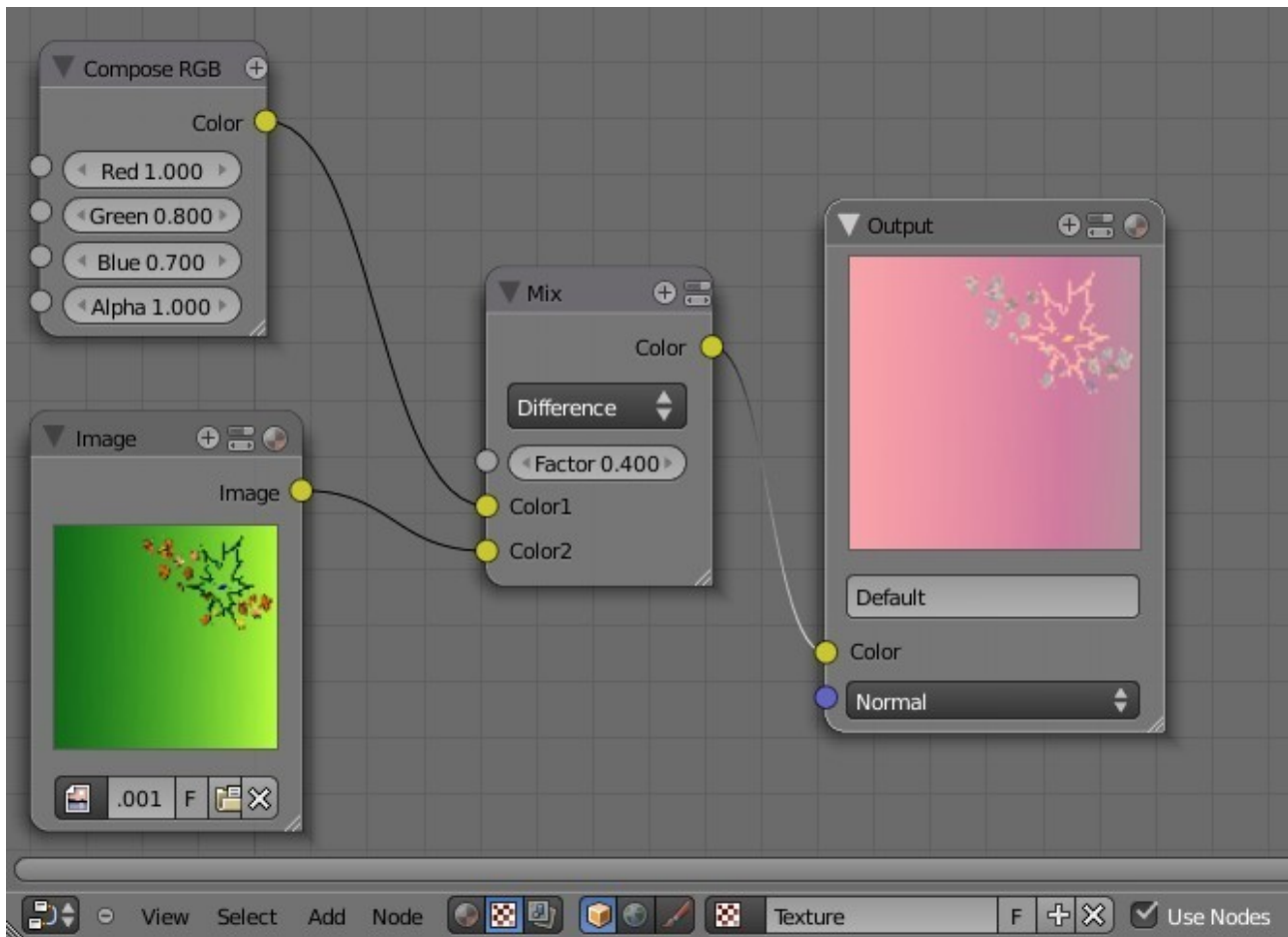
Here the Compose RGB node created a color. The Mix node combines the color with an image from the Image node to produce a texture as seen in the Output node. The texture is applied to a Plane object selected in the 3D Window.

Image loaded into the Image Node
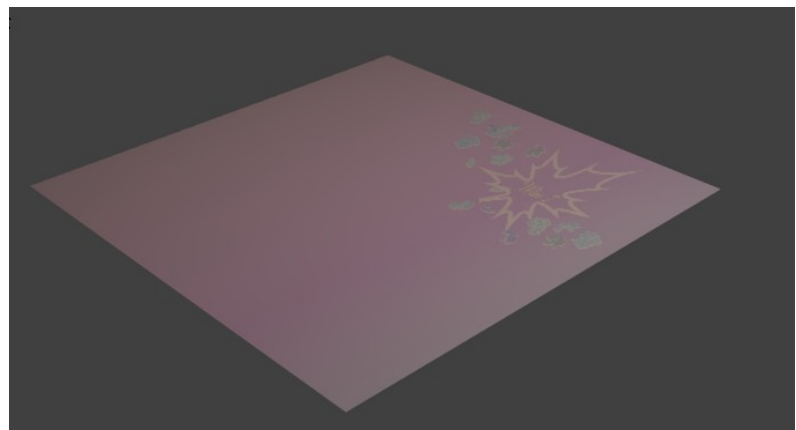
Rendered Image

Compositing Nodes

Compositing nodes or composit for short allow you to create and enhance an image. The contents of the Blender scene can be the basis for the image or an image already saved on the hard drive can be used. A presaved image can be combined with other images or the Blender scene to create a new image.

Unlike Marterial and Texture Nodes it is not necessary to have an object selected in the 3d Window or to have a material applied to an object. Of corse by default any object added to a scene has the default material even though this does not display in the Properties Window until the 'New' button is pressed. To demonstrate the activation of the Compositing Node Editor start with a new blender scene and delete the default Cube. Add a Monkey object (Any object will do). Deselect the object in the 3D Window.

Change the 3D Window to Node editor and select the Compositing mode in the window header. Tick 'Use Nodes'.

The Monkey only displays after an image has been rendered.
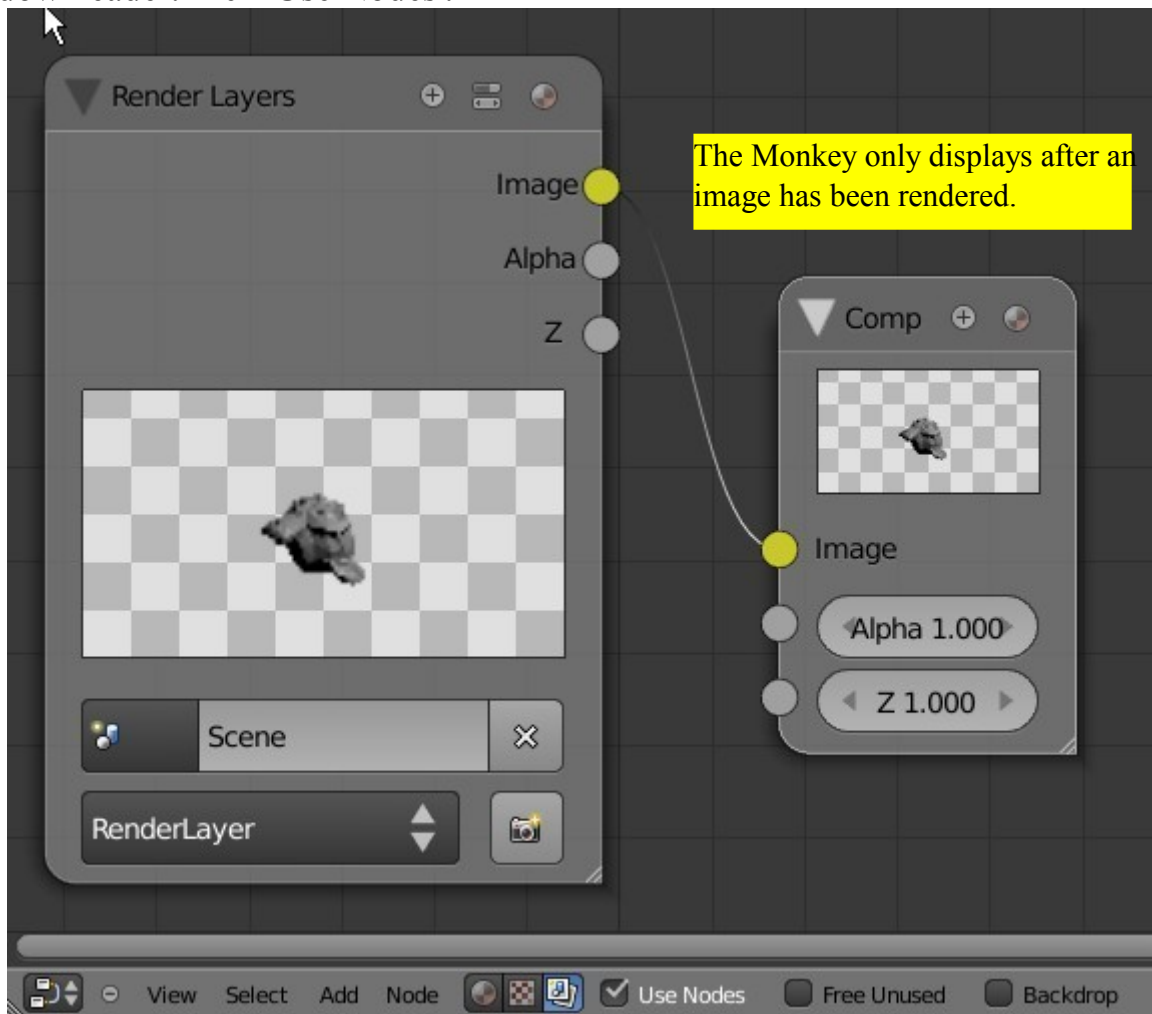
Two nodes display in the window. 'Render Layer' and 'Comp'. Increasing the size of the 'Comp' node will recveal that it is actually 'Composite'.

