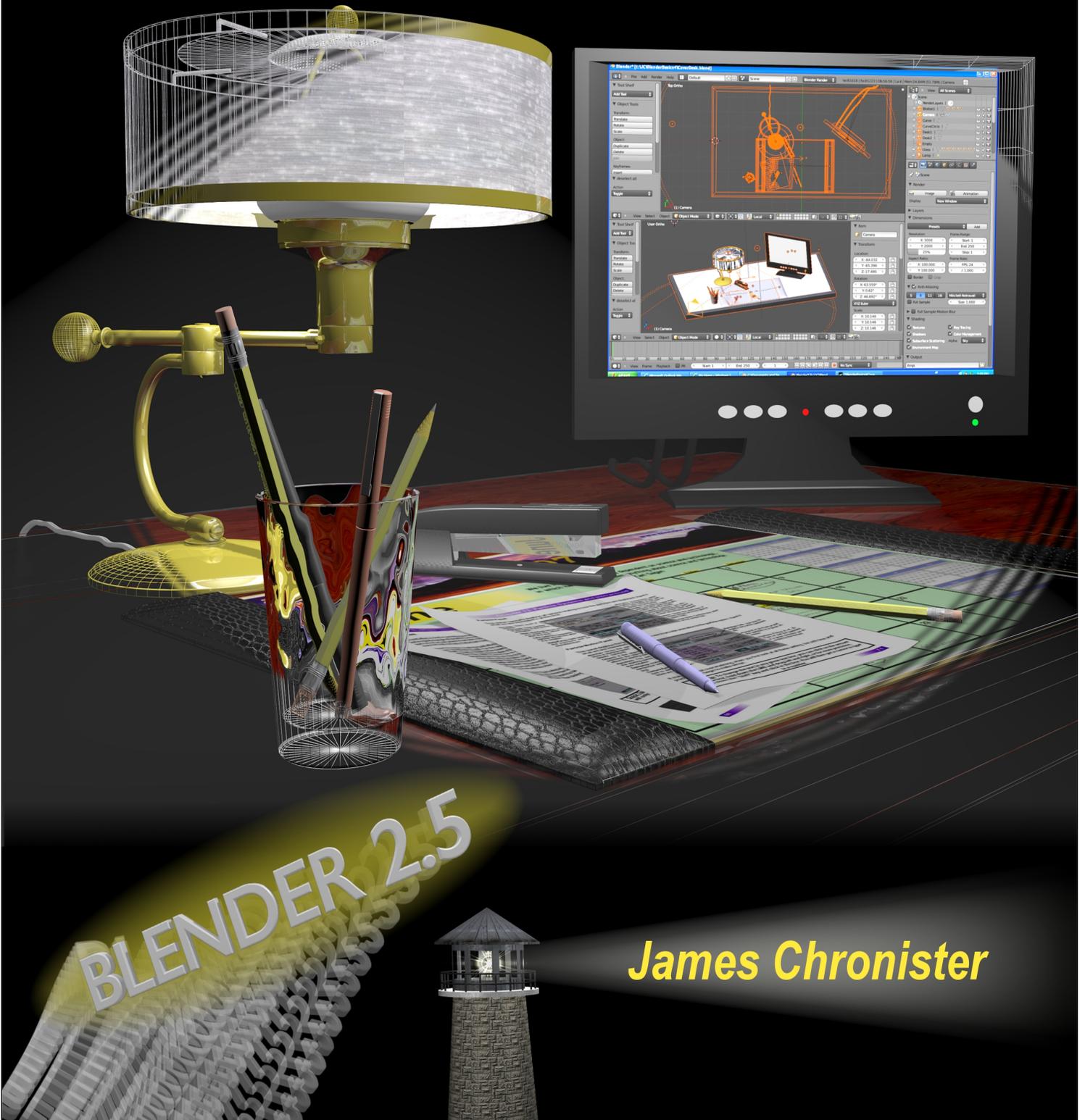


Blender Basics

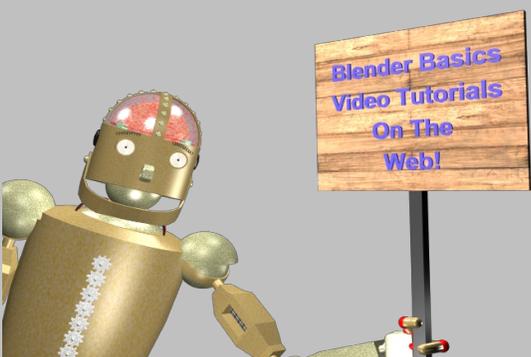
Classroom Tutorial Book

4th Edition



BLENDER 2.5

James Chronister



You can now find video tutorials for Blender Basics on line for each chapter. Visit:

<http://www.cdschools.org/cdhs>

Look under the “Academics” tab and select “Technology Education”. You will find a link to video tutorials in any of the drafting and animation classes.



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Information regarding the Blender program and development can be found at www.blender.org. Blender users can also find information on how to use the program at www.blenderartists.org. Daily Blender news and tutorial links can be found at www.BlenderNation.com.

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About Blender

How can Blender be free?

People usually associate freeware software with the terms “bad”, “with limited features” or just a “demo”. Blender is fully functional. It works as an open-sourced, community development program where people from around the world contribute to its success. Blender is a rendering\animation\game development open-sourced freeware program maintained by the Blender Foundation and can be downloaded, free of charge, from www.blender.org. The goal of the foundation can be summarized as follows:

“The Blender Foundation is an independent organization (a Dutch “stichting”), acting as a non-profit public benefit corporation, with the following goals:

1. *To establish services for active users and developers of Blender.*
2. *To maintain and improve the current Blender product via a public accessible source code system under the GNU GPL license.*
3. *To establish funding or revenue mechanisms that serve the foundation's goals and cover the foundation's expenses.*
4. *To give the worldwide Internet community access to 3D technology in general, with Blender as a core.*

Blender website (blender.org)

Blender can be a difficult program to learn with limitless possibilities. What do you teach in the time you have to teach? That's a tough question because you can't teach it all. This tutorial book is designed to get you up and running in the basics of creating objects and scenes and animating. The best advice I can give you about learning this program is Don't Give Up! Any rendering and animation program has a tough learning curve and Blender is no exception. After a few weeks, things get easier. This tutorial has been developed to be used in conjunction with daily lesson planning and demonstrations. Because of this, some areas of Blender have not been described as fully as they could be. If you are using this guide as a stand-alone teaching or “self-help” tool, you may need to seek additional help from reputable places like www.blender.org and www.blenderartists.org to make sense of things. These sites give you access to help forums and tutorials. There are literally thousands of Blender users world-wide that browse the forums to give and get advice. Make use of that vast knowledge base!

Version Information:

The current release at the time of this printing is **version 2.5x**. Since Blender is developed by a worldwide pool of individuals giving freely of their time, releases can happen in as little as 4 months and as much as 1 year. Because of such a large number of individuals contributing to Blender, major changes can occur between releases showing substantial improvements. **Version 2.5 is a drastic move from past versions of Blender!** The interface has changed in an effort to improve the work flow and make it more comparable to other programs.

Rendering and Animation

Rendering and Animation Basics

RENDERING:

A rendering is a pictorial output of a 3D scene or object. Features like materials, lighting, oversampling and shadows control the effects and quality of the rendering. The more of these features you add, the more realistic your scene become, but also lengthens rendering times.

Materials and Textures:

You can control the way an object appears by applying color and textures. Materials provide realism with added effects. You can control glossiness (specularity), self-emitting lighting characteristics, transparency and pattern repetition. Ray-tracing can provide reflection (mirror) and refraction (transparency) effects. Textures can be made from any scanned photograph or drawn object in an image-editing or painting-type program. Images in almost any format (jpeg, bitmap, png) can be used. Blender also has many built-in texture generators that can simulate a variety of surface characteristics such as wood, marble, clouds, waves and surface roughness.

Lighting:

Lighting provides the realism to your scene through reflections and shadows. You can control the type of light, intensity and color. Some lights can give a "fog" or "dusty" look with a halo or volume lighting effect. Illumination distances can also be set.

Cameras:

Your camera is your point-of-view for the scene. Just like a real camera, you can control lens length to achieve close-ups or wide angles. Clipping distance can also be set to control how far and near the camera sees. Depth-of-field can be controlled using nodes.

ANIMATION:

An animation is a series of rendered images that form a movie. The quality of your movie is controlled by all of the above mentioned features including frames per second (fps), output size, file type and compression. The most common method of animation is called *key-framing*. Key frames are created at various points in the animation while the computer generates all of the transition frames between the two keys. Basic animation options include changing size, rotation and location of objects.

Time Factors:

In order to animate, you must first set the length of your animation in frames and your frames per second (fps). The length in time can be calculated from these.

Frame Rate Options:

NTSC- U.S. and Japan video standard of 30 fps

Film- Movie standard of 24 fps

PAL- European video standard of 25 fps

*We typically use a frame rate of 25-30 fps depending on computer speed or if we plan to save the file to DVD. Hit the "PAL" or "NTSC" setting buttons for these.

Creating Keys:

A key is placed at the beginning and end of a desired move, size change or rotation of an object. Think in terms of how long you want a change to occur and relate it to your fps. For example, if you want an object to move from point A to point B in 2 seconds and you have 30 fps, place 2 keys 60 frames apart.

Following Paths and Objects:

In most animation programs, a camera can follow a path or object (or both) as it moves. This feature saves a lot of animation time and reduces the number of keys needed.

Output Options:

We typically save our movies in MPEG format for Windows. This type of file plays easily on most media players and at a high quality. Depending on how you plan to use your movie (i.e. on the web, saved to DVD, played in a presentation), you may wish to use different formats. Examples include Apple Quicktime and Windows AVI formats. Different formats also allow you to adjust the quality settings. For example, AVI formats can be compressed using a variety of compressors called CODECs.

Real-Time Animation (Blender only):

Real-time animation allows you to add physical properties to your objects and use the keyboard and other features to control them. You can create actors, change masses, control dampening (friction), set force and torque in x, y, and z planes and create relationships with other objects within the scene. With time and practice, interesting 3D games and real-time architectural walk-throughs can be created.

Blender allows you to use the physics engine to create animation tracks. You can now use the physics to create realistic falling, rolling, etc. animations and use them in movies.

Basic Key Commands

Basic Blender Commands

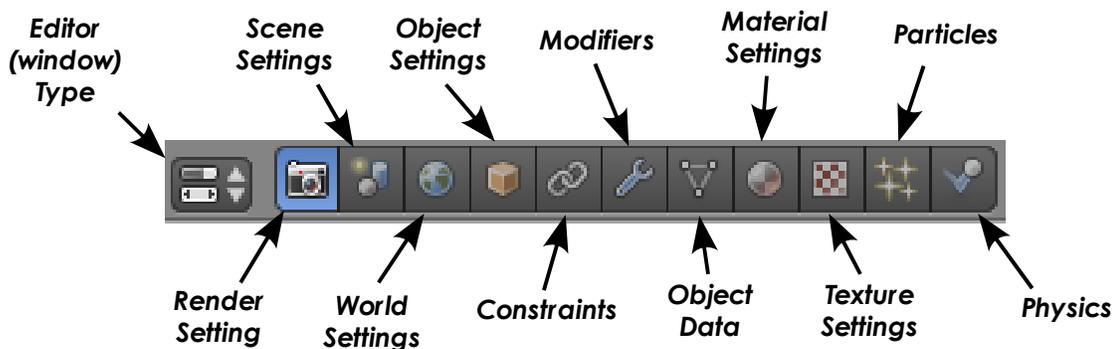
This is just a partial list of Blender commands. Please visit the Blender.org website for more details.

- TAB key-** Toggles between **edit mode (vertex editing) and object select mode**. If you're in edit mode when you create a new object, it will be joined to the selected object.
- 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.
- Space Bar-** Brings up a search window to find basic commands.
- "Z" key-** Toggles view from **wireframe to solid**.
- Alt "Z"-** Toggles a **texture/shaded view**.
- "R" key-** **Rotates** an object or selected vertices. (pressing X,Y,Z after "R" will limit effect)
- "S" key-** **Scales** a selected object or vertices. (pressing X,Y,Z after "S" will limit effect)
- "G" key-** **Grabs or moves** the object or selected vertices. (pressing X,Y,Z after "G" limits effect)
- "A" key-** While in edit mode it's good for **selecting all vertices** for commands like remove doubles and subdivize. Pressing "A" 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 re-sized and/or rotated, 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.
- "E" key-** While in edit mode, selected vertices can be **extruded** by pressing "E".
- "O" key-** The "O" key (not zero) will put you into **proportional vertex editing** while in edit mode. Proportional editing now also works in object mode.
- "B" key-** Gives you a **box (window drag) to select multiple objects**. In edit mode, works the same to select multiple vertices.
- "C" key-** Gives you a **circle select** in edit mode that can be sized by scrolling the mouse wheel. Press LMB to select, press wheel to deselect. Right mouse click or "Esc" to exit.
- Shift-"A"-** Brings up the **tools menu** where you can add meshes, cameras, lights, etc.
- 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.
- Mouse-** Left to manipulate (**LMB**), right to select (**RMB**), center wheel to zoom and rotate view. If you hold down "shift" and center wheel you can pan around on the screen.
- Shift Key-** Hold down the shift key to **make multiple selections** with the right mouse button.
- Arrow Keys-** Used to **advance frames in animation**. Left/right goes 1 frame at a time, up/down goes 10 frames at a time.
- "P" key-** While in *edit* mode, pressing P will **seperate selected verticies**. In *object* mode, pressing P will cause you to enter into the **game (real-time) mode**. Press Esc to exit game mode.
- ATL/CTRL "P"-** Creates or breaks **child/parent relationships**. To create C/P relationships, hold down shift key and select *child* first, then *parent*. Hit Ctrl P. To clear a relationship, do the same except hit Alt P.
- "U" key-** In Object Mode, brings up the **Single-User menu to unlink materials, animations (IPOs)**, etc. for linked or copied objects.
- "M" key-** **Moves selected objects to other layers**.
- Ctrl "M"-** **Mirrors** an object. Select "M", then X,Y,or Z to mirror on that axis.
- "N" key-** Brings up the **numeric info. on a selected object** (location, rotation and size). Info. can then be changed in the panel.

Basic Key Commands

- Ctrl "J"**- **Joins selected objects** together.
- "F" key**- **Makes a face in edit mode** of the selected vertices. You can only select 3-4 vertices at a time to make a face. By selecting 2 vertices and pressing F will close shape.
- Alt "F"**- **Will Face or Fill** a closed set of selected vertices.
- Ctrl "F"**- Brings up a **"Face Specials" menu** with other face options.
- Shift "F"**- **Camera Flying** is enabled and will cause the camera to "fly" through the scene.
- "X" or Delete**- **Delete** selected objects, vertices or faces.
- "K"-LMB** In *edit* mode, K and left mouse button will allow you to **slice faces**.
- Ctrl "R"**- In *edit* mode, will bring up options to **slice or cut faces**.
- Shift- "S"** In both *edit* and *object* modes, this will give you options to **locate objects or the cursor** to assist in precise placement.
- Function Keys**- F1-Load File; F2-Save File; F3-Repeat History; F11-Last Render; F12-Render
- "I" Key**- The "I" key is used to **insert animation keys** for various things. Objects can be animated with basic Rotation, Location and Size keys and combinations thereof.
- "T" Key** Opens the **Toolbox** at the side of your viewport.
- Ctrl "T"**- Used to create a **Track To Constraint** to make one object follow another (like a camera with a target).
- Ctrl "S"**- Used to **Save** your Blender file
- Alt "C"**- Used to **convert meshes, text and curves**. For example, text can be converted into a mesh for other transform options.
- "Shift" "Space"** Toggles between **multiple screens to full screen** of active view port. Can also use **"Ctrl"- "Up Arrow"** to do the same thing.
- Ctrl "0"**- If using multiple cameras, this will **switch to the selected camera**. (Number pad "0")
- Armatures**- Meshes can be controlled by "bones" or armatures. Create a mesh with vertices at the joint locations, then create an armature string within it. Child/Parent the mesh to the armature using the armature option. You can then animate in Pose Mode.
- Ctrl-Tab**- Puts you into **Pose mode** for manipulating armatures.
- Import/Export**- Blender accepts many different file formats through the import/export commands. When inserting other Blender files or objects into another scene, use the APPEND option from the file menu and select the appropriate options. Multiple objects can be selected with Shift-Right mouse button.
- Multiple Viewports**- To create multiple viewports, move your cursor to the upper-right corner of an existing viewport. When your cursor turns into a "+" over the tab triangle, press LMB and drag to spit viewport area. To join areas, repeat the process.

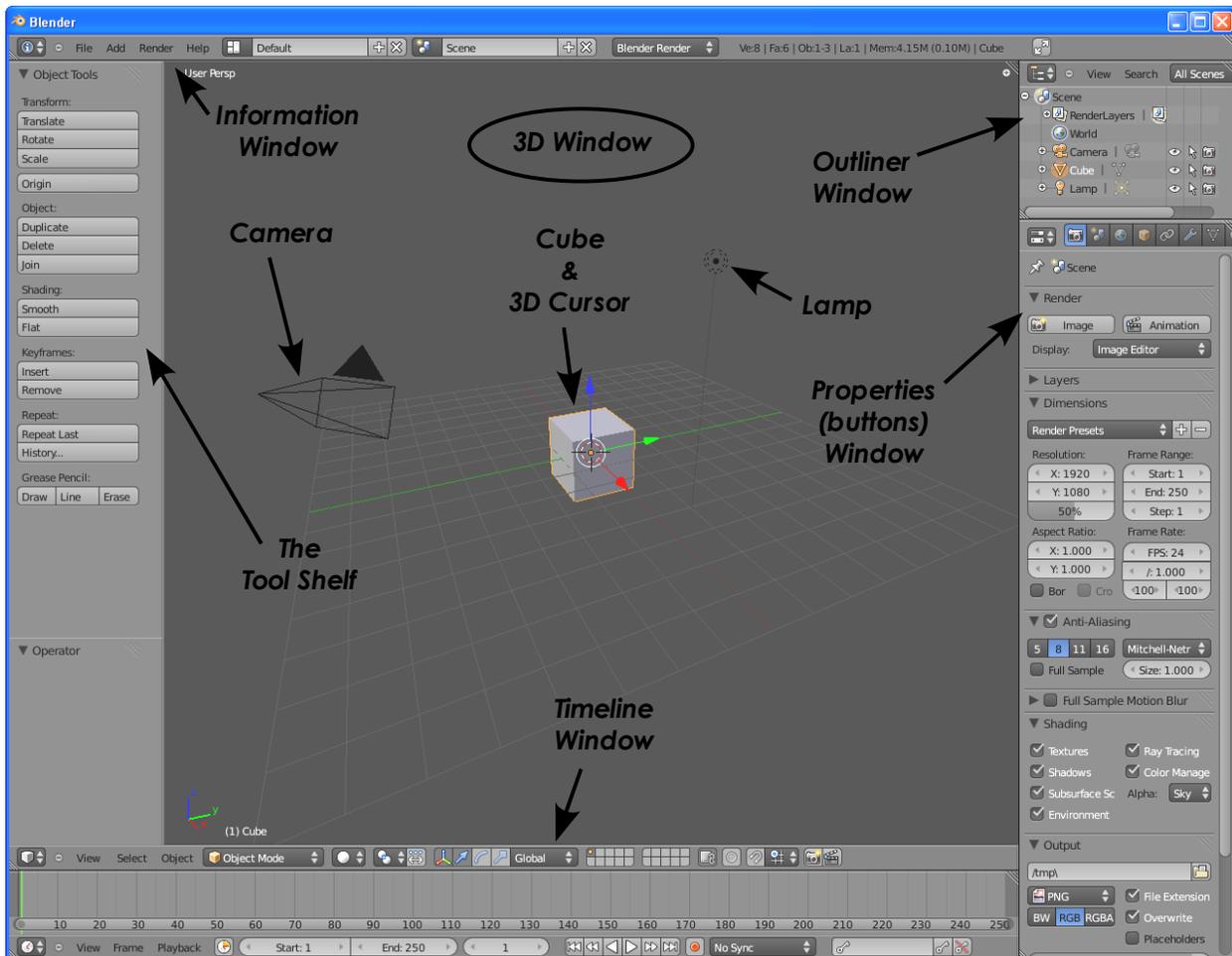
The Basic Blender Buttons:



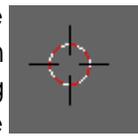
Chapter 1- The Blender Interface

The Blender Screen

Years ago, when I first looked at Blender and read some tutorials I thought that this looked easy and made sense. After taking the program for a test run, I decided to forget about it for a while because I couldn't make anything. The interface is different than any other programs I've experienced before. I thought I'd try again and after a few weeks however, things began to make sense and I realized the potential of the program. Even if you're familiar with previous versions of Blender, the new 2.5/2.6 interface is a drastic change! Here's what you are looking at when you open the program:



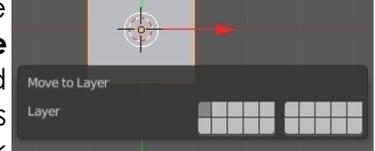
You are looking at a scene consisting of a cube, lamp and a camera. The cube is a basic mesh object to give you something to look at, a lamp to illuminate the scene, and a camera to show the scene. Older versions of Blender may open with different scenes, but the idea stays the same. The 3D cursor in the middle of the cube is used to locate where new items will be placed. It can be moved around on the screen by clicking the Left Mouse Button (LMB). Along with familiar pull-down menus like other programs, you have multiple viewports on the screen serving different purposes. We will talk about these later and how they can be changed.



3D Cursor

Chapter 1- The Blender Interface

Blender works with layers much like other programs where objects can be placed in different layers and displayed as needed. It's a good idea to get comfortable with layers because as your scenes get bigger, turning layers on and off help with the speed of your work and being able to see things better. To change things between layers, select the object with the **Right Mouse Button (RMB)** and type **"M" for move**. Try it with the cube and change layers. By the way, if you put it in a layer that's turned off, it will disappear. To turn that layer visible, click



(LMB) on that button. To turn on multiple layers, hold down "Shift" and click on the buttons. Layers containing objects will display a dot.



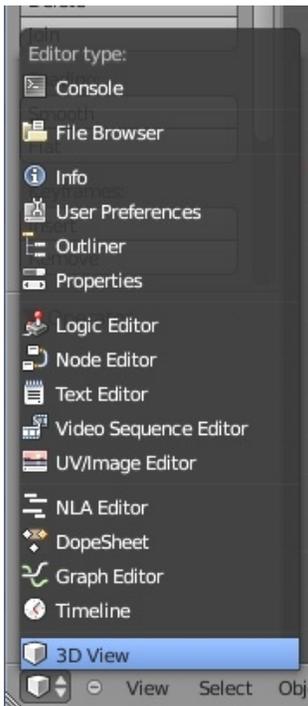
RoboDude Asks:

"How do I select multiple objects in Blender?"

Hold down the "Shift" key while using the RMB (Right Mouse Button).

Window Types

Blender has a variety of different window types and every window can be set to any type. For example, your initial screen has 5 windows (see previous page), the top one with the tool bars (Information window), the 3D window, and the bottom Timeline window. On the right, you have the Outliner and Properties windows. The button to change window types in the upper or lower left corner of each window. There are a lot of window types. The ones we are most interested in are:



File Browser- usually comes up automatically as needed

Info- menus, screen, scene and render engine options

User Preferences- can be selected from the "File" menu

Outliner- displays all objects in your scene and settings

Properties- once called the buttons window, where most settings and scene options occur

Logic Editor- game and real-time animation controls

Node Editor- post-production effects for a scene

Video Sequence Editor- compile final movies with images, effects and sounds

UV/Image Editor- setting textures for games and movies

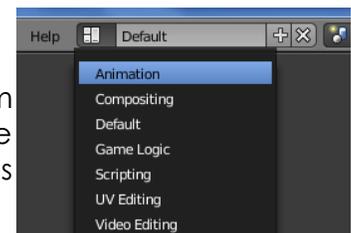
Graph Editor- replaces IPO window- displays animation data

Timeline- animation timeline with display and record controls

3D Window- your basic 3D scene window to work in

Ready-Made Screens

Blender has several ready-made screens for you to choose from that make optimal use of these windows. They can be accessed from the top pull-down menu area. Besides "Default", you can choose depending on what you're doing.



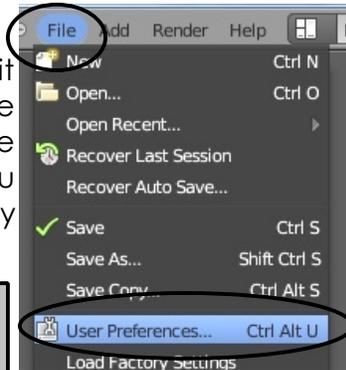
Chapter 1- The Blender Interface

The User Preferences Window

The User Preferences Window can be called up by selecting it in the “File” pull-down menu. This is where you can customize Blender to react to your particular needs. If you would like these setting to be in place every time you open Blender, you can save them by clicking the “Save As Default” button or by pressing **Ctrl “U”**.

RoboDude Says:

Be careful to only use this setting at the beginning of a drawing session and on your own personal machine (not school computers). If a drawing is open at the time, that drawing will automatically open every time you use Blender. It will become the default scene and replace the cube, lamp and camera basic setup!



Blender works well using the default settings, but there are several things you may want to change for your own use to streamline your work flow or react better for your computer. By looking at the tabs across the top of the window, you can select options in several areas. Here are a few you might want to look at:



Editing Tab- Instead of new objects aligning to the “World”, you may want to try “View”. The Global “Undo” steps are defaulted for 32. If this isn't enough, add more.

Input Tab- The “Emulate Number Pad” option is great for laptops without number pads.

Add-Ons Tab- There are some great add-ons included. A good one is “Dynamic Space Bar Menu”. ***This will emulate the space bar as in previous Blender versions.***

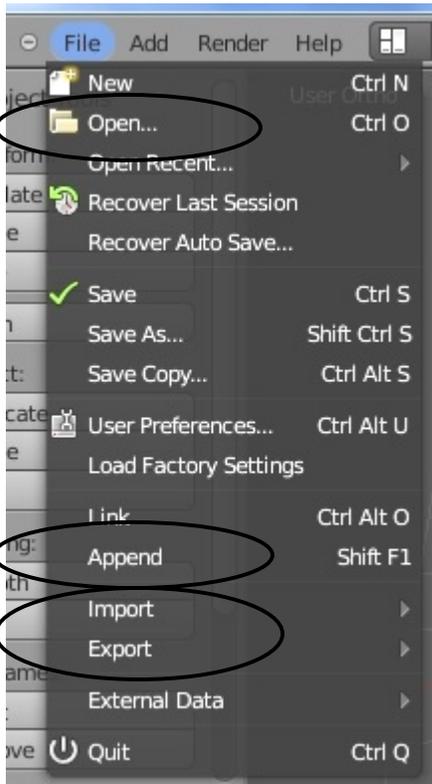
Themes Tab- This is where you can change the appearance of everything!

File Tab- If you save sounds, textures, etc. in specific folders, set the paths to save time.

System Tab- If you need to make adjustments to sound and memory or game setting, they can be done here.

Chapter 1- The Blender Interface

Open, Saving and Appending Files



Blender utilizes commands similar to other programs when it comes to saving and opening your work with a few exceptions. Blender can use the “**Open**” command to open Blender (.blend) files and the “**Append**” command to bring in elements from other Blender files into another Blender file. The open command can be used to import VRML (.wrl) and .DXF files from other programs. These are generic file interchange extensions that most programs can work with. Blender also has extensive **Import** and **Export** options in the file menu.

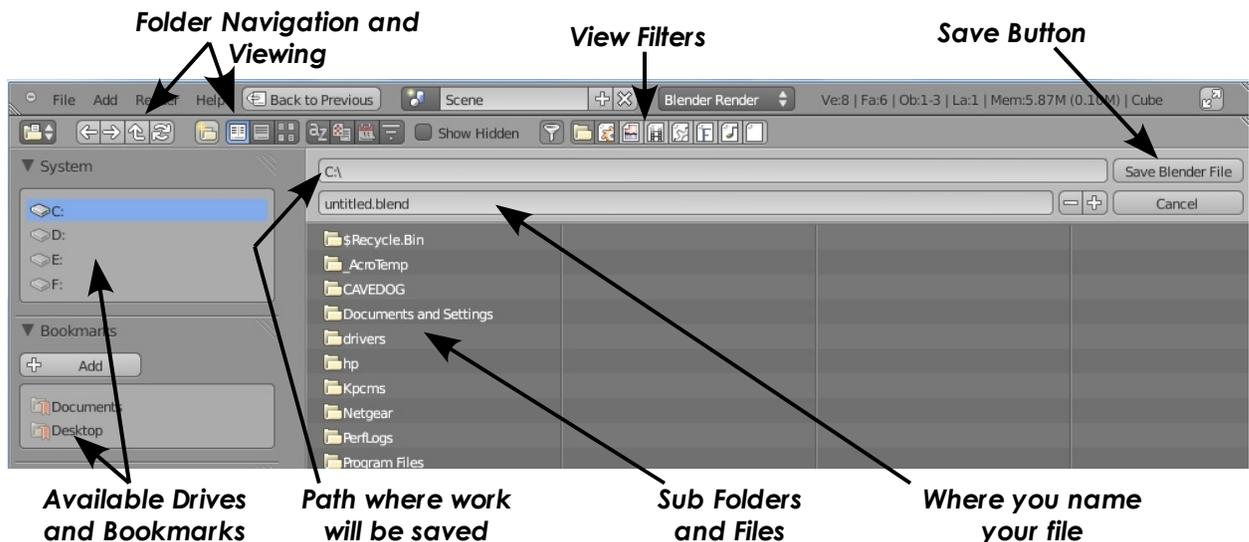


RoboDude Says:

Be careful to save your work often! Unlike most programs, Blender will not warn you to save your work when exiting the program- it will just close, losing any work you may not have saved.

The Save Command:

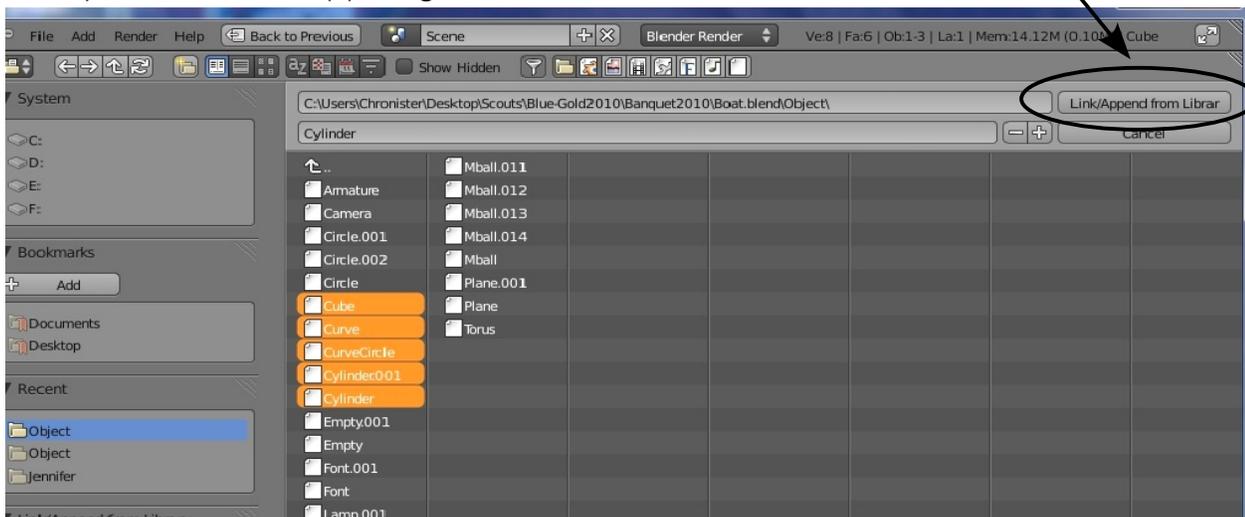
When you first start working with Blender, it seems almost impossible to figure out how to save your work, even with the improvements in 2.6. The file interface almost resembles old MS-DOS. Also, every time you save over an existing file, your previous save becomes a back-up file and is saved with a new extension (.blend1). This always gives you a back-up if a problem occurs. Here's what you see when you hit the save command:



Chapter 1- The Blender Interface

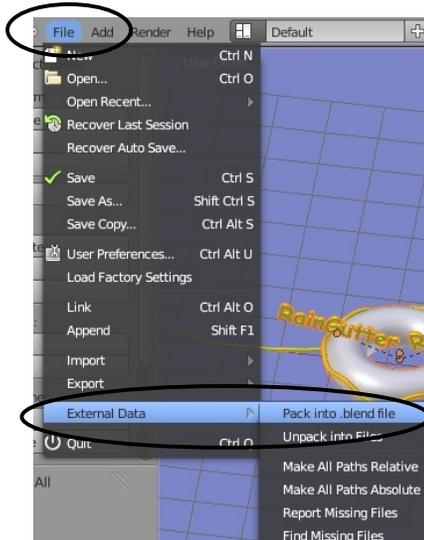
The Append Command:

When you need to insert elements from one Blender (.blend) file into another one, you need to use the **Append** command from the file pull-down menu. While in Append, you need to navigate to the Blender file you wish to insert from, then select what you want to append into the open file. 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 objects will select/deselect them (hold down "Shift" to select multiple objects). Typing "A" will select them all. After you select all objects to append, click the "Link/Append from Library" button in the upper right corner of the screen.



The **Link** option allows you to link to another Blender file rather than inserting it into the open file and also found in the File menu. This option allows for changes to the linked file that will be automatically updated when the other file is opened.

Packing Data



If you plan to open this 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 model. 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, however, your file size may explode. *When data is packed, a small package shows up on the top of your screen letting you know that the file is packed on older versions of Blender-not 2.5 versions.* You can also unpack data to bring the file size back down.

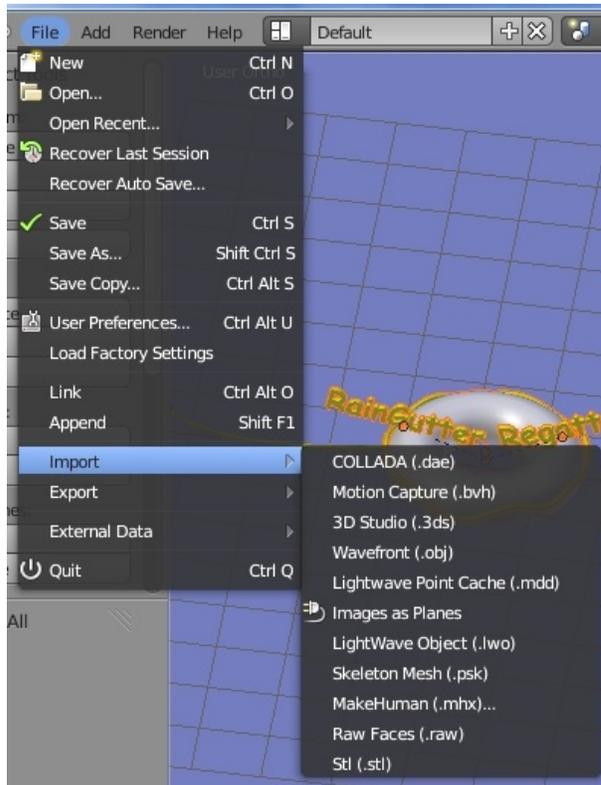
Chapter 1- The Blender Interface

Importing Objects (from other file formats)

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

- VRML (.wrl) files- Many programs are able to export their files as VRMLs. SolidWorks is a good example that we use. These files import into Blender without any problems in most cases.
- .DXF files- A very popular file format for exporting and sharing. AutoCAD and SoftPlan architectural software traditionally exports with .dxf formats. Again, Blender usually accepts these files flawlessly.

To save a file as one of these types from another program, you will need to find an *export* command or a "save as" option. This will vary depending on the program you are using. Refer to that program's help files. To import a VRML or DXF file into a Blender scene, open a new drawing or one you wish to insert the object(s) into. You will simply need to use the Open command in the File pull-down menu. The program knows that you are trying to open something other than a .blend file and will insert it into your current scene. Now you need to find the object(s) you just inserted. Depending on how that object was drawn, it may need to be re-sized or rotated. If the Open command doesn't work, then use the Import command.



With every new release of Blender, the import/export format options list grows. This makes Blender much more compatible with a variety of other 3D modeling and animation software programs. You should be able to find a format in the list that will work with your other programs.

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.

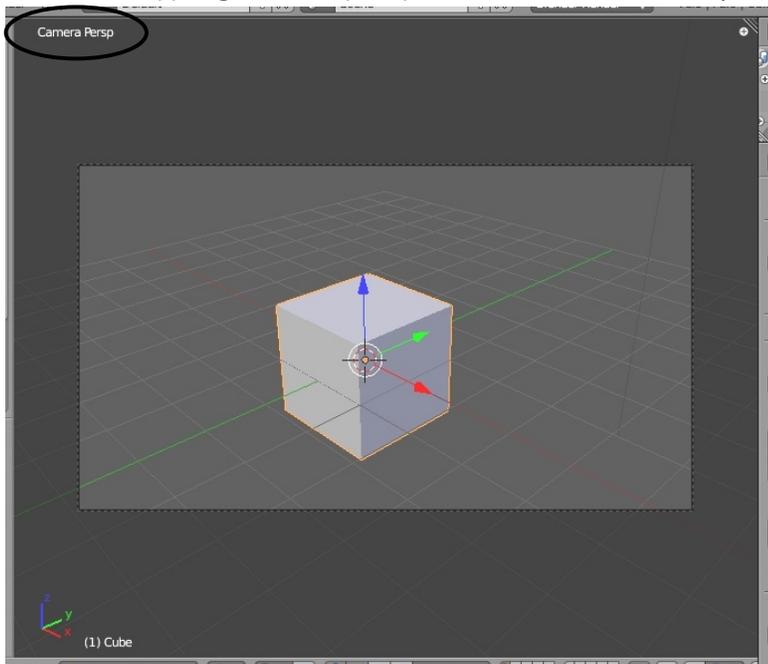
If a file format isn't available, check in the "Add-Ons" section in the User Preferences menu. There may be an add-on script written for your file type, but not turned on.

Chapter 2- Working with Viewports (windows)

Moving Around 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, you should have some skills in 2D drawing and layout.

Moving around in the 3D window is controlled by the mouse and the keyboard number pad (NOT the numbers across the top of the keyboard- these change layers). Think of a standard 3-view orthographic drawing- top, front and right side views. These views match up with the number 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 typing those numbers. Typing "0" will put you into camera view (what the camera sees).



By default, the camera is represented by a single line, representing the edge of what is rendered and shaded to the outside. You also have the option of turning on an additional dashed line box to represent a *Title Safe* box (helpful in planning). Changing these settings will be discussed in a later chapter. You will also notice a small note in the upper-left corner of the viewport telling you the view name and if it is orthographic or perspective.