Render an image (F12) to create a picture of the Camera View with the Monkey.
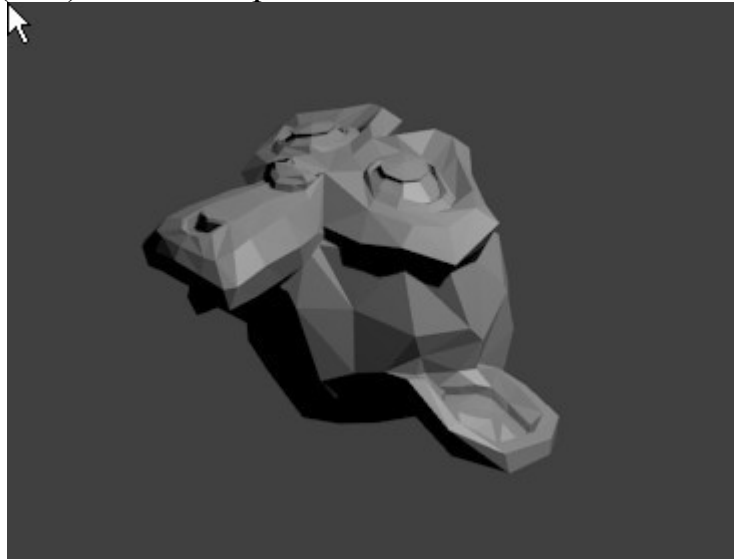
Remember the Monkey is not selected in the 3D Window and no material has been applie. Through the ''Render Layer' and 'Composit' nodes Blender is rendering an image of the Camera view in the scene.

Note for Blender to render an image there must be a 'Composit' node in the Node Editor.

The following are two examples of simple Compositing Node arrangements.

Example 1
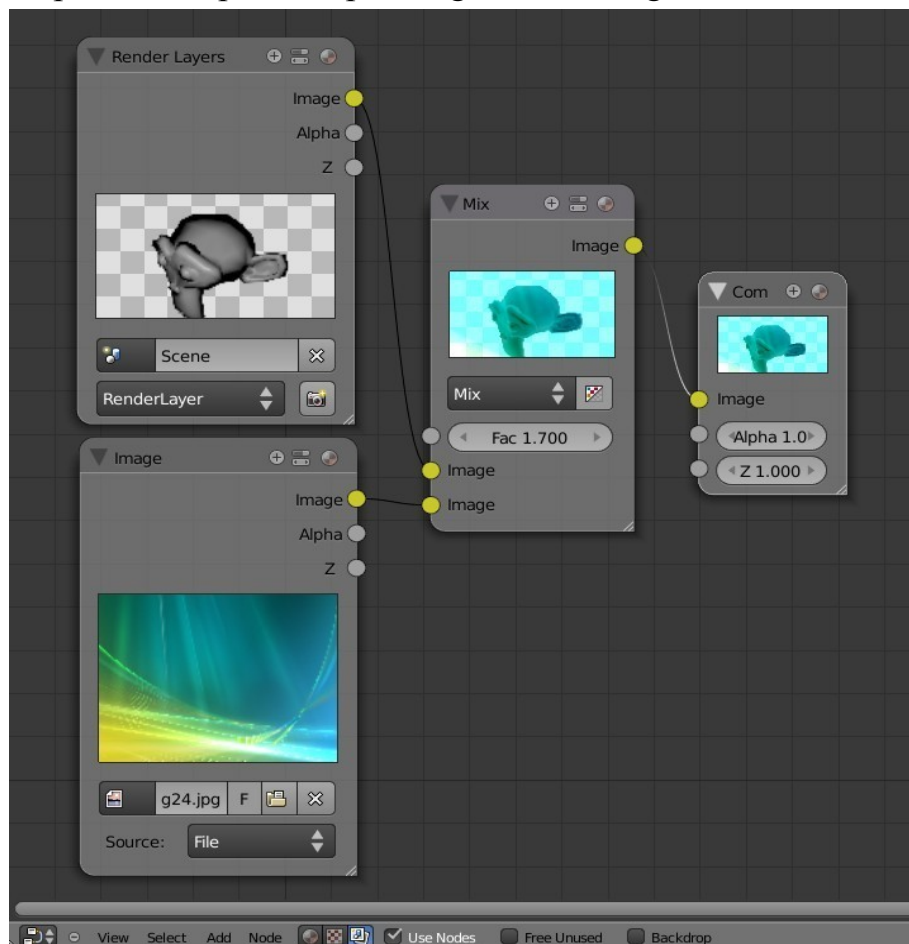
The image to the right has been loaded into the 'Image' node' then using a 'Mix' node has been combined with the Blender scene containing a Monkey object to produce the rendered image below.
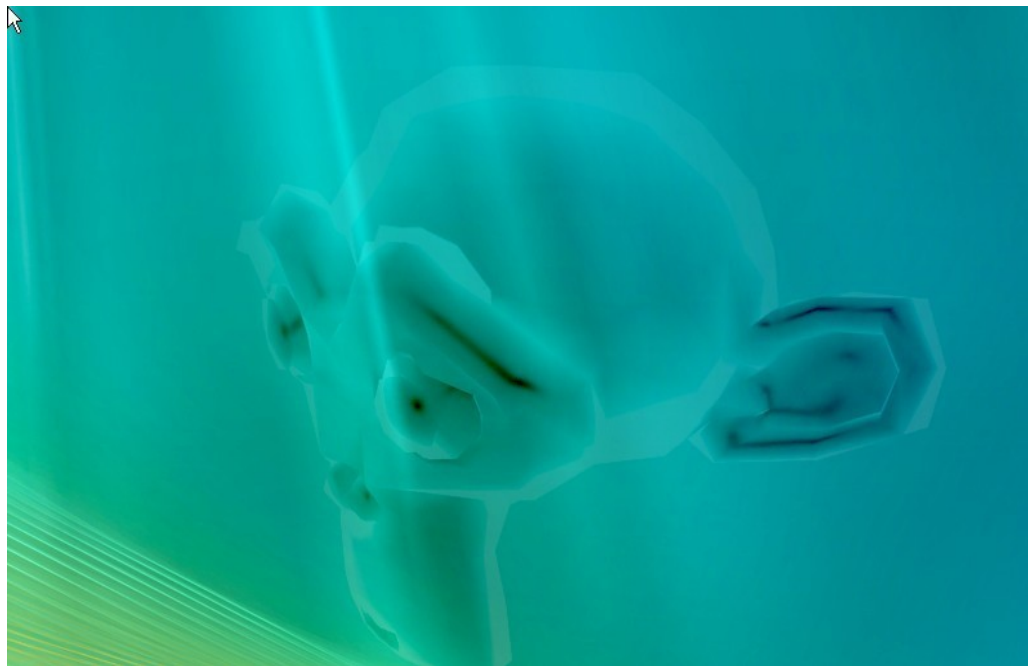
Example 2
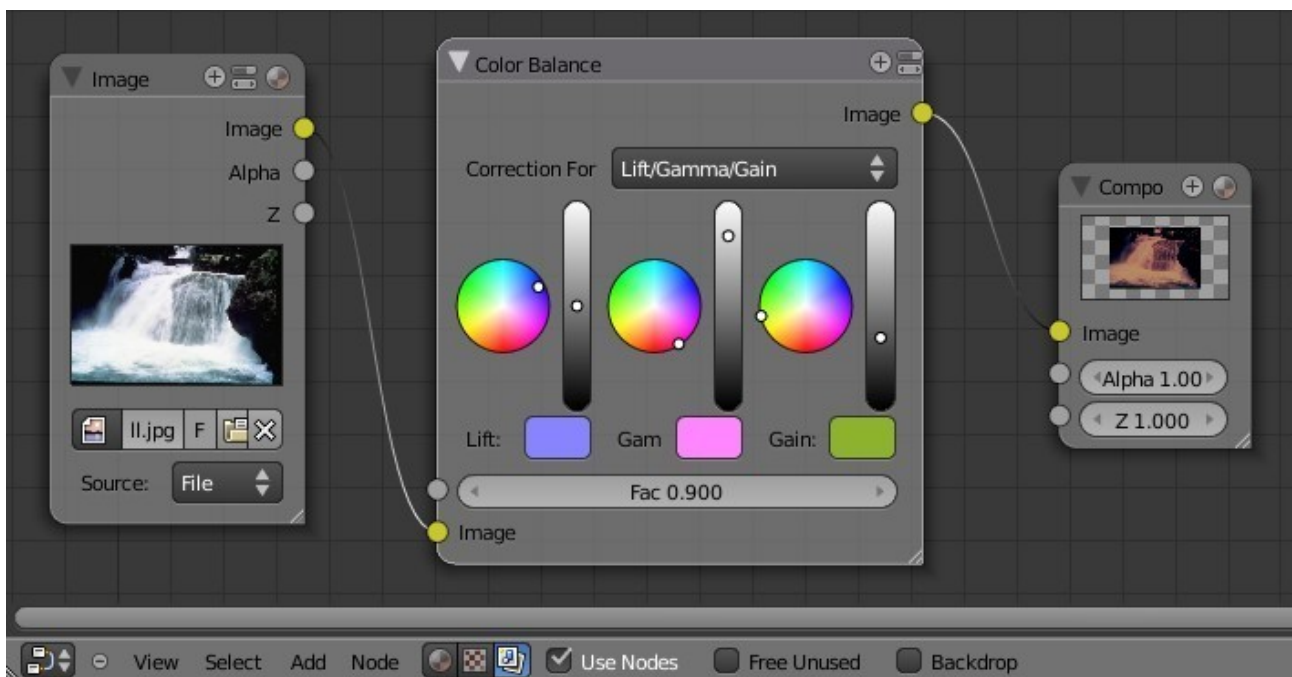
The image above has been loaded into an 'Image' node then enhanced using a 'Color Balance' node to produce the render of the image below.
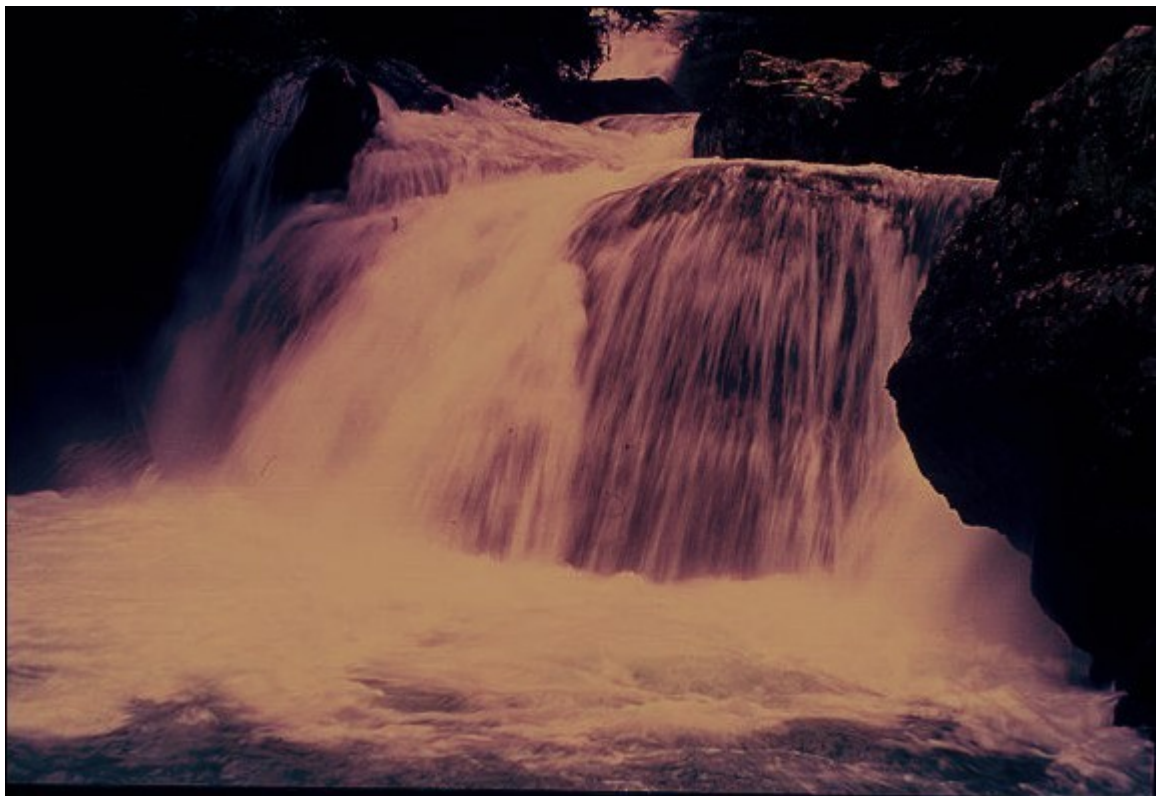
The combination of nodes is endless and requires experimentation, studying tutorials and recording of results to aquire an understanding of what can be achieved using the node systems.