The number pad 5 key will always toggle you between perspective and orthographic views. The number pad arrow keys (2,4,6,8) will rotate you around in 3D space. The "+" and "-" keys on the number pad will zoom in and out. The number pad "." (period) key will center your view up on the selected object on your screen. **"Ctrl" and 7,1, or 3 will give the opposite view.**

The mouse serves a number of functions. The Left Mouse Button (LMB) will move the 3D cursor around on the screen and for dragging windows for selecting objects. *Wherever the 3D cursor is located is where the next item you create will be placed.* The 3D cursor serves other purposes that we will discuss later. The Right Mouse Button (RMB) is used to select object or vertices (in edit mode). The mouse wheel serves 2 purposes. Scrolling the wheel zooms in and out (like the + and - keys). Holding down the mouse wheel will let you rotate the view. Holding down Shift and Mouse Wheel will let you pan around on the screen.

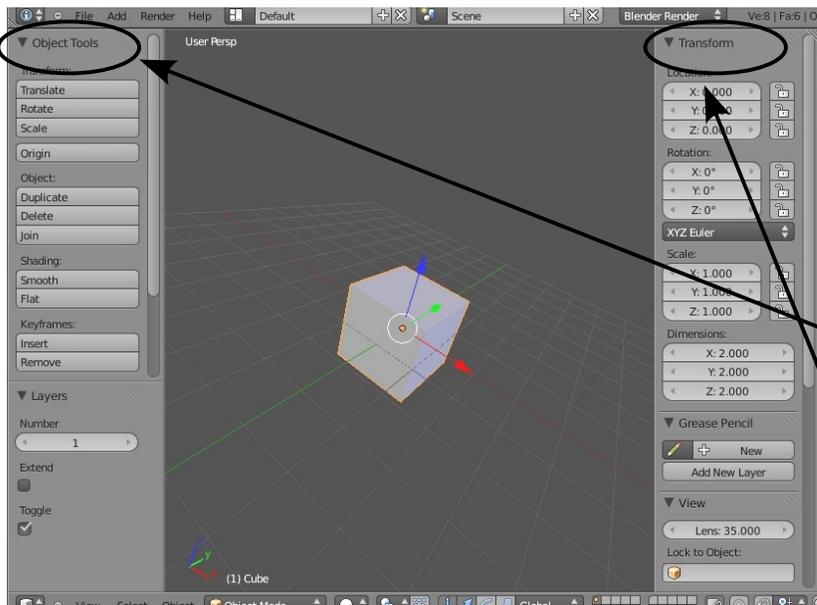


RoboDude Says:

Practice using these controls before moving on to other lessons. Without getting a grasp on working in 3D space, you will have a difficult time creating and modifying objects.

Chapter 2- Working with Viewports (windows)

Window and Button Control



So now you know how to save your Blender file and move around in 3D space. We're still not really able to create anything yet, but soon. You have a default screen with several viewports. You may have noticed that along with the *Tool Shelf* on the left side, you can also have a *Transform* panel on the right of your viewport. These are definitely useful panels as you will soon see, but they take up a lot of space. You can minimize them by

dragging on the edge of them with the LMB while your cursor looks like a left/right arrow. So how do you bring them back out when you need them? With your cursor in the 3D window, you could type "T" for the *Tool Shelf* or "N" for the *Numeric Transform* panel. This will open the panels up again (pressing either button a 2nd time will close the panel up). You can also click on the small "+" symbols at the sides of the viewport to open them.



The 3D View Window Header:

A lot of the key commands we will talk about in the book can be controlled in the Window Header. Some of the common operations found there are:



Scrolling in the Properties Panel:

You may notice that many of the buttons and panels are off the screen. Accessing those buttons can be done by holding down your mouse wheel (like it's a button) and using it to pan



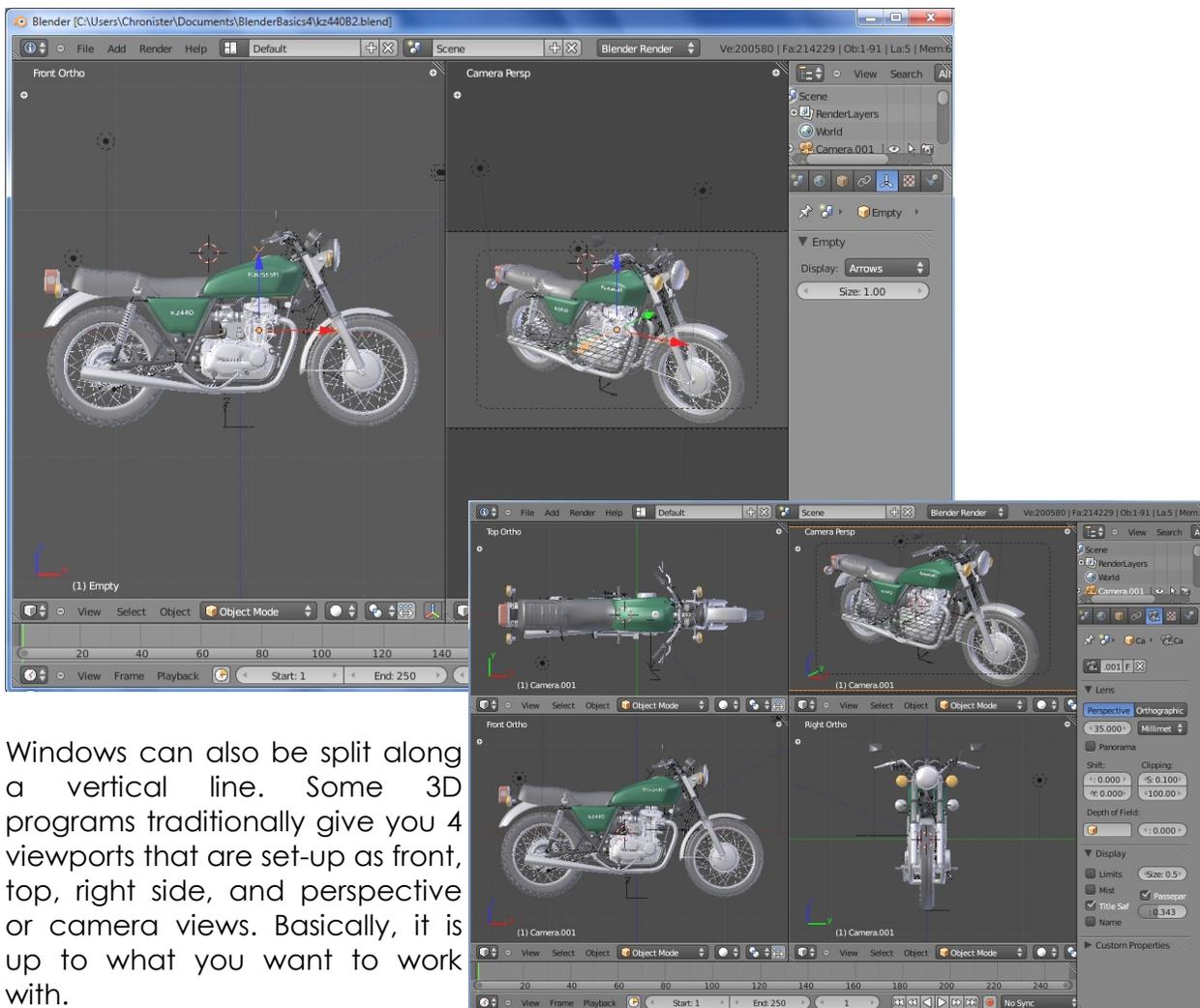
left-to-right. The same can be done to access the panels below the buttons. You can also use the "+" and "-" keys on the number pad to zoom in and out on the panels.

Panels can also be minimized and maximized to take up less space by clicking on the small triangles found on each.

Chapter 2- Working with Viewports (windows)

Creating Viewports (also called windows)

Most times, you need more than one 3D window to work with since you're trying to locate objects in three dimensions. Most rendering and animations programs allow for multiple viewports along with graphical views of various data. Blender allows the same. Remember that Blender starts with 5 viewports, but only one 3D View window (discussed on pages 1-1 and 1-2). You can change the size of any of these windows by using the LMB and dragging on the line between the viewports. In order to split a viewport, move your cursor over the *small triangle in the upper right* corner of the 3D View Window. When the cursor turns into a "+", drag with your LMB to split your screen into 2 viewports. Joining viewports together works the same way. Click on the triangle and drag over the viewport you wish to remove. There's no limit to the number of times you can split your windows. I like to traditionally work with 2 views like the example shown below. I use the left view to flip between my principle views (top, front, side) and the right view for camera view and animation tracks (which we'll discuss later). In the view shown below, I've minimized the Tool Shelf and Transform Panel to maximize screen space.

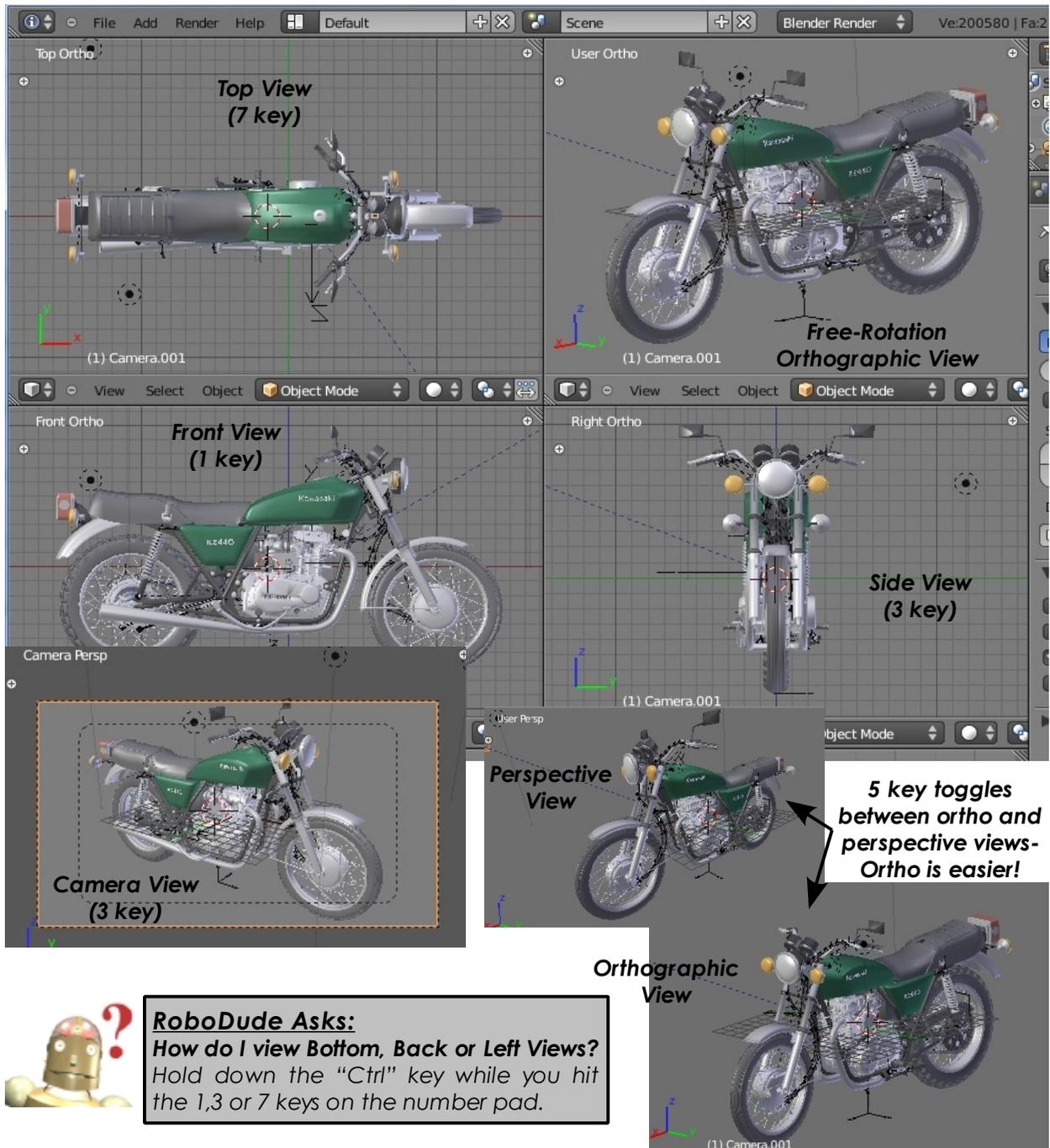


Windows can also be split along a vertical line. Some 3D programs traditionally give you 4 viewports that are set-up as front, top, right side, and perspective or camera views. Basically, it is up to what you want to work with.

Chapter 2- Working with Viewports (windows)

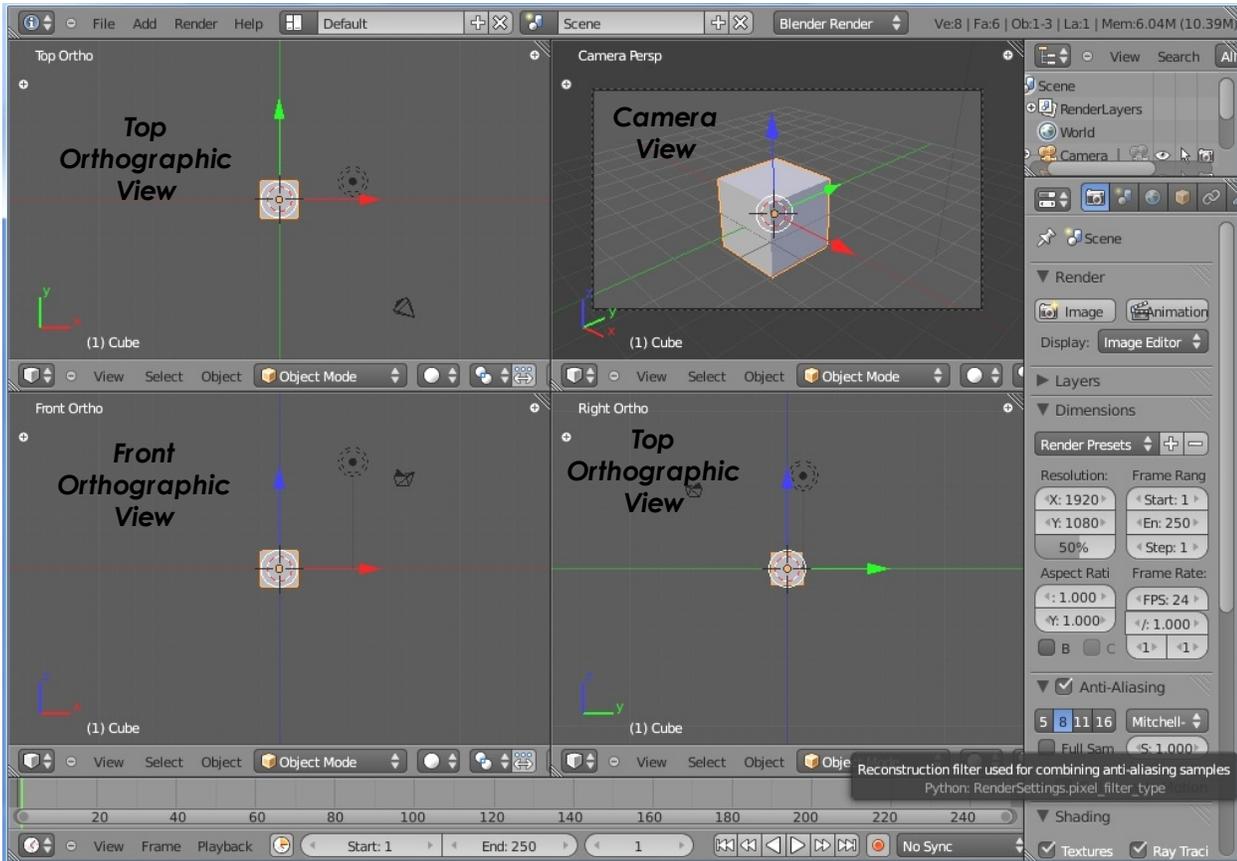
Typical Views and Buttons:

Here are some typical views used to model in 3D and the buttons on the **number pad** to go along with them. In order to make them work, you need to have the "Num Lock" button pressed. Get use to working with the principle views (top, front, side) in orthographic mode when locating the 3D cursor. You will usually need to check the location of the cursor in at least 2 views when placing objects. New to Blender 2.6 is that the name of the view is displayed in the upper left corner of the viewport.



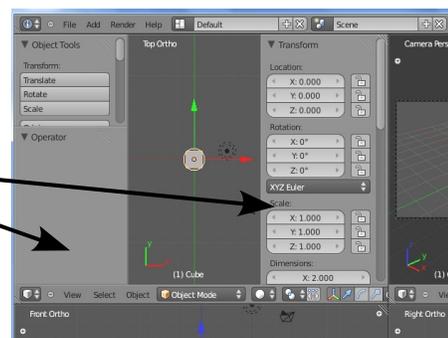
Viewports Practice Exercise

In order to get some experience with these commands, set up a screen with four viewports using a top, front, side and camera or perspective views as displayed below:



Be prepared to be able to demonstrate the following techniques to the instructor when asked:

- *Panning around on the screen, scrolling the buttons/panels*
- *Zooming*
- *Changing window types*
- *Centering the view on a certain object*
- *Switching views (top, front, side, camera, free-rotate)*
- *Opening and closing the Tool Shelf and Transform Panel*



**** Call the instructor when finished****

Chapter 3- Creating and Editing Objects

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 chapter we will talk about creating basic shapes and using modifiers to form them. There are a lot of different types of things to draw in Blender. Right now we will only discuss Meshes.

Start a new drawing in Blender and save it in your "My Documents" directory. Call it Sculpture. Since there a variety of operating system and saving structures, you may need to set up folders as needed.

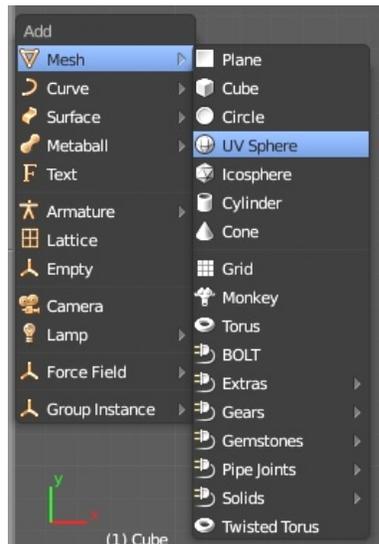


RoboDude Asks:

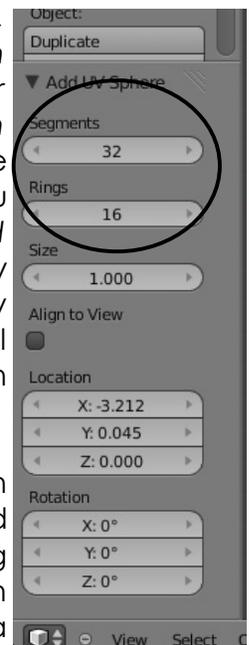
Why do I keep losing my work?

Blender will not prompt you to save you file when exiting the program.
Remember to always save your work often!

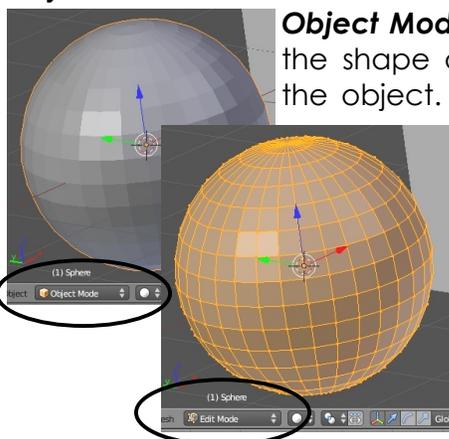
Placing Objects On Your Screen:



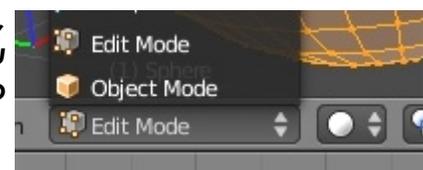
The 3D Cursor (bull's-eye) location is used to place new objects. Use the left mouse button to move the cursor in 3D space. When you have it in a good location, press **Shift-"A"** to bring up the insert menu. Select **Add**, then **Mesh** and select **UV Sphere** (my mesh menu may display more items than your menu due to selecting different Add-Ons in the preferences menu). You will then be asked how many segments and rings you want in the **Tool Shelf** (open this if closed with the "T" key). You can change these by dragging the mouse in the block or by clicking in the box to type. Your sphere will change to reflect your settings. You can also adjust some other settings there.



When you place an object in Blender, it comes into the scene in **Object Mode**. There are basically 2 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. Object mode affects the object as a whole. The **Tab** button toggles you between the two. You can also see and change your mode at the bottom of the viewport. **After inserting an object into your scene, always make sure you're in Object Mode. Otherwise, the next object you create will be joined to that mesh!**

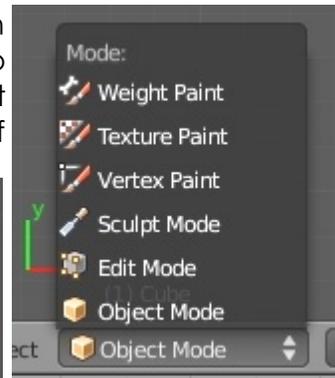


Chapter 3- Creating and Editing Objects

As mentioned on the previous page, another way to switch between **Edit** and **Object** mode besides using the **Tab** key is to use the **Mode menu** at the bottom of the 3D screen. Notice that there are a few more modes than just Edit and Object. Some of these will be discussed in later chapters.

Precise 3D Cursor Placement:

To precisely place the 3D cursor, use the “**Shift-S**” keys for options to move the cursor to objects, grid, and vice-versa.



Mesh Types

When pressing the space bar and choosing to add a mesh, you will notice several mesh types (often called primitives) available. More can be added through *Add-Ons* in the *User Preferences* menu. They are:

	Plane-	A simple two-dimensional shape. Can be sub divided and used with proportional vertex editing to make nice hilly terrain or shaped.
	Cube-	Basic 3D shape. Nice object to start with to shape into rectangles and other shapes.
	Circle-	Won't display as a 3D object unless filled, but can be extruded and shaped.
	UV Sphere-	A sphere generated with rings and segments, like the latitude and longitude of the earth.
	Icosphere-	A sphere generated with triangular shapes. Like Epcot Center.
	Cylinder-	Like a can, with ends closed, but if you leave the ends off, it is a tube.
	Cone-	Basic closed cone shape.
	Grid-	Can be used and extruded like the plane.
	Monkey-	A fun shape that someone decided to include in the mesh list.
	Empty Mesh-	A mesh without any visible verticies, edges or faces.
	Torus-	A donut shape.



RoboDude Asks:

How do I set the quality of a mesh?

Remember that after selecting a mesh type, you will see the setting for that mesh at the bottom of the *Tool Shelf*. Also, don't forget to be in **Object Mode** when making a new mesh- otherwise, your new mesh will be joined to another mesh.

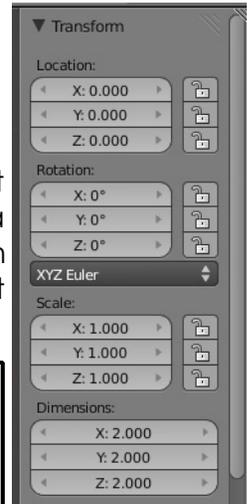
Chapter 3- Creating and Editing Objects

Using Main Modifiers to Manipulate Meshes

Before we look at actually changing the shape of the meshes and turning them into other shapes, we should become comfortable with creating, moving, rotating and scaling basic meshes. The three main modifying commands used in Blender (in Object mode) are:

- “G” key- move or grab and object
- “S” key- sizing or scaling an object
- “R” key- rotating an object

If you would like to do any of these operations through an exact number (i.e. rotate 90 degrees on the X axis or size something to a specific number), type the “N” key to bring up the Transform bar on the right side of your screen (or click the small “+” at the top right corner). You can also lock numbers.

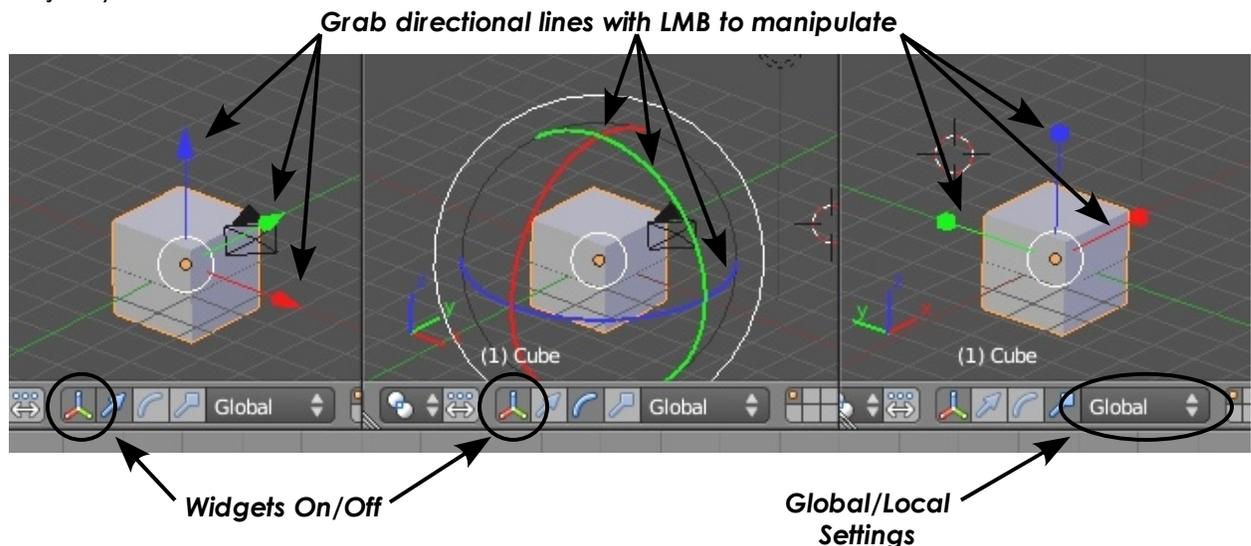


RoboDude Says: If you would like to move something along a straight axis line (X,Y,Z), enter the Move command and drag the object the direction you wish to go. Press the mouse wheel (don't scroll, press it like a button). The object will lock on a straight line. In the Move command, you can also type X,Y, or Z.

You may be wondering- “What are these units of measurement?” By default, you are measuring in Blender Units. We will look at changing this to an actual metric or imperial system later.

Using the Transform Widgets:

Rather than typing R,S or G to manipulate an object, you can turn on the widget feature and simply grab the axis you wish to change. You can also change the motions to reflect Global (normal X,Y,Z planes), Normal or Local (X,Y,Z planes in relation to the object) movement.

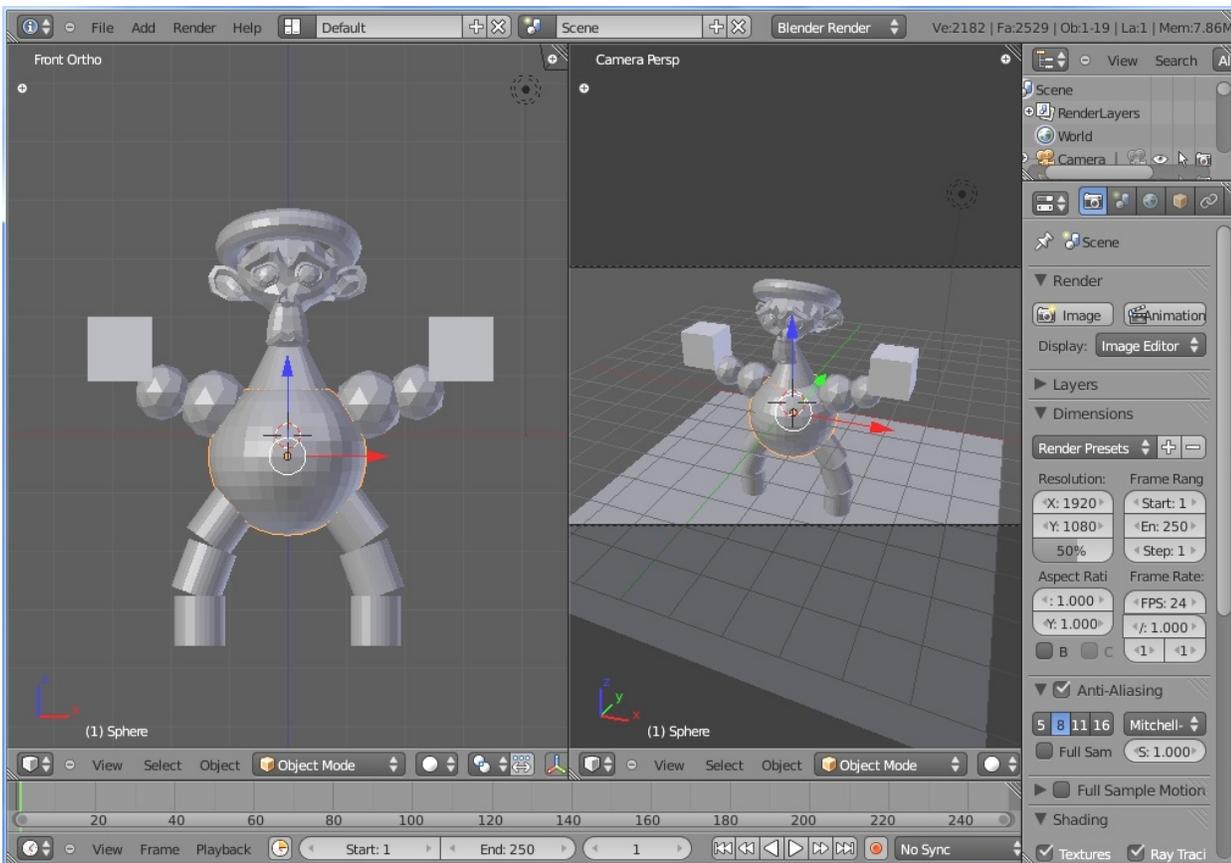


Create a Sculpture Practice Exercise

Create a sculpture using at least 1 of every type of mesh found in the *Add-Mesh* menu (do not use grid or circle). Remember to make sure you are in **Object Mode** before creating a new mesh. Use a plane for the ground and scale it large. Divide your 3D window into two so you can have one working view and one camera view. Use the RMB to select objects on the screen. Experiment with sizing and rotating objects. New commands:

Size	("S" key)- to change the size/scale of the object.
Rotate	("R" key)- to rotate the object.
Move	("G" key)- to change the location of objects.
Duplicate	(Shift-"D")- to make a copy of something on the screen.
Shaded	("Z" key)- used to toggle the window from wireframe to solid view.
Tool Shelf	("T" key)- shows editing commands and setting mesh detail.
Transform	("N" key)- show the transform panel for exact placement of mesh.

Remember to make use of the number keys 1,3 and 7 to change your principle views!
Also play with the camera location and angle to get a nice view!
Save your work often!



**** You do not have to make a monkey-this is just an example of using the meshes! ****

**** Call the instructor when finished****

Chapter 3- Creating and Editing Objects

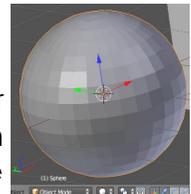
Edit Mode- Mesh Editing

After you have created a mesh, you can go into Edit mode (Tab key or Mode option in window) 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 pink or yellow dots on the selected object. Pink dots are unselected vertices while yellow dots are selected vertices.

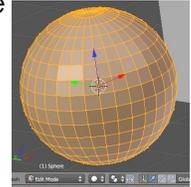


RoboDude Asks: How Do I UNDO a mistake?

Pressing CTRL-Z will take you back 1 step at a time (edit or object modes). CTRL-SHIFT-Z will redo what you undid.



Object Mode



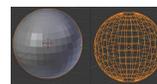
Edit Mode

Selecting Verticies:

While in edit mode, to select a single vertex, RMB click on the vertex. To select multiple vertices, hold down the **Shift** key while RMB clicking on them. To drag a window around vertices, type "**B**" key and drag a window to select. Typing the "**C**" key will bring up a circular selection tool that can be sized by pressing the "+ or -" keys on the number pad. Scrolling the center mouse wheel will do the same as "+ and -" keys. To select vertices in circle select mode, hold down the LMB. To de-select vertices, hold down the mouse wheel. Pressing "**Esc**" will get you out of the circular selection tool. **In order to select all vertices or deselect currently selected ones, hit the "A" key (for all) once or twice.**

Viewing (Shading) Options:

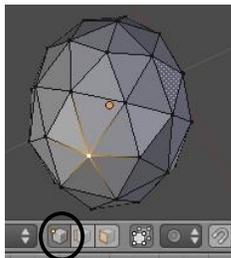
In order to be able to see your objects better in object and edit modes, you can change the way your scene is displayed. The main options are Solid and Wireframe and changed with the "Z" key, but other views are available. All are available in the bottom of the 3D window by the drawing modes.



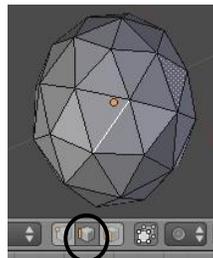
Solid Wireframe

Edit Mode Selection Options:

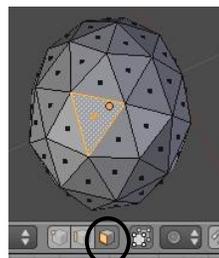
By default, you are selecting vertices, but you can also select edges and faces. You can find these options at the bottom of the 3D window while in edit mode.



Vertex Select



Edge Select



Face Select



In Solid view, this button will hide back faces, edges and vertices. (Occlude background geometry)

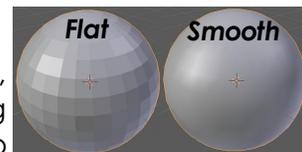
After selecting the vertices, you can use the same basic modifiers we talked about in the previous exercise ("**G**"-grab or move, "**S**"-scale, "**R**"-rotate).

Chapter 3- Creating and Editing Objects

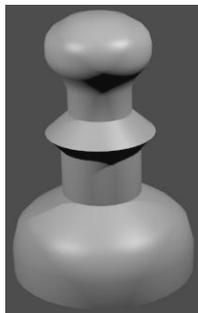
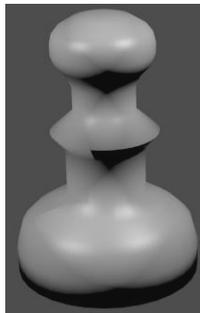
Using the Shading Smooth-Flat Options and Auto Smooth:



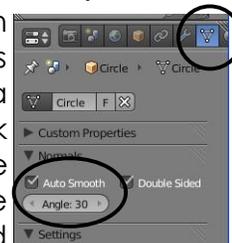
As you add objects and view them in Flat shading, you will notice that circular objects are not being displayed smooth. In the *Tool Shelf*, you will see two



buttons under Shading labeled **Smooth** and **Flat**. These 2 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 quality as a final rendered image.** **Auto Smooth** (found in the *Object Data*



buttons) is used to smooth objects when faces meet at a certain degree or less while larger angles are kept sharp. This is a great feature when *Smooth* does not work properly alone. To use *Auto Smooth*, hit the *Auto Smooth* button. Adjust the degree angles as needed. To see a rendered picture of what the camera views, press **F12**. *Smooth* and *Auto-Smooth* are great for flat objects as well and help rendering.

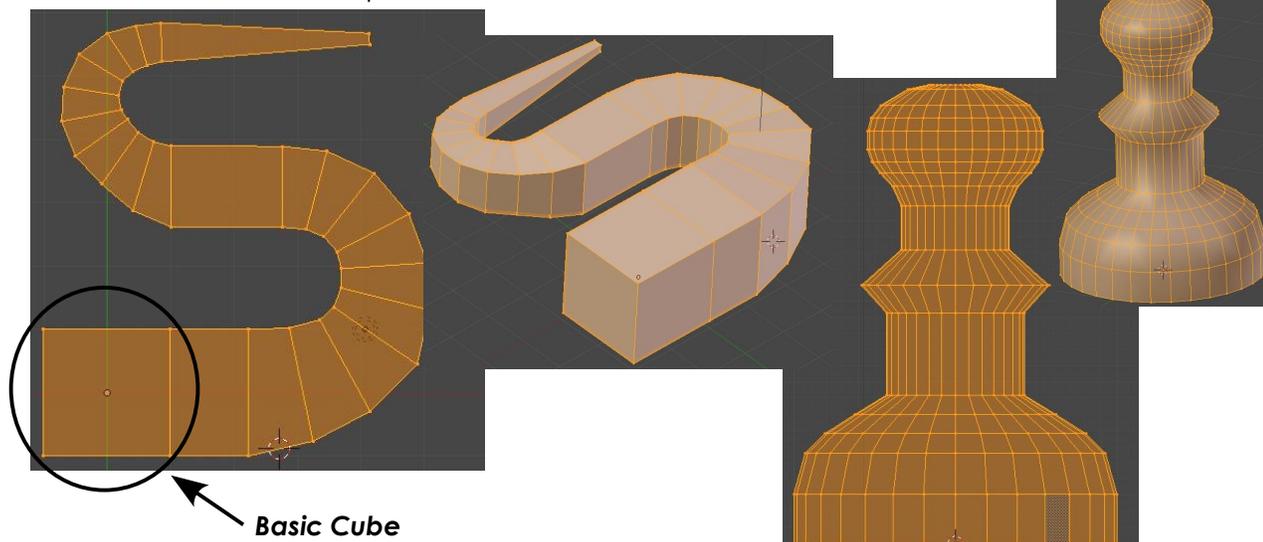


Smooth Only

Auto Smooth

Extruding Shapes:

Shapes can be lengthened by selecting a group of vertices, then by pressing the “**E**” key (or by selecting it in the *Tool Shelf*). You will make a duplicate of those vertices. They can then be “**G**” (moved), “**S**” (scaled), and “**R**” (rotated). When extruding a face, it will extrude in a locked direction, perpendicular to the face. When extruding connected vertices only, the extrusion will be free-moving. If you use the “*Extrude Individual*” command in the *Tool Shelf*, it will extrude only the vertices and no faces (it won't be visible in 3D). Feel free to experiment with them. Below are example of a cube, extruded from the right side (only right 4 vertices were selected) several times using scale and rotate and a pawn extruded from a circle.



Chapter 3- Creating and Editing Objects

The Tool Shelf

If you're familiar with older versions of Blender, this is a big change. In edit mode, you were able to access several edit commands with the "W" key (Specials Menu). You still can, but most of these options are now in the *Tool Shelf* as well. There are also commands that were once grouped in Editing buttons in the tool shelf. Here's what you can find there and some descriptions of what we need:

Tool Shelf- Object Mode:



Transform:

Rather than hitting G,R, or S, you can click these buttons.

Origin:

Used to re-center your object's geometry and center point.

Object:

Copy, Delete or Join selected meshes

Shading:

Changes a between flat shading and smooth shading (works best with Auto-Smooth in Object Data buttons)

Keyframes:

Same as hitting "I" key for animation.

Repeat:

Repeat your last operation or a list of past operations.

Grease Pencil:

Used to make mark-up notes on your screen.

Tool Shelf- Edit Mode:



Transform:

Same as Object Mode, but for selected vertices only.

Deform:

Edge Slide- moves selected edges.

Rip- opens mesh at a selected vertex.

Smooth Vertex- smooths a selected area with clicks.

Add:

Extrude- same as hitting "E" with vertices selected.

Subdivide- cuts selected vertices and provides more detail.

Loop Cut/Slide- controlled dividing.

Duplicate- Make copies.

Spin/Screw- revolved copying.

Remove:

Deletion options, merging of vertices, and removal of double vertices.

Normals:

Flips face calculations to all face the same way. Helpful with smoothing.

UV Mapping:

Used to help make textures match the mesh.

Shading:

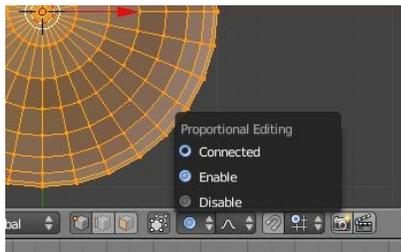
Same as in object mode.

More About the Object's Origin:

The object's origin is the small dot for an object. By default, it is in the middle of the object, but can get moved if you move an object in edit mode (moving vertices only and not the entire object). To fix this, or to move it to a usable location (for example, a door needs its origin on the edge to act like a hinge), use the origin option in the tool shelf to move the object-to-center, the center-to-object, or center-to-cursor location. Remember that the cursor can be accurately placed using the Shift-"S" command.

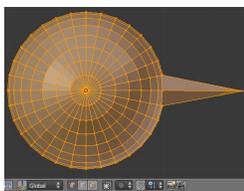
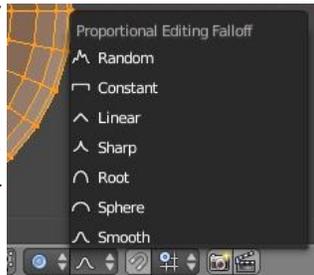
Chapter 3- Creating and Editing Objects

Proportional Editing

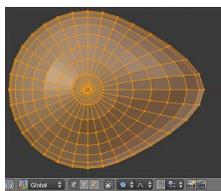


Proportional Editing is used to create a flow in the shape when editing vertices. To turn proportional editing on, press the "O" key while in edit mode or by selecting the **small circle button** on the toolbar (enable). **Proportional Editing**

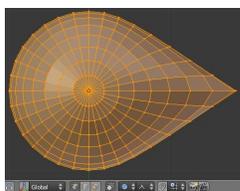
now also works in Object Mode! By selecting the prop. editing command in object mode, objects around the selected object will move proportionally with it. You have several options for effecting vertices in proportional editing. We usually use **Sharp** or **Smooth** falloff, but feel free to experiment with the other options. The examples below are with one vertex selected.



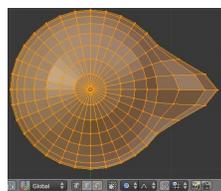
Proportional Editing "Off"



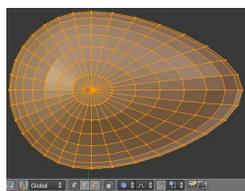
Smooth Falloff



Sharp Falloff



Small Area



Large Area

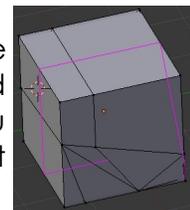


RoboDude Asks: How do I control the number of vertices affected?

By pressing the "+" and "-" keys on the number pad or by scrolling the center mouse wheel. You will see a circle on the screen that changes size.

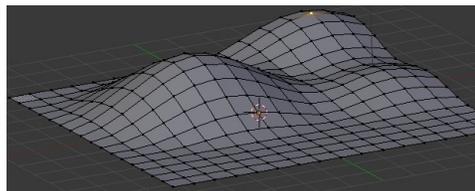
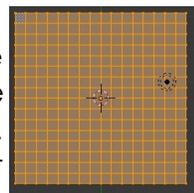
Knife/Cut Tools:

The **Knife Tool** allows you to split edges differently than the subdivide command. To use the knife tool, select the vertices you wish to cut, hold the "K" key while dragging a line across the surface you wish to split. You can also select the "Loop Cut and Slide" option in the Tool Shelf to cut around an object.



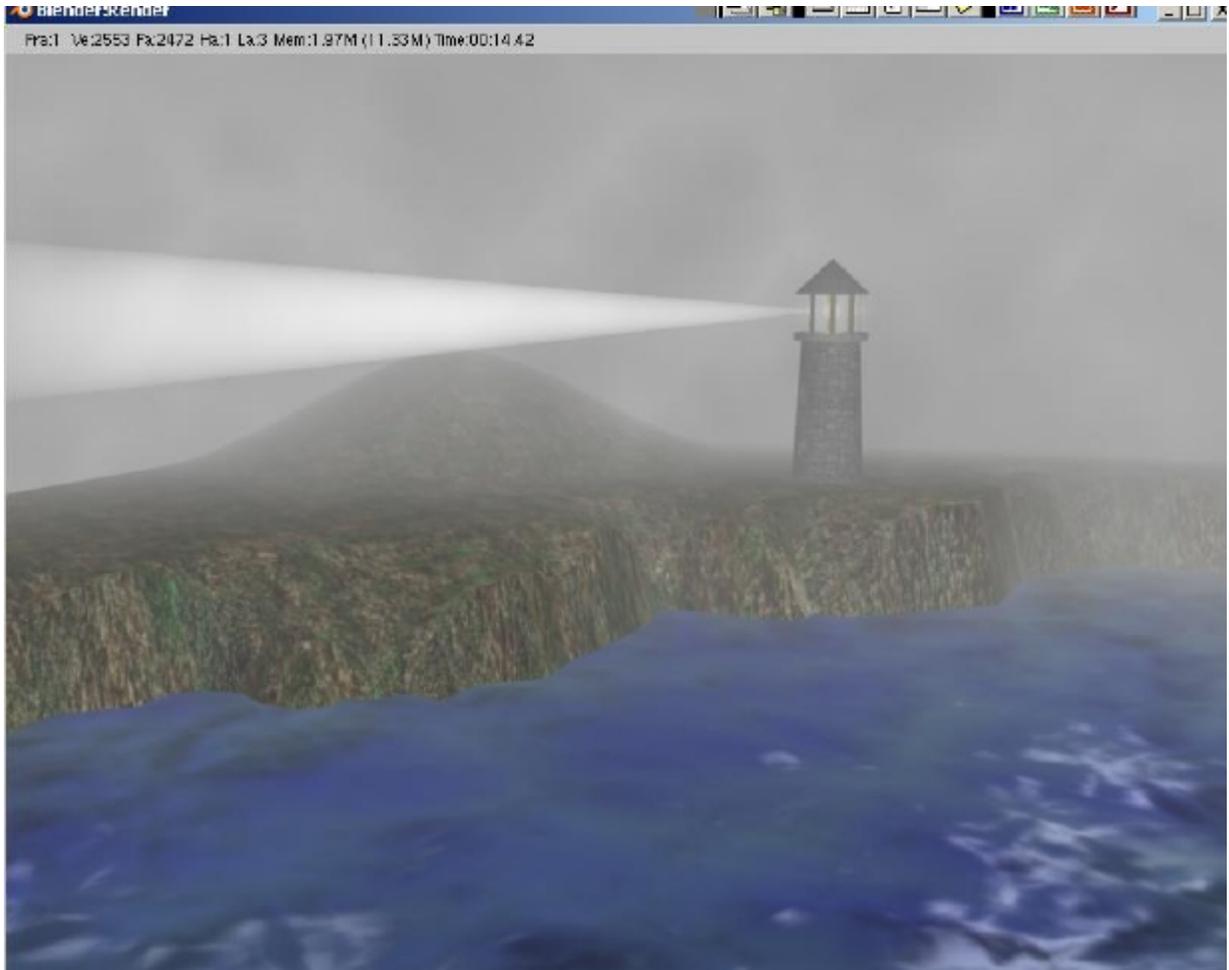
Using Subdivide and Proportional Editing to Create Ground Contour:

You can use proportional editing to create flowing landscape easily. The first thing you need to do is create a plane in the top view (**7 key**). While in edit mode, make sure all vertices are selected (vertices are yellow). You can use the "A" key to select them all. In the Tool Shelf, select "**Subdivide**". Do this a few times. Select a single vertex somewhere near center. Next, switch to a front view ("**1**" key) and enter *Proportional Editing*. Select *Smooth Falloff*. Type "G" to grab (move) the vertex. Use the "+ -" keys on number pad or scroll mouse wheel to change the size of the selection. Select other vertices and falloffs for more hills and shapes. To see your final work in a smooth display, exit edit mode ("**Tab**" key) and ,with the object selected, Select Smooth from the *Tool Shelf*. This will smooth the mesh in display and final output. Finally, hit the "**Z**" key to shade your view.



Basic Editing- Landscape and Lighthouse

Over the next several chapters, we will be developing a nice landscape scene in an effort to build your Blender skills while you become more comfortable with the program. Below is an example of what we will be completing:



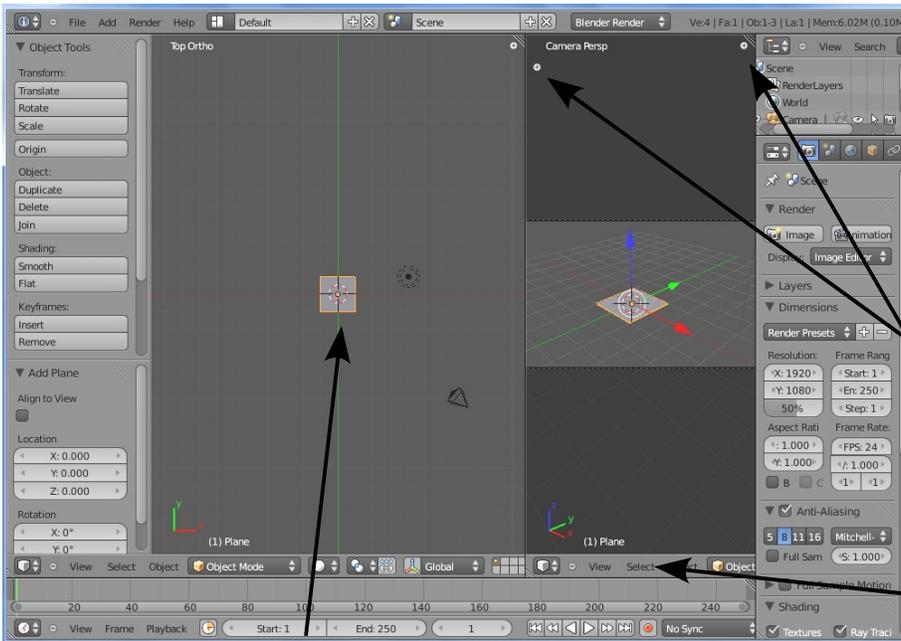
This is the basic scene, but as you work through the chapters, you will be encouraged to add more elements and details to your lighthouse and landscape to make it your own. We will eventually add rain to our “stormy night at sea” scene and animate the water, light and camera.

The first thing we need to do is create a new Blender scene and save it as “Landscape Scene”. Again, we will be using this file for the next several chapters, so keep it safe and save often! Split the workspace into 2 viewports as shown on the next page. We will use the left viewport for working in and the right one for camera and 3D views.

While in the top orthographic view (number pad 7 and 5- note the label in the top, left corner) erase the initial cube from the scene, then add a plane from the mesh menu (Shift “A”- add- mesh- plane). For now, you may want to turn off the 3D widgets and minimize the Tool Shelf and Transform Panel on the right view

Basic Editing- Landscape and Lighthouse

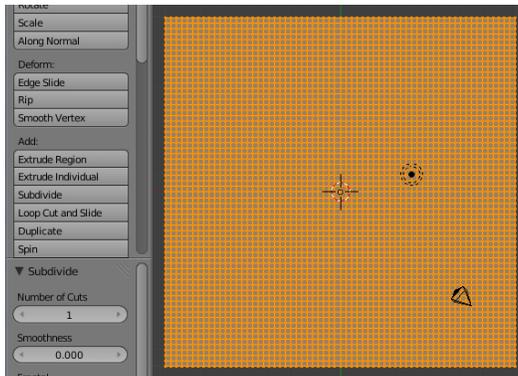
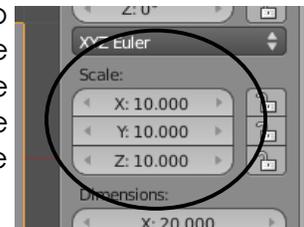
PRACTICE EXERCISE



Your scene and viewports should look something like this. To maximize workspace, you can close and open the Tool Shelf and Transform panels at any time. To re-open them, click on the small "+" or type "T" for Tool Shelf and "N" for Transform Panel.

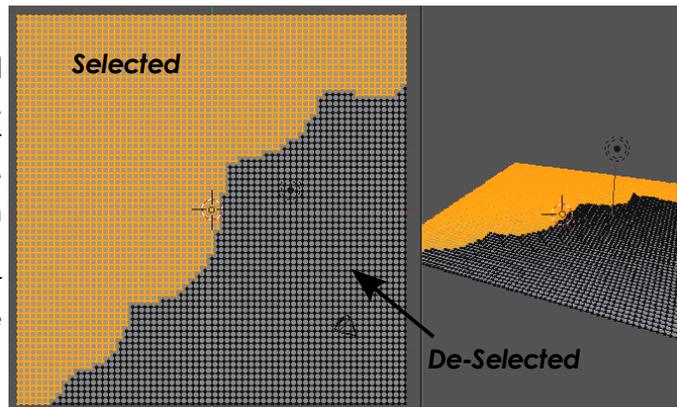
In order to see all your buttons, Hold down your mouse wheel and scroll here.

This plane will be used for our ground. Our next step is to scale it up a bit. To do this precisely, we will use the **Transform Panel**. With the plane selected and in Object Mode, press "N" to bring up the Transform Panel. Change the **Scale X, Y, and Z to 10.000**. Close the Transform Panel. You may need to zoom out to see the entire plane.



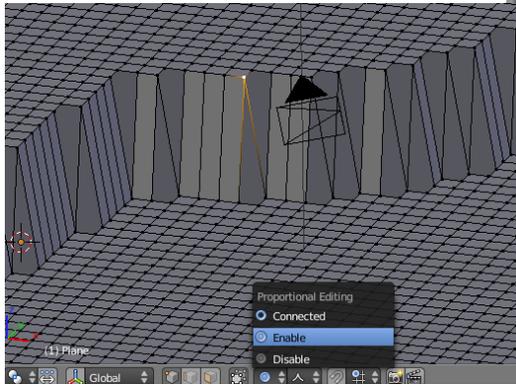
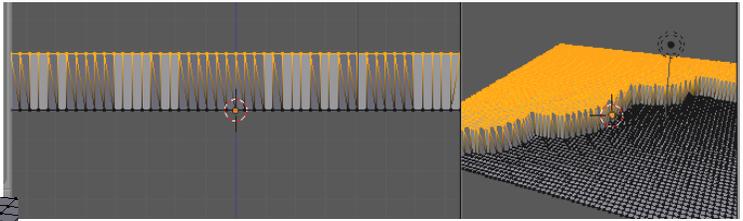
Next, go into Edit Mode (tab) and make sure all vertices are selected ("A" key). In the **Tool Shelf**, click **Subdivide 6 times**. Your plane should be well subdivided.

Deselect all vertices using "A" and press "C" for the circular selection tool. While holding down the LMB, select half the vertices as shown. Keep the edge random similar to what is shown so it looks like a rough shoreline. If you select too many vertices, remember that by holding down the mouse wheel, you can deselect vertices.



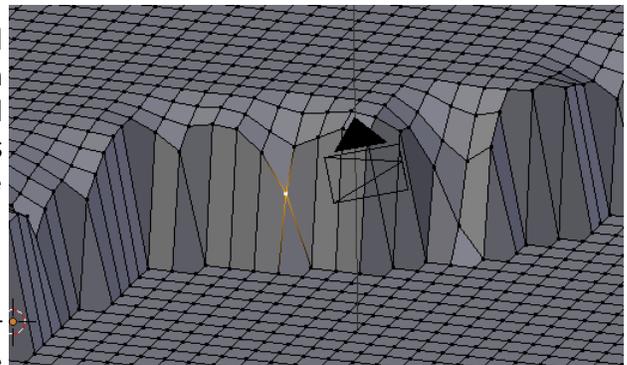
Basic Editing- Landscape and Lighthouse

Now switch to the **front view** (number pad 1). Your plane will now just look like a line. Type "G" to grab and move the selected vertices. Move them up about 2 Blender grid blocks. You may want to type "Z" to keep the move locked to the vertical axis. Use your right side viewport to spin around and get a nice look at the landscape.



Now it's time to make some fine adjustments to the mesh to make the cliff edge a bit more random. Turn on the proportional editing button (small bull's eye button) and experiment with the types of falloff. Select single vertices, "G" to grab and scroll the mouse wheel to change the affected areas while moving. While in the move command, type "Z" to lock to z-axis.

Randomly pull the edges of the cliff up and down to different levels. You may even want to do some of this with proportional editing off. Try selecting a few vertices back on the high flat land and create some hills. Leave a flat area close to the cliff to place the lighthouse later.

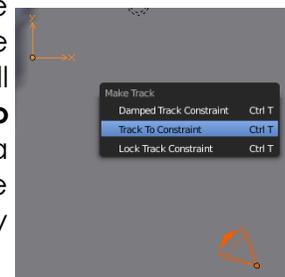


The scene's looking better, but a bit angular. Exit edit mode (tab) and find the "Smooth" button in the Tool Shelf. Press it and you should see a much better looking landscape (you must be in object mode to see the smoothing).



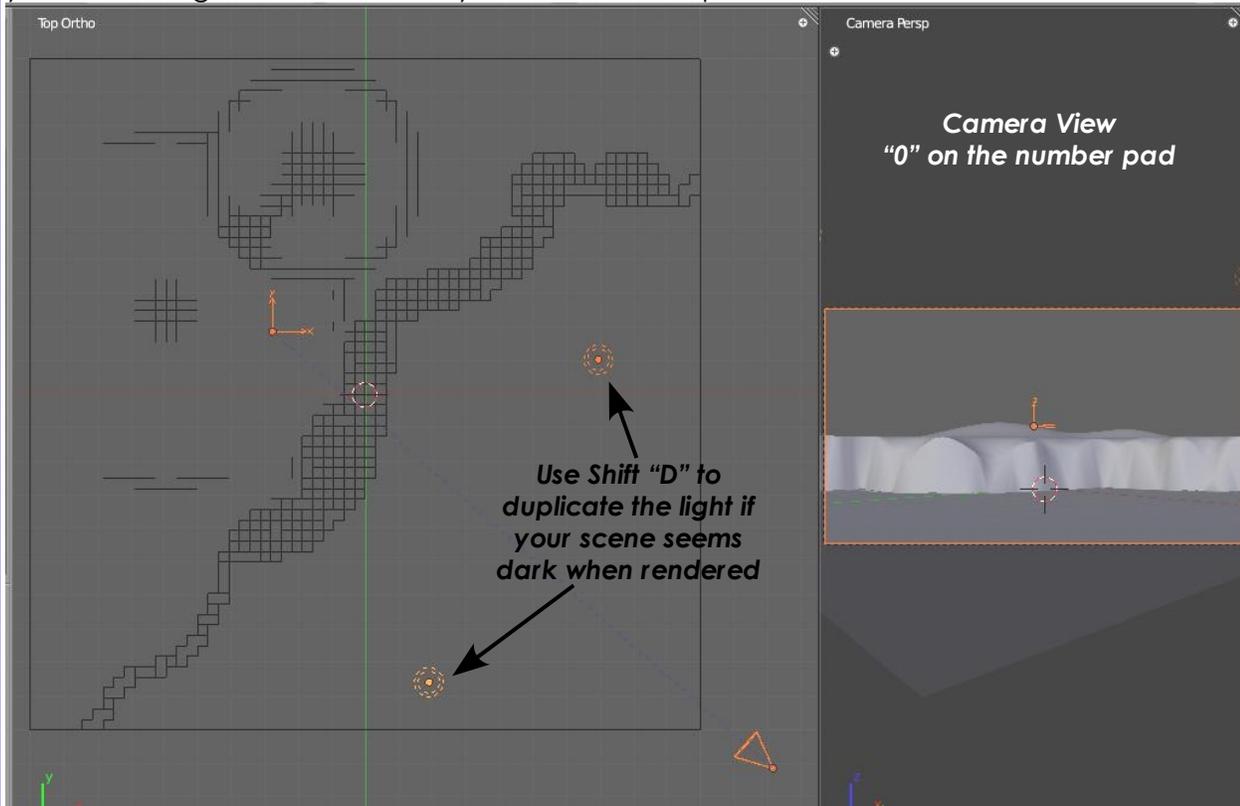
Now it's time to set up the camera. We will start by adding an Empty object in the top view (7 number pad key). An Empty is basically used for targeting purposes and does not render as a visible object. Press Shift "A"-Add- Empty.

Now, RMB click on the camera to select it. We will add a *Tracking* constraint to the camera to always point toward the Empty. With the camera selected first, hold down the Shift key and RMB click on the Empty. Both objects will be highlighted. Press **Ctrl-T** and add a "TrackTo Constraint". A dashed line indicates the link. With the camera selected only, move it around- it always points to the Empty. If the link appears to work backwards, it means you had the Empty selected first. Use the UNDO command to back up and try again.



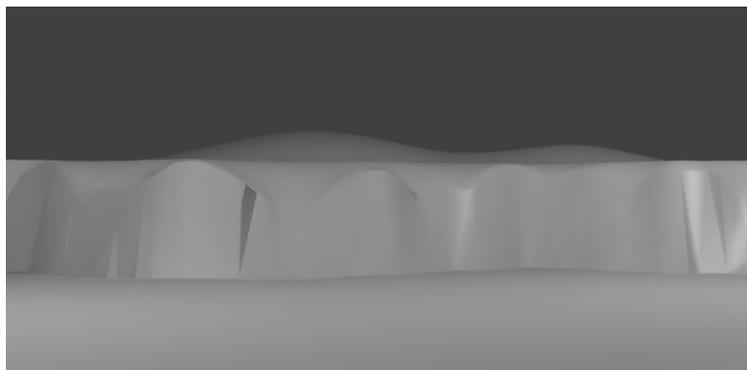
Basic Editing- Landscape and Lighthouse

It's time to place the Camera and Empty at good rendering locations. You will need to use the move command ("G" key) and place the Empty and Camera using your principle views of Top (#7), Front (#1), and Side (#3). Try to get the camera low so it looks as though you are viewing the shore line from a boat. Place the Empty on the cliff line. Use the picture below to frame up your view. You do not want to see any edges on your rendering. Use the "F12" key to render out a picture.

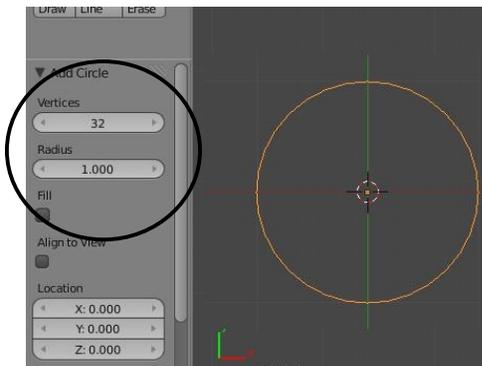


Here is the final render. We're still missing water, textures and a few other things, but it's a good start. Feel free to develop and refine the landscape contour any way you wish. The more time you spend with it, the quicker you will become comfortable with the program and the more realistic it will become.

Save the scene and start a new Blender file (I hope you've been saving every few minutes anyways). We are finished with the landscape for now and will now begin developing the lighthouse as a separate scene that we'll add to the landscape at a later time. Save this new Blender file as "**Lighthouse**".

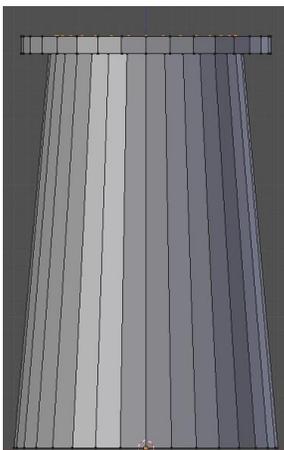
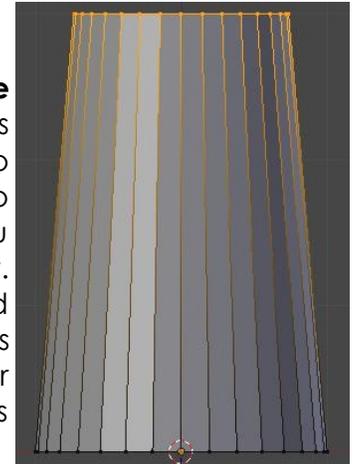


Basic Editing- Landscape and Lighthouse



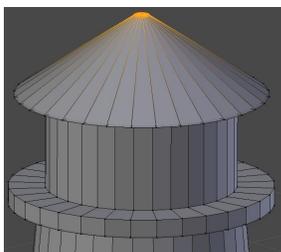
Now it's time to start shaping a lighthouse using the **Extrude** and **Scale** commands. Begin by deleting the default cube and add a **Circle** (Shift "A"- Add- Mesh- Circle) in the Top Ortho View (#7, 5). Use the default setting of 32 vertices, radius of 1, and Fill checked. (found at bottom of the Tool Shelf). These setting will be fine for what we are making. Depending on what you are making and what it will be used for, you may require more or less vertices.

You will now need to switch to the **Front View** (#1) so the circle appears as a line. Enter *Edit Mode* and make sure all vertices are selected (yellow) and press "E" to *Extrude*. If you forgot to check the "Fill" button when making the circle, you will need to press the "Z" key as you extrude to lock on the Z axis. If you filled the circle, it will extrude on the Z axis automatically. Extrude the lighthouse about 3 Blender grid blocks high and LMB click to place them. Hit "S" to *Scale* them in slightly. This is your lighthouse- feel free to adjust sizes as desired. Remember to stay in the front view throughout this process! Rotated views can cause a distorted lighthouse.

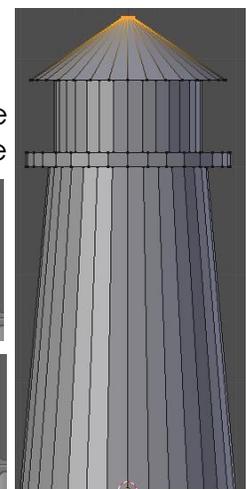
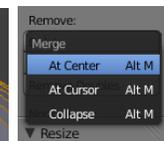
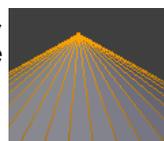


It is now time to make the small walkway around the top. Press "E" to extrude again and right mouse button (RMB) click. This will place the new extruded vertices right on top of the old ones. Then "S" to scale. Pull your mouse away from the lighthouse and scale the walkway outward as desired. LMB click when you have a good size. Remember, you can always UNDO (Ctrl-Z) if it doesn't seem right. Extrude again to give the walkway some height. You will then Extrude, RMB and Scale again to reduce the size back inward.

Continue extruding and shaping to get the light area and the roof. The point of the roof will actually have 32 vertices which you could scale

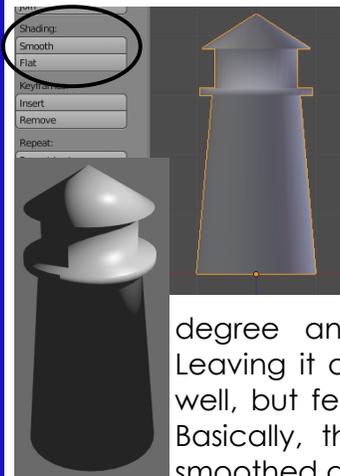
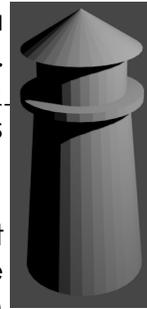


very small so that it appears to be a single point, but we will use a Tool Shelf command to correct this. Select the "**Merge**" option and "**At Center**". You will see that 31 vertices are being removed, leaving only one at the center.

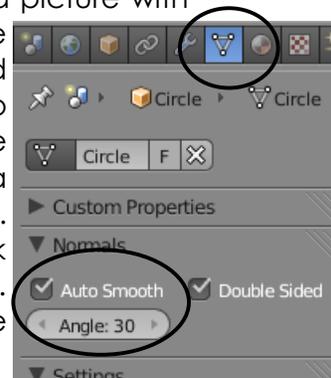


Basic Editing- Landscape and Lighthouse

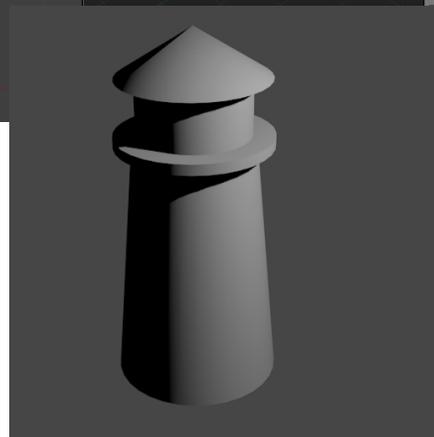
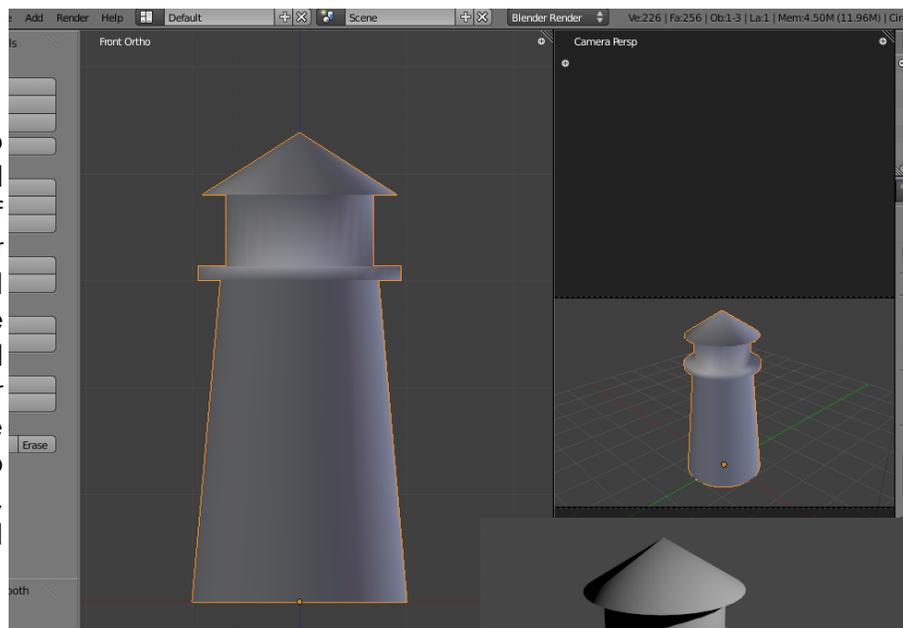
Exit *Edit Mode* for the lighthouse then select and move your *Camera* to a location that displays the lighthouse well and press "**F12**" to render an image. The lighthouse looks good, but angular. It will take more than Smooth Shading to make it look good. Some edges actually need to stay sharp. This is where Auto Smooth becomes important.



Select the lighthouse again. In the *Tool Shelf*, select the "**Smooth**" button under shading. Ignore how the lighthouse look on the screen. Render a picture with "F12" to see the results. Some things are smooth that should remain sharp (and some other strange edge effects). Go to the **Object Data** buttons and find the "**Auto Smooth**" button. You will notice a degree angle below the Auto Smooth button. Leaving it a the default of 30 degrees should work well, but feel free to experiment with other setting. Basically, this setting determines which faces are smoothed and which ones are kept sharp.



Finally, press "F12" to render a picture and check your results. If you haven't saved your file, do so now and remember to save often. We are finished with our lighthouse for now. If you have the time, feel free to modify the lighthouse, change the style, add more features, etc.



**** Call the instructor when finished****

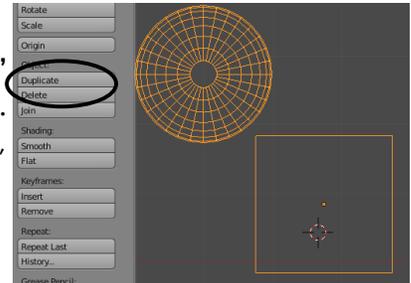
Chapter 3- Creating and Editing Objects

Joining/Separating Meshes and Boolean Operations

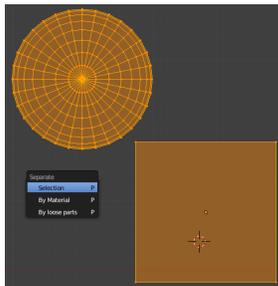
Now that you have some experience with basic editing, here's a few more options:

Joining Meshes:

To join 2 or more meshes together, Hold down the **"Shift"** key 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. Also available in the Tool Shelf.



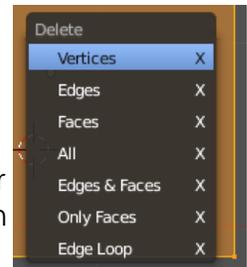
Separating Meshes:



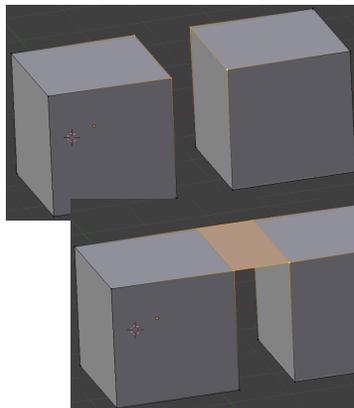
In order to break up a mesh, you need to be in edit mode (**Tab** Key) and select the vertices you wish to separate from the rest of the mesh. With vertices selected, type the **"P"** key (I like to think of it as *partition*) and select your option. You also an option to separate *all loose parts*.

Deleting Vertices, Edges, and Faces:

If you want to make a hole in a mesh, select the vertices, edges, or faces you wish to remove, then hit the **"Delete"** key. Select the option of what you wish to delete.



Adding Faces:



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 of 2 cubes joined together with a space that needs filled between them. In edit mode, select the 4 vertices (hold down **shift** key and **right click** on them), then type **F**. A face will be created. **Ctrl- F** will give a *Face Specials* menu of options that will allow a larger set of closed vertices to be faced with additional options.

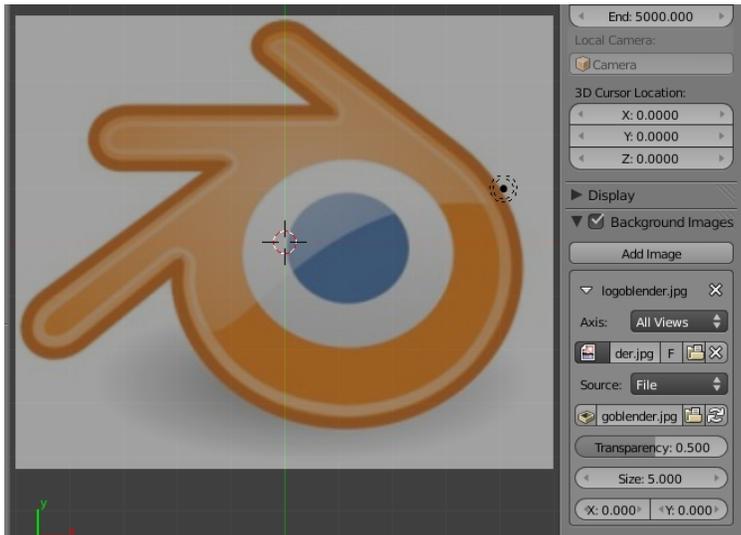
RoboDude Says: Adding and deleting faces and vertices are the basics in any model construction. It is important to become comfortable with these operations while knowing how to accurately work within your viewports.



Verticies and Faces- Logo Design

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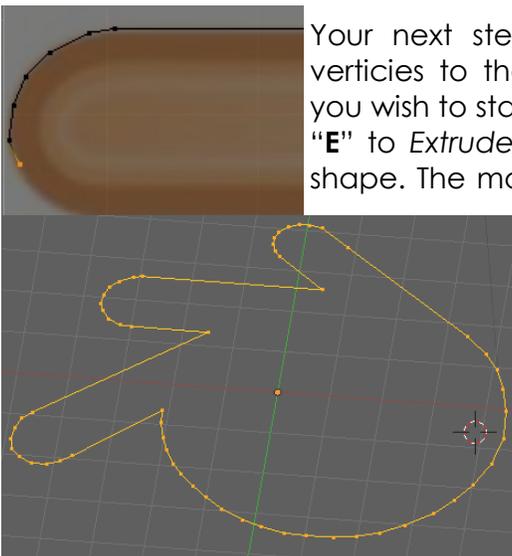
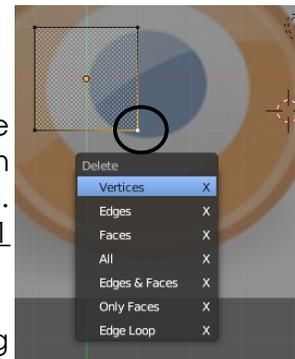
For this exercise, you will be creating a 3D logo for a favorite team, company, or school. You will be using many of the techniques discussed on the previous page. Your first step is to go to the internet and search for an image you wish to use as a background image to model. I will be using a Blender Logo for my example. Save that image on your computer, then in Blender, erase the initial cube and open the Transform Panel if not already open on the right side of the window ("N" key or the small "+" in the upper right corner of the window). Scroll down the list and find the "**Background Images**" panel. Check the box and open the panel. You will see an "Open" button that will allow you to load your image. Load your image and it should show up in the background of the 3D window.



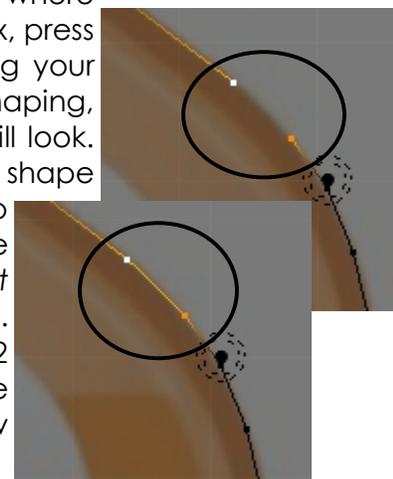
The image will only display in a principal ortho view (7,1, or 3- 5 key switches between ortho and perspective). You will notice that you can control which views the image displays in, if you want to display a movie or image as a background, the transparency of the image, the size and X,y offset.

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Make sure you are in the Top Ortho View and create a Plane from the Add-Mesh menu. Go to wireframe view ("Z" key) and Edit Mode (Tab key). Delete 1 vertex so all you have are 3 verticies.

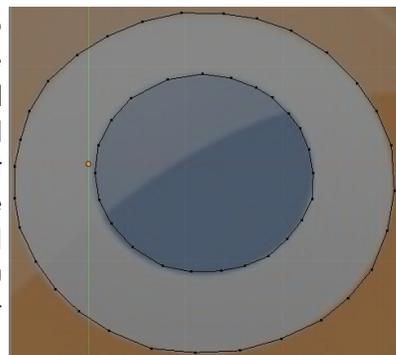
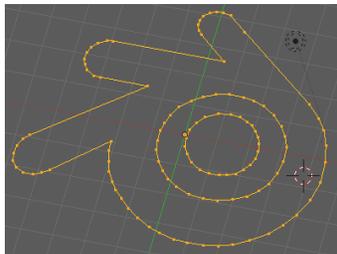


Your next step is to move the 3 existing verticies to the edge of the shape where you wish to start. Select an end vertex, press "E" to Extrude and continue outlining your shape. The more care you take in shaping, the better the logo will look. Continue around the shape until you get back to the beginning. While holding down the Shift key, press "F" to Face. This will connect the 2 ends and close the shape. You will now have the basic shape.