CH22- Game Engine

01-Game Engine

02-Game Animation

Game Engine

Blender has the functionality to create interactive video games. The program integrates real-time motion with physics and logic blocks allowing you to turn objects into actors and move them around. This process also incorporates character animation and allows interactive walkthroughs to be created where doors open and close.

The Game Engine is extensive in its application and it is not possible to cover all of its intricacies in this document. You will have to research and experiment beyond the scope of this very brief introduction to become proficient.

To get you started and wet your appetite for Gaming follow this very basic example. At least it will show you how to open the door to the Game Engine.

Begin with the default Blender scene, delete the Cube and add a UV Sphere. Gaming is a form of animation therefore as with all animation it is best to keep animated objects with a low vertex count. To keep things simple the default UV Sphere will suffice.

In the 3D Window Tab into edit mode with the Sphere selected and grab one single vertex on the side and make a pointer as shown in the diagram. This will give an indicator showing which direction you are pointing when moving around. The Sphere with the pointer will be our Actor.

Vertices Grabbed and Moved
To form a Pointer
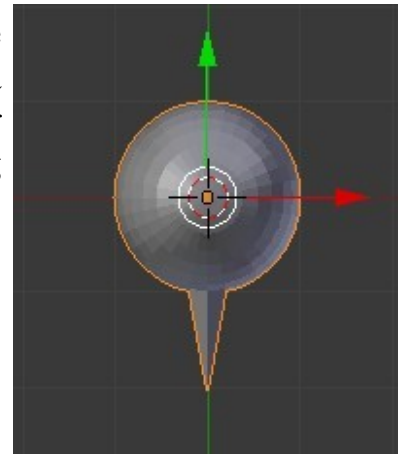
Go to the Information Window header and change the screen arrangement from the Default screen to the Game Logic screen. This arrangement has the Logic Editor Window, 3D Window, Properties Window and the Outliner Window displayed. The Information Window header is across the top of the Screen.

The screen is configured for setting up the Game Engine but Blender is not ready yet. In the Information Window header change Blender Render to Blender Game.
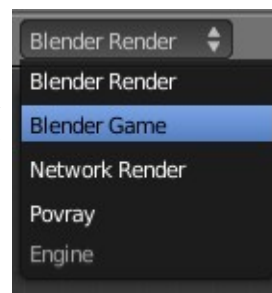
With the Sphere selected in the 3D Window go to the Properties Window-Physics button- Physics tab and set the Physics Type : Dynamic. Note that in doing this the 'Actor' box is ticked indicating that the Sphere is an Actor. If it is not ticked, tick it.

OK! check if the Sphere is behaving itself and is going to cooperate as an Actor in this little drama, set the 3D Window to front View (Num Pad 1) and with the cursor in the 3D Window press the P Key. This puts the 3D Window into Play mode (Play the Game). The Sphere should be seen to descend in the window and disappear out of sight. Press Esc to return the Sphere to center stage in the window.

You have proved that the Sphere actor is behaving itself. Gravity has taken hold of the Sphere and caused it to fall. Since there is nothing below the Sphere to obstruct its motion it falls to infinity. We had better do something to correct this.

Put the 3D Window into Top view and add a Plane to the scene. Scale the Plane up six times. Go back to front View and move the Sphere up above the Plane. Move to User Perspective View (Num Pad 0 for Camera View then Num Pad 5 for Camera Perspective then Num Pad 5 again for User Perspective).

Above the Plane
3D View
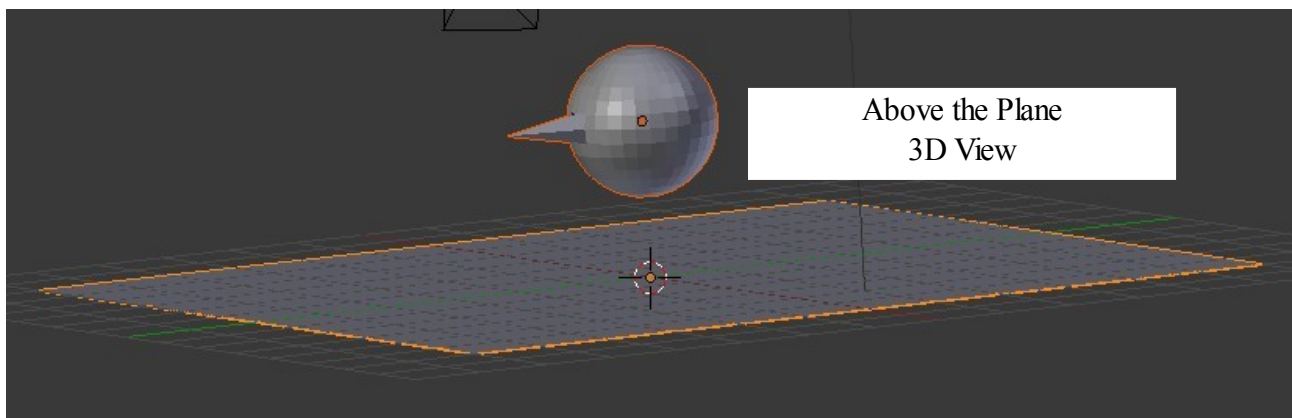
Press the P Key to see the Sphere descend and sit on the Plane.

Sitting on the Plane
Game Play View
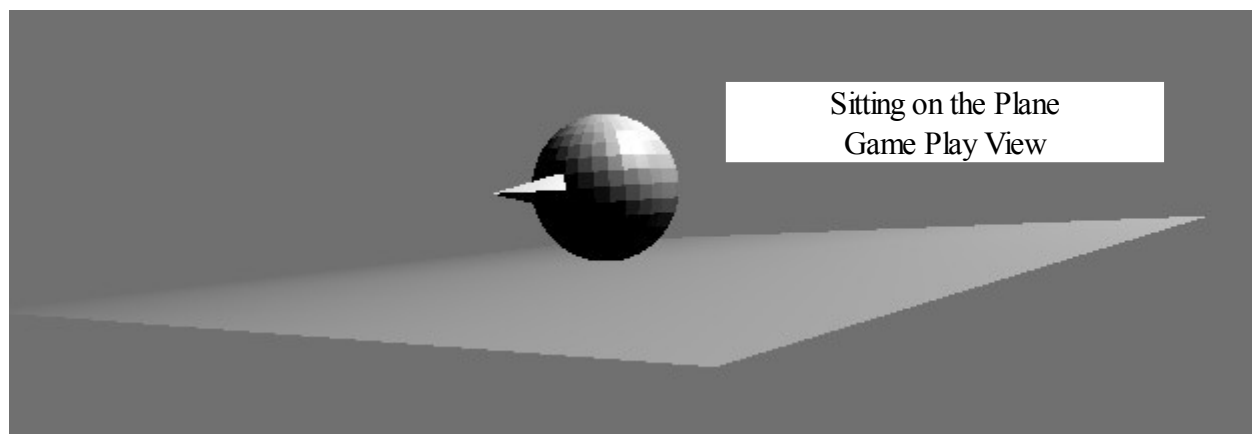
Press Esc to go back to Object mode.