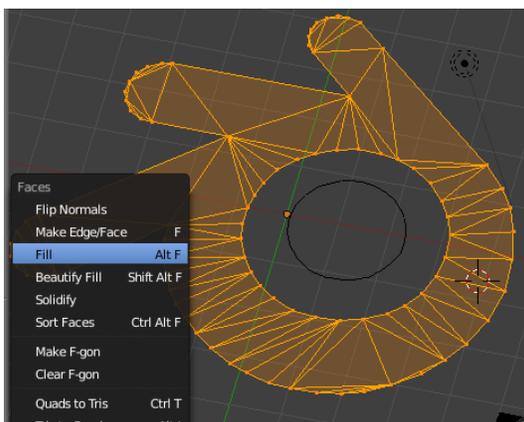
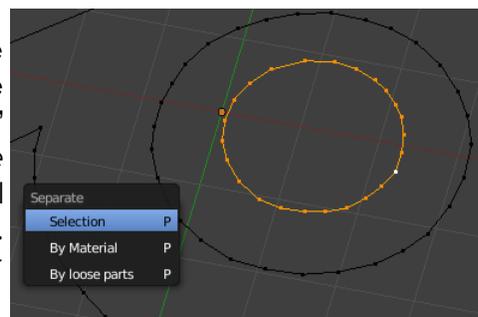


Verticies and Faces- Logo Design

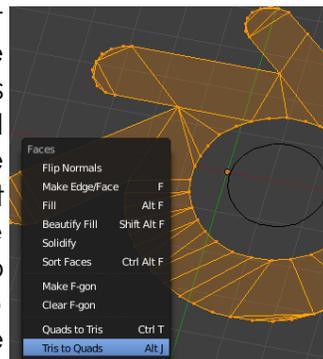
The next step is to create the inner edge of the shape. To do this you need to copy (not extrude) a vertex over to the inner edge (*Shift-"D"*). From there, continue to extrude and close the inner edge as you did with the outer edge. Notice that the Blender logo also has a blue inner circle. We will also copy and extrude a circle for that ring. If you have other details to add, do that at this time.



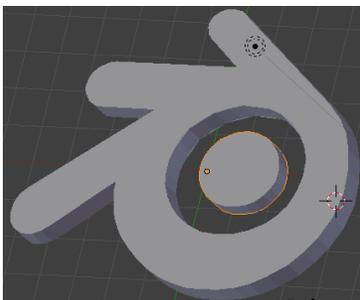
Before we face the mesh, we will need to separate the vertices into different meshes that will receive different materials. Select those vertices using the "**B**" or "**C**" commands and hit "**P**" to *partition or separate* them from the main mesh. For my example, I will select the inner ring that will get a blue material. After separating all the vertices, go back to *Object Mode*.



It's now time to face the mesh. We could select 3-4 vertices at a time and hit "**F**" to face them, but that would take a long time! Instead, we will use the **Ctrl-"F"** menu. First, enter *Edit Mode* for one of your meshes and make sure all vertices are selected ("**A**" key). Hit **Ctrl-"F"** and select "**Fill**". If the shape is complex, not closed, or has double vertices somewhere, this option may not work and forces you to find the problem or face it manually.



Once it is filled, you may want to go back into the **Ctrl-"F"** menu again and select the "**Tris-to-Quads**" option to convert triangles to quads for less faces and a cleaner look. Do this for all meshes, then switch to the *Front View* and *Extrude* the meshes to a desired thickness, like you did with the lighthouse.



Your logo is finished for now. We will not be addressing this as an actual exercise, but after reading the chapter on *Materials and Textures*, you can come back and add color to your logo.

**** Call the instructor when finished****

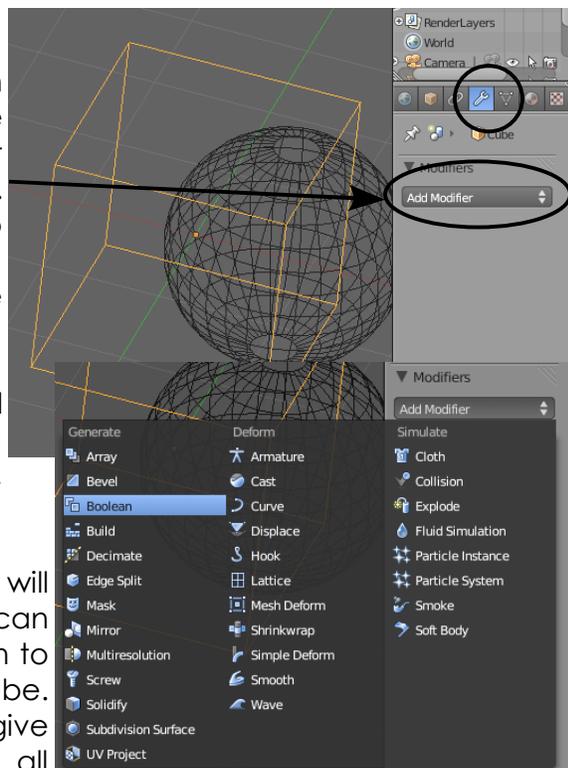
Chapter 3- Creating and Editing Objects

Boolean Operations:



Boolean operations allow you to cut or join meshes by using other meshes. In other words, A mesh can be made combining 2 meshes different from the Join command. When using Join, the 2 shapes still retain all vertices. When using Boolean, a new shape is calculated (union) and removes interior geometry. A mesh can also be used to cut a hole in another mesh (difference) and a shape can also be made from where the 2 shape intersect with one another (intersect).

In the sample shown below, a cube and a sphere have been placed overlapping each other. With the cube selected, we will be applying a Boolean Modifier. This is the first time we have accessed the Modifier buttons. If the resolution of your computer is not set so that you are able to see the Modifiers button, hold down your mouse wheel to scroll over the buttons to gain access to it.

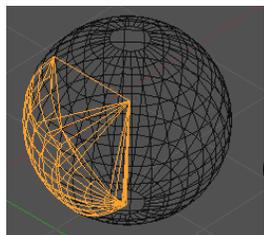


Click on the “**Add Modifier**” button. You will see a variety of modifiers that can be added and many will be discussed later. For now, select the **Boolean** modifier.

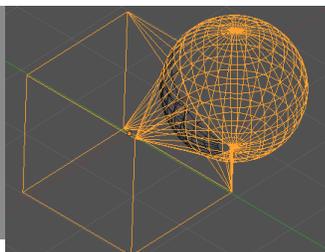


In the Boolean panel, you will see a block where you can select the object you wish to use to modify the cube. Clicking in the box will give you a drop down of all objects in the scene.

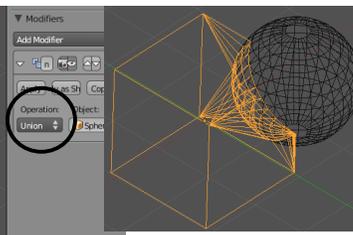
Selecting the sphere will display the changes to the cube. Below, you can see what each option will display:



Intersection (what is shared)



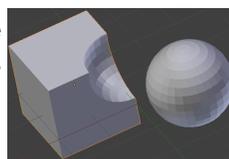
Union (joins the meshes)



Difference (subtracts the mesh)



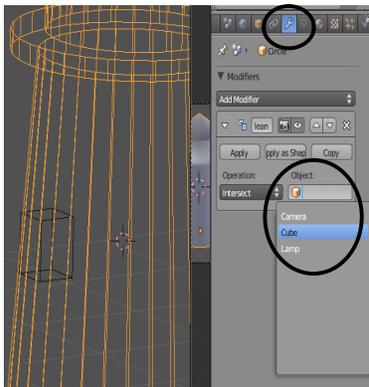
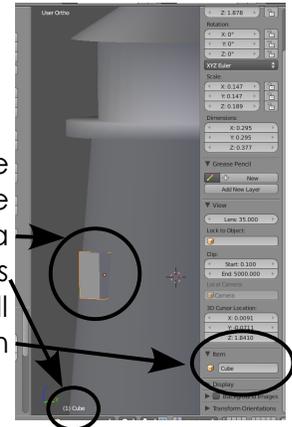
By hitting the “**Apply**” button, the new shape becomes set and the sphere can be removed.



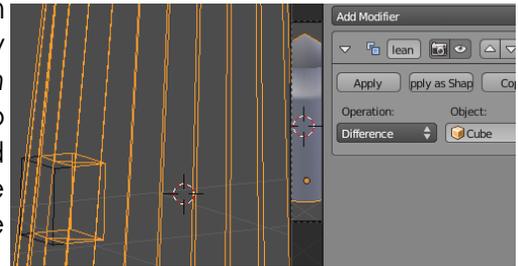
Boolean Edting- Lighthouse Windows

To begin this exercise, start by opening up your **Lighthouse** file from the previous exercise. We are going to use Boolean operations to cut some simple windows in your lighthouse.

Begin by adding a **Cube** (*Shift "A"-Add-Mesh-Cube*) to your scene and scale it to an appropriate size and shape. Using your principle views of #1,#3, and #7, place the cube in a good location for a window. With the cube still selected, make note of the cube's name, displayed in the lower left corner of the viewport. We will need to know that name later. The name can also be changed in the Transform window.



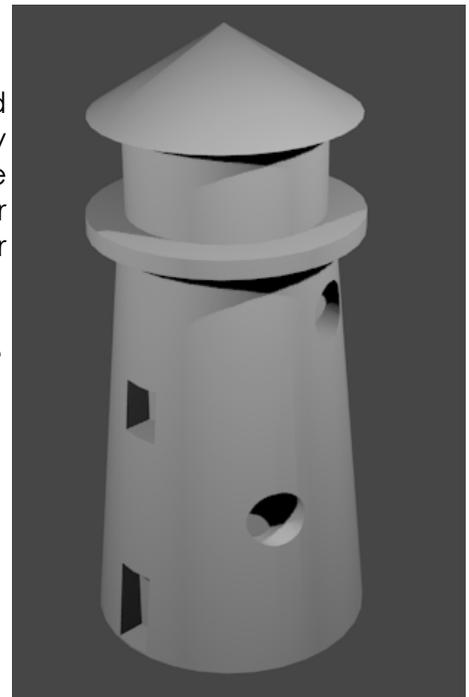
Now select the **Lighthouse** and enter Wireframe view ("Z" key). Go to the **Modifiers** Panel and add a **Boolean Modifier**. Select the **Cube** from the list under **Object**. By changing the **Operation** from "**Intersect**" to "**Difference**", you should see a cut in the lighthouse to match the cube. Hit "**Apply**".



Now you can move the cube to a different spot and add another Boolean modifier to cut another window using "**Difference**" and "**Apply**". You can even use different mesh shapes to cut other window and door shapes. Press "F12" to see a rendered view of your results.

Remember to add the Boolean Modifier to the lighthouse and not the cube!

**** Call the instructor when finished****



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Chapter 4- Materials and Textures

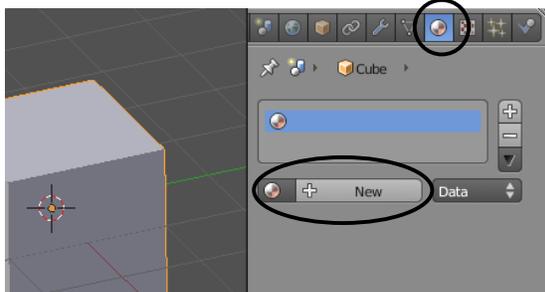
Materials and textures are what change your model from being gray to brilliant. You can add color, make things glow, become transparent like glass or make them look like brick, grass, stone, metal, fabric, wallpaper, etc. There's a lot to cover in this chapter so let's get started.

Basic Material Settings



You must **always** add a material before you can add a texture. To add a material, first select the object you want to work with. Then go to the **Materials** panel in the **Properties** window.

Then click the **"New"** button (unless you are working with the initial cube- that has a material on it by default). You will see more options open up. The material block is used to change some of the physical properties of the object in how it looks. If you plan on using just straight color and no texture, this is where you set the object's color. The panels can float around so they may not be in this order, but here is what you see with all panels collapsed:



List of all materials linked to object

Browse list of all materials in file

Preview Sample

Diffuse- The actual color of the object settings

Shading- Control self emitting light and ambient lighting effects

Subsurface Scattering- effects for final rendering

Strands- used for hair and grass effects

Shadow- setting related to how the object casts and receives shadows

Add a new material or duplicate the one currently selected

Change the material name here

*How to display the material:
Surface- Normal mode
Wire- Render as a wireframe
Volume- useful for smoke simulations
Halo- Gives verticies a glow*

Different ways to display the sample

Specular- controls the objects glossiness settings

Mirror-Transparency- Raytrace settings will be discussed in a later chapter

Options- a few setting related to the world and rendering

This is just an overview of the basic material panels. On the next page, we will highlight some of the important panels we will be using at this time.



RoboDude Asks: How can I see all the panels on the screen?
It may be impossible to see all of the panels at once, but you can scale the by pressing the "+" and "-" keys on the number pad and pan with the mouse wheel.

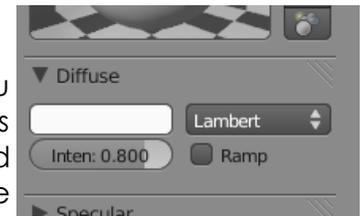
Chapter 4- Material and Textures

Material Panels:

Here are some of the basic material panels and settings:

Diffuse:

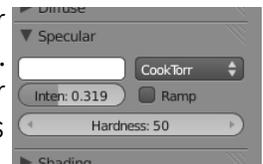
Diffuse is actually the color that is given off by the object. If you want the object to be red, set it here. You will also see settings for the way the material is calculated (default-Lambert) and the intensity slider. The Ramp button will allow diversity of color.



By clicking on the color sample in diffuse (or in any other block dealing with a color), the color wheel will pop up. You can set the color using the wheel and light/dark slider, setting in manually using RGB, HSV, or Hex numbers. You'll also see an eyedropper for picking a color elsewhere.

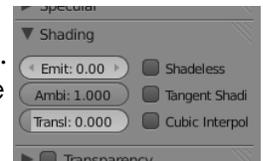
Specular:

Specular settings control the *glossiness* of the object (is it flat or shiny?) You will see a color sample, calculation model and ramp as in Diffuse. The color sample indicates the color reflected back (usually kept white). Intensity controls the amount of glossiness while the hardness slider controls the hardness and softness of the glow. Check the sample as you change these settings to see how it changes appearance.



Shading:

If you want something to glow, even in low light, adjust the *Emit* slider. *Ambient* light allows the object to also react as if indirect light were hitting it. There are also a few other shading settings here as well.



Transparency:

For now, we will only look at using the "Z Transparency" option (Raytrace has it's own chapter). After checking the *Transparency* box and "Z Transparency" selected, you can control how transparent an object is using the *Alpha* slider.



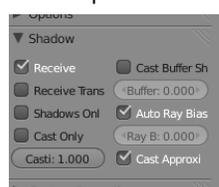
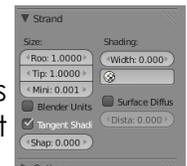
SubSurface Scattering:

Is used to improve rendering for materials where light enters the material and leaves through another point (*like skin*).



Strands:

Strands are used to represent hair or grass when used with particle systems (discussed in a later chapter). With strand settings, you can control the root and tip width of the strand.



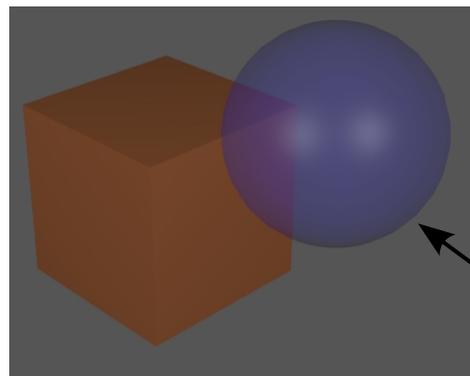
Shadow:

There are time when you do not want an object to be able to cast a shadow and times when it doesn't receive shadows properly from objects with transparent materials or ray-tracing features. Those options are controlled in this panel.

Chapter 4- Materials and Textures

Transparency Using Z-Transparency:

The easiest way to make something transparent in Blender while still maintaining a fast render speed is to use the **Z-Transparency** feature and controlling the **Alpha** setting. In the *Material* panel, turn on *Transparency* and select *Z-Transparency*, then slide the **Alpha** control

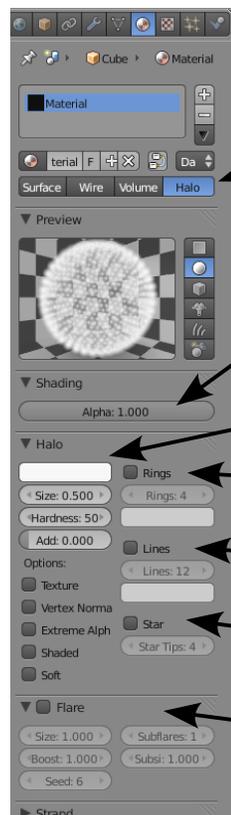


down. Press the F12 button to render an image. If you need features like distortion (refraction), then you will need to use **Raytrace Transparent**. Refraction is the effect you get like looking through a magnifying glass or a crystal. Avoid using Ray features at this time. They are discussed in a later chapter.

Z-Transparent material

Halo Settings

By using Halos on objects, you are basically only making the vertices visible when rendered. Halo effects give you a star-like image on every vertex. **Sometimes, it adds a nice effect to take a plane and delete all vertices except for one.** This one vertex can be used like a shooting star or a "Tinkerbell" effect in an animation. Tie it to a particle effect (discussed in a later chapter) and you can produce some interesting results. When you press the "**Halo**" button in the material panel, here are your options:



Turn ON Halo

Halo Transparency

Halo Color and Hardness

Check to add rings, count and color

Check to add lines, count and color

Check to add stars and tips

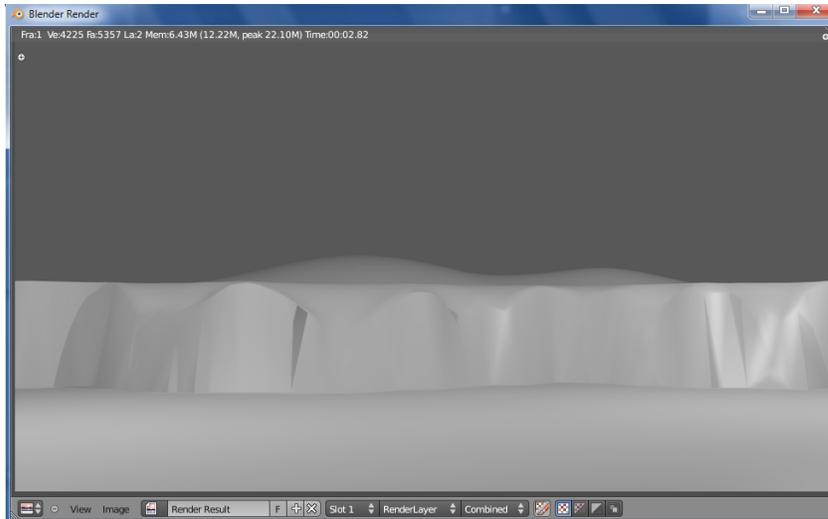
Flare adds additional rings and effects



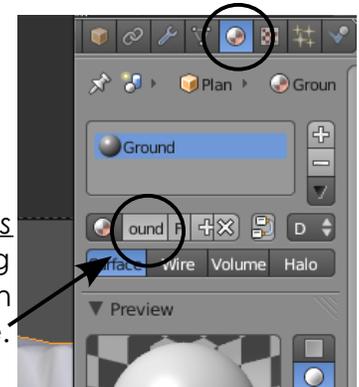
Halos can also be animated to give a variety of effects. Animation basics are discussed in a later chapter. There are also other options with halos not discussed. Halos are also used to control the size and appearance of particles in smoke and fire effects. These will also be discussed in a later chapter. Feel free to experiment!

Applying Materials-Landscape

It's now time to add some color and water to you project. Open your "**Landscape Scene**" model that you created in the *Basic Editing* chapter. Render a picture with "F12" and it should look something like this:



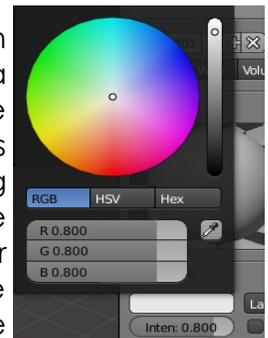
Lots of gray.... In this exercise, we are just planning to experiment with material colors and settings. We will also add a plane to the scene to act as the water. In the next activity, we will add some texture to it.



With the landscape plane selected, go to the *Material Buttons* and select "**New**". It is good to get into the habit of naming your materials. By default, it will be "Material", probably with some zeros and numbers after it. Create an appropriate name. The name block may be small on your screen.



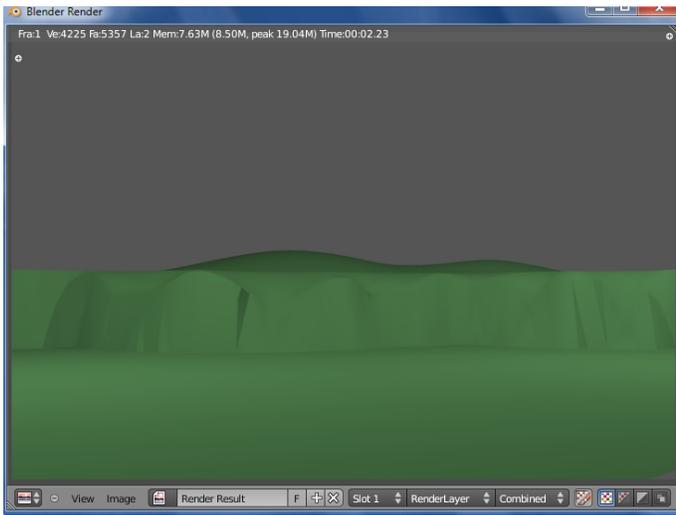
Under "*Diffuse*", click on the color swatch to open the *Color Wheel* and select a shade of green. You can select a shade of green 2 ways- by using the RGB sliders at the bottom of the panel or by moving the dot in the wheel, then adjusting the brightness with the white-to-black slider on the side. I know this doesn't look too realistic at this point, but we will apply a nice soil/grass texture in the next exercise. For now, you're just working with material basics.



Since ground usually isn't glossy, Take the "*Intensity*" slider down to **0** (or almost 0) in the "*Specular*" panel. I would leave the color white here.

Applying Materials-Landscape

Now that you've adjusted the color and glossiness in the materials panel, Press "F12" to render a new image.

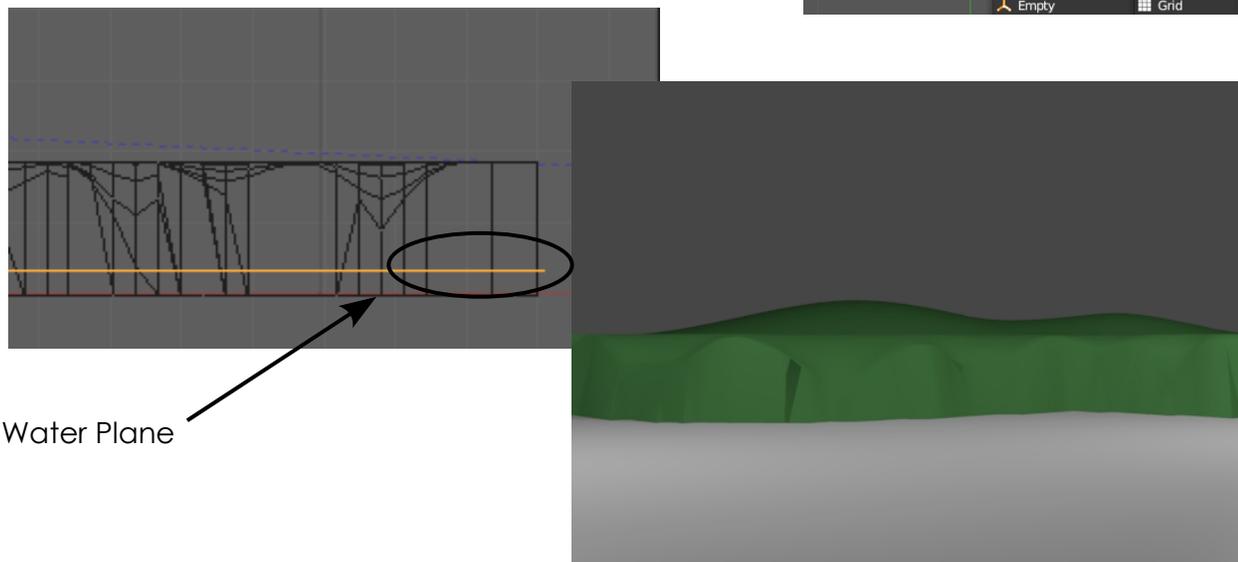
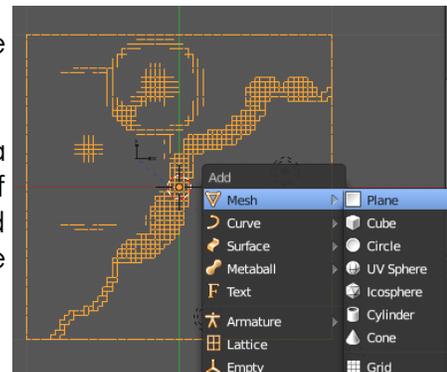


Looks better than gray, but still needs more work. We will apply a texture to the mesh in the next exercise. Remember that you always need to place a material on an object before you can add a texture. For future reference, if we were planning to apply an image (picture) as a texture, you would not need to adjust the color. However, you would still need to adjust specularly as needed.

We're now ready to add some water to our scene. For this we need to add a Plane from the Top View (#7) (Shift-"A"- Add- Mesh- Plane)

After adding the plane, **Scale** the plane to about the size of your ground.

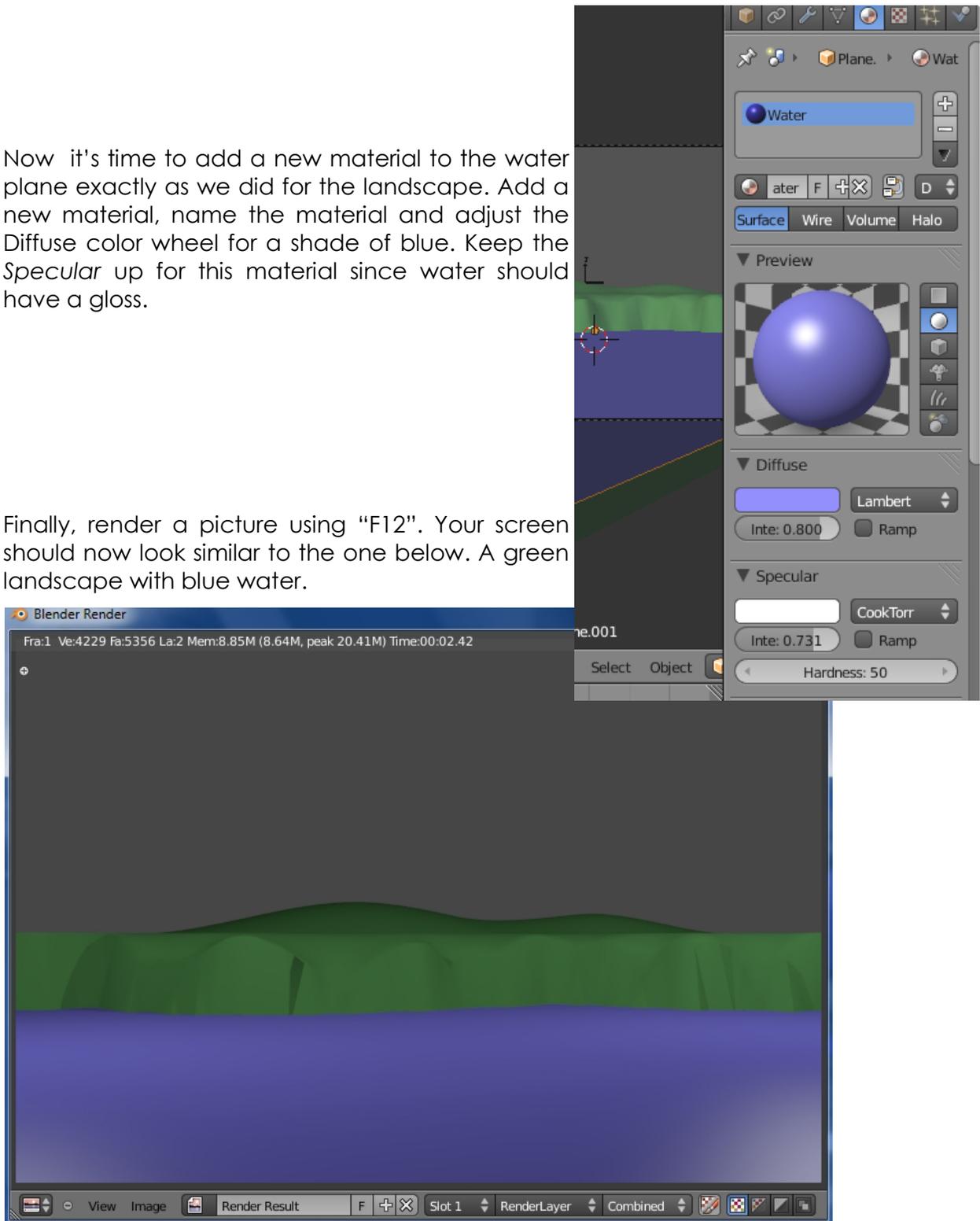
Switch to the Front View (#1) and move the plane to a location somewhere between the top and bottom of your landscape rise. Press F12 to render an image and check for appearance. Make sure that you do not see the edge of the plane in camera view.



Applying Materials-Landscape

Now it's time to add a new material to the water plane exactly as we did for the landscape. Add a new material, name the material and adjust the Diffuse color wheel for a shade of blue. Keep the *Specular* up for this material since water should have a gloss.

Finally, render a picture using "F12". Your screen should now look similar to the one below. A green landscape with blue water.



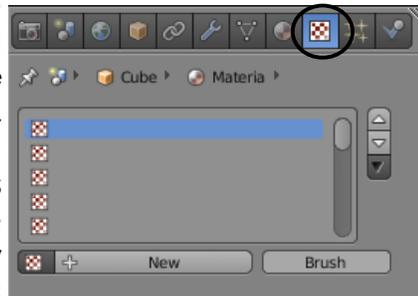
**** Call the instructor when finished****

Chapter 4- Materials and Textures

Basic Textures Settings



After you create a material and would like to add some kind of texture to the object (i.e. brick, carpet, wood grain, etc), you then click on the **Texture** button beside the Material button. After you click the "New" button, you have some choices in the texture buttons. First, you need to decide if you wish to use one of Blender's preloaded texture generators or provide your own image as a texture. Blender is capable of using almost any image file type whether created in a paint program or is a photographic image. JPEG images are most common. Blender can even place a movie on an object as a material! This is a good effect if you want to add animation *within* your animation.



Here's what you see in the texture panel:

Texture Channels:

You can add multiple textures to an object. For example, lets say you want a marble texture on an object, but also want to add a roughness to the surface. You would add a texture for both effects.

Texture Name:

Like materials, it's a good idea to name your textures. In this area, you can also add "+" and delete "X" materials.

Texture Type:

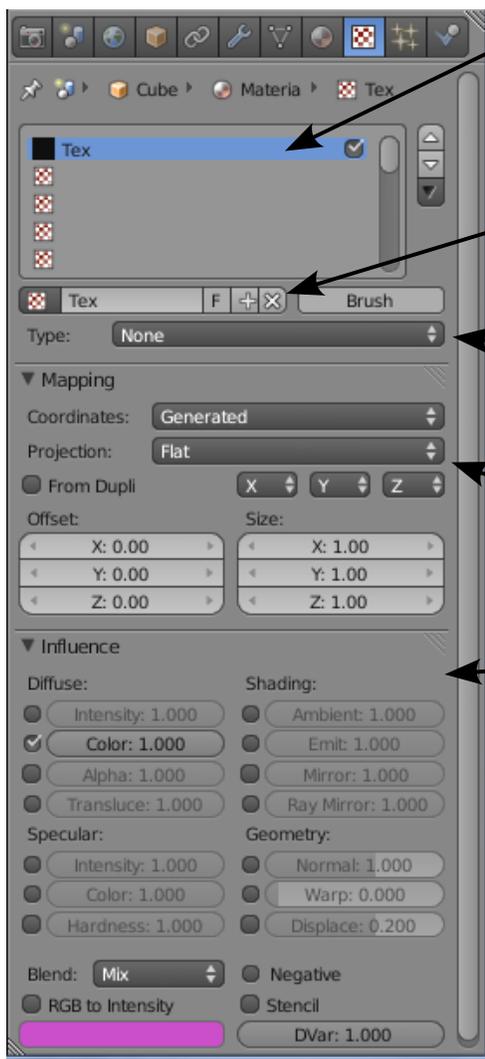
Choose between built-in texture generators for wood, marble, stucci, etc or select an image or movie.

Mapping:

Setting that control how the texture is mapped onto the object. Also control the size and offset of the texture on the object.

Influence:

Settings that control appearance such as brightness, transparency, glossiness and roughness. S are also effected by the Material setting. Materials and textures work together. Many textures use a secondary color in their generation. That is also controlled in this panel.



RoboDude Says:

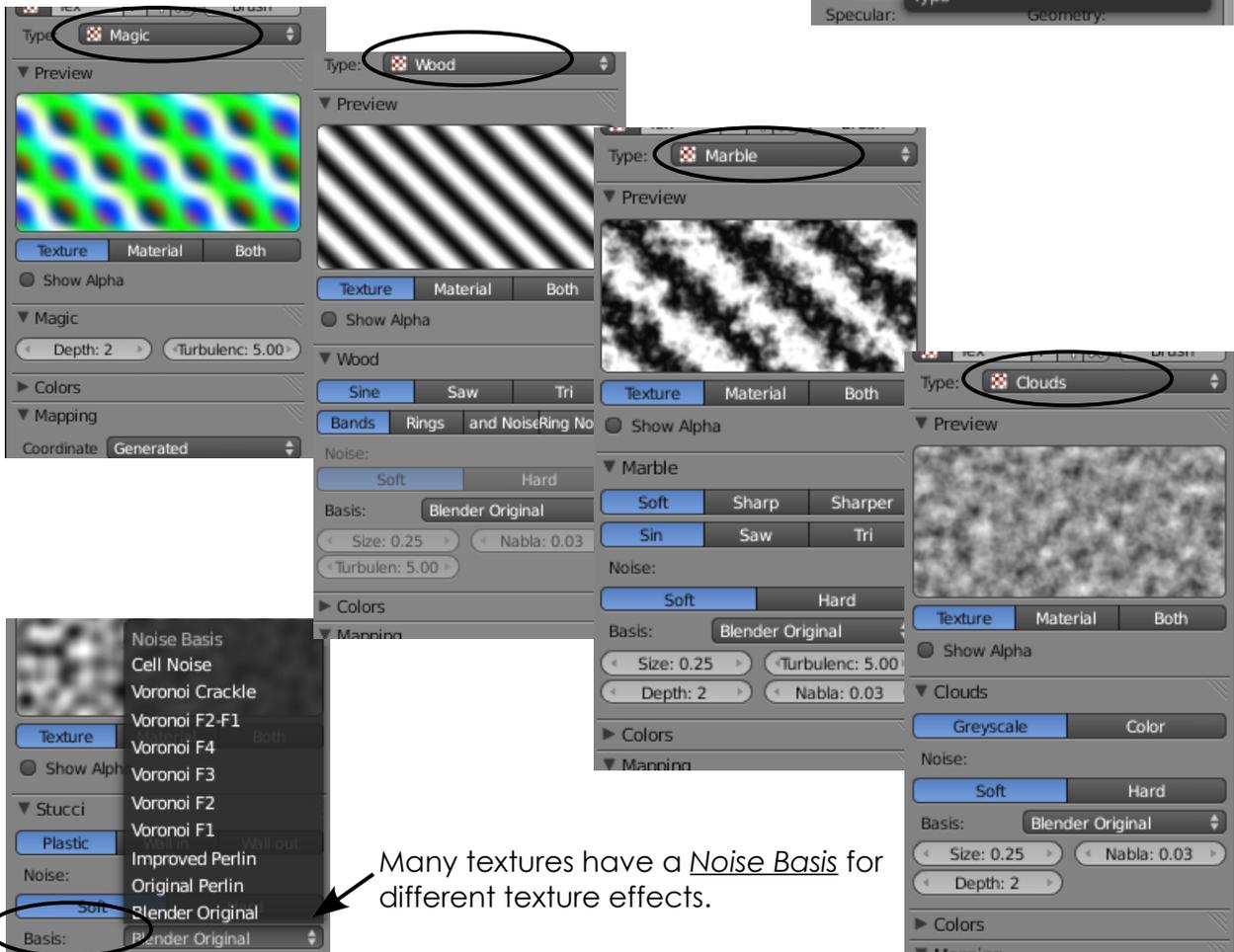
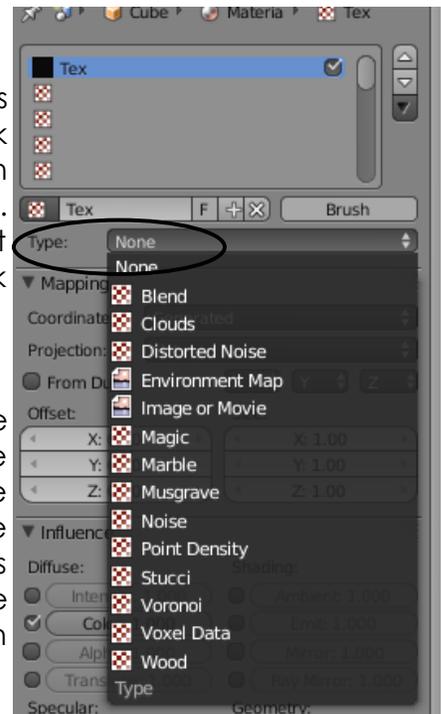
You can't add a texture unless you've already added a material. Material and Texture properties work together!

Chapter 4- Material and Textures

Blender's Built-In Textures:

Let's say you want to use one of Blender's built-in textures (under the "Type" option). For now, we just want to look at **Clouds**, **Stucci**, **Magic**, **Marble** and **Wood**. These can produce some interesting effects with a little practice. When you select one, setting options will open for that effect. Each texture has different tools available to work with, but some similarities are present in most:

Most of Blender's texture options deal with turbulence and noise (randomness of the pattern) The wood texture also has some features dealing with the pattern of the wood grain (bands and rings). After you place the texture, you still need to go back to the Materials Buttons to fine tune the look on your object. The *Stucci* texture involves a little more work and will be discussed later in this chapter.



Chapter 4- Materials and Textures

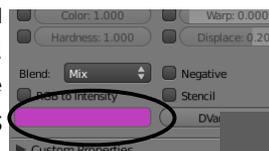
For an example of how to work with a texture, we will apply a wood texture to a cube. We'll start with a basic cube that has a material applied to it. Since wood is usually various shades of brown, we'll make the *Diffuse* color brown. We'll also take *Specular Intensity* down a bit.



We'll now go over to the texture buttons and add a new texture. Make the texture type "Wood". In the wood texture panel you will see some different ways to represent the wood grain. "Sine-Saw-Tri" will give you a different stripe while "Bands-Rings-Band Noise-Ring Noise" will give you a different pattern. For my example, I will select "Ring Noise" and hit "F12" to render a picture.



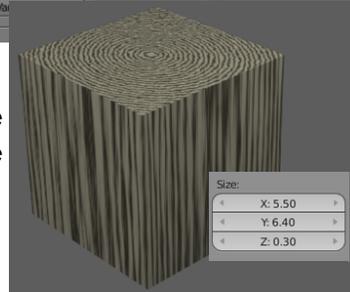
If you look at your render, you should see your wood grain, but you have a secondary color that needs to be corrected! To fix this, scroll down through your texture panels to find the color swatch to change this to a better color. I will choose a darker brown.



You can also adjust the *Size (X,Y,Z)* of the texture and the *Noise Basis* for more effects. Feel free to experiment with the



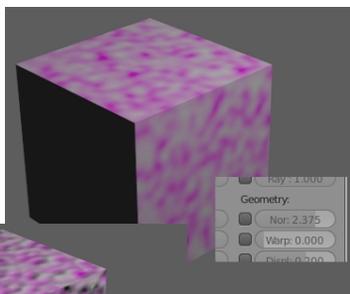
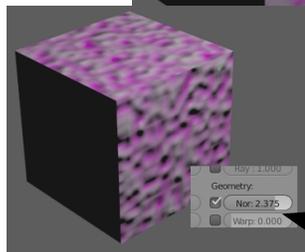
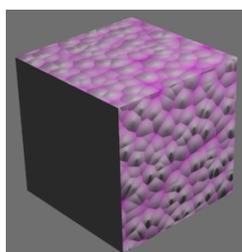
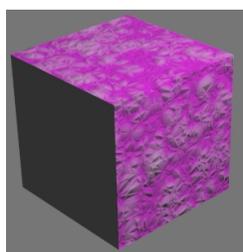
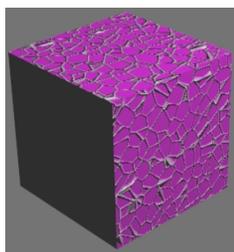
various other settings.



The Stucci Texture:

The *Stucci* texture provides interesting effect on the surface of your object. In the *Texture Buttons*, select it as you do for any of the other texture generators and adjust the settings. In the *Stucci* panel, I will adjust the size to 0.15. Next, go down to the *Influence* panel and turn on "Nor" under *Geometry* for normal. Adjusting the "Nor" slider to adjust the amount of the effect. Play with the setting to get a bumpy effect. Turning the size setting way down can also give you a grainy effect.

Below are some samples of different *Noise Basis* patterns.

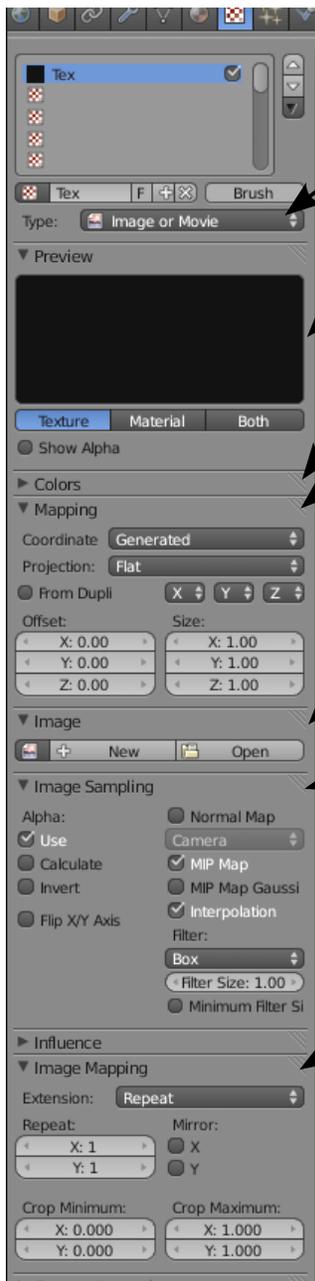


Normal Off
Normal On

Chapter 4- Material and Textures

Using Images and Movies as Textures

The basic texture generators are nice, but not complete. Most of the time you need to place textures like grass, brick, metal, fabrics and such into your model. **Anything that can be saved as a JPEG image can be used as a texture in Blender.** Most other image type files can be used as well (png, targa, TIFF, bmp). If you want to put a picture of your face on an object- you can! Movie files can also be placed on an object as a material. To use a JPEG as a texture, add a *Material* as before, go to the *Texture* buttons and select the **"Image or Movie"** option under **"Type"**. When you select this, here is what you see for options:



Texture Type:

Changed to "Image or Movie"

Preview Window:

Can be set to display Texture or Material or Both

Colors Panel:

An image can be adjusted if colors are not quite what you want (i.e. a wood grain that you may want more red in it)

Mapping Panel:

Textures can be projected Flat, Cube, Tube, or Sphere onto an object. Important block! Here, you can also adjust the offset and size of an image on your object.

Image Panel:

This is actually where you open the image or movie you wish to use for your texture. If you don't see thumbnails of your images, you can change the window's viewing type (see page 1-4 for details).

Image Sampling Panel:

Make adjustments to your image such as Alpha (transparent images). For example, you have a tree image made in a graphics program with a transparent background. Set alpha here to remove that background.

Image Mapping Panel:

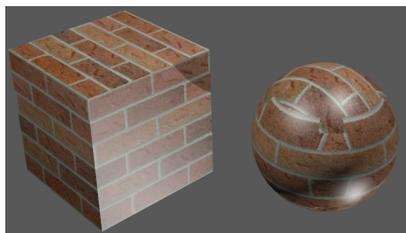
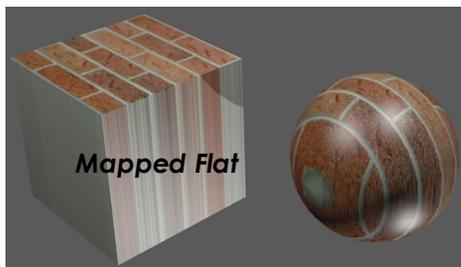
If you would like to have the texture repeat (i.e. a brick pattern where you need to use the image several times on a surface), set it here. You also have mirror options in case the image you're using doesn't appear seamless.

RoboDude Asks: I've worked with all these settings, but the texture still won't map correctly- what's wrong?

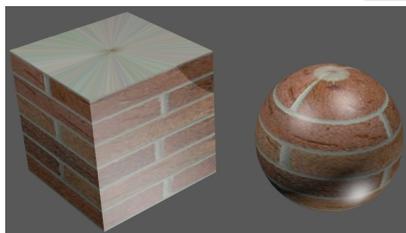
Textures can be affected by rotation and scaling of objects. Try pressing Ctrl-"A" to reset scale and rotation.

Chapter 4- Materials and Textures

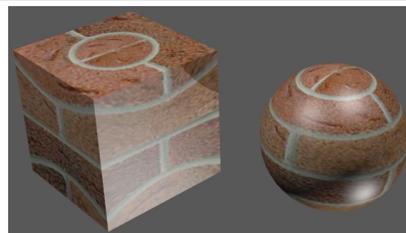
For an example of using images, here is a cube and sphere rendered using a brick image. You will notice that, by default, the image is mapped onto the top and stretched down the sides of the object. This is called "Flat" mapping. This can be adjusted in the "Mapping" panel. Your other options are shown below:



Mapped Cube



Mapped Tube



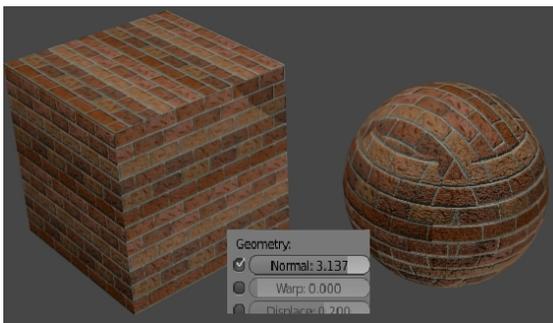
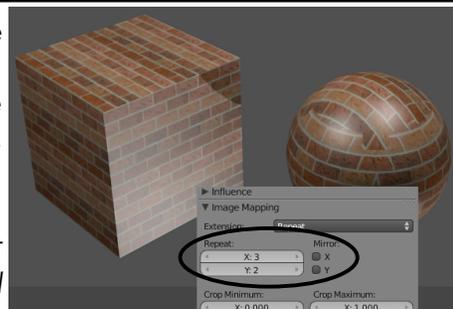
Mapped Sphere



RoboDude Asks: Why can't I find any images to use with Blender?

Blender does not come with any images installed with the program, only the built-in texture generators. You will need to supply your own images. There are many texture libraries available on the internet or you can create your own.

Let's say I want to use the "Cube" mapping, but the bricks are too large. I can control this in the "Image Mapping" panel under the "Repeat" option. The image I used tiles well, but if it does not you can press the Mirror- X and Y buttons.

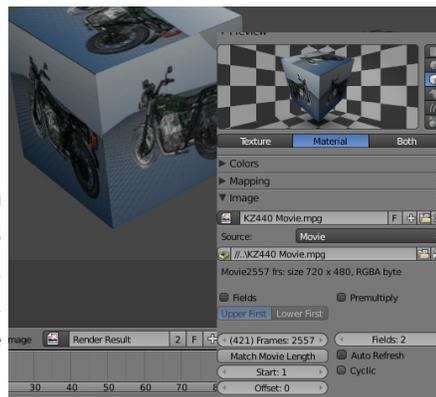


Remember that the *Material* and *Texture*

panels work together. The bricks look good, but a bit too glossy and flat. You can make adjustments to Specular in Materials (glossiness) and add a "Normal" to the brick texture in the *Texture* panel under the "*Influence*" panel. This will simulate depth and add a nice effect to the brick.

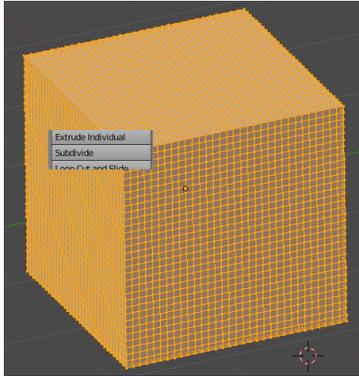
Movies as Textures:

You load a movie just as you would load an image, except that you have a few other options. You can control which frames of the movie to use, when it starts (offset) and if the movie cycles through your animation. This can be a great option for animated backgrounds, and motion on objects. Remember that all movie formats may not be supported.

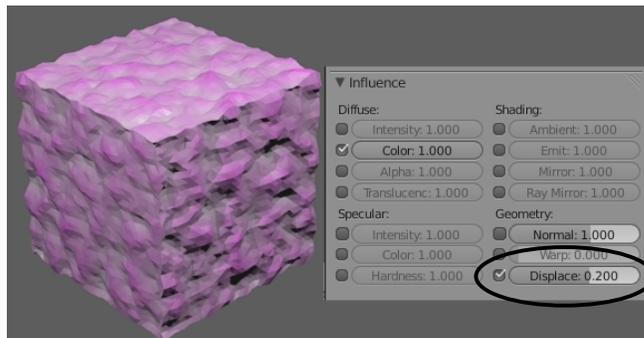
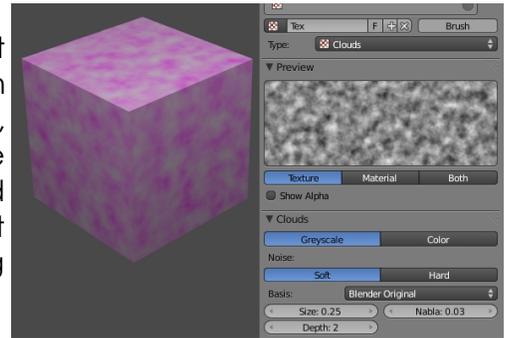


Displacement Mapping

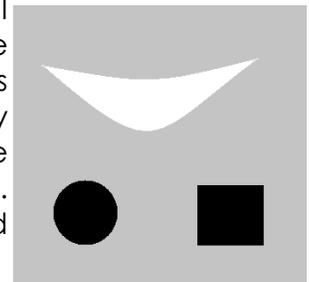
Displacement Mapping is using a texture effect to deform the mesh. Basically, you can make a cube, sphere, etc. look wrinkled or deformed without having to move vertices around to do it. To start, create a cube or sphere. If you start with a cube, go into **Edit Mode** (tab) and select **all vertices**, press the **Subdivide** button a few times in the **Tool Shelf**. Displacement works off of vertices so if you don't have it subdivided a few times, you won't get a good effect. Next, put a material and a texture on the object. I used the Cloud texture in Blender. Here's what we have by pressing F12:



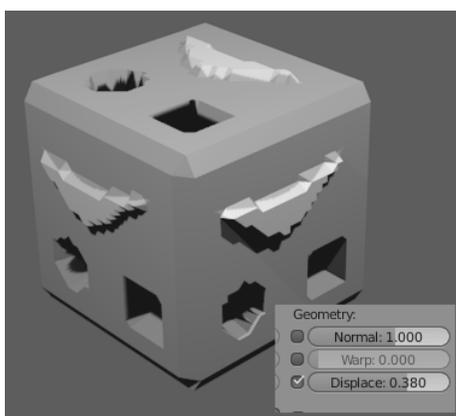
Nothing that we haven't already experienced in this chapter so far. Now, go to the **"Influence"** panel and find the **"Displacement"** button to turn on Displacement and adjust the slider. Re-render (F12). Displacement basically works by pushing vertices with the varying colors in the texture. This is also controllable.



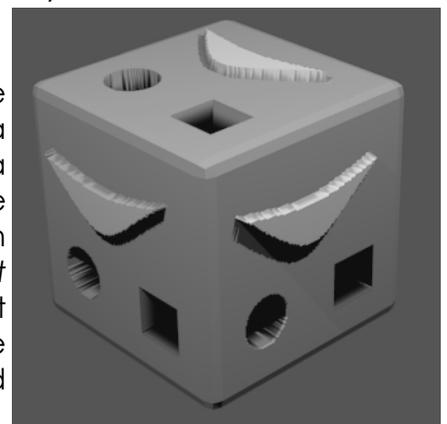
For our next test, I will create a simple image in a graphics program using only simple gray, white and black shapes. Gray is considered the base color.



Here are the effects of the image on the object mapped with the **Cube** wrap. Notice that the white shape was pushed out while the black shapes went in. The quality of the cuts and extrudes is determined by the subdivision (vertices) on the mesh.



To the right, the shape has been subdivided a few more times for a better edge. While *Normal* gives the illusion of depth, *Displacement* will actually deform, but it makes the shape more complicated and slower to render.

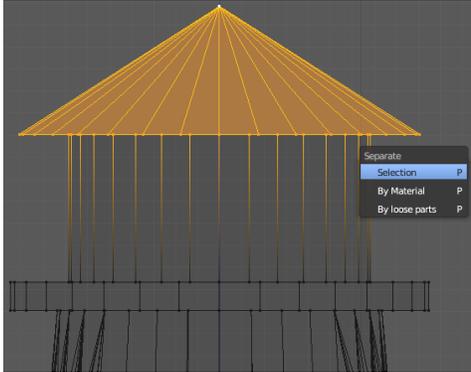


Applying Textures- Landscape & Lighthouse

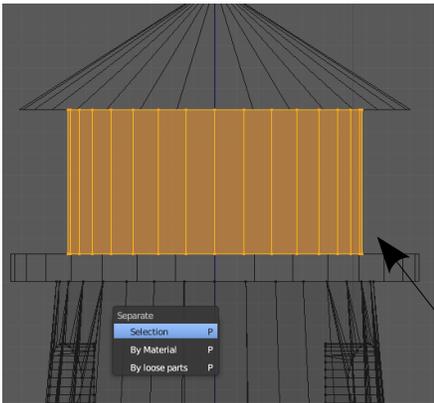
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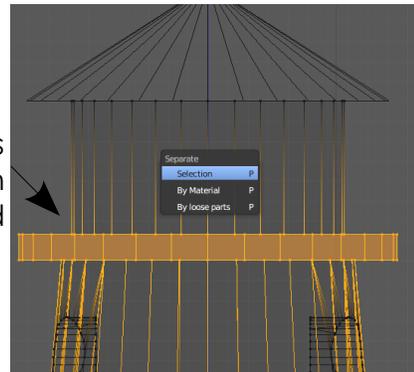
Let's start by adding textures to your lighthouse. Open your "**Lighthouse**" model, switch to a *front view* (#1), and enter *Edit mode* (tab). Make sure you are in *wireframe* view ("Z" key). Deselect all vertices using the "A" key (remember- deselected vertices are pink, selected vertices are yellow). Zoom in on the top portion of your lighthouse.



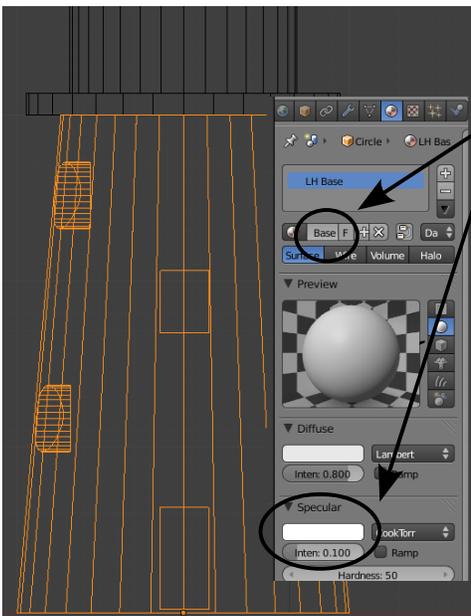
Begin by box selecting ("B" key) the top of the lighthouse (roof only) as shown. We will separate these vertices from the rest of the mesh, making it easier to apply a different material and texture to that part of the lighthouse. Press the "P" key to partition (separate) and choose the "Selected" option. The top of the lighthouse is now a separate mesh.



Now select all the vertices that form the walkway with the box selection and separate them using "P".

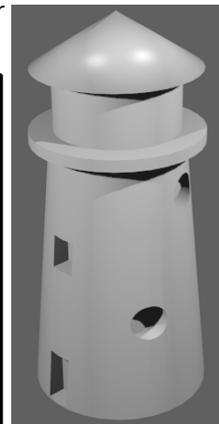


Lastly, select all the vertices that form the lighted area of the lighthouse and separate them using "P".

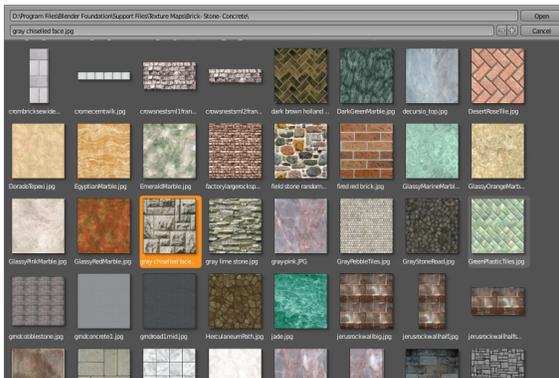


Exit *edit mode* (tab) and zoom out to see the entire lighthouse. The base of the lighthouse should be selected. Go to the *Material* buttons. Select "New" and name the material **LH Base**. Change the *Specular Intensity* setting down to **0.1**. This will keep the gloss down. We do not need to set a color in the RGB sliders since we will be applying an image texture to the mesh. Just to check our results so far, Press F12 for a render.

If you notice any strange effects when rendering, it is the result of separating the mesh. Try entering Edit Mode, select all vertices and use the "Recalculate" Normals, or "Remove Doubles" options in the Tool Shelf. There may even be the possibility that you have a double mesh.

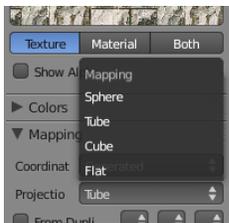


Applying Textures-Landscape & Lighthouse



Now it's time to add a stone image in the texture buttons. You will need to find a texture to use. You can search the internet for free stone textures, look through the Blender websites, or go to http://www.cdschools.org/_lcdhs/site/default.asp and look under "Academics" and "Drafting and Design Technology" for a compiled zip file. Once you have some saved images, go to the Texture buttons and select

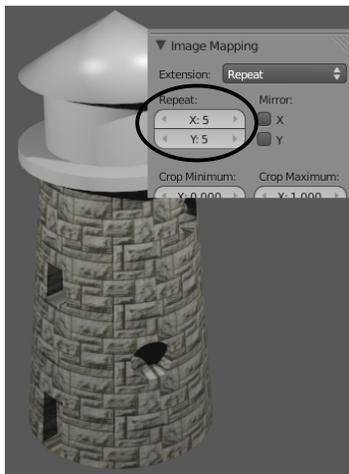
the Image or Movie option. Hit "Open" in the Image panel and find a texture you would like to use. Hit **F12** to render an image:



Looks a bit distorted. The texture is being mapped Flat by default which means it is being mapped to the top plane and stretched down the sides. To fix this, go to the Mapping panel and change the Projection from "Flat" to "Tube". Render another picture and you should see an improvement.



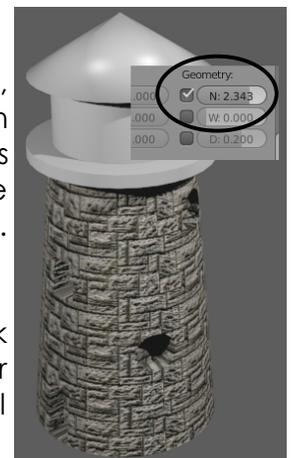
The image should now wrap around the lighthouse nicely, but the stones may be a bit large. The image may also look a bit flat. It would be nice to simulate some depth to that stone texture.



To change the image size, find the X and Y Repeat buttons in the Image Mapping panel. Change them from 1 to a higher number. For this example, we used 5 for each, but depending on the texture you used, it may be different. If your image shows a bad line at the seams, try clicking the **Mirror** buttons by each repeat setting. This will *mirror* the image to minimize repeats.



In order to simulate depth to the stone, add a "Normal" to the stone texture in Textures under the "Influence" panel. This will simulate depth and add a nice effect to the stone. Some texture will work better with this than others due to color contrast. Render another image to check your results.



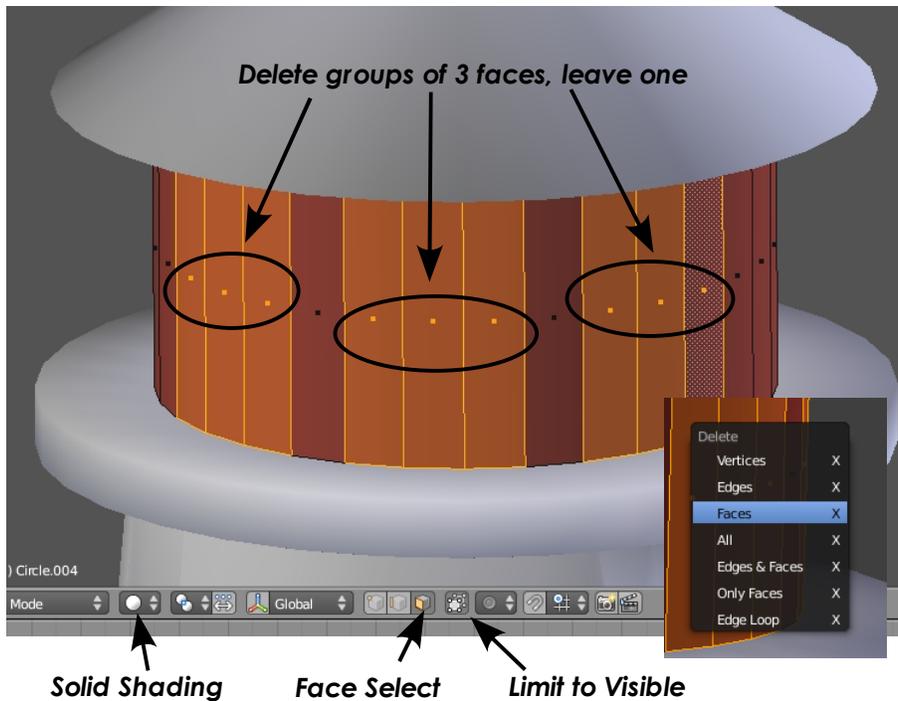
Continue doing this for all parts of your lighthouse to get the look you wish. You can also use straight materials on some parts. Our next step is to cut some windows in the top of the lighthouse. Feel free to try some of Blender's built-in texture generators.

Applying Textures- Landscape & Lighthouse

Here's the final result of my texturing. I decided to go with a straight color of red for the light area and a stucci texture on the walkway to simulate stone/concrete. Since the lighthouse will be toward the back of our final scene, it doesn't need to be "photo realistic".

It's now time to cut some windows to let the light shine out. We will do this easily by deleting faces in *edit mode*.

First, select the tube mesh and enter *edit mode* (*tab*). Change from selecting *vertices* to *faces*. (see page 3-5 if you forget). You'll also want to switch from *wireframe* view to *solid shading* ("Z" key) and hit the button to *limit selection to visible*. You will need to select every 3 faces and delete "*faces*". You will leave 1 face (as the post between the



windows), and delete the next 3 faces. Continue all the way around. Since there are 32 divisions, it should work out perfectly all the way around.

With the faces deleted, exit *Edit mode* and render a picture with F12. Your lighthouse should look something like the picture below.

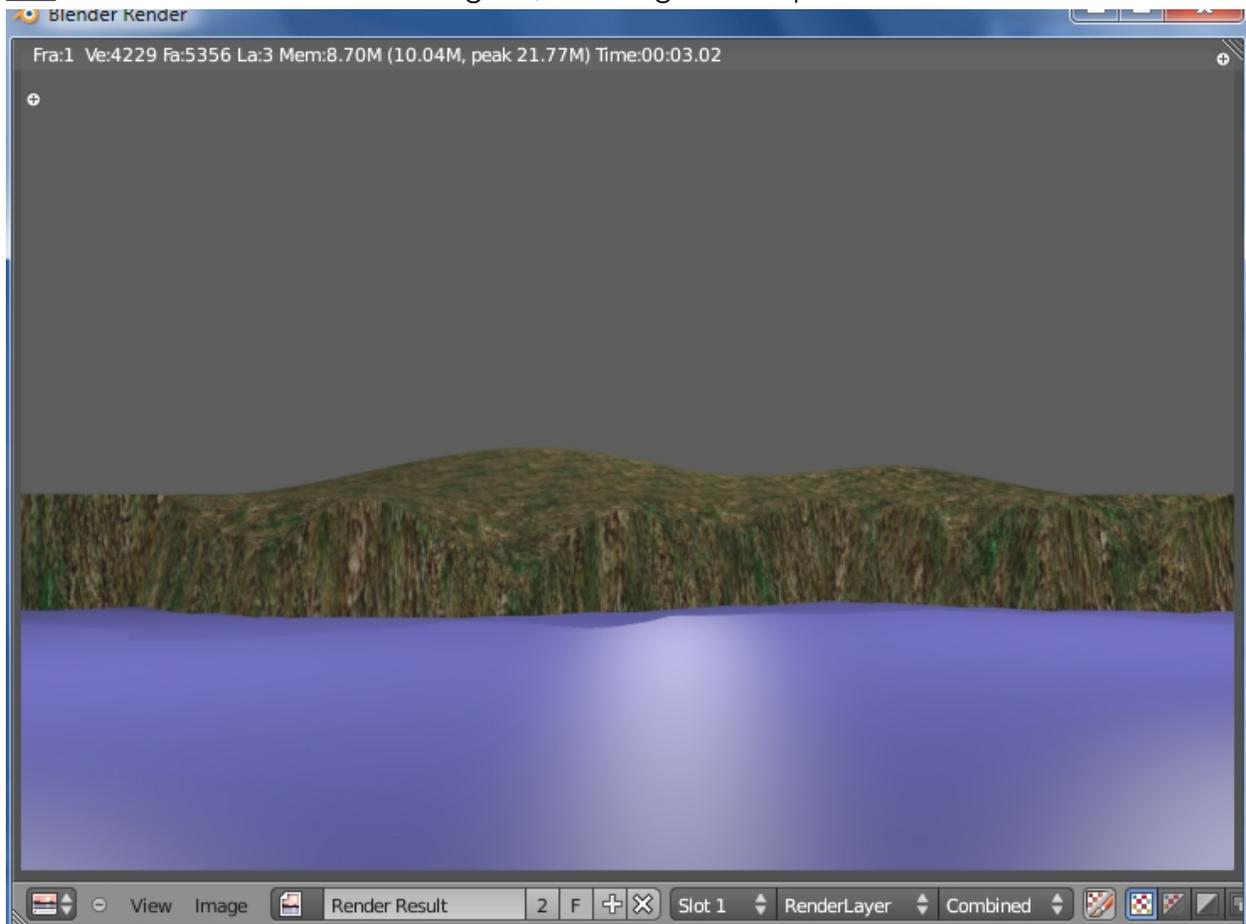


Now that we're done texturing and editing the lighthouse, it's time to join the meshes back together. In *Object Mode*, select all the meshes by RMB (right-mouse-button) clicking on them while holding down the **Shift** key. Hit **Ctrl-J** and confirm the operation. The lighthouse should once again be a single mesh. You should also have a final rendered view, fully textured! After joining your meshes, you now have one mesh with multiple materials and can see them listed in the material panel. You may need to go back and adjust them after joining, but should not need much.



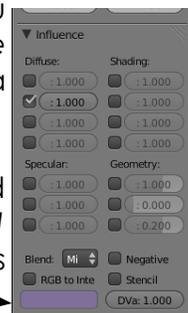
Applying Textures-Landscape & Lighthouse

Now it's time to save the "**Lighthouse**" file and bring up the "**Landscape Scene**". It's now time to find a nice grass/dirt texture to use on our ground and repeat the same process we used for the lighthouse. Since we already have a material from the previous lesson, we can use it. Take Specular Intensity down since it shouldn't be shiny. Add a new texture and load an image of your choice. Use the X and Y repeat setting as needed and apply Normal to show depth. You may want to keep this image Mapped Flat. Here's the final result with a grass/dirt image that repeats well:



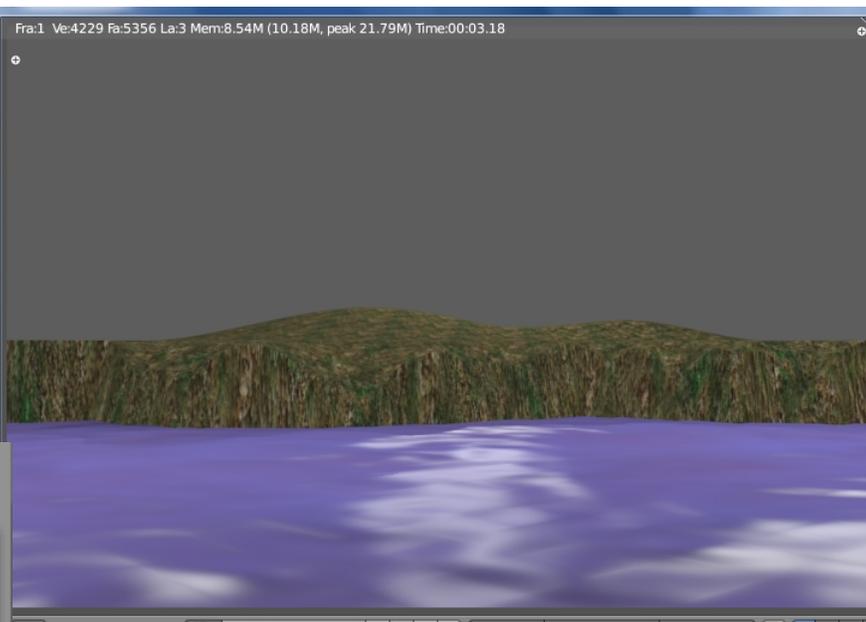
Let's work on the water now. Select the plane representing the water. Again, use the material we previously created. Keep Specular Intensity high since water is glossy. We will be using Blender's built in cloud texture type instead of an image for this one. Go to the Texture buttons and add a Cloud texture. If you render a picture, you will see the original blue and the pink color. Go back to the Texture buttons and change the secondary color in the Influence panel to a slightly different shade of blue/gray.

Remember that our goal is to have a stormy night so pick colors that would reflect that type of scene. Adjust both colors (Material Diffuse color and texture color) for the best effect. Adjust the Normal setting to show waves and render an image to check.

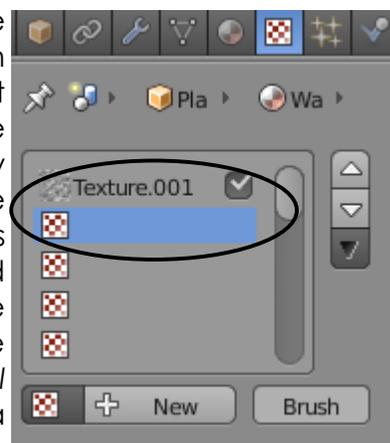


Applying Textures- Landscape & Lighthouse

The results look pretty good. To get higher waves, remember to adjust the *Normal* setting. You can also try to experiment with different "*Noise Basis*" options to get a desired look for your waves. Some will look better than others.



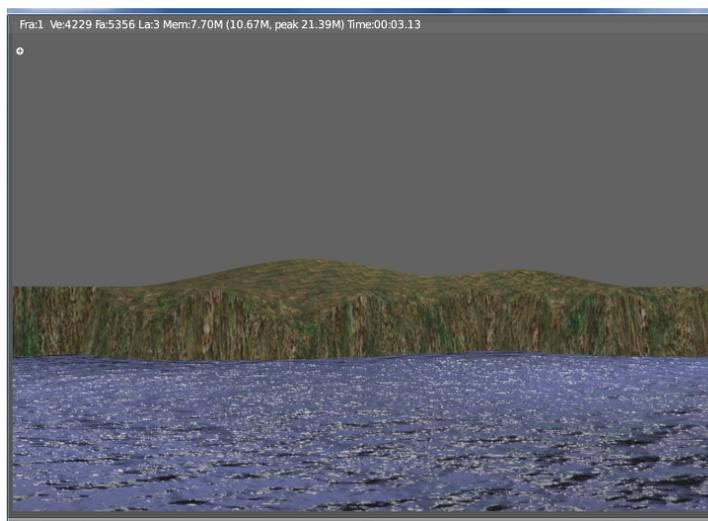
Remember that Blender has the ability to use multiple textures on one object. Select the next texture channel under the current one and add a new texture to this channel. For the Texture Type, select *Sticci*. This additional channel will add another level of detail to the waves. As before, select a Noise Basis and adjust the *Normal* setting and colors to get a desired result.



The scene to the right required adjusting the material color and settings on both texture channels. Adjust the size, type, texture color, and normals to get a good balance.

That's it for now. We will come back in a later chapter and animate the waves. Remember to SAVE!

**** Call the instructor when finished****



Chapter 5- Setting Up a World

Using Color, Stars and Mist



You've created a nice scene for your lighthouse, but we're missing a really nice background. Depending on which release of Blender you're running, you will either have a black, gray or blue background. This is due to the fact that some releases do not start with a world setup initially (black) and newer releases start with a blue or gray background (a basic world set-up). Blender gives you some basic options in the **World** settings. You can control the colors of the top and bottom (**Zenith and Horizon**), stars, fog or mist, clouds and, of course, loading JPEG images. In order to create a new world, select the **World** button. If a world has not already been placed in your scene, click the **"New"**. This will give you a basic world with a horizon and a zenith color. Press the **"F12"** button to render your scene. You have some basic options that you can set in the world buttons. Here's what you see:



← *Preview Window: Sample of your world settings*

← *Mapping Options: You can flatten (Paper), Blend (Horizon/Zenith colors), or Real Sky (gives true horizon)*

← *Color Settings: Horizon (bottom), Zenith (top), and Ambient (reflected light). Ambient supplies global illumination.*

← *Ambient Occlusion: Another way to simulate ambient lighting.*

← *Environmental Lighting: Global lighting settings.*

← *Gather: Raytrace or Approximate. Approx. will allow for indirect lighting effects. (discussed in the lighting chapter)*

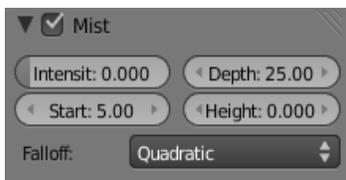
← *Mist: 3D fog settings.*

← *Stars: 3D star field settings.*



When setting just a straight gradient color for your world, Select the "Blend" option above the color swatches and set the Horizon and Zenith colors.

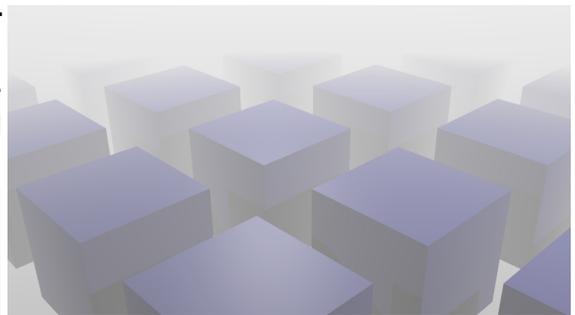
Mist Settings:



When using Mist, You will need to set both the **Zenith and Horizon colors** to the color of the mist you desire (middle gray for a real fog), turn on the Mist button, then adjust the **Start** (start from camera distance) and **Depth**(depth of mist). You also have a **Height** setting to vary fog height (like fog at the ground level). The **Intensity** slide can adjust intensity. **Depth** and **Intensity** work together for the best effects.



I can't see through my fog! Your Depth setting is too low- the fog is too thick!

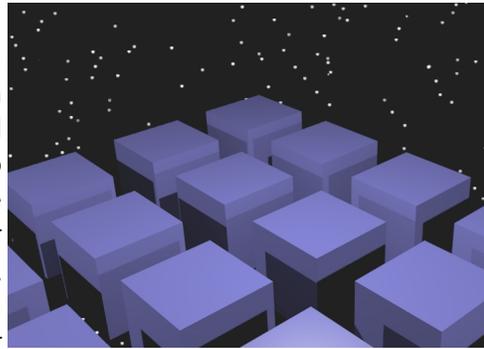


Chapter 5- Setting Up a World

Star Settings:

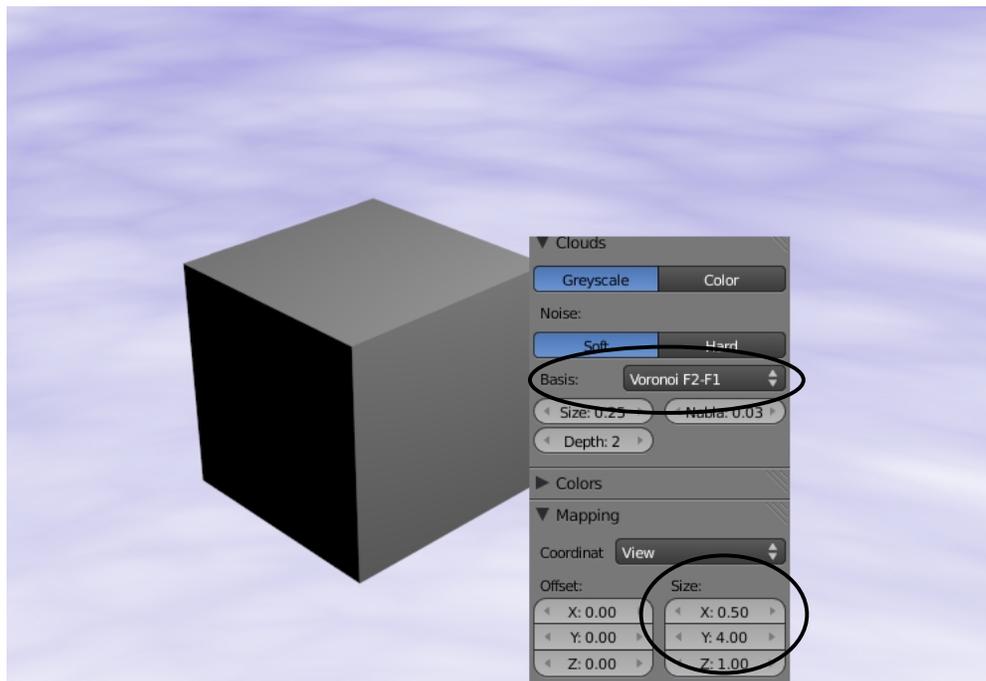


When using Stars, you will need to set both the Zenith and Horizon Sliders to black (for a space scene). Turn on the *Star* button and adjust the **Star Separation** (distance between stars) and the **Min. Distance** (starting distance from camera). You can also set **Star Size** and **Color Noise**. This is a true 3D star field meaning that if you move the camera through it, the stars will move past the camera.