It is time to tell Blender when and how we want our Actor to move.

In the Logic Editor Window you see the Logic Blocks, 'Sensors', 'Controllers' and 'Actuators'.

The Sensor is what will trigger an action.
Click on the 'Add Sensor' dropdown to see the options. ————

The Controller is what will control the action
click on 'Add Controller' to see options. ————
They probably are meaningless.

The Actuator tells the Actor what to do.
Click on 'Add Actuator' ————
Again meaningless.

This is assuming that you
haven't done this before.
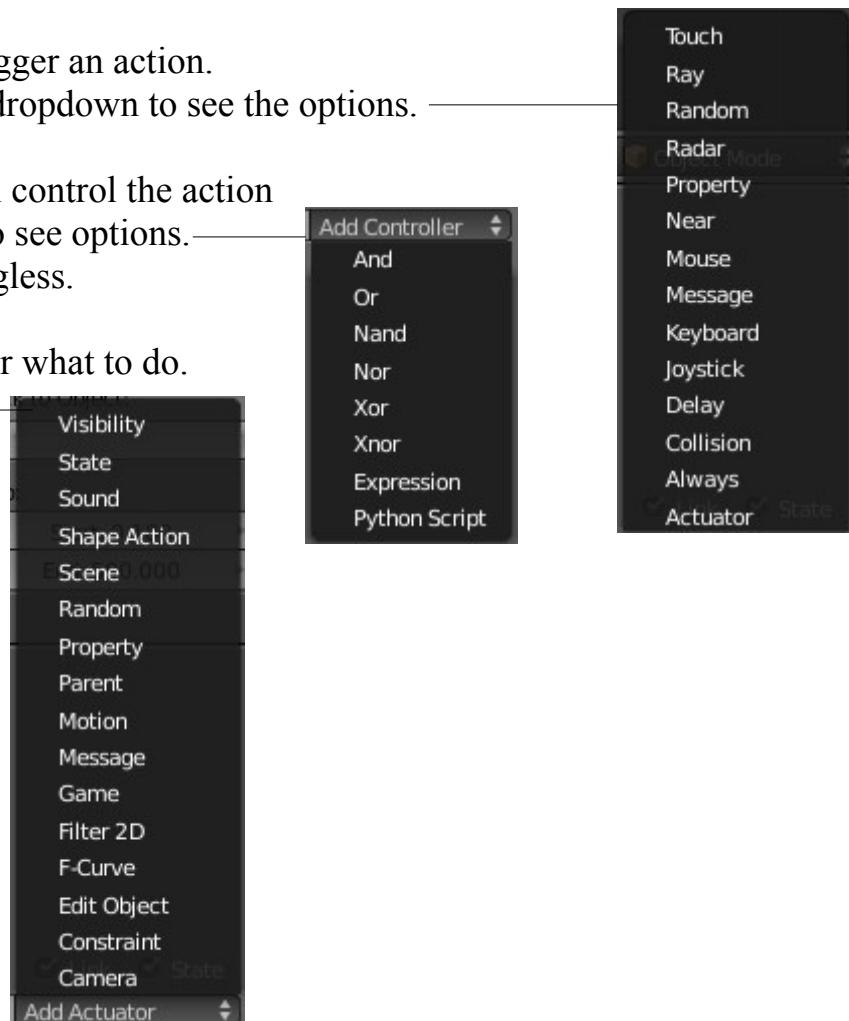
We will make some settings and make something happen to give you an idea how this all works.

In the Sensors Logic Block click 'Add Sensor' and select 'Mouse'. Our mouse will be the device we use to trigger the action. If you want to change your mind about this click on the drop down where it says 'Mouse' and you can select something else. Let's stick with Mouse.

Where it says 'Mouse Event' in the Sensor panel you select what part of the mouse will be responsible for the trigger. Click 'Left Button' to see options but stick with 'Left button'.

In the Controller Logic Block click 'Add Controller' and select 'And'. Why? will have to be explained later.

In the Actuator Logic Block click 'Add Actuator' and select 'Motion'. Motion because we want our Actor to do some moving about. Leave the Motion type as 'Simple Motion'. Its not time to go complicated.

In the Motion type there are two slots: Loc (Location) and Rot (Rotation) with x, y and z values. x, y and z are the axis and the value will give the speed of the action.

Enter 'Loc' y:0.20 which means move along the y axis at speed 0.20. Note this is in the positive y direction. To move in the opposite direction enter -0.20.
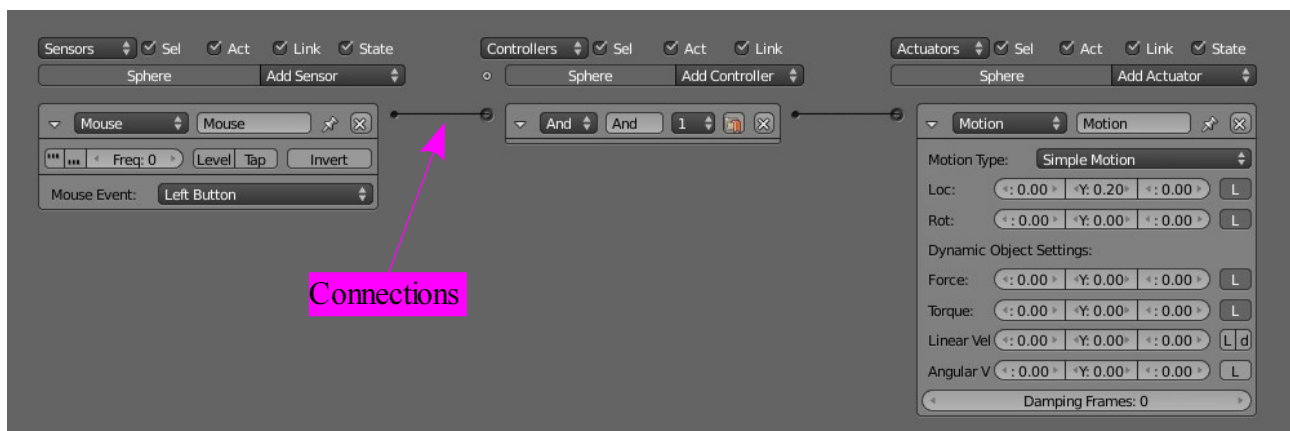
The last step for now is to connect the Logic Blocks. Click on the little black dot at the RHS of 'Sensor and drag over to the little circle on 'Controller. Do the same between 'Controller' and 'Actuator'.

Time for a test run. Put your mouse in the 3D Window and press 'P Key' (Play the game). Give your mouse LMB a click. Just a click. You will see the Sphere in play mode move. It may not be in the direction of the pointy bit on the Sphere but that can be adjusted. If you hold LMB down the Sphere will continue moving and fall off the side of the Plane and disappear into infinity. Press 'Esc' to end the game.

We will add a few more controls.

Adding controls (Logic Blocks) soon fills up the Logic Editor Window so to save space you can click on the little triangles at the upper LHS of the panels and collapse them. Click again to expand

Add more Sensor,s Controllers and Actuators as shown below taking particular attention to the values in the Motion Actuators. Do not forget to connect them together.

Motion Actuator Collapsed
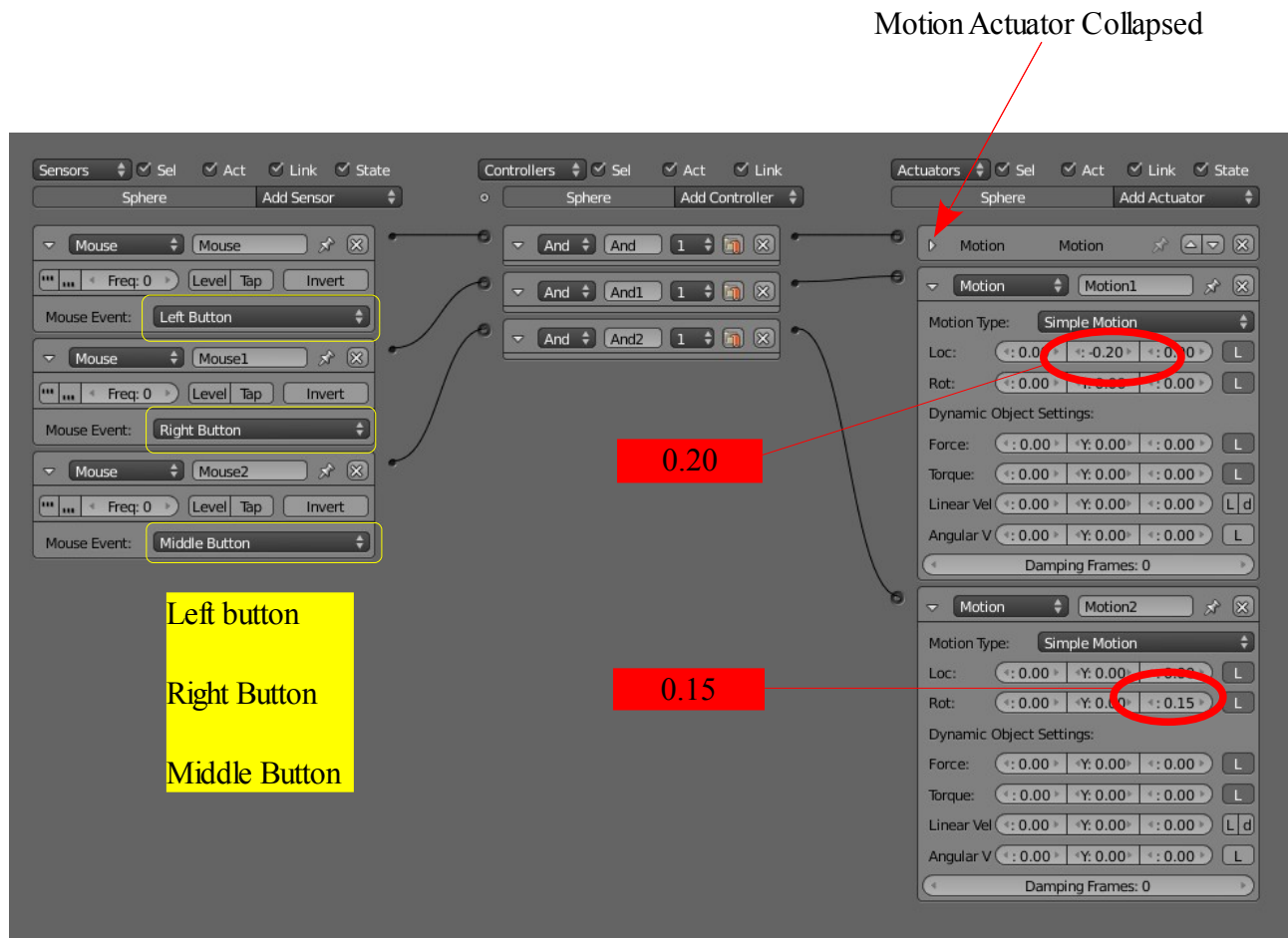
With the controls set as show above you can drive the Actor around the Plane. Play with the Mouse buttons and you will soon get the hang of it. Note the Sphere only rotates in one direction. You can add another set of controls to rotate in the opposite direction. Maybe change the Mouse sensor to Keyboard and use the A an S keys for rotation. You could change all the Sensor controls to Keyboard and use a pattern of keys.