Creating a 3D Cloud Backgrounds

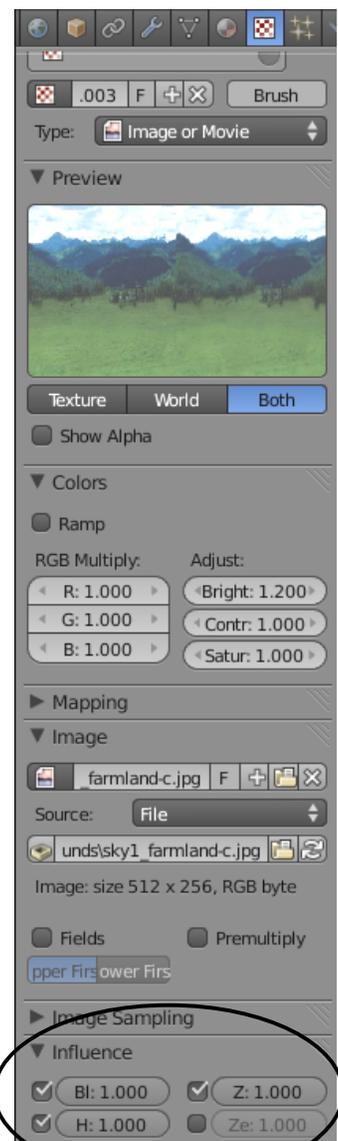
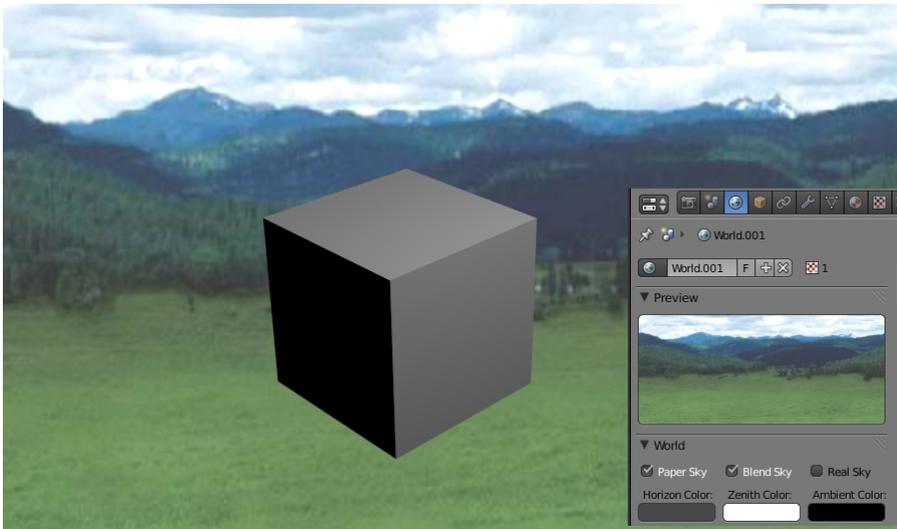
There are several ways to create clouds, but the easiest is to use a texture in the world settings. To set up a scene with clouds, create a world as described previously. Set the *Zenith* color to white. Keep the *Horizon* at a blue color (make sure *Blend* is checked). Now, go to the texture buttons and create a new texture using "Clouds" (you will notice that the texture will be linking to the world and not a material) Go down to the *Mapping* panel and adjust the *Size X* and *Y* sliders (try a low *X* and a higher *Y*) to get the effects that you want. Press F12 to check your results. If you plan on moving the camera in your scene, you may want to hit the "Real" button in the *World* panel. Try a different Noise Basis like Voronoi F2-F1 for a puffier look. Clouds can also be animated which will be discussed in a later chapter.



Chapter 5- Setting Up a World

Using an Image in the Background

If you plan to use an image in your world settings, use one that is large and high quality. Low resolution images have a tendency to be grainy and unrealistic. To use an image, **create a world** as described before, then go to the **Texture** Settings. This time, select the **"Image or Movie"** type option and select your image (described in the *Materials and Textures* chapter). Go back to the world settings. Take your **Zenith** color to white and check the Blend button (and also the Paper button if desired). After you do this it should look much better. If you hit "F12", the background image shows up, but may look like a black-and-white image. In order to correct this you need to go back to the texture settings and select the "Blend", "Horizon", and "Zenith" buttons under *Influence*. This should correct the problem and display the proper colors.



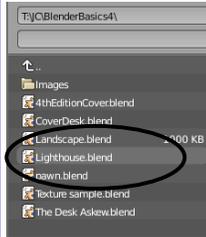
RoboDude Asks: How do I make a puffy-looking mist or cloud effect?



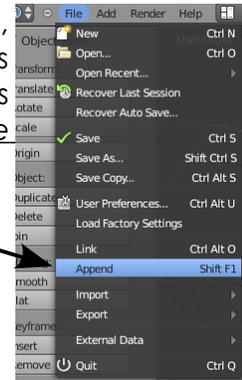
If you would like to have a mist or "cloudy" looking effect that move and blows by (like used in "*Elephants Dream*" movie, use a cloud texture and the mist settings. Cloud textures can be animated (discussed later) and will look 3D with the mist settings. We will actually use this effect in the next exercise.

Adding a World to Your Landscape

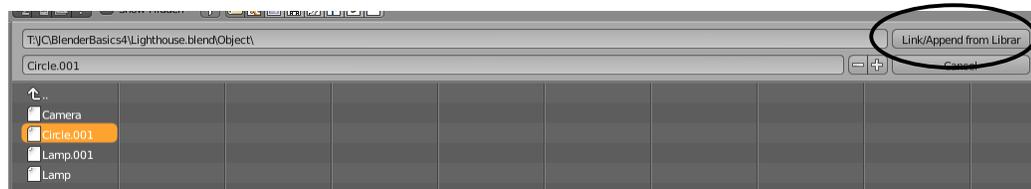
Open your "**Landscape Scene**". Before we add a world to your scene, we need to **Append** your lighthouse into the scene. Append was discussed back in Chapter 1 (page 1-5) and is used to bring elements from one Blender file into another one. With the Landscape Scene open, go to "**File**" and "**Append**".



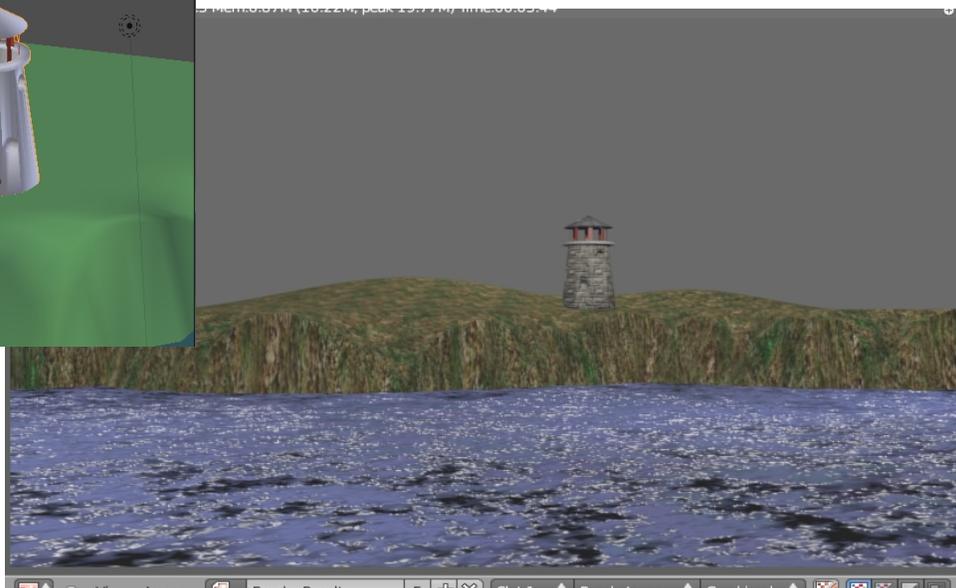
Find and select your "Lighthouse" file.



In the append window, select "**Object**" which will take you to all of the objects in the lighthouse file. You should only see a camera, a few lamps and the circle object that represents the lighthouse. If you see more than one object, you might have forgotten to join the meshes back together. Go back into the lighthouse file and do that before you append. Click on the mesh Circle (or Circle.00X) that represents your lighthouse to select it, then click the "**Link/Append from Library**" button.



Your lighthouse will now be in your landscape scene. It will probably need to be scaled and moved to a good location. Always work in your 3 principle views (#1,3,7) to get it accurately moved and scaled. Try for something like this final rendering:



Adding a World to Your Landscape

It's time to add a world to our scene. Feel free to experiment with any of the settings, but we are actually looking for a "dark and stormy night", say, at late day or dusk. I'm imagining it being foggy, with a billowing effect.

Start by going to the World buttons and delete the default world by hitting the "X" by the name block, then "**New**".



Since we want a fog, set the Horizon and Zenith colors to 2 slightly different shades of gray. To do this, you can click on the color swatches and pick the gray from the menu blocks. Press the "Blend" button as well if not already set.

Turn on the **Mist** button and start with a Depth setting of about **25**; Intensity at **0**; Start at **0**; and Height at **0**. Render the image and make adjustments as needed. Your goal is to be able to see the lighthouse, but be a bit foggy.



You should try for something like the render below:



Adding a World to Your Landscape

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This foggy scene looks good, but it would be nice to see some depth. Many times, a fog can appear “billowy” with varying density. For this, we will add a *Cloud Texture*. Go to the *Texture* buttons and add a *Cloud* texture. Make sure *World* is selected by the preview. Try different *Noise Basis* settings to get the look you want.

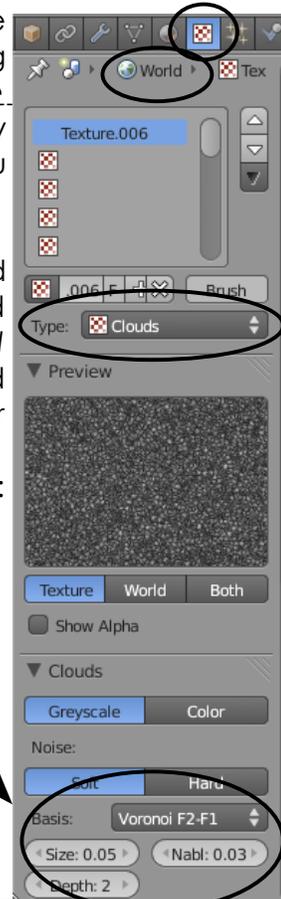
At this point, go back to the *World* buttons, render an image and make adjustments as needed. You can adjust the sizes of the cloud texture, adjust the colors, work with the mist settings (*Depth* and *Intensity*). You may also want to go back to the texture settings and adjust the Noise Basis. We will animate this fog rolling by in a later chapter.



The settings used for the render below are:

Texture Settings:
Basis: Voronoi F2-F1- Size 0.05
Mist Settings:
Intensity 0.100; Depth 22.00

**** Call the instructor when finished****



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 hitting "Shift-A", like creating all other objects discussed up until now. To change which camera is active, you need to select that camera and press "Ctrl" and number pad "0". This changes the active camera.

Like all other objects in Blender, you can adjust the camera settings as well. With the camera selected, click on the **Camera button**. Here are some of the settings options you have:

Perspective/Orthographic- Used to set the camera from showing a true-life perspective view to an orthographic view.

Lens (Focal)- 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.

Panorama- Changes camera view to reflect a cylindrical camera.

Shift- Pushes the view left, right, up, down from actual camera view, without changing perspective.

Clipping- Start and End- How close and how far an object can get to the camera and still be seen. In very large scenes, this needs to be set higher or things "disappear" from view.

DOF- (Depth-of-field)- Used with nodes to blur foreground and background objects. This will be discussed in the "Working with Nodes" chapter.

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

Size- How big to draw the camera on the screen. You can also control size with scale.

Show Mist- Used to give you a visual display of how far the camera sees if using Mist (discussed in Chapter 5).

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.

Passepartout- Shades the area on the screen outside of the camera's view. You can control the darkness of the shaded area with the **Alpha** slider.

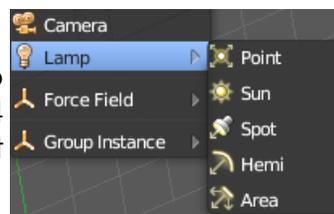


Chapter 6- Lighting and Cameras

Lighting Types and Settings

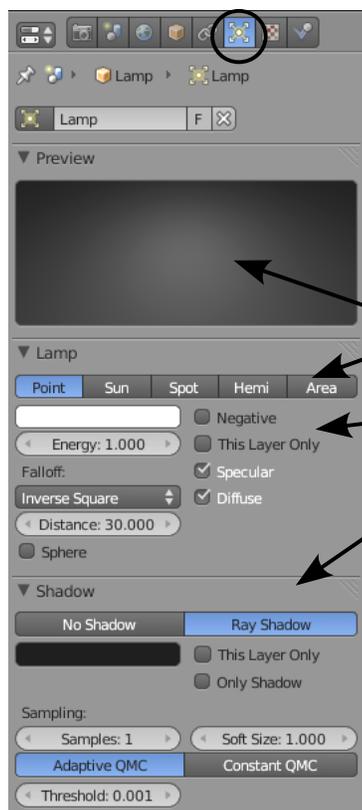
When you create a scene in Blender, you start with a few basic elements that will include a camera, but may or may not include a light. Remember that what the camera sees is what will render out as a picture or movie depending on what you tell the program you want as a final output. To get a simple rendered view, press the "F12" key. If the picture is black, 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. Most scenes usually require 3-4 lamps. *Be careful not to use too many lamps!* The different types of lamps available for you to use are as follows:



- Point-** Basic Blender Lamp- shines all directions.
- Sun-** Provides even angle of light, regardless of placement from objects.
- Spot-** Shines a direct angle of light.
- Hemi-** A wider light, much like area lights.
- Area-** Provides large area lighting (like a classroom). Can be scaled.

In traditional Blender rendering, only spotlights are able to cast shadows. However, with Ray-tracing (discussed in a later chapter) all lamps can cast shadows.



Lamp Settings:

To create a lamp, position the 3D cursor in a desired location and press "Shift-A" and select **Lamp, then type**. The lamp will be placed on the screen. You now have several options to select. With the lamp selected, click the **Lamp** button to bring up the adjusting options. Here's what you see:

- Preview Window:** Sample of your lamp settings.
- Lamp Type:** Can be changed any time. You will get different options depending on the lamp selected.
- General Settings:** This is where you select the color of the lamp, it's energy (brightness), the distance it shines, and a few other options.
- Shadow Options:** Shadow style, color and quality. Ray-shadow will be discussed in a later chapter.

These are your basic settings. Sun and Spot give you some different options. The Sun can actually be used to simulate sky and atmosphere variations. The spotlight will be discussed on the next page.



RoboDude Says: Instead of adding too many lights, experiment with the Energy and Distance settings first. In a large scene, the default distance setting may not light the entire scene!

Chapter 6- Lighting and Cameras

Spotlight Settings:

Spotlights are unique in that you can simulate a foggy scene with them and cast shadows in the traditional Blender program. Ray-tracing (discussed in a later chapter) can cast shadows for all lamp types, but because of the more complex rendering calculations that need to be performed, renders much slower. If you watch professionally made animations on T.V., you will see that ray-tracing with reflections is not always used because of the rendering time. It is only used when needed. You can do the same thing. Again, we will focus on using the Buffer Shadow settings. Ray-trace shadows will be discussed later. Here are your spotlight settings:

Shadow Type: Buffer is the old style and fastest.

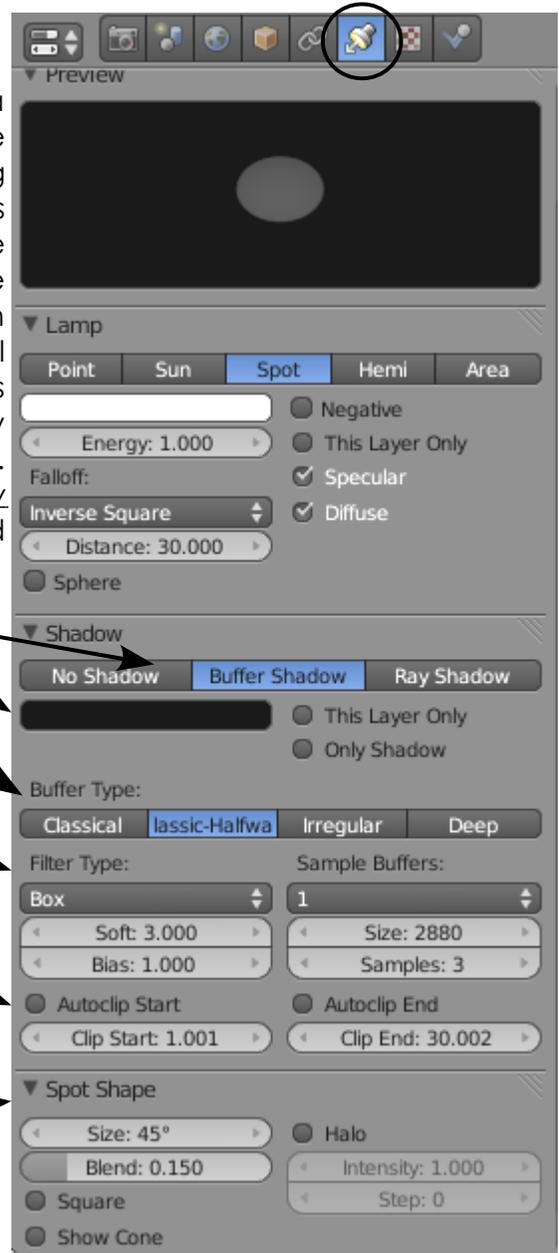
Shadow Color: Adjusts the color of the shadow.

Buffer Type: By holding your mouse over these buttons, it will tell you the benefit of each style (i.e. Deep supports transparency and better filtering, but slower).

Filter and Sample: These settings can be used to refine your results, but could add to your render times.

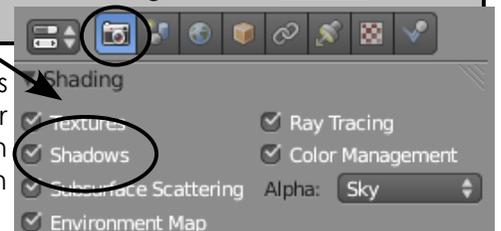
Clip Start and End: Gives a range for calculating shadows. Represented by a line down through lamp. Keep this line as short as possible to give the best shadowing. New to this release is the Autoclip options to set these for you.

Spot Shape: Set the Angle Size, Blend (edge softness), and Shape (round or square). You can also give it a haze with the Halo settings and intensity.



RoboDude Asks: Why can't I see my shadows or why do they look bad? If you have shadows, but look bad, try a larger Clip Start number to shorten up the area of calculation or adjust the Sample Buffers Size and Samples. If you don't see any shadows at all, you might need to go to the Render buttons and turn on Shadows under Shading.

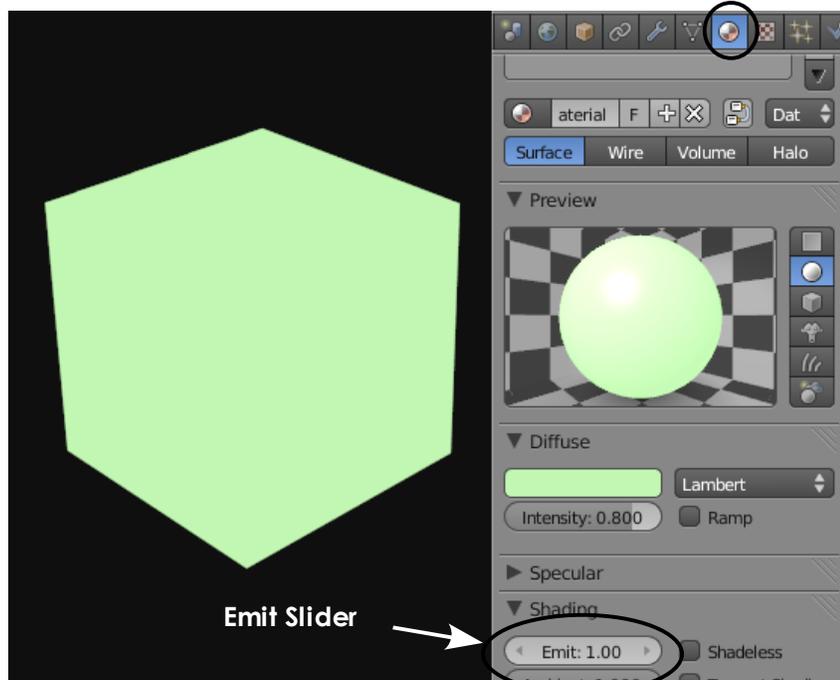
Different lights can be used to get different effects. As mentioned before, try not to add too many lights to your scene. It is better to keep it down to 3-4 and play with their locations and setting, rather than flood the scene in light. Think of it in terms of real lighting situations.



Chapter 6- Lighting and Cameras

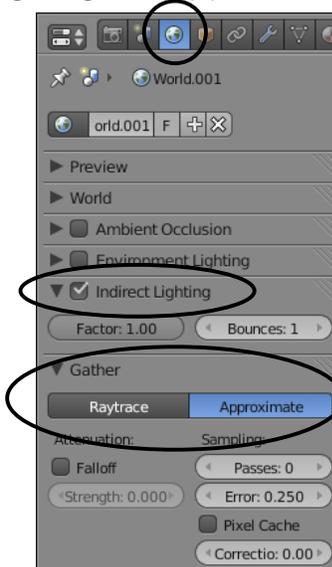
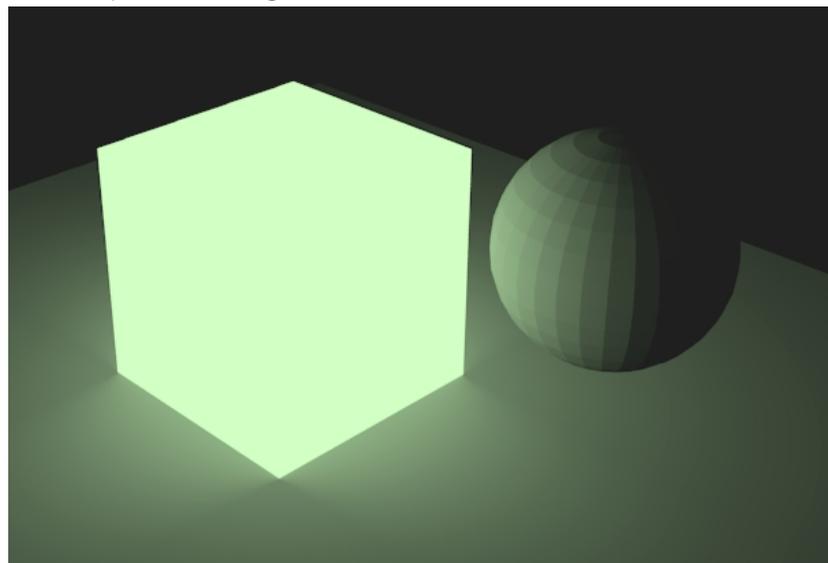
Indirect Lighting

New to Blender 2.5/2.6 is the ability to make objects emit their own light. Indirect light is light that bounces off other objects, like real life. There has always been an *Emit* option in the Blender material settings so an object could glow, even when light wasn't hitting it, but it could never light up things around it. It now can. First, let's set up the material with the *Emit* feature on. For the scene below, I have removed all lamps and the default *World* from the scene. The only reason why the cube glows in the render is due to the *Emit* setting. The plane that it is resting on is not illuminated.



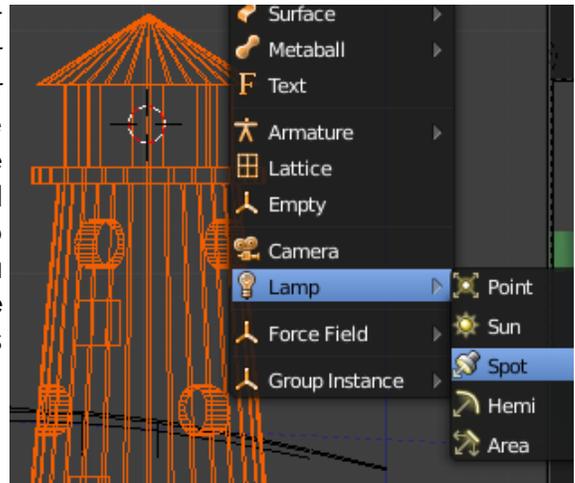
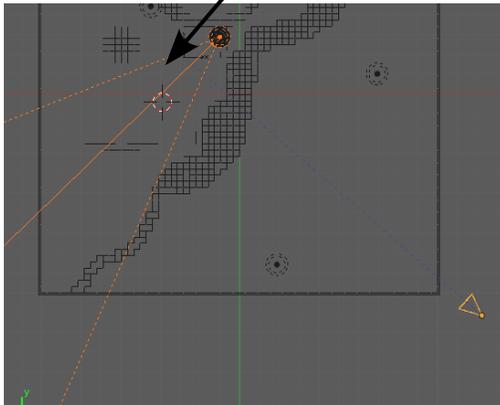
This is what Blender could do before this version. In order to turn on indirect lighting, I need to add a *World* back into the scene. I set the Horizon and Zenith colors to black for added effect. In the World settings, find the panel labeled *Gather* and turn on *Approximate*. This will then open a panel called *Indirect Lighting*. Check and open the panel. You will see a *Factor* (influence) slider and *Bounces*, which will control how many times the light bounces. A rendered scene now shows reflection on the floor plane

and a sphere sitting beside the cube, invisible before indirect lighting was applied.



Lighting Up Your Landscape

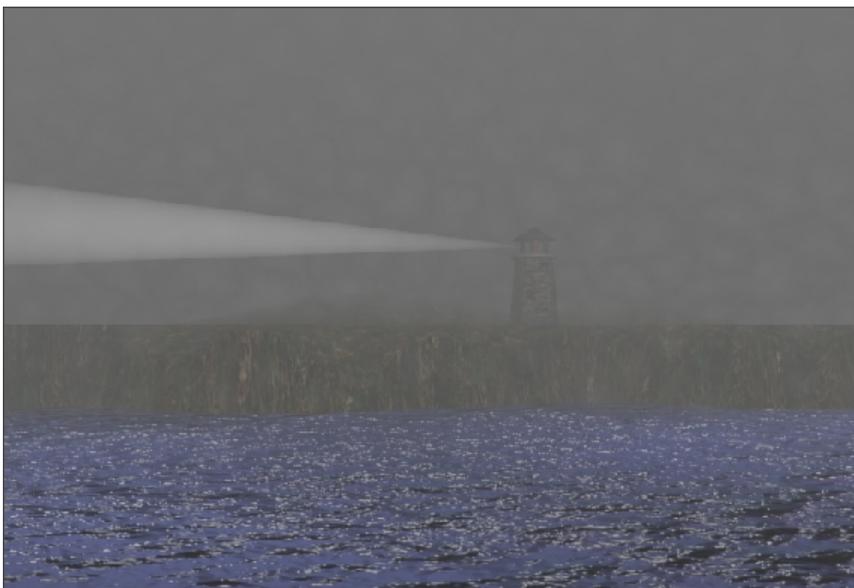
What is a lighthouse scene without a light shining out through the fog? Open your "**Lighthouse Scene**" and place the 3D cursor directly in the middle of the lighthouse where the spotlight should shine. Use your 3 principle views (#1,3,7) to place the cursor in a good location. After the cursor is located, check to see if you are in the *front view* (#1) and add a **Spot Lamp** (Shift"A"-Add-Lamp-Spot). Rotate the lamp as necessary so it is pointed across your scene and not directly at the camera.



After the lamp is added, go to the *Lamp buttons* and make sure it is set to **Buffer Shadow**. Adjust the **Energy** to about **1.2**. In the *Spot Shape* panel, adjust the **Size** slider to about **10**. This will give you a narrow beam that is about 10 degrees wide. Also turn on the **Halo** button. Render an image. Fine tune the spot light with *Distance* and

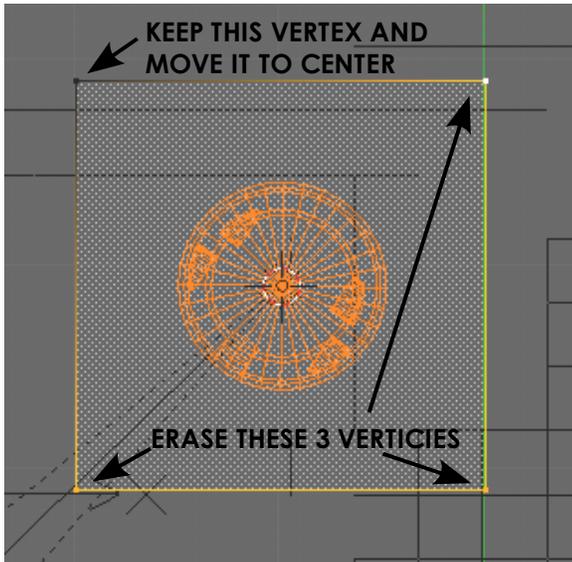
Energy setting and the *Halo Intensity* slider.

Your final rendering should look something like the image below. Looks good, but something is missing. There should be something in the middle of the lighthouse emitting that light. We'll do something simple, but effective for that next.



Lighting Up Your Landscape

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Now it's time to add something in the middle of that lighthouse. Basically, we're going to add a mesh with a single vertex and place a *Halo Material* on it.

Start by making sure the 3D cursor is still in the middle of the lighthouse top. If it isn't, an easy way to get it there is to select the spotlight and hit "**Shift-S**" and select the option "**Cursor to Selected**". This is a great command to use and use often. In the *top view*, add a plane. Enter Edit Mode (tab) and delete *all* but one vertex. Move that remaining vertex to the center of the lighthouse. After you move the one vertex, exit Edit Mode (tab).

Now go to the Materials buttons and Add a new material. Press the Halo button. Here, you will see some Halo settings. Adjust the Halo Size (try 1.0 or more), turn on Rings and Star, and try adding more Rings and Stars. You may want to try adjusting the Hardness and Add sliders.

Your end result should look something like this with a ring and star in the center of the lighthouse. You may need to darken your world setting a bit to get the best effect.



**** Call the instructor when finished****

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Basic Setup Options



The render window is where you tell the program what you want as an output for 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 Ray-tracing 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 Settings**. Obviously, the higher the quality of the output, the slower it will render and the larger the file size will be when finished. *For a review of rendering and animation basic, refer back to pages vi and vii in the manual.* Blender has organized these options into 2 tabs in version 2.6- "Scene" and "Render". Click on the **Render** button to get started.

The Rendering Interface and 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 as MPEGs.

Image/Animation Buttons: Pressing F12 is the same as hitting the Render button. To make a movie, hit Animation.

Display: Determine if your render occurs in a viewport or in a new window.

Layer: Control which layers or groups to render.

Dimensions: This is where you set the size, frame range, scaling and frame rate of your rendering. If you make an animation and it runs too fast or slow, you can change the mapping and scale the time with Old Map and New Map. Think of it like scaling time. Presets can also be selected.

Anti-Aliasing: Samples with smooth the edges of objects. Default is 8.

Motion Blur: Used to show blur from fast movement.

Shading: This is where you set what features you want rendered. Turning off what you don't need speeds renders.

Output: Set file types for outputs and saving locations. You can also set compression quality for images. It's always a good idea to type the file extensions when naming output files. *For movies, there will be encoding options in a panel.*

Performance: Settings for render performance.

Post Processing: If doing composites or sequences (discussed later) are controlled here.

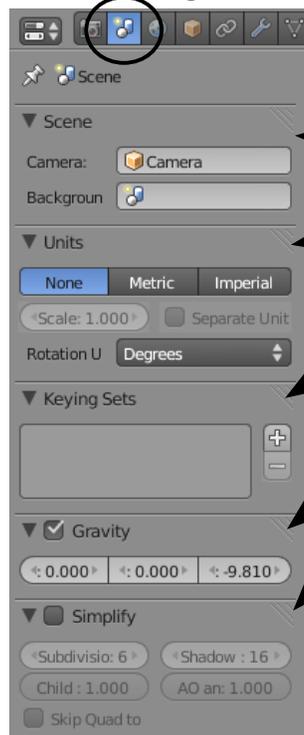
Stamp: Labeling for frames and movies if needed.

Bake: Baking is a feature where certain processes can be saved to speed rendering.



Chapter 7- Render Settings

Scene Settings:



Some items in the Scene settings tab are relatively new to Blender or grouped differently than past versions. Here's what you see:

- Scene:** This is where you can set which camera and background to use (if using multiple cameras and backgrounds).
- Units:** New to Blender, you can set between "Blender Units", Metric or imperial. Angular measurements can also be set.
- Keying Sets:** New to Blender. Can be used for reference with the new F-Curve system (discussed in a later chapter).
- Gravity:** Used for real-time physics and game logic.
- Simplify:** Useful for preview-quality rendering. Saves time by changing the quality of the meshes and shadow.

Most of these settings you will leave set to default unless you need something specific. For example, a space movie where the ships do not need gravity.

Here's a sample output setting:

Lets say you want to render a movie at DVD quality. In the U.S., we would use a render preset of NTSC 4:3 which would give us an output size of 720 x 480 pixels at 30 frames-per-second. If we wanted a 10 second movie, we would set our frame range from 1 to 300 (30 FPS). If we want a movie, we would choose MPEG in our Output panel and give it a name with the .mpg extension. We may be fine with all other presets.



RoboDude Says: Experiment with these settings to become comfortable with them. It's sometimes best to work and model with small output sizes, then render at higher settings.

Rendering a JPEG (.jpg) Image

In order to render a simple JPEG image, set up all of the options previously discussed. It is important that the file type is set to JPEG in the *Render Output* panel. For single pictures, it's nice to have a high quality image because time isn't as important when you're rendering a single image as it is when rendering a movie. Press the "**F12**" button or "**Render**" button to bring up the render window. With the render window up, Press "**F3**". This will open the file save window. Here is where you give your file a name and set the location. **Remember to type .jpg after the name of the file so it saves properly. Windows will not know what to do with the file if the .jpg extension is missing and Blender may not put it on for you.**

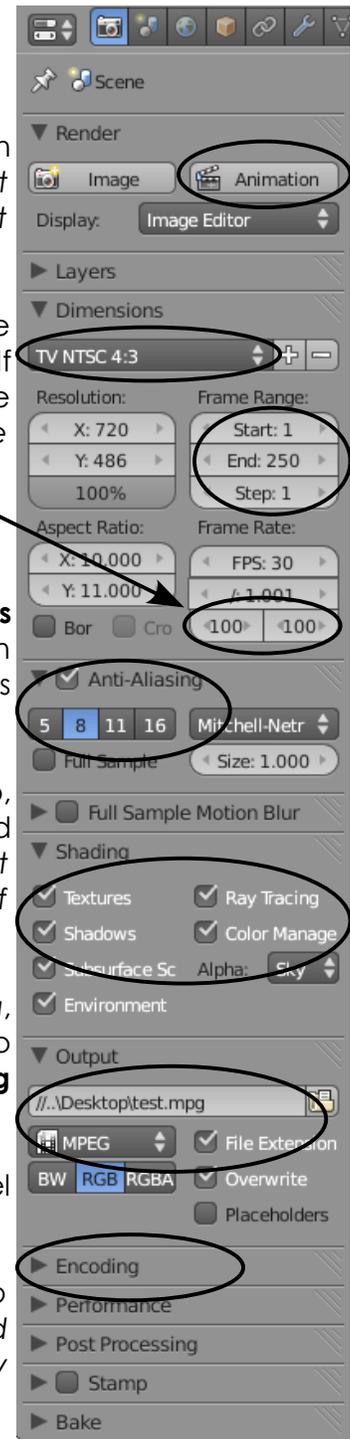
Creating an MPEG Movie File

In chapter 9, you will be creating your first computer animation. After you create all of your objects, apply materials and textures, and create your animations, you will be ready to make a movie file of your scene. Here are the steps to saving that movie file:

Seven Easy Steps to Create an MPEG Movie File: (our settings)

1. Select "**TV NTSC 4:3**" (or whatever your output choice) in the **Dimensions** panel. This will set your *X&Y size, Aspect Ratio and Frame Rate (FPS)*. Check the output percentage under *Resolution*.
2. Check the "**Start**" and "**End**" frames for the length of the animation. Also check the **frames per second** setting. If your animation timing is too fast or slow, try changing the "Map New". (ex. need to slow movie 1/2 speed- change New Mapping to 200 and double End frame).
3. Make sure that **Anti-Aliasing** is **ON**, set to **8**.
4. In the **Shading** panel, check to make sure the **Shadows** and **Ray-Tracing** buttons are on or off (depending on your output wishes). Check all other shading options as needed. Don't forget **Motion Blur** if needed.
5. Change the file type to **MPEG** in the **Output** panel. Also, click the file folder button and set your *location and name of the movie file*. Remember to type **".mpg"** at the end of the name or Blender will put a bunch of numbers on the end of the file (the frames rendered).
6. If you desire any additional setting in the *Encoding, Performance, Post Processing* and *Stamp* panels, do so now. **You may want to select "DVD" in the Encoding presets.**
7. Finally, hit the **Animation** button at the top of the panel to animate your movie.

Now just sit back and relax. The movie may take a while to compile (minutes, hours, days depending on complexity and computer speed) since it needs to render each and every frame of the movie.



Rendering-Saving a Picture of the Landscape

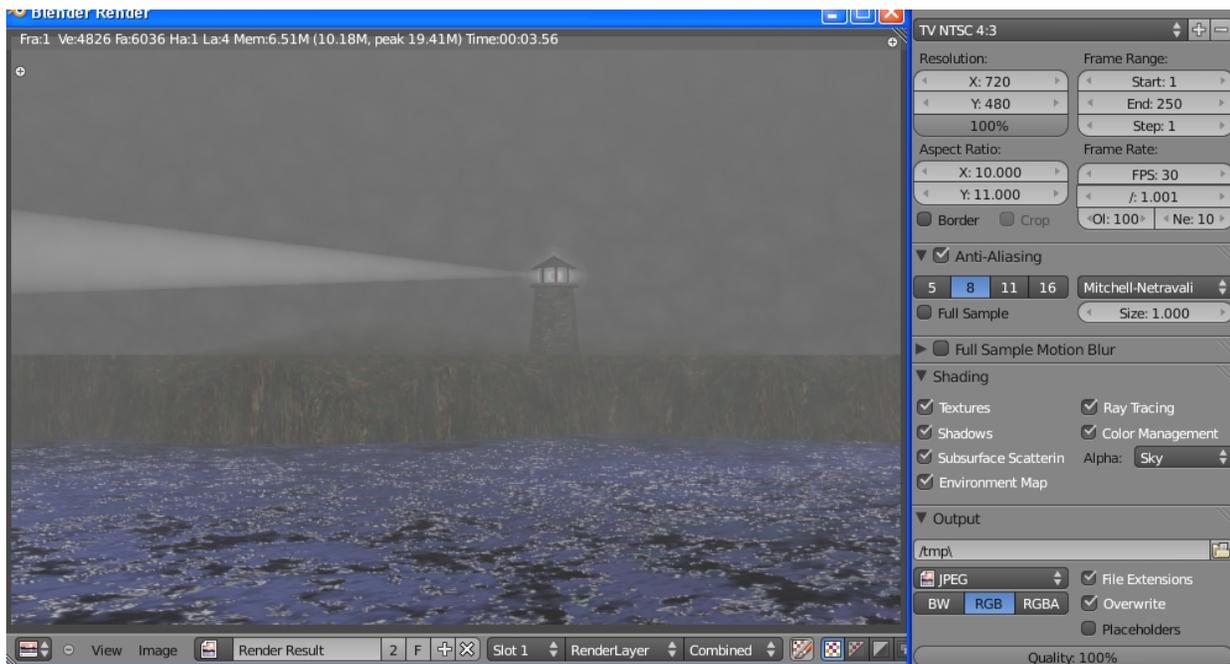
Open your **Landscape** file and set up a good view for rendering to a JPEG file. Set your render options for the following:

1. Select file output type as JPEG, set compression quality to 100%
2. Turn on shadows
3. Turn on Anti-Aliasing and set to 8
4. Click the NTSC button to render an image at 720 x 480.
5. Name your file: *Landscape Image.jpg*

Double check all other settings as per the chapter descriptions, render image (F12) and save the image (F3). *Don't forget to add .jpg to the end of the file name!* We will soon be using the animation setting so begin to become familiar with those adjustments. We will be using them within the next few exercises.

Additional Exercise:

Render your landscape at the "1280 x 1024" size setting. After you save it, open the picture in a program that allows you to set it as your desktop background (i.e. Windows Picture and Fax Viewer).



**** Call the instructor when finished****

Chapter 8- Ray-Tracing

Ray-tracing is used to produce mirrored and *reflective* surfaces. It is also being used to create transparency and *refraction* (bending of images through transparent surfaces-like a magnifying glass or a lens). With ray-tracing, all Blender lights can cast shadows if you desire. Ray tracing can produce some stunning effect, but can come at a high cost in rendering times. **Use it only where needed.** Don't try to ray-trace everything. The professionals don't even do that. Watch any 3D show on T.V. and you will see it being used selectively. You can get some great shadow and texture effects with Blender's traditional spotlights and material settings at a fraction of the render times.

To get ray-tracing to work, you need to go to the *Render* settings and turn on "Ray Tracing" in the Shading panel (see previous chapter). Now you are ready to apply some of the ray-tracing features to your objects. *Until you do that you won't see any difference in your renders.*



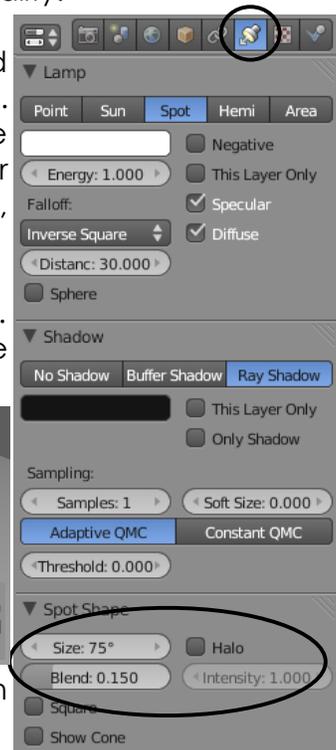
Lighting and Shadows



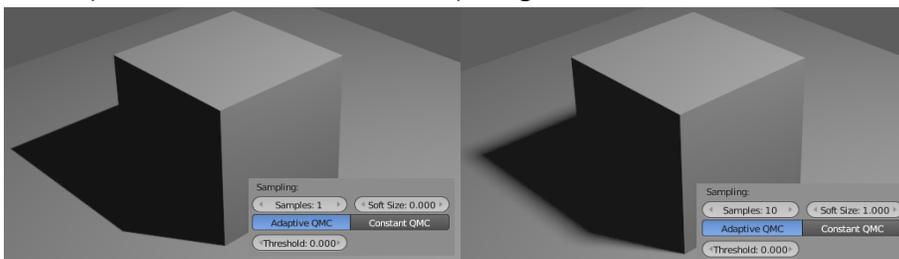
To get a ray shadow for a lamp, select the lamp you want to cast shadows (all types work with ray-tracing), go to the **Lamp** settings, find the "Ray Shadow" button and activate it.

When you activate ray shadow, you will see a few setting for most of the lamp types. You will see "Soft Size" settings for edge softness and "Samples" for improved quality.

You will also see two options called "Adaptive QMC" and "Constant QMC". These are just ways to generate the shadows with Adaptive being quicker while Constant can give better quality, but slower renders.



You will notice a few extra setting options for a ray spotlight. *Spotlight Size*, *Spotlight Blend*, and *Halo Intensity* work the same as they do for a buffer shadow spotlight.



Notice the shadows above. The left image was rendered with Samples at 1 and Soft at 0. The right image was 10 and 1.

Chapter 8- Ray-Tracing

Reflection (mirror) and Refraction (transparency)

To create a mirror, or reflective surface on an object, select that object and add a material. You can also add textures to an object and have a mirror surface. In the *Material* buttons, you will find a panel called "**Mirror**". All of the ray-mirror features are found in that panel. Check the "**Mirror**" button and experiment with the reflection settings. The **Reflect** slider controls the amount of mirror. A full slider would be a perfect mirror.

For *Transparency*, press the "**Transparency**" button to activate it. Two main adjustments are **IOR** (Index of Refraction) is used to create the Lens effect and bends light. **Fresnel** is used to control the amount of transparency. There are some other setting that you may feel free to experiment with, but these are the main settings.

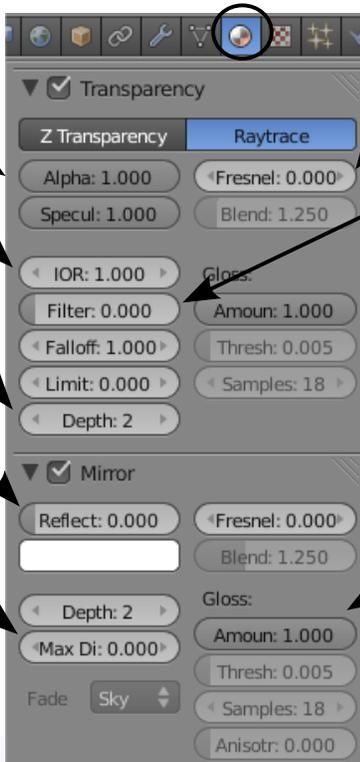
Alpha: This transparency setting can also be used with Ray Transparent.

IOR: (Index of Refraction) Controls the amount of distortion.

Depth: If you cannot see through the object properly, Depth needs to be set higher.

Reflect: Controls the amount of mirror. Full reflect will give you the effect of a real mirror or chrome.

Distance and Fade: Controls how much is actually reflected and what it should fade to when it reaches that maximum distance. 0 means no limit.

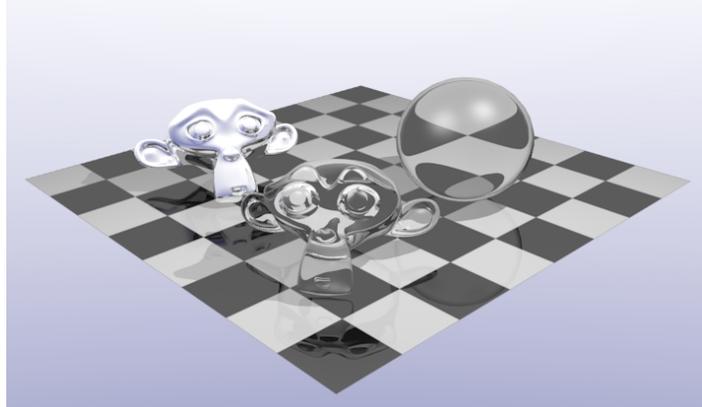


Fresnel: Controls the amount of Ray Transparency.

Filter/Falloff/Limit: These settings control additional effect with how light passes through an object.

Fresnel: In mirror, this causes a fogging effect on the surface.

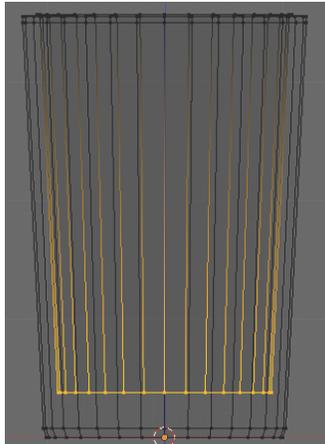
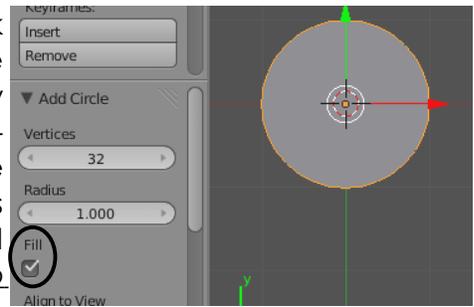
Gloss: These settings control additional effects to the mirror.



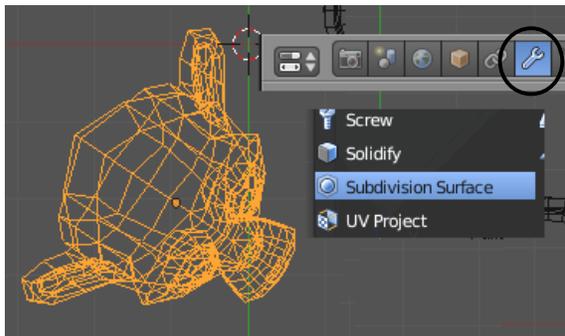
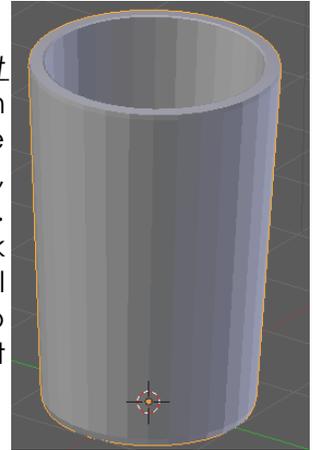
The image to the left uses a small amount of ray mirror on the floor and a high ray mirror reflection on the back monkey head to simulate chrome. The front monkey head and sphere are using a high fresnel and IOR setting to simulate glass and distortion.

Ray-Tracing Practice Exercise

Since we don't have many objects that would work well with mirror/transparency in our lighthouse scene (except the water, which would create a slow rendering), we will create a new scene for our ray-tracing exercise. Since we have experience using the *Extrude* command from our lighthouse modeling, let's use it to make a drinking glass. Start a new scene and erase the *Cube*. Next, add a *Circle* mesh in the *Top* view and check the "Fill" option in the *Tool Shelf*.

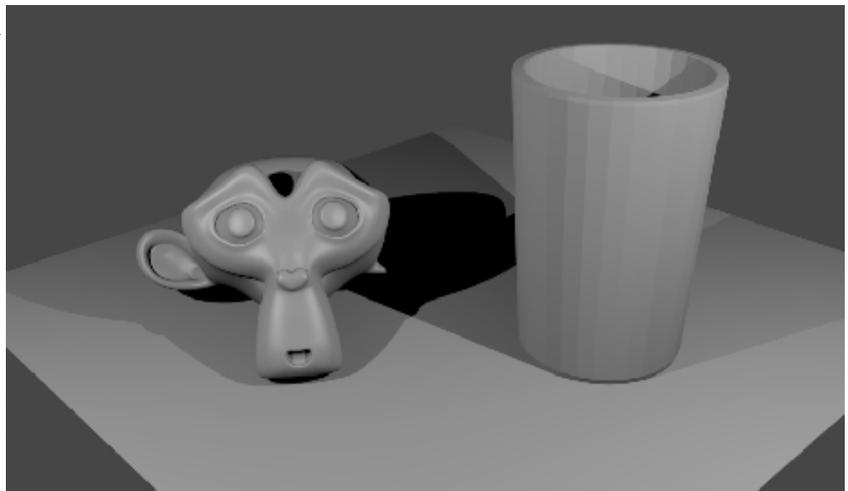


Now switch to a *Front* view, switch to *Edit* mode and *Wireframe* shading. Begin *Extruding* ("E" key) to shape a simple drinking glass. As you extrude upward, scale the top out a bit to show taper. When you reach the top, extrude back down inside the glass to show wall thickness. When you finish, go back to *Object* mode, *Solid* shading, and hit "*Smooth*" in the *Tool Shelf*.



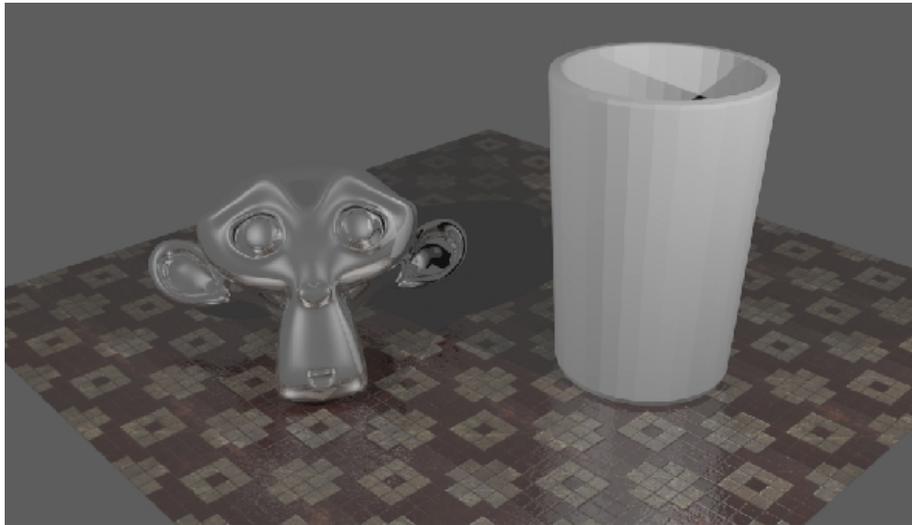
It's now time to add a Plane for the glass to rest on. For fun, let's also add a monkey head to the scene. Set the monkey head *Smooth* from the *Tool Shelf*, then go to the *Modifiers* panel and add a *Subdivision Surface* modifier to shape up the monkey. Sub-Surf adds imaginary rows of vertices to an object in order to improve image quality. Adjust your lights and camera angle to get a scene something like the one shown below:

Now that we have our basic scene, it's time to add materials and texture to our objects. Add an appropriate texture to the floor of your choice and give it a small amount of Ray Mirror as discussed on the previous pages. Also, add a material to the monkey head and take Ray Mirror up to simulate chrome.



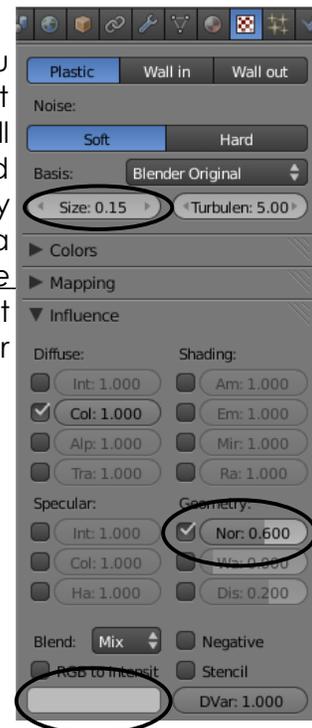
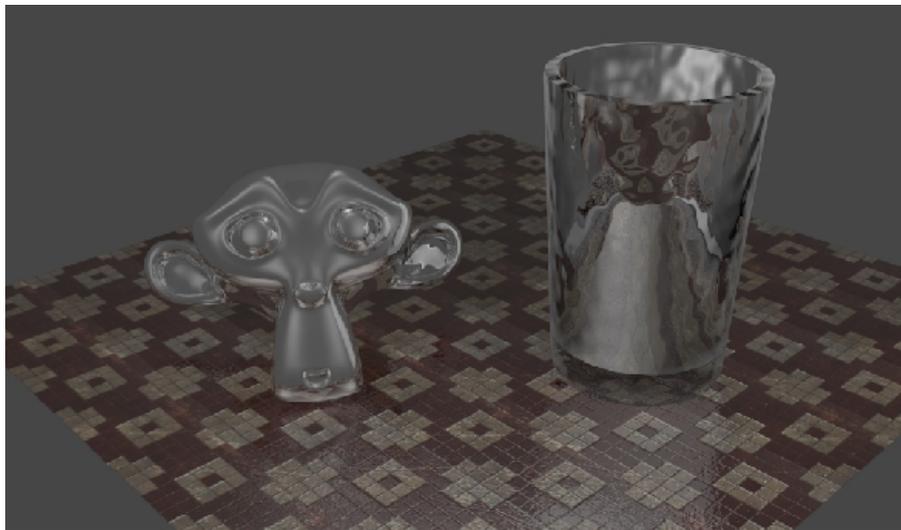
Ray-Tracing Practice Exercise

You should now have a scene that looks something like this. You may notice the floor I used looks like it has depth to it. In the Texture settings, I applied a "Normal" map to it, like we did with the water in our lighthouse scene. If you need help, refer back to the chapter on materials and textures.



It's now time to place a material on the glass. For the glass, you will want to apply Ray Transparency (fresnel) and a small amount of IOR for refraction. When you render the scene, you will probably notice that you can't see through the entire glass and will look dark. Take the *Depth* setting up to 5 in the Transparency panel. This will correct the problem. You may also want to apply a *Stucci* texture to the glass to show waviness. Try taking the *Size* down to 0.15 and add some *Normal* as well. You will need to get rid of the pink color. Try setting it to white. Experiment with your setting until you are pleased with the results.

When finished, render your results and save it as a JPEG image.

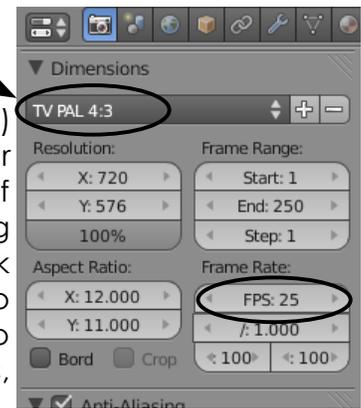


**** Call the instructor when finished****

Basic Key-framing and Auto Key-framing

Now that we know how to make stuff and make it look good, it's time to figure out how to move it around in your scene. If you're familiar with older versions of Blender, this is a **HUGE** change from the past! What used to be called the **Action Editor** and **IPO(Interpolation)** windows are now called the **Dope Sheet** and **Graph Editor** windows. Basically, The Dope Sheet shows your animation keys as points that can be easily copied or moved on a line. The Graph Editor shows your animations as graph curves, where different things can be done with them. This is a big area with lots of things we can do and talk about. Many of the features available will become understandable with practice and by getting beyond the basics. This is a highly developed area in Blender where new features will more than likely be available before this document can ever be printed. For this reason, we will deal with the basics. The first thing we need to do is go back and re-read the section on **Rendering and Animation Basics (pages vi and vii)**.

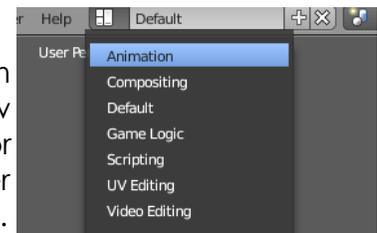
Selecting a preset form will set your frame rate correctly.



After you set up your scene and set the Frames/Second (FPS) in the render button area, consider what you want your "actors" to do and how long they should take to do it. One of the problems that beginner animators experience is making the motions occur in an appropriate time. Remember to look at your frames/second (FPS) when animating and relate it to time. For example, if you want something to take 3 seconds to get from point "A" to point"B" and you are running at 25 fps, you need to complete the animation in a total of 75 frames.

Moving Through Time:

In the picture below, you will find some controls at the bottom of the screen in the Timeline window. If the Timeline window isn't visible by default, you can select the Default or Animation screen in the top toolbar. There are several other ready-made screen layouts that we'll discuss in later chapters.

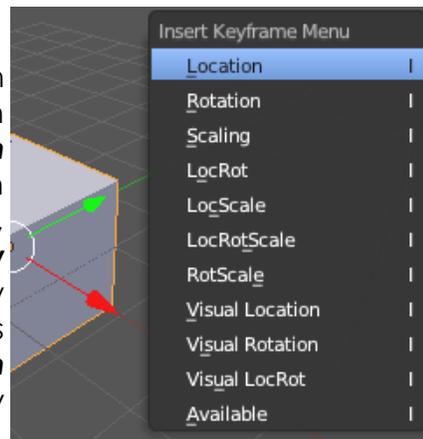


<p>Timeline window type</p>	<p>Current frame: This is your current frame. Can be controlled with the Arrow Keys- Up/Down will change 10 frames, Left/Right will change one frame at a time.</p>	<p>Playback Controls: Just like any player, moves through time.</p>	<p>Synchronization: Used to match playback- sound & video.</p>
<p>Alternate Playback: If this is selected, you can set the playback start and end frames here different then the actual scene frames.</p>	<p>Start and End Frames: Sets the movie length, unless the Alternate Playback button is press. The it will just display working frames.</p>	<p>Key-framing: Control for inserting/removing key frames/types.</p>	

Chapter 9- Animation Basics

Moving, Rotating and Scaling:

These are the 3 basic modifiers to use on an object in animation. When you create key-frames in Blender with these modifiers, Blender will figure out all the **in between** locations on the other frames. To insert a key on an object, go to the frame where you wish to place the key, move, rotate or scale the object, then press the **"I" key** to **"Insert Key"**. Make sure your cursor is in the 3D window when you push the "I" key. The menu to the right pops up. You have 3 main options for now- **Location, Rotation and Scaling** and combinations of these. Select the key option of what you've done to the object. Now, advance to the next frame where you want to put a key (i.e. frame 25 if you want a movement to occur after 1 second), move, rotate or size the object, then press **"I" to insert another key**. Remember, you can change frames quickly with the arrow keys.



Continue placing keys along your timeline to create your animation. For the most part, location and size keys work flawlessly, **but care needs to be given to rotation keys**. If you try to rotate an object too far in one set of keys, the object may not rotate in the exact direction you want it to. It may rotate oddly. Try small angular steps while animating rotation keys. There are ways to control this better and tools to simplify this process that will be discussed later.



RoboDude Says:

If an object doesn't seem like it rotates properly with animation keys, try pressing Ctrl-A to reset the object's scale and rotation.

Automatic Key-Framing:

Typing "I" to insert keys is the traditional way of entering key frames, but it can become annoying when you have a lot of items to insert key frames for (for example, bones in a skeleton). This is where automatic key framing becomes a useful feature. To turn on automatic key framing, press the *small red circle button* in the playback buttons on the *time line window*. This will "record" any motion you do on a given frame and insert the necessary key frames needed. Don't forget to set a key on your initial frame. Auto key framing won't do that unless you change something on that frame.



Key Frames:

At any frame where you insert a key, a yellow line will display in the timeline.

Auto Key Frame Button:

Eliminates the need to press "I" to insert keys.



RoboDude Says:

Don't forget to turn off automatic key framing when not needed! You may end up animating things accidentally when you don't want to!

Viewing Your Animation:

There is a simple way to view your animation without having to render out a movie. Take the **current frame number** to the place where you want to start viewing the animation. Place your cursor in the 3D window you wish to view your animation and press the **“Alt” and “A”** keys together. The animation will play. Blender will attempt to display the movie at the correct *frames-per-second*, but may be unable to do so due to scene complexity, computer speed, or image settings (solid or wireframe -Z key).

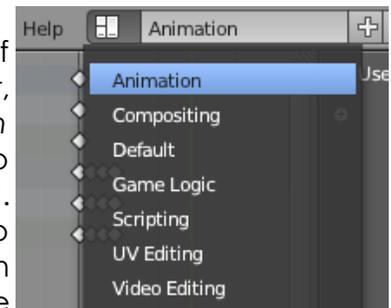
You can also see your animation by pressing the “play” button in the Timeline window. You can also play backwards.



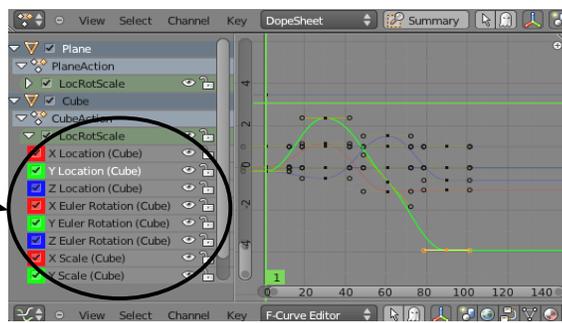
Movement may not be exactly how you planned it. Blender automatically defaults to trying to create a smooth flow through the keys you've place. This can be changed and will be discussed later.

Working with the Graph Editor and Dope Sheet

Animation is difficult to do without some basic knowledge of the **Graph Editor and Dope Sheet**. As mentioned earlier, these used to be called the *IPO (interpolation) and Action Editor* windows. The best way to access these windows is to change your screen layout from **“Default”** to **“Animation”**. You will see the 2 windows on the left and it may help to make those windows larger. All objects that have animation



keys on them will be displayed in the windows and their data displayed to the right as diamonds (*Dope Sheet*) and curves (*Graph Editor*). You can zoom in/out and pan in this window with the center mouse wheel. Like actual objects, the curves can be edited in an edit and object mode. Older versions of Blender would only show you the curves of a selected object, but 2.6 can display all objects in the scene. At first glance, it can be rather confusing! To simplify your view, you can check/uncheck objects to hide/show their curves. By opening a triangle under an object, you can select individual curves for that object and edit them.



Chapter 9- Animation Basics

More About the Dope Sheet:

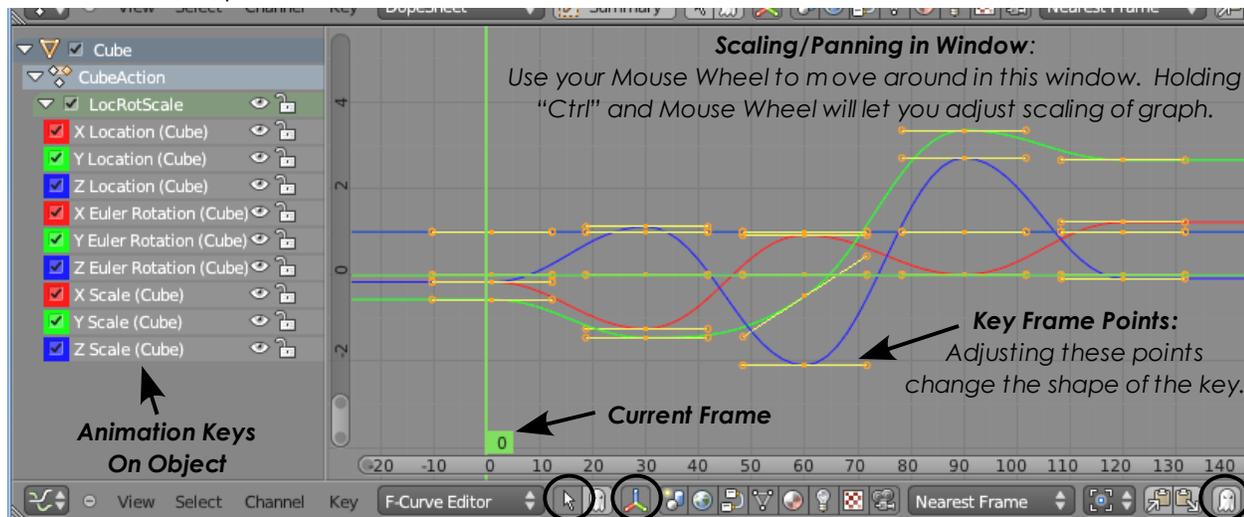
The Dope Sheet shows your animation keys as small diamonds along the timeline. This can be very useful when you want to copy keys to other points along the timeline or select multiple keys and scale them to slow down an animation. You can select keys the same way you select other



objects in Blender- by using the RMB while holding "Shift"; the "B" key to box select, or just RMB a single key. You will notice that when you select a key in the Dope Sheet, the same key is selected in the Graph Editor. You will see many of the same options that are available in the Graph Editor, discussed below.

More About the Graph Editor:

In older versions of Blender, you could animate many things, but not everything. The newest version boasts that everything can be animated and so far from what I've seen, this appears to be true. Everything can also be displayed in the Graph Editor, but trying to look at everything at one time is confusing. Below is a short description on how to control the Graph Editor window:



Menus for viewing and options for curves and keys.

Isolate the window to just viewing of selected object (very useful).

Turn off object curves (helpful when looking at world, material, etc. curves).

Viewing options for different types of curves

Snapping, pivot and copy/paste commands.

Creates a background image of a curve-useful when working on an objects and need to see the curves for another object.

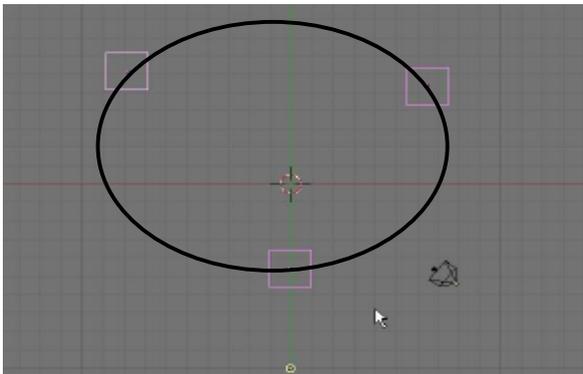
Chapter 9- Animation Basics

As mentioned before, when you create an animation for an object, Blender automatically tries to “smooth” the path of animation through your key points. You have ways of controlling the results of the path. One way is to click on the path(s) you want to modify in the Graph Editor window and, with the cursor in the Editor window, type “**Shift-T**” for type. You can also access these “*Interpolation Modes*” by going to the “**Key**” menu and select “**Interpolation Mode**”. You have 3 options:

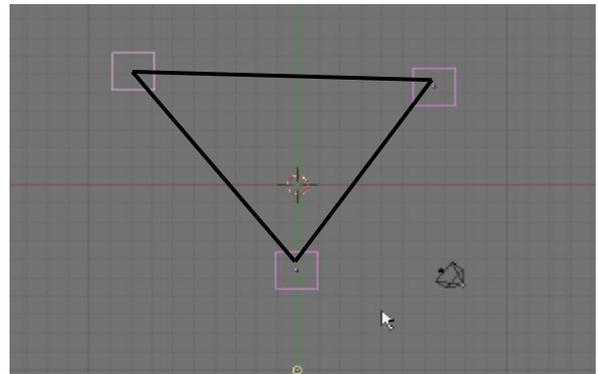


- Constant-** Gives a square waveform, like turning it on and off. No smooth flow.
- Linear-** Takes a straight path from point “A” to point “B”. Solves problems of animations swinging way out of where you want it to go, but jerky motion at key points
- Bezier-** The default type which tries to make the motion through the points smooth.

Every application may require a different type and can be frustrating to work with until you get some practice.

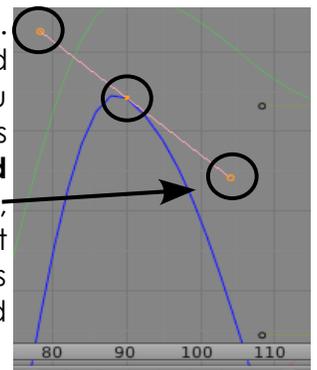


Animation path of a cube with 3 keys placed at shown locations with **Bezier** path type selected. Path is smooth, but curves way out.



Animation path of a cube with 3 keys placed at shown locations with **Linear** path type selected. Path is straight, but jerky at key points.

There is another way to keep the bezier type, but control the flow. It requires you to go into the track in **edit** mode (unlocked) and adjust vertices on the graph individually. First, select the track you wish to modify (Loc, Rot, Size- X, Y, or Z) and make sure the track is unlocked (Tab key). **When you do that, each key will be displayed as 3 points.** By grabbing (“**G**” key) an end of the “3-point spline”, you can move and size it to get a different flow through that point. This technique requires some skill and practice. Key points can also be moved to different locations using this method (change a key from one frame to another.)



Chapter 9- Animation Basics



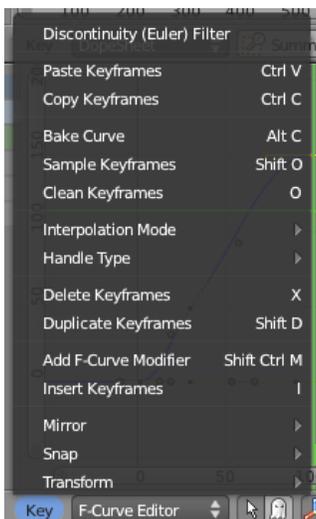
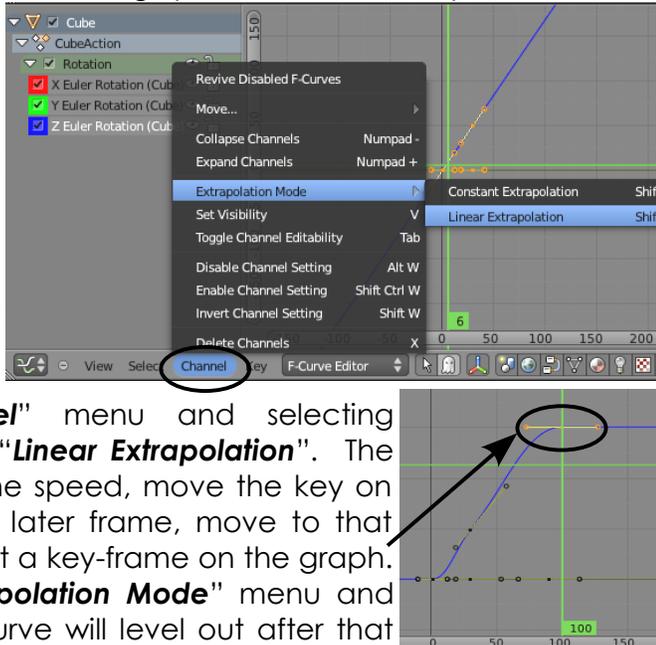
RoboDude Asks: I messed up my animation. How do I start over?

If you ever need to start over with an animation, you can erase all the animation tracks in the Graph Editor window and start over. To select all tracks, hit the “A” key once or twice, then the “Delete” key. Be careful that you only have the keys for the selected object!

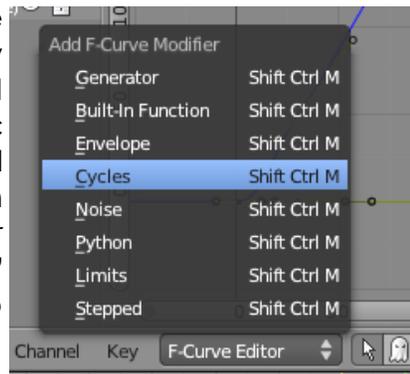
Modifying Curves in the Graph Editor:

What else can you do in the Graph Editor? There are some simple features that will allow you to set a constant motion or rotation, mirror a curve, apply noise, and set something to cycle through an animation like walking. These are all features that, with a little practice, will save you a lot of work.

Let's first look at an example of making something spin at a constant speed. You first need to set 2 key frames at frame 1 and something like frame 30. Rotate the object 90 degrees between the 2 keys. If you are running at 30 frames-per-second, this would give you a full revolution in 4 seconds, but right now, your animation would stop after 1 second and only spin 90 degrees. In the Graph Editor window, find the rotation track that shows the rotation curve and select it. In my case, it is the Z Rotation curve. By going into the “**Channel**” menu and selecting “**Extrapolation Mode**” you can choose “**Linear Extrapolation**”. The curve will extend infinitely. To change the speed, move the key on frame 30. To stop it from spinning at a later frame, move to that frame (say, frame 100) and hit “I” to insert a key-frame on the graph. You can now go back into the “**Extrapolation Mode**” menu and choose “**Constant Extrapolation**”. The curve will level out after that frame.



Under the “**Key**” menu, you will find some other useful tools to shape your animations. There is a useful “**Mirror**” option that can flip a curve. This would be useful for objects such as gears and wheels where you need to match the animation of an object, but need to turn in the opposite direction. You will also see a new option in the Key menu called “**Add F-Curve Modifier**”. The classic “**Cycles**” option can be found there (useful for repetitive motion like swinging) along with other useful modifies such as “**Noise**” which will give a “jitter” effect to something's motion.

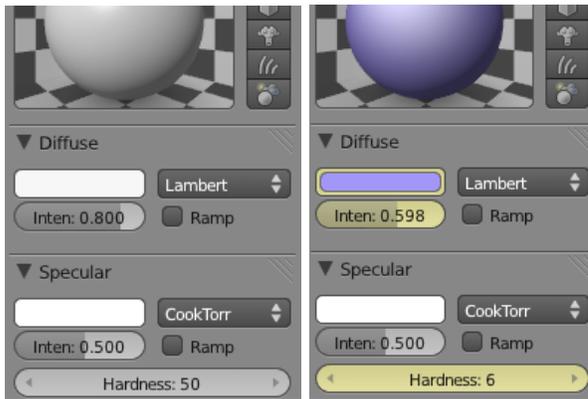


Chapter 9- Animation Basics

The previous section dealt with basic object animation. Deforming meshes, following paths, creating bone structures (armatures) and creating child-parent relationships will be discussed later. Animation can be a frustrating thing to perfect. Practice is the best way to learn it and by asking questions.

Animating Materials, Lamps and World Settings (and more)

Earlier we mentioned that everything can be animated in Blender and those animation tracks can be viewed in the Graph Editor. *If you can change a number or a color in a box, it can be animated.* Let's spend some time looking at some of these things.



Above: No Material Keys.

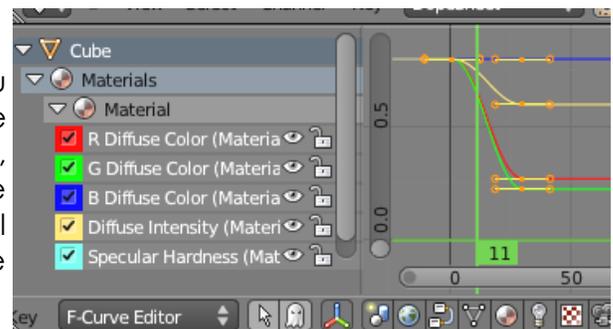
Top Right: Keys applied to Diffuse Color and Intensity and Specular Hardness. Key frames displayed in yellow.

Right: Animated features are displayed in green on non-key frames.

For my example, I'm changing the material settings on a cube. At frame 1, I'm setting a key frame on the *Diffuse Color* and *Intensity* and *Specular Hardness*. In order to put a key frame on any data block, simply place your cursor over the block and hit "I". You will notice the block will turn yellow, indicating that a key frame is present on that setting at that frame number. The block will remain green for all other frames, indicating that the setting is animated. This will even work for check mark boxes.

To see the animated effects, you will need to place your cursor in the buttons window and press "Alt-A". The numbers will scroll showing the setting has been animated. You may not be able to see the final effects until a movie is rendered out. This process will work for any window setting.

Notice the Graph Editor to the right. You can open the Material graphs for the cube and see all the settings you applied, provided you have set the buttons at the bottom of the window to display material keys. These keys can be edited the same way discussed on the previous pages.



These techniques are useful for animating items such as changing spot lamp size, intensity and color, rolling fog and clouds in the *World* settings, and waves in the *Texture* settings.

RoboDude Says:

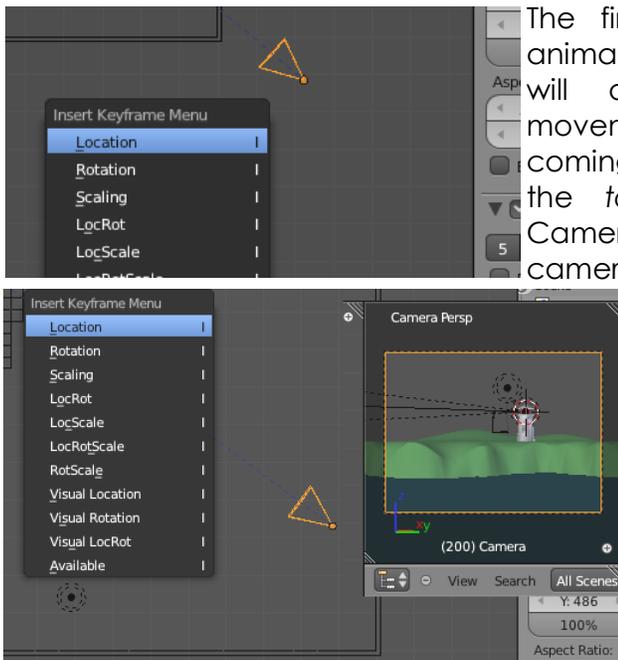
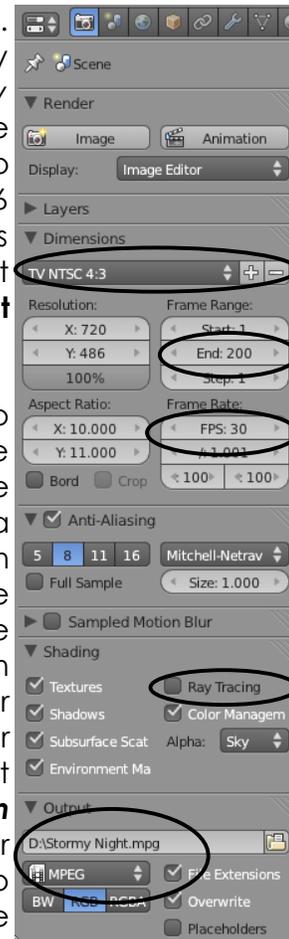
Remember that you can always undo a bad animation key by using "Ctrl"-Z !



Animating Your Lighthouse

PRACTICE EXERCISE

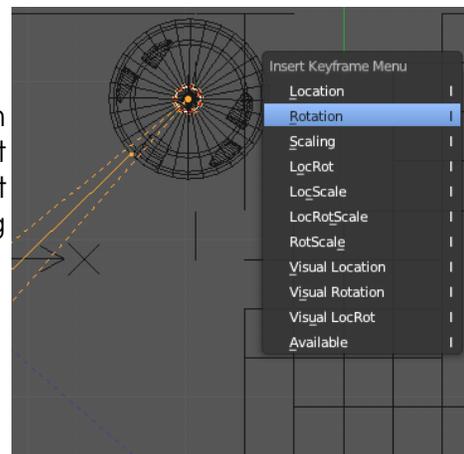
Open your "**Landscape Scene**" file and go to your scene buttons. It's time to animate our "dark and stormy night". We will start by making the correct setting to do a movie. First, review the "7 Easy Steps to Create an MPEG Movie" found on page 7-3. Follow those steps and name the output movie file as "**Stormy Night.mpg**". Also set the **End** frame to **200**. Our movie will be 200 frames long, or 6.6 seconds at 30 fps. You will also want to make sure Ray Tracing is turned **OFF**. Ray Tracing will slow down your renders and is not necessary for this scene. Change your screen layout from **Default** to **Animation**. Remember, this is found at the top of your screen.



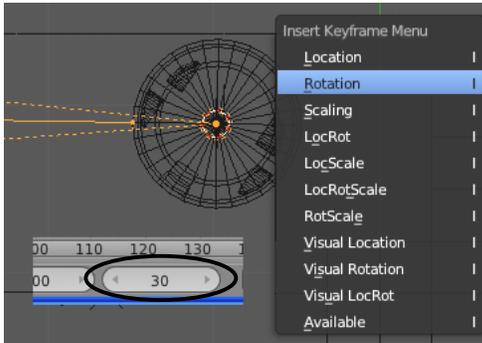
The first thing we plan to animate is the camera. We will do a short, simple movement of the camera coming closer to the shore. In the *top view*, select the Camera. Make sure the camera is at a good location and does not render any edges of your planes. At **frame 1**, hit "I" to insert a **Location** key. Now use your arrow keys to move to **frame 200**. Move the camera closer to shore, hit "I" to insert another location key.

The motion doesn't need to be much. we don't want the boat moving too fast! Go back to frame 1 and hit **Alt-A** to see your animation. You should see the camera animated. Press **Esc** to stop playing the animation. *Save your file.*

Now we're going to animate the spotlight rotating in the lighthouse. In the *top view*, select the *spotlight*. At **frame 1**, press "I" to insert a **Rot** (rotation) key. It doesn't matter at what angle the spotlight is starting at in the animation.

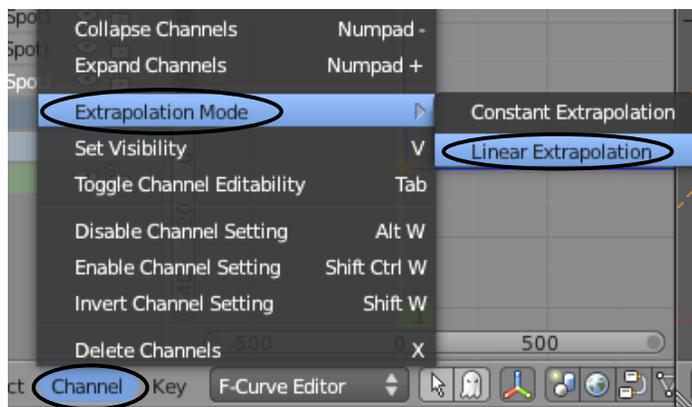
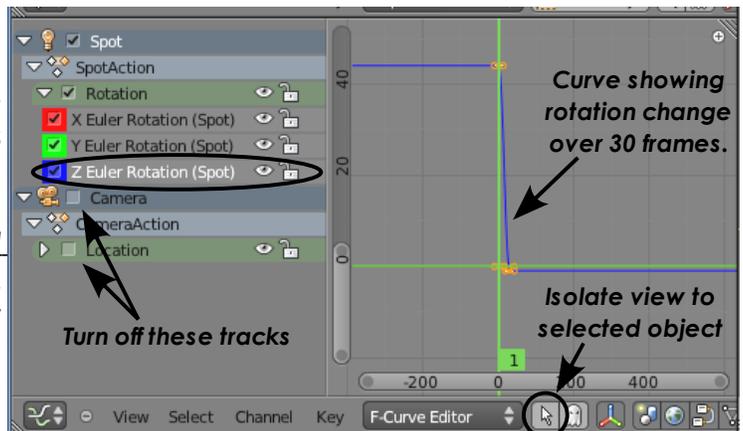


Animating Your Lighthouse



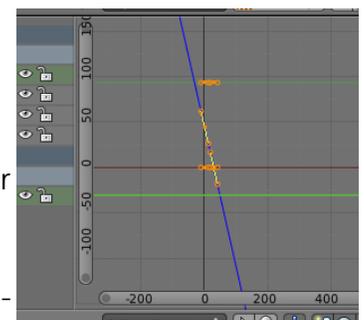
Go to frame **30** (one second) and *rotate* the spotlight **45 degrees**. To do this, type “**R**” to rotate, then type **45** on the keyboard. Press “**Enter**” or **LMB** click. The lamp will have rotated exactly 45 degrees. If you want the lamp to spin the *opposite* direction, type “-” after the 45. Press “**I**” to insert another Rotation key. Use your left arrow key to go back to frame 1. You should see the lamp spin back to its original position.

In order to keep the lamp spinning consistently the entire animation, we could attempt to continue along the time line, inserting keys every 45 degrees and 30 frames, but that would get boring very fast. Instead, we will use an Extend mode in the Curve Editor window. Enlarge the Curve Editor window large enough to work with and turn off the animation tracks for the camera to simplify your view. You could also press the small arrow button at the bottom of the window to isolate viewing to only the selected object as well. Expand the tracks displaying the rotation keys for the Spotlight. Isolate the track that shows change over time by clicking on it, representing the animation of the lamp over the 30 frames. It will probably be the “**Z Euler Rotation (Spot)**”, the blue curve.



With the curve selected, go to the “**Channel**” menu, “**Extrapolation Mode**”, and “**Linear Extrapolation**”. The curve should now extend infinitely in both directions. Test your animation by pressing the “**Play**” button in the Timeline, or hitting “**Ctrl-A**”. The lamp should spin the entire animation.

The lamp speed should be fine, but if you wish to speed it up or slow it down, you could select the rotation keys at frame 30 in the Dope Sheet and move them to a different location. The curve will adjust.

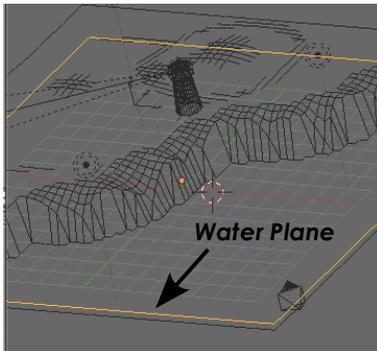


PRACTICE EXERCISE

Animating Your Lighthouse

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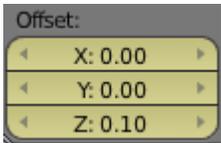
E
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Now it's time to animate the water. We want to create some rolling waves, not too fast or slow. This is a little trial-and-error. I've tried to take some guess work out of the process. To begin, select the **Water Plane** and go to your **Texture** buttons and find the **Offset** settings in the **Mapping** panel. We will animate the **Offset Z** number.

Because we used a 3D texture and not an image to create the water effect, it can be animated to give the illusion of motion. Remember that we added 2 textures to the water. Right now, we are only animating the 1st texture.

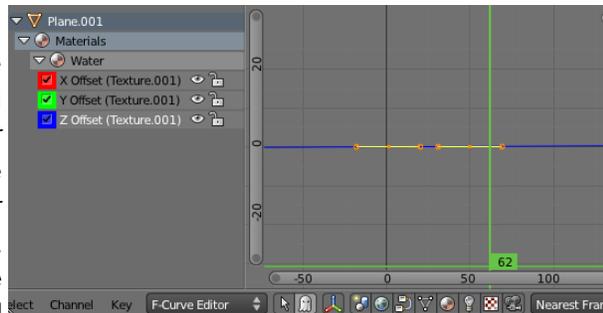
At **frame 1**, place your cursor over the **Offset Z** number and press the "I" key to inset a key frame. The Offset blocks will turn yellow, indicating that a key has been placed on them.



Now advance to **frame 50** and change the **Offset Z** number to **0.1**. This will cause the water to "roll" up slightly. Again, with your cursor over the Offset Z button, press "I" to insert a key frame. This will cause the texture offset to roll from frame 1 to 50.

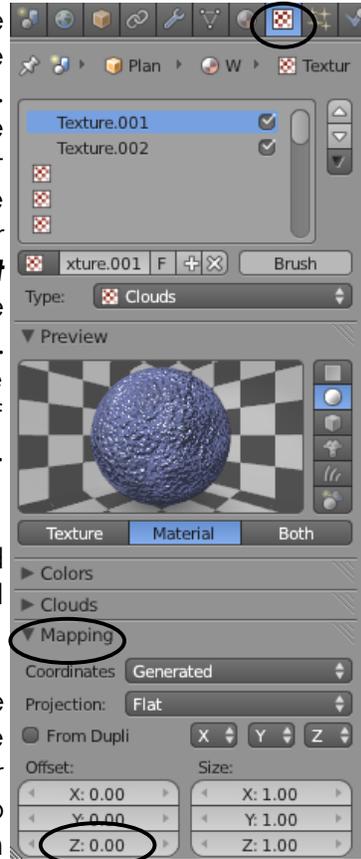
Since we can't really hit **Alt-A** to see the animated texture in the window, we have to wait until we animate a movie to see the speed and effect. If you place your cursor in the properties window area and hit "Alt-A" you will see the number changing in the Offset Z block.

It's now time to extend the curve for the texture setting just like we did for the spinning lamp. First, go over to your Graph Editor window and find the material tracks for the plane. Remember that you can isolate your view to just the plane with the arrow button. Select the "Z Offset" curve, go to the "Channel" menu, "Extrapolation Mode", and "Linear Extrapolation". Don't worry if you do not see much of a curve due to the small change we placed on the setting.



That's it for animation for now. We have animated the camera moving, the lamp spinning and the waves rolling. Later, we will add some rain using particles. You can always change your resolution percentage size to animate faster and check your wave effects. Check your movie setting and press **Animate** in the Scene buttons. Sit back and wait for your movie to animate.

** Call the instructor when finished**



Chapter 10- Adding 3D Text

We've discussed creating a lot of objects so far, but 3D text can be considered a very important element to add. There are 2 ways to create text for Blender scenes. One way is to use the built-in text generator. The other method is to use an external program to generate the text and import it into Blender. Each method has its benefits and disadvantages. Text made in Blender can be easily changes by entering edit mode ("Tab" key) and 3D features can be changed by making adjustments in the edit buttons. Text made in an external program like **Elefont** may give you additional options and different fonts.

Blender 3D Text Settings

To create text in Blender, select the location of your text with the 3D cursor, then press "**Shift-A**" to "**Add**". Select "**Text**". The word "**Text**" appears on the screen in Object mode as a flat, 2D object. To change the text, enter Edit mode ("**Tab**" key). Go to the **Font Settings**. Text can easily be changed by entering edit mode again. Some text settings are similar to many text programs while many are not. Here are your basic options:



Shape Panel:

Set the resolution quality and 3D filling options.

Geometry Panel:

Most common setting- Offset will make the text appear more bold; Extrude gives thickness (depth), bevel angles the edges of the extruded text. You can use a curve object to effect taper and bevel shape.

Font Panel:

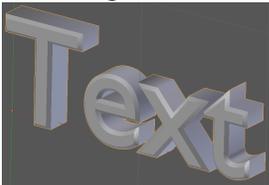
This is where you set the font style you wish to use. Blender's font is the default, but can be changed to any *True-Type* font. If using a Windows PC, you can typically find a font folder in the C:*Windows* folder. *Shear* will take the place of the *Italic* setting. *Text on Curve* can be used to shape text.

Paragraph Panel:

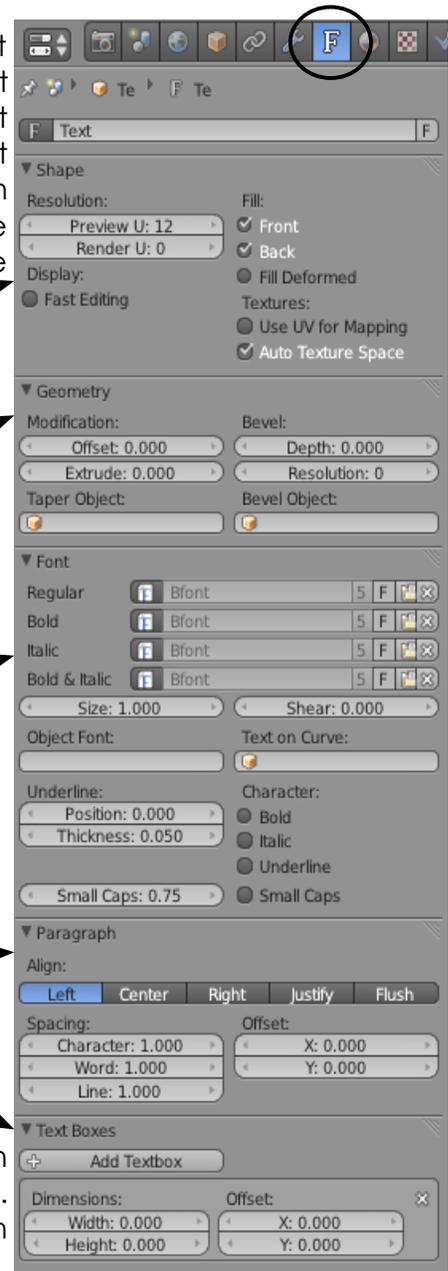
Typical justification setting and spacing options.

Text Boxes Panel:

By default, text can run on a long as you wish, but you can assign a box to keep text contained.



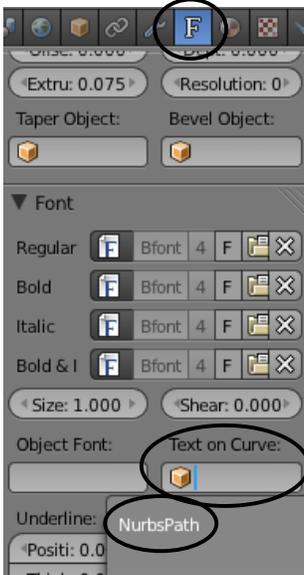
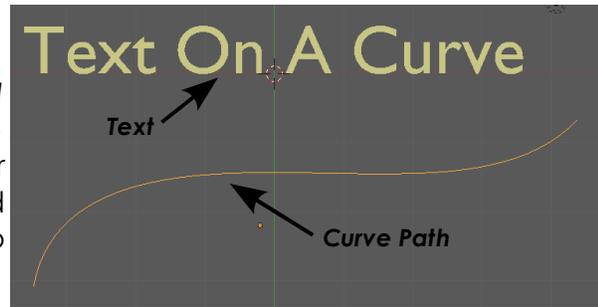
The text to the left has been extruded and a bevel applied. Some fonts will work better than others.



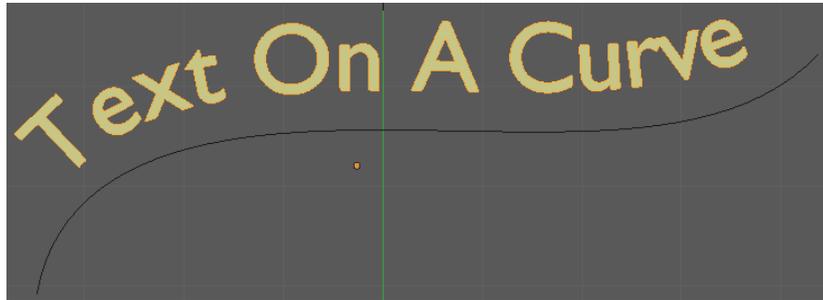
Chapter 10- Adding 3D Text

Creating Text on a Curve:

Blender text has the ability to follow a **Curved Path**. In order to create curved text, hit "**Ctrl-A**", select "**Add**", "**Curve**", then "**Path**" (or any other curve shape). Enter *Edit Mode* and shape the curve as desired, then hit **Tab** to exit edit mode.



After you create the text and have the text selected, go to the **Font Settings** and find the box "**Text On Curve**". Click in the box to show all available curves that can be used to deform the text. The text will take the shape of the curve. You may need to change the spacing of the text so it flows properly.

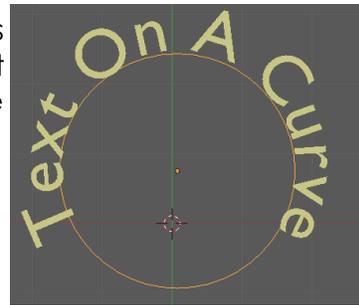


Other curve objects can be used as well to shape the text. So you don't accidentally erase the curve while you work, place the curve in an unused layer (M key).



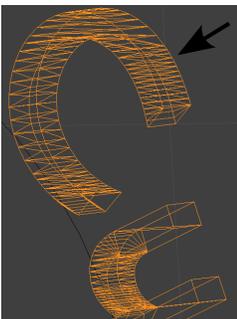
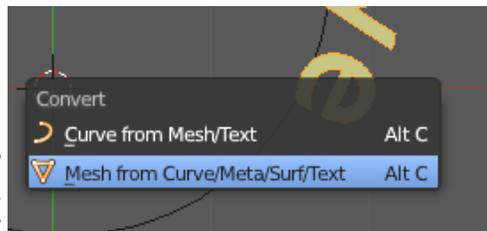
RoboDude Says:

When extruding text for normal titles and labels, be careful not to extrude the text too thick. It may effect how well the text can be read.



Converting Text to a Mesh

At times you may need to convert text into a mesh for certain purposes (i.e. using a Build or Particle Effect). To convert text into a mesh, press "**Alt-C**" to convert it first into a **Curve** or **Mesh**. In edit mode, the text will now display with vertices.



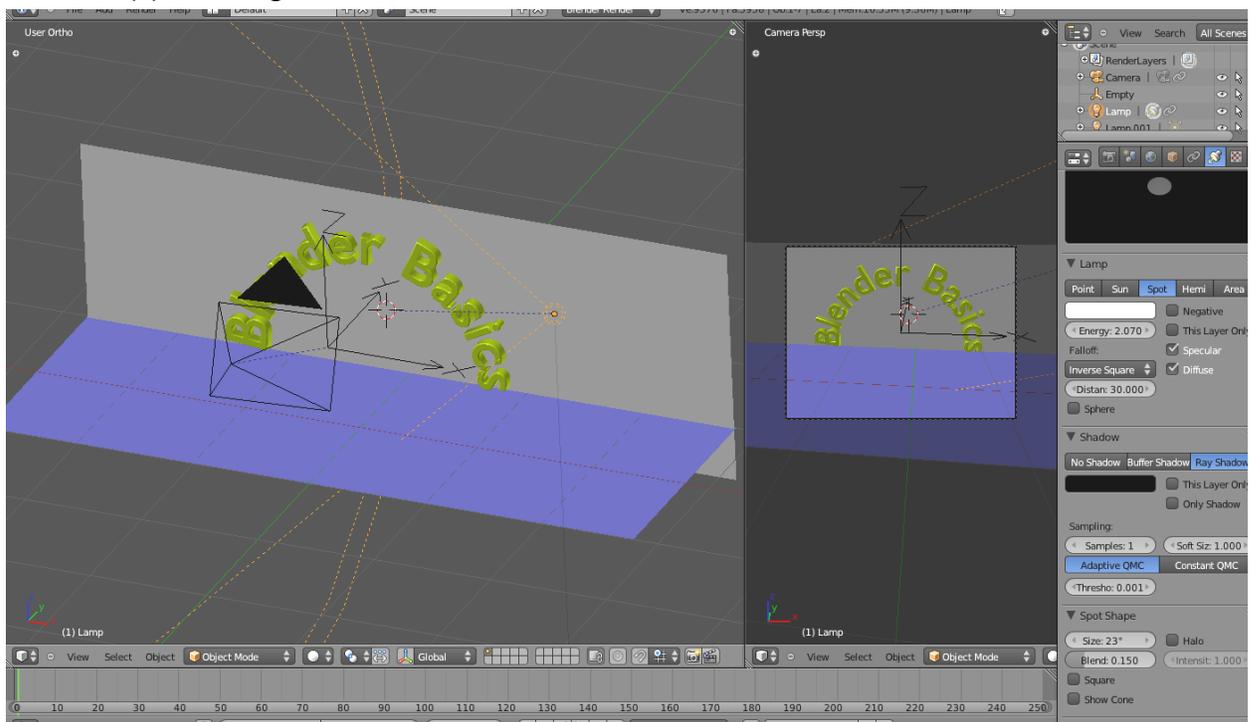
Occasionally, you may feel limited with Blender text (although it seems to improve with each new release). In these cases, you may wish to use an external 3D text program like **Elefont** which saves files in standard DXF format, then import them into your Blender file.

3D Text- Company Logo

Create a new Blender scene and set up the views any way you wish. You will be creating a company logo of your choice with text. Keep it simple and utilize meshes, textures, lighting effects and ray-tracing to enhance your scene.

When you finish setting up your scene, render a JPEG image and save it to your directory.

Note: The text you see in the scene below was placed on a Bezier Circle Curve. If you leave the circle in the scene it will render faced. The text was converted into a mesh, then the curve deleted. The water was created the same way we did the water in the lighthouse scene (with much less Normal) with ray mirror added. The wall also had a normal applied to give the brick texture some relief.



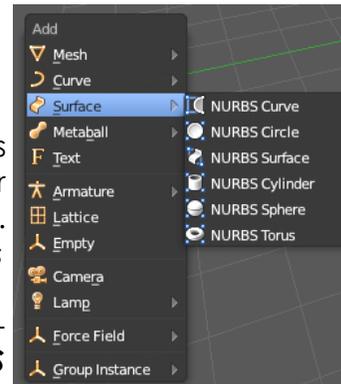
**** Call the instructor when finished****

Chapter 11-NURBS and Meta Shape Basics

When you press "**Shift-A**" for "**Add**", you will notice other object types beside meshes, cameras and lights that can be created. Two types of objects that can be created are **Surfaces** (NURBS) and **Meta Objects**. A lot can be said about surfaces, but for this tutorial, I want you just to become aware that they are there and describe some basics about them. Meta objects have been expanded to a variety of shapes and can be used to give you a "liquid metal" effect where the objects "pull" together as they become close to each other.

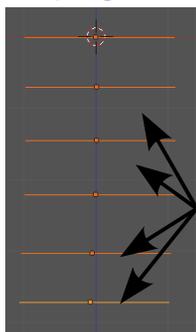
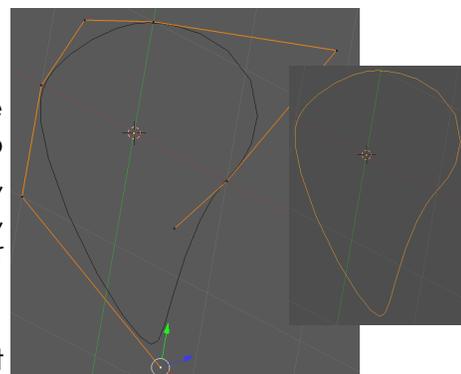
Using NURBS to Create Lofted Shapes (surfaces)

If you look at the **Surface** menu, you will see a variety of shapes that can be created. These shapes can be use as they are or converted to meshes so you can work with traditional verticies. *To convert a surface into a mesh, select the object and press the "Alt" and "C" keys and choose the appropriate option.* You can do a lot with NURBS and there are several tutorials on-line describing them, but for now, we will just work with a **NURBS Circle** to create an interesting looking tunnel.

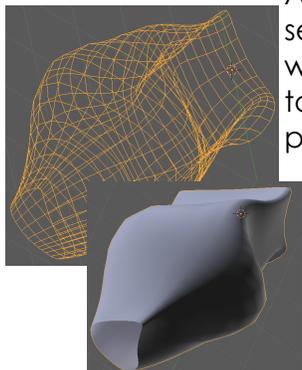
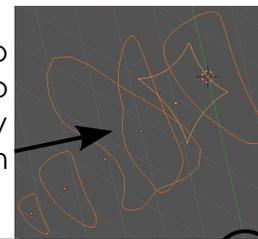


Creating a Lofted Tunnel

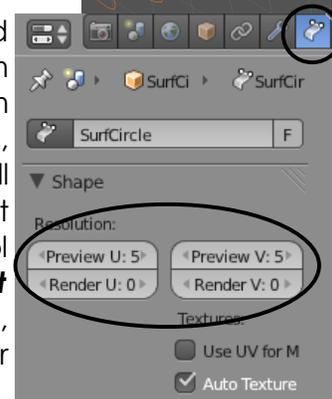
This process will take several profiles of a NURBS Circle and connect them together. First thing you need to do is create a **NURBS Circle**. To do this, press "**Shift-A**", select "**Surface**" and "**NURBS Circle**". In Edit Mode, select the points and shape the circle a bit. After shaping, exit edit mode.



Change your view so you are looking at the edge of the circle (*try front view if circle was made in a top view*). You may also want to switch to a wireframe view. Use the "**Shift-D**" keys to duplicate the circle several times. Then rotate your view so you can select each circle and edit the shapes in **edit mode** (Tab key).



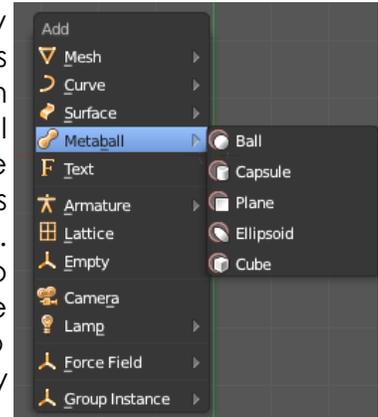
After shaping the circles, exit edit mode and select them all by RMB clicking on them while holding the "**Shift**" key. To join them together, press "**Ctrl- J**". For the final step, press "**Tab**" for edit mode, "**A**" to select all verticies, then "**F**" for face. Your result should be a lofted object. You can control the detail of the shape in the "**Object Data**" panel. If you need it to be a mesh, press "**Alt-C**". This is a great technique for making boat hulls and other related items.



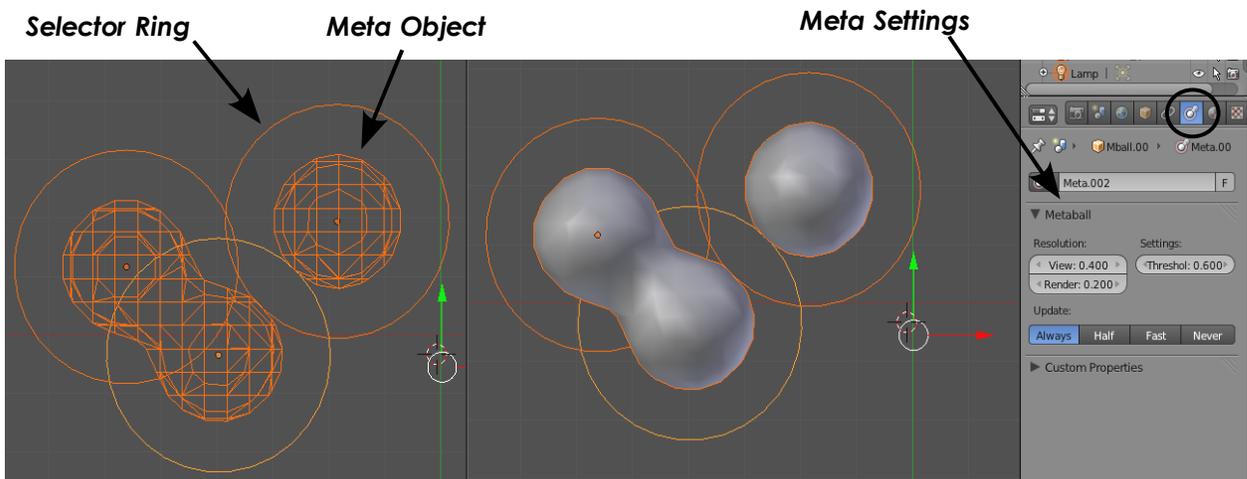
Chapter 11-NURBS and Meta Shape Basics

Liquid and Droplet Effects Using Meta Shapes

Up until a few releases ago, Blender only had the capability to make one Meta shape- a ball. Interest grew, programmers added other shapes and cleaned up the code. You can now make several different meta shapes in Blender. They all work with the same principle. As the shapes get close to one another, they begin to “pull” and flow together. Meta shapes can be animated like other objects and can be textured. Ray-tracing settings like reflection and transparency can also create some stunning effects. Meta shapes are created like other objects, *except that the first shape acts like a parent to the other shapes*. As that shape is moved, the others display a rotation. Materials are also linked for all meta shapes.



Meta shapes can seem a bit confusing at first because of their interactions. For example, individual meta objects are selected by RMB clicking on the Selector Ring around the object. When clicking on the actual meta shape “mesh” itself, all shaped are selected. Remember that meta shapes are linked and controlled by the first meta added. By selecting the object, materials are linked to all shapes. Remember to select the ring to transform just that object. You can also control the quality and effect of the meta shapes in the properties window. Experiment with these to get a desired effect.



RoboDude Asks:

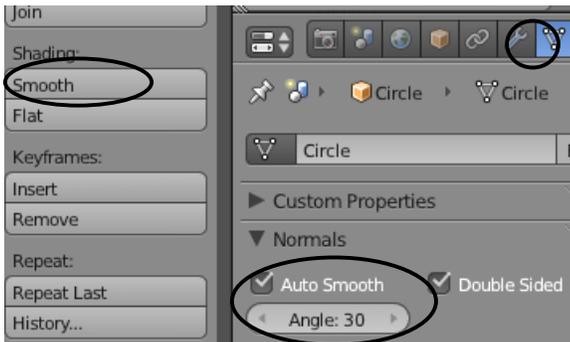
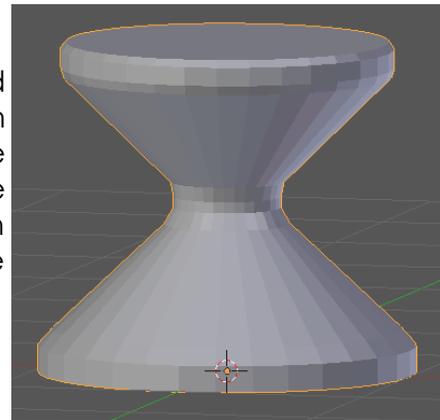
Why are all my Meta shapes joined together?

If you get into Edit mode while making your meta shapes, they will all join together. Remember to be in Object mode while making Meta shapes.

Meta Shapes- Lava Lamp Practice Exercise

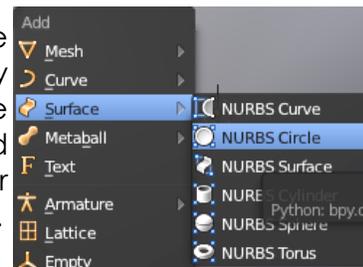
Create a new Blender Scene, erase the initial cube and name it "Lava Lamp". For this activity, we will be extruding circles, lofting NURB circles and using meta balls to create an interesting lava lamp.

Begin by making a *Mesh Circle* in the top view and select the *Fill* option in the Tool Shelf to fill the circle. In the *Front View*, enter *Edit Mode* and *Extrude* (E key) the circle to form the base of the lava lamp to a shape something like seen to the right. You will want to *Smooth* (Tool Shelf) and *Auto-Smooth* (Object Data buttons) the base.



We could make the glass bottle by extruding a circle exactly as we did the base, but for

practice, let's loft the shape by using *NURBS Surface Circles*. Go to the *Add- Surface* menu and add a *NURBS Circle*.

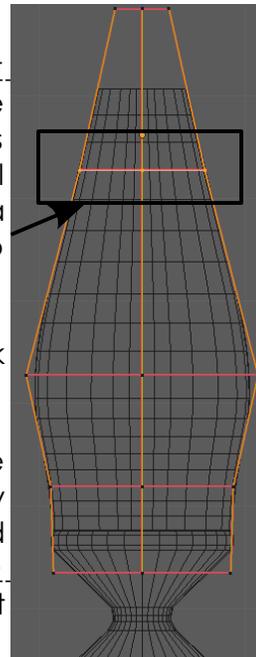
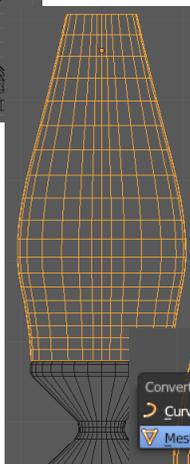
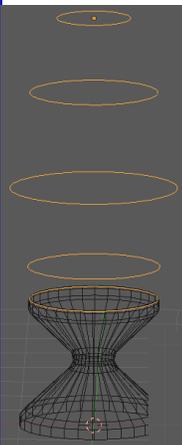


After adding the *NURBS Circle*, switch to a front view and duplicate it a few times. Size them to match the shape you want for the lamp. While holding the "Shift" key, select all the circles and join them together with "Ctrl-J".

It's now time to give the circles a surface. Enter *Edit Mode* and select all vertices with the "A" key. Press the "F" key to face the circles. It may not look exactly as you wish so you may need to deselect all vertices ("A" key) and box select ("B" key) a single ring of vertices in the front view to move or scale them.

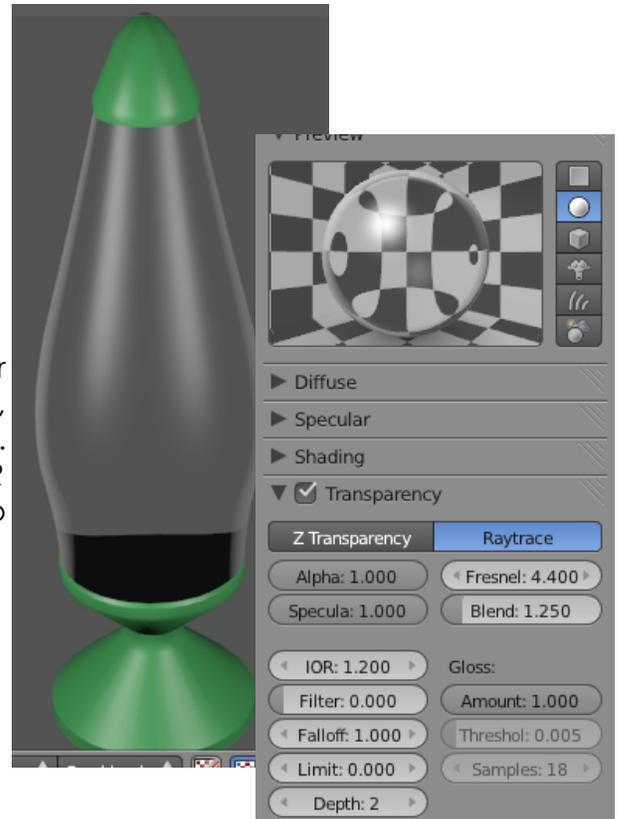
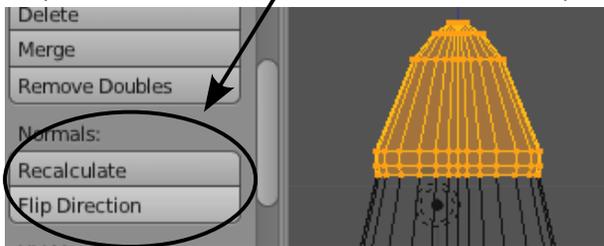