The foregoing is about as simple as it gets so its over to you to research and experiment.
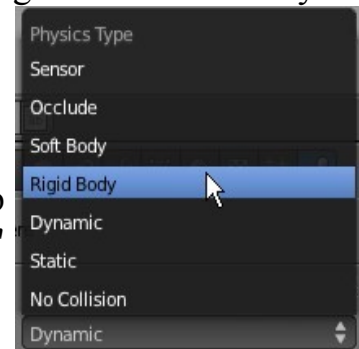
Animation – Using the Game Engine

The Game Engine Physics may be used to record an animation. In Chapter 11 we discussed animating the complex movement of an object by following a Curve Path. This procedure saved time by negating the application of keyframes and allowed the movement to be easily modified by changing the shape of the Curve Path. Some times you will not be in a position to set a predetermined path. You may wish to experiment to find the best movement to depict what you wish to show.

This is where the use of the Game Physics is a little bit of magic. You can drive your object around the scene and have the movement recorded.

Continue with the previous Game Engine set-up.

In the Properties Window – Physics button – Physics tab click on the 'Physics Type' drop down and change 'Dynamic' to 'Rigid Body'.

In the 'Info Window' header at the top of the screen click on 'Game' and tick 'Record Animation'. When your object is driven using the Game Engine the movement will be recorded. When you exit the Game (press Esc) and return to the 3D Window pressing the Alt + A Key will replay the movement in the 3D Window.
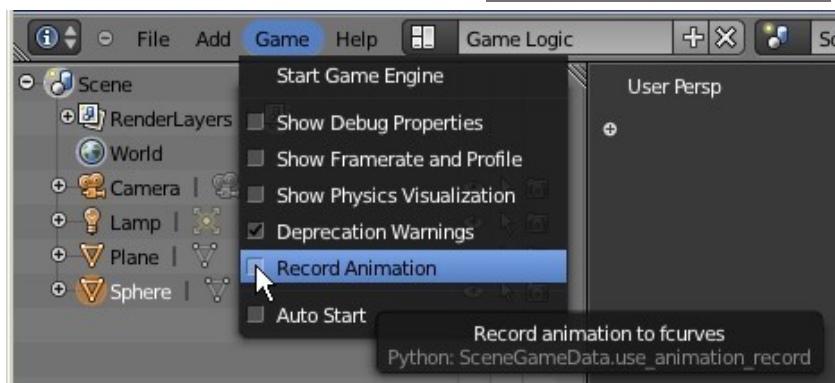
Before doing any driving bare in mind that as soon as you press the P Key to start the game the animation recording is up and running.

Look at the Properties Window – World button – Physics tab and note: Physics Steps-FPS60. Also in the Render button – Stand Alone Player tab note: Quality-FPS60. The animation is recording at 60 frames per second. In no time at all you will record many many frames. I suggest for the time being you limit your driving in the game to a few seconds of simple short moves.

OK! Give it a go. Remember simple, short and press 'Esc' to quit.
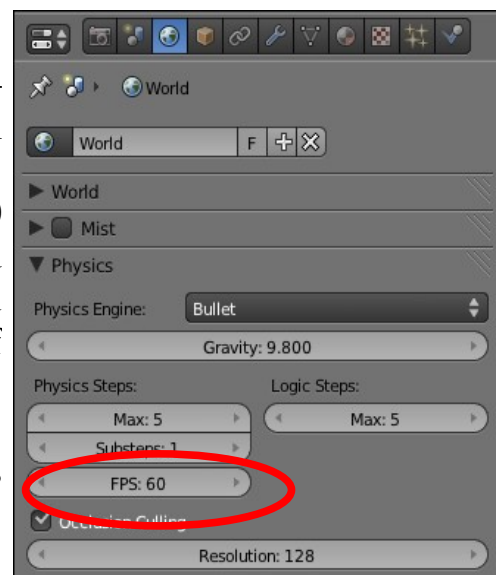
After this short burst of tentative experimentation, with your actor returned to the centre of the scene in the 3D Window, press Alt + A to see the animation of your game movement.

What's happening? You probably see your object move but it doesn't complete all the movement you made in the game. Why?

Change the 'Text Editor Window' at the RHS of the screen to the 'Graph Editor Window'. You will see your animation displayed as a graph with many lines and there are numerous channels entered in the Dope Sheet panel on the LHS of the window.
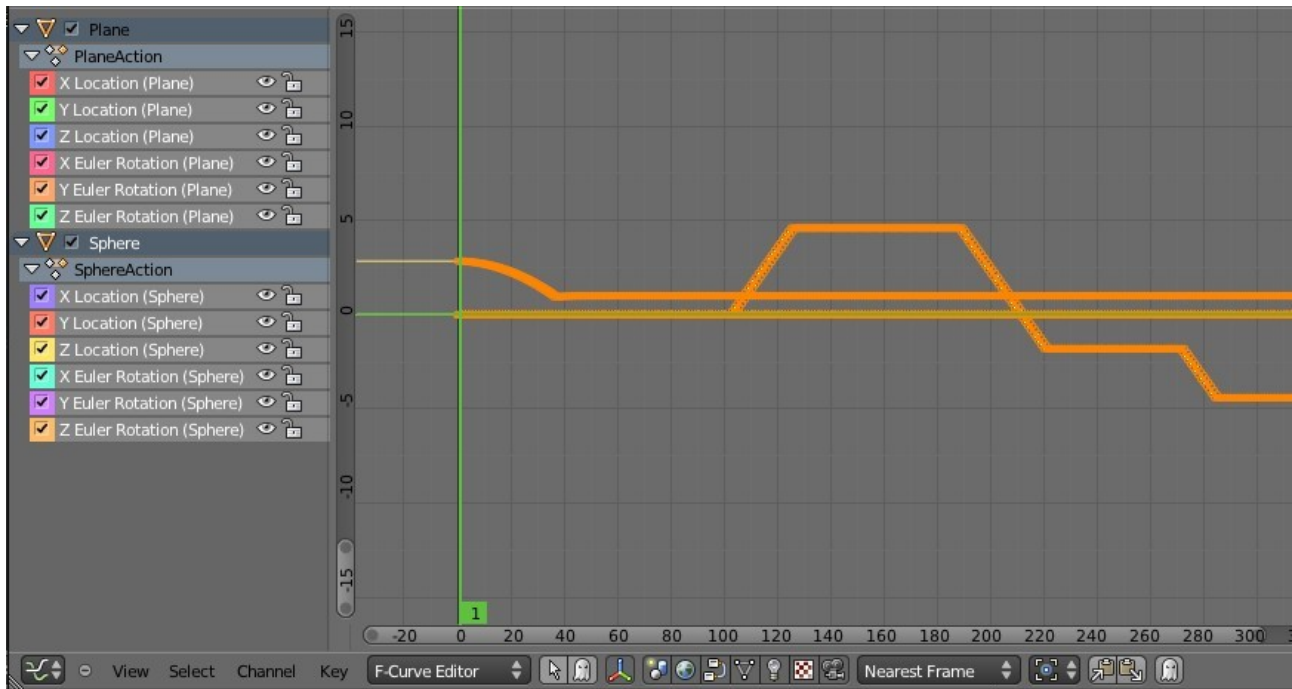
Change the 'Logic Editor Window' to the 'Timeline Window'. Wow! Its full of vertical yellow stripes (keyframes). Blender has recorded keyframes at each frame of the animation. If you played the game for eight seconds at 60FPS (frames per second) you have recorded 480 frames each having a keyframe (My game went a tad longer, 8.166 sec.).

Timeline Window
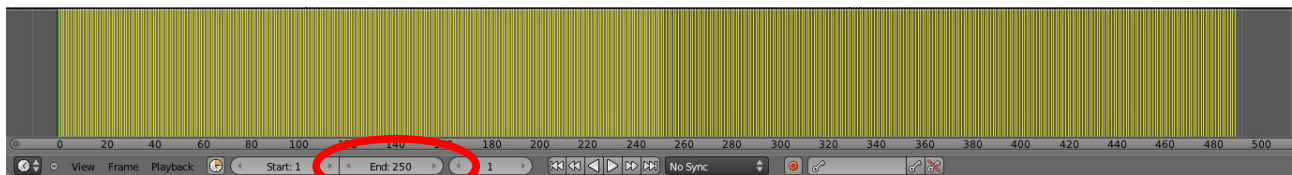
In the 'Timeline Window' your animation is set, Start:1 and End:250, therefore when you play the animation in the 3D Window (Alt + A) you only play the first 250 frames. Change the End value to equal the number of keyframes shown in the Timeline to see the full animation of the game movement.

CH23- Video Sequence Editing

01-Making a Movie

02-The Video Editing Screen

Return to Contents

Video Sequence Editor

Making a Movie

Movies are made by piecing together video clips. A video clip is the short segment of video you produce when you render an animation. It follows that you can only make a movie when you have video clips saved on your computer. How to render animation to video has been covered in a previous section and we will assume that you have some clips saved. Make a note of where you have saved your clips and make suer you are conversant with the File Browser Window.

The first step in the movie making process is to set the video output format you want your movie to be in and to set the file path to the folder where you want to save the movie file.

Start Blender and in the Default Screen Arrangement go to the Properties Window-Render button. In the Output tab set your file path by clicking on the Browse Folder button.

In the File Browser navigate to your folder.

Next set you Movie Video file type. The default output setting is 'PNG'. Change 'PNG' to 'AVI Codec'.

AVI Codec will give you a file you can burn to DVD and play in a video player.
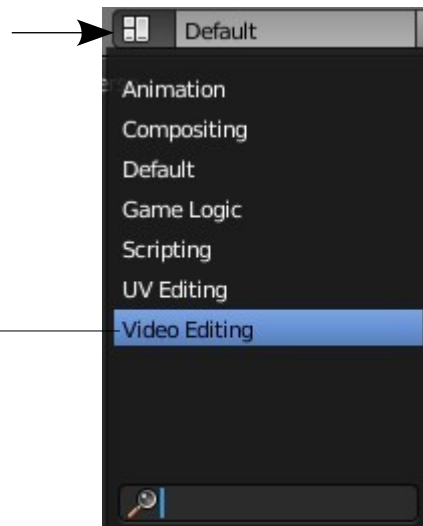
File Path

Output

Click to select File Output Format

Browse Folder Button

Having set the above options open the Video Editing Screen.

In the Information Window header click here to display the Screen options

Select: Video Editing

The Video Editing Screen
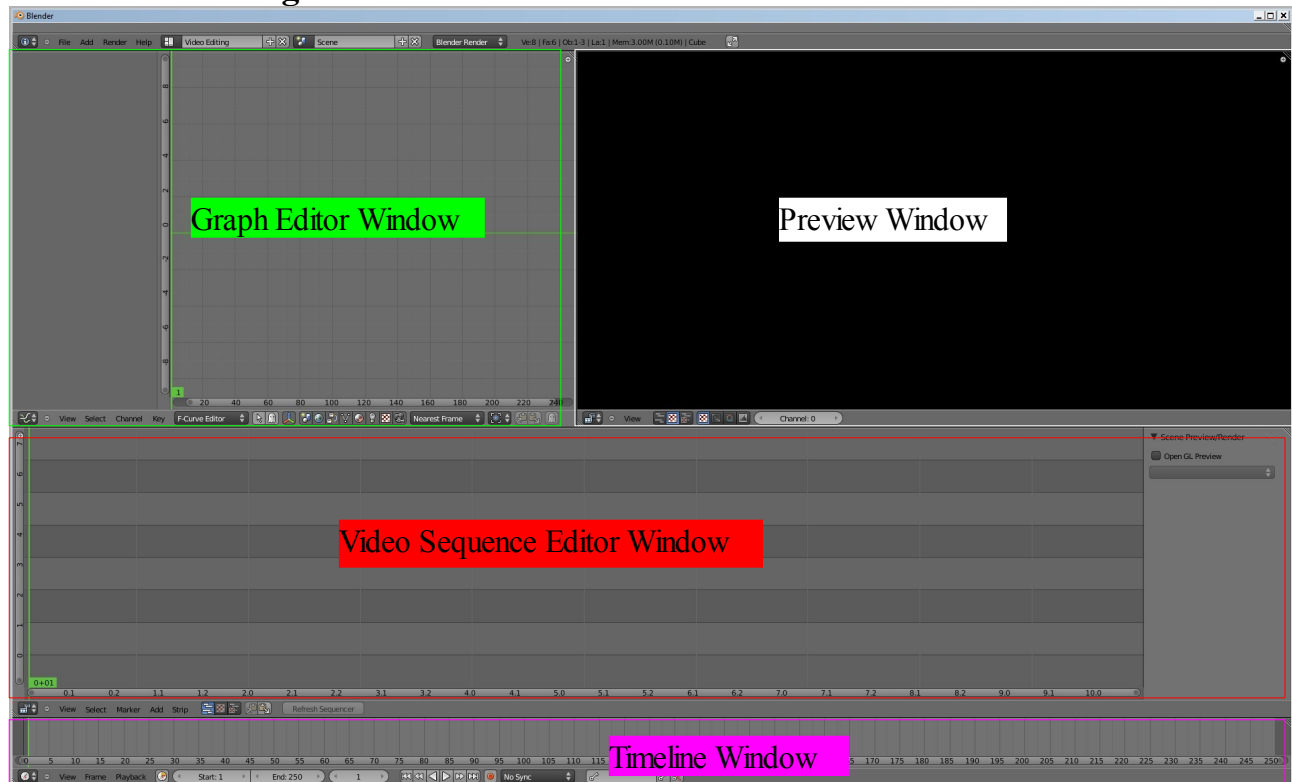
In the Video Sequence Editor click on 'Add' in the header and select 'Movie'

The File Browser window displays. Navigate to the folder containing your video clips. On my computer my clips are in 'C:\SubAnim\'. You can see that I have five clips which form a movie when spliced together.

Click on your first clip to highlight (Clip shown in orange) then click on 'Add Movie Strip' in the upper RH corner of the File Browser.
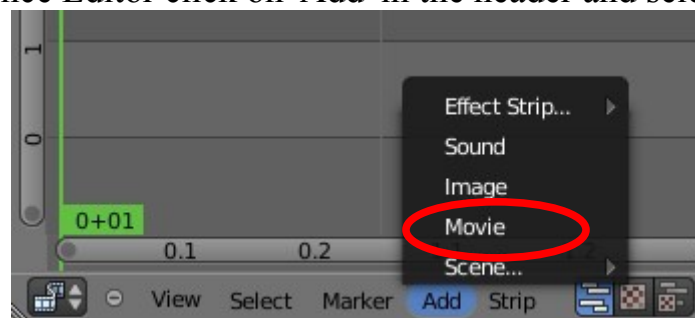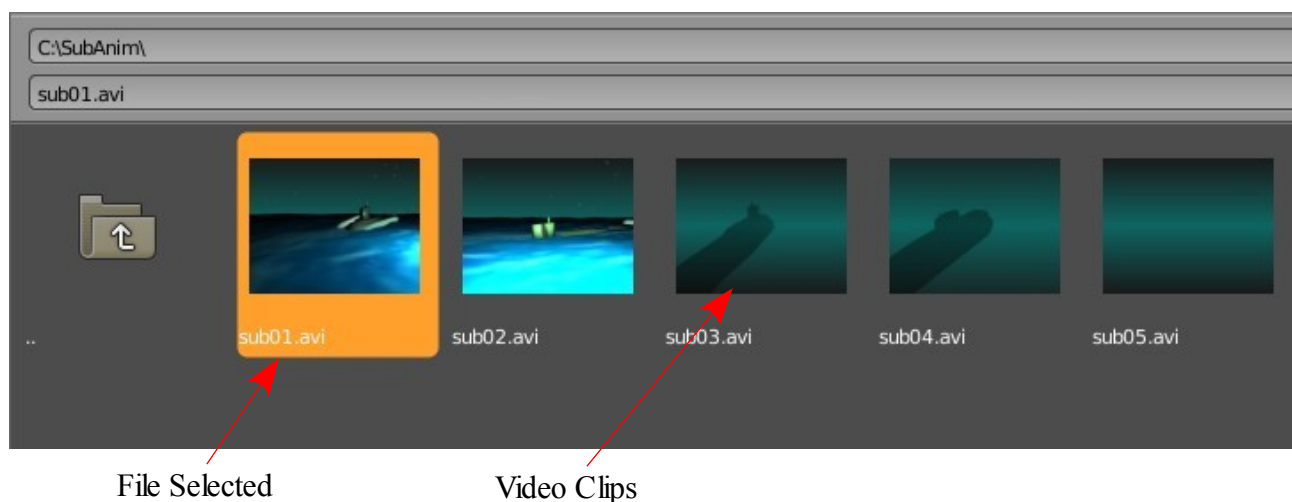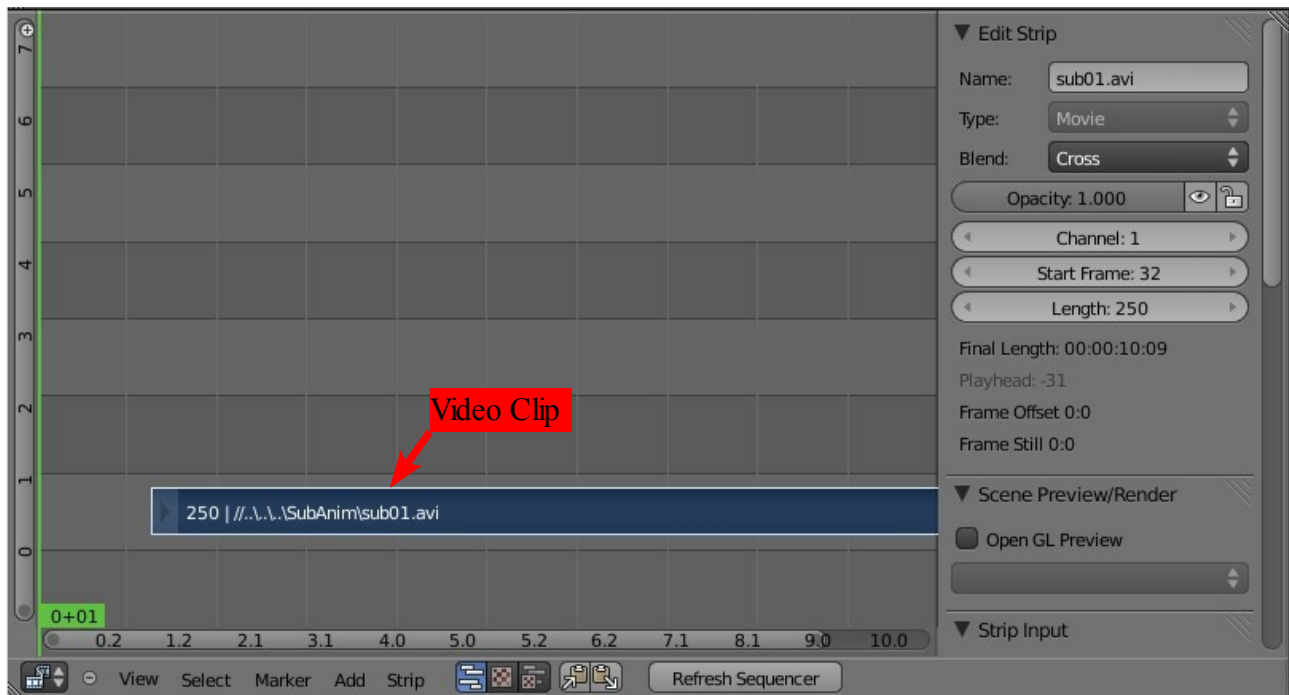
The video clip is is entered into the Video Sequence Editor as a blue strip with a white border. The white border indicates that it is selected.

If you press the E Key you can drag the clip R or L along the screen. The vertical green line is a cursor and as shown is located at position 0+01 which is the beginning of the timeline. Drag the clip until the start of the clip is at position 0.00.
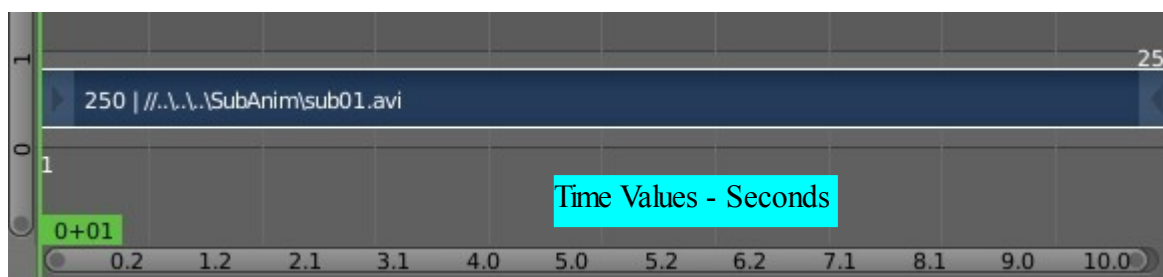
After positioning the clip at the start of the timeline move the green cursor to the right. At position 0.00 you will see thin vertical black line. This is the marker for position 0.00. Dragging the green cursor allows you to scrub through your video clip which you will observe in the Preview Window. With your normal cursor in the Preview Window pressing Alt + A plays the clip.

The graduations across the bottom of the Video sequence editor are seconds (Time values).

Beginning of Clip at 0.00
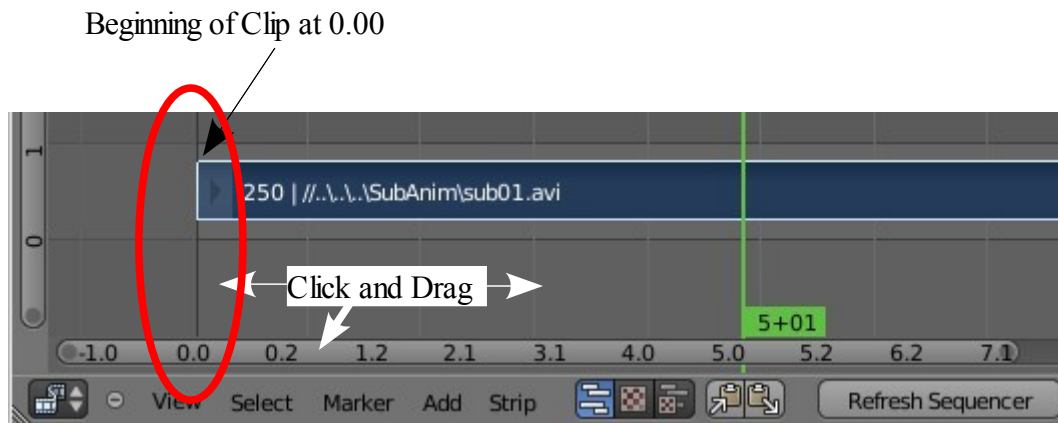
In the Timeline Window at the bottom of the screen change the 'End' value to 120.

Beginning of Movie 0.00

You will see a another thin black line move in from the RHS of the window and locate at position 5.00 seconds. This line will represent the end of the render in the final movie output.
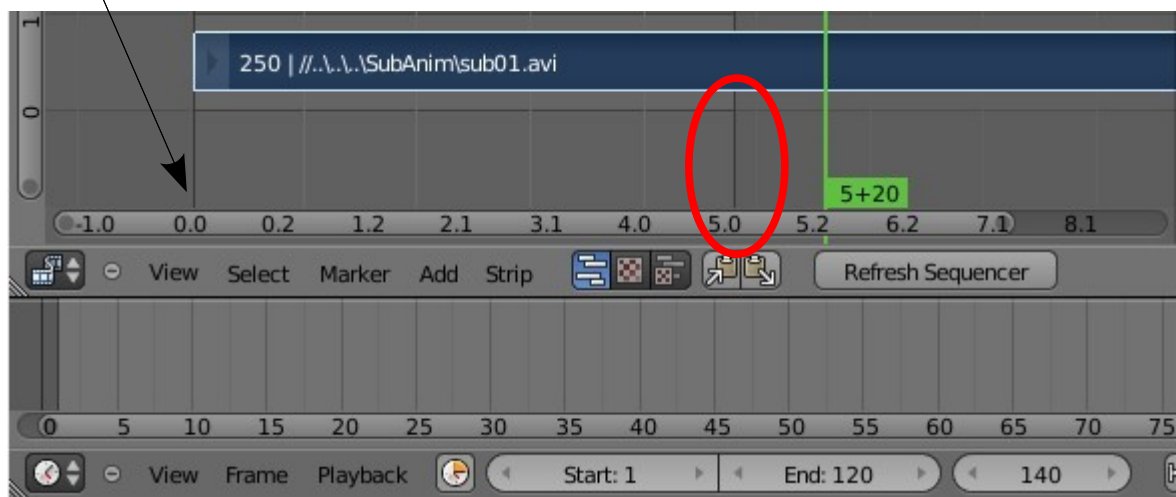
Remember that in the render set up in the Properties Window the frame rate for the animation was 24 frames per second. 120 frames played at 24 frames per second equates to 5 seconds.

Place the cursor in the Video Sequence Editor Window and zoom in (Num Pad Plus). Click on the time graduation bar and drag to the right to move the Editor Window to the left.

Click on 'Add' again and select your second video clip. The second clip is placed on the same line as the first clip. The lines are called 'Channels'. At the RHS of the window is an 'Edit Strip" tab. Change the channel number in the 'Edit Strip' from 1 to 2 and you see your second clip move up a line (Channel). Another way to do this is to R Click on the clip and drag it up.

You have to line up the end of Clip 1 with the start of Clip 2. R Click on Strip 2 and drag it. Numeric values showing the end and start frames of the clips display allowing you to accurately align the ends. For example end of Clip 1 frame 250 and start of Clip 2 frame 252.

Second Clip
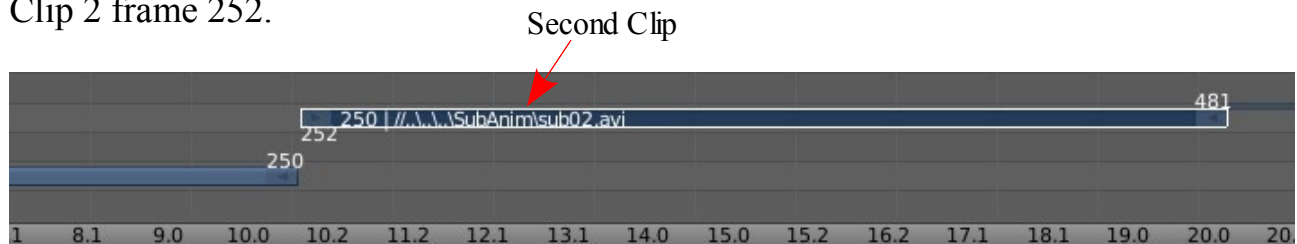
You can align the clips on the same frame number or a slight gap is tolerated or you can overlap the clips slightly.

After aligning all your clips (I'm only using two clips for this demo.) go to the Timeline Window at the bottom of the screen and change the 'End' frame so that the thin vertical black line in the Video Sequence Editor Window line up with the end of your last clip. This sets the end frame for the movie file render.
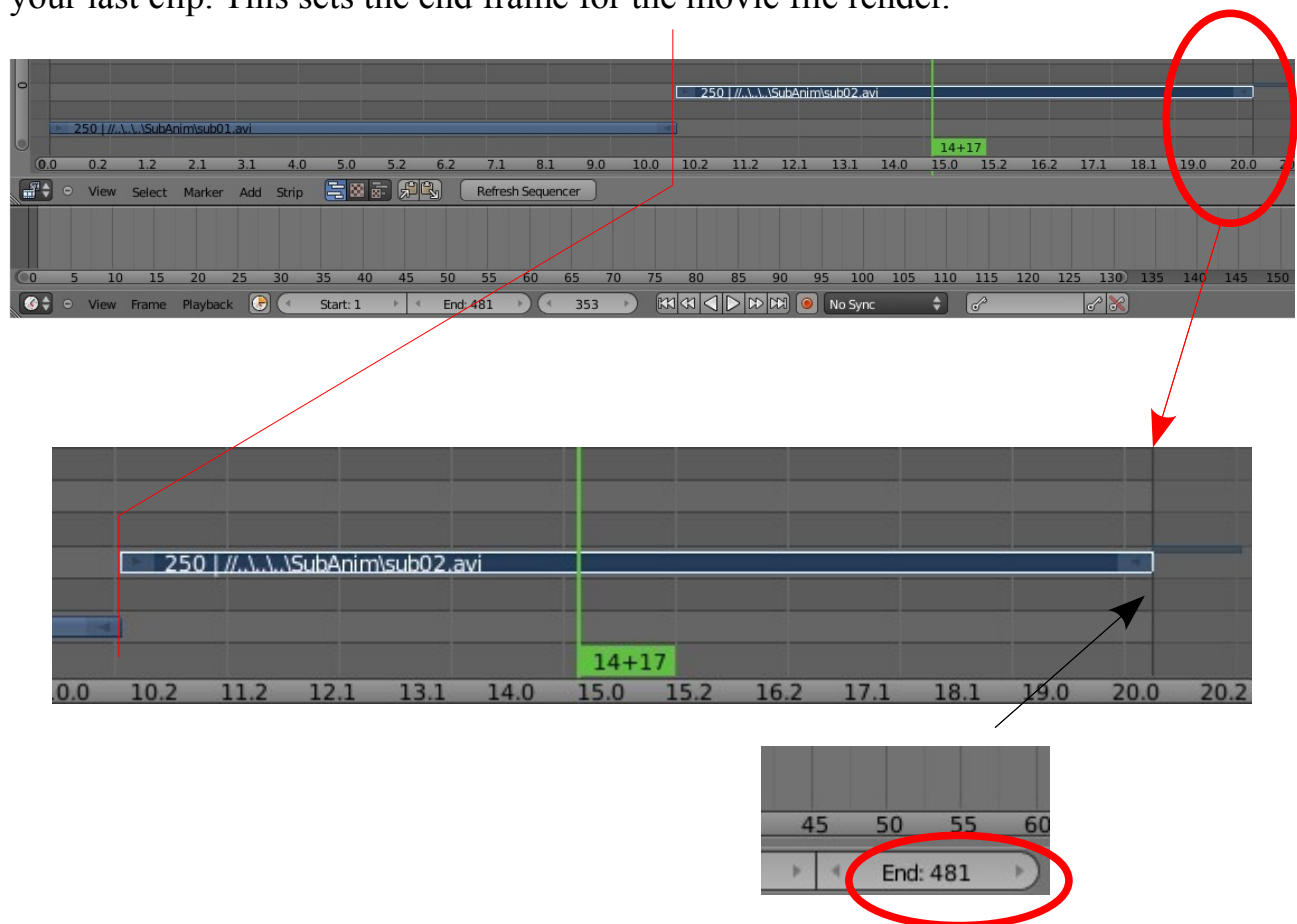
Before you render the movie you can add a sound file. (MP3 or Wave)
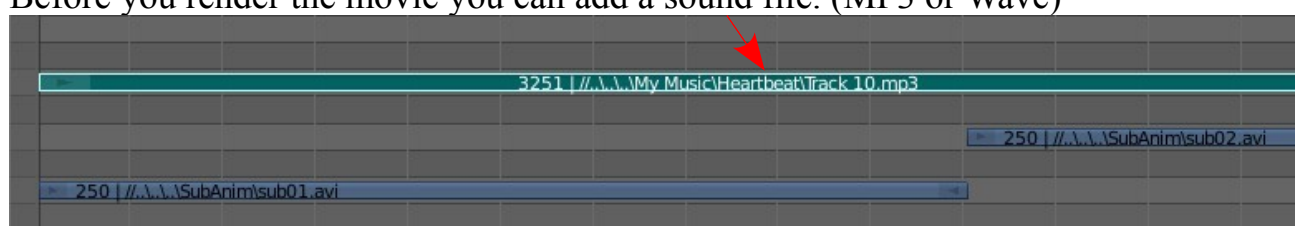
Before rendering you can play a preview by putting the cursor in the Preview Window and pressing Alt+A.

Preview Playing
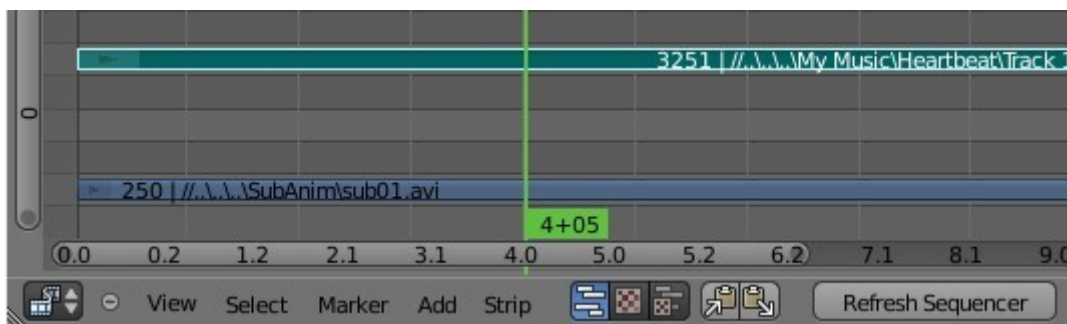
Its time to render.

In the Information Window header click on 'Render' and select 'Render Animation'. Wait for the render to complete. The render plays as it proceeds in the editor Window. After completion find the movie file in the <u>output folder</u> you set and give it a test run in a media player.
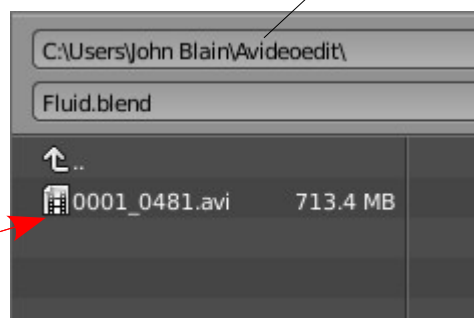
Movie File in Output Folder

This has been a brief introduction to the Video Sequence Editor to get you started.

CH24- Appendix

01-Commands

02-References

Basic Blender Commands

This is just a partial list of Blender commands. Please visit the Blender.org website for more details.

TAB key   Toggles between edit mode (vertex editing) and object select mode.

Ctrl+ Z   The global UNDO command. With each press, one step will be undone (up to 32 steps possible by default). If in edit mode, it will only undo editing steps on the selected object.

Z key   Toggles view from wireframe to solid

Alt Z key   Toggles a texture/shaded view.

R key   Press R key and drag mouse to rotates an object or selected vertices.

S key   Press S key and drag mouse to scales a selected object or vertices.

G key   Press G key and drag mouse to move the object or selected vertices.

A key   While in edit mode selects all vertices for commands like remove doubles and subdivide. A key twice will clear selected and reselect.

Alt +A   Plays animation in selected window. Your cursor must be in that window for it to play.

Ctrl +A   After an object has been resized and/or rotated, brings up the Apply menu, this can reset the object's data to 1 and 0.

W key   Brings up a " Specials " menu while in edit mode of specific edit mode options

Shift+D   Duplicates or copies selected objects or selected vertices.

Shift+RMB Multiple select objects or vertices

Shift+A   Displays the Add menu. Add objects to scene.

Shift+S   Displays the Snap Menu eg. Snap object to cursor.

Shift+Space Toggles multiple windows to full screen window.

E key   While in edit mode, selected vertices can be extruded .

O key   The "O" key (not zero) will put you into proportional vertex editing while in edit mode.

B key   Gives you a box (window drag) to select multiple objects In edit mode.

C key   Circle select gives you a circle to select multiple vertices, that can be sized by scrolling the mouse wheel. Press Esc to cancel.

Alt + A	Brings up the tools menu where you can add meshes, cameras, lights, etc.
Num Pad	Number Pad controls your views. "7" top, "1" front, "3" side, "0" camera, "5" perspective, "." Zooms on selected object, "+ and −" zoom in and out. The + - buttons also control affected vertices size in proportional vertex editing.
LMB	Left mouse Button click to manipulate using the 3D Manipulator Widget. Click in the 3D Window to locate the 3D Cursor. Click in the Tools Panel to activate functions. Click in panels to enter values etc.
RMB	Right Mouse Button click to select.
MMB	Middle Mouse Wheel Button click to manipulate specified options. Scroll wheel to zoom in and out. Scroll to expand-contract selection options.
Shift key	Hold down the shift key while clicking RMB to make multiple selections.
Arrow keys	Used to advance frames in an animation. Left and Right 1 frame increments. Up and Down 10 frame increments.
P key	In edit mode, separate selected vertices. In Object mode Game Engine enters Play mode.
U key	In Object mode brings up Make Single Users menu.
M key	Brings up Move to Layer option.
N key	Toggles numeric data display for the selected object.
Ctrl+J	Joins two selected objects.
X key and **Delete key**	Delete.
Function	F1 – Opens File Browser Window. F2 – Save File. F3 – Save rendered image. F12-Render.
I key	Insert animation key.
Ctrl+T	Displays Make track menu.
Ctrl+S	Opens File Browser to save file.
Alt+C	Opens convert menu. Convert Mesh/Curve.
Ctrl+Tab	Various functions depending on Window mode type.

References

The following web sites are recommended as sources of information for Blender 3D.

The Blender Site
http://www.blender.org

Wiki Users Manual
http://wiki.blender.org/index.php/Doc:Manual

Blender Nation
http://www.blendernation.com

Below are a few examples of the many free graphics programs available on the internet. You may find them usefull or just interesting.

FastStone Image Viewer   A usefull tool for organising your image files.
http://www.faststone.org/download.html

Make Human   Creates the Human Figure.
http://sites.google.com/site/makehumandocs/Home

Pov Ray   A way of creating graphics.
http://www.povray.org

Serif Draw Plus   Graphics drawing programs.
http://www.freeserifsoftware.com

Lohmuller   An interesting graphics site.
http://www.f-lohmueller.de/

Ivy Generator   Grow Ivy on everything.
http://graphics.uni-konstanz.de/~luft/ivy_generator/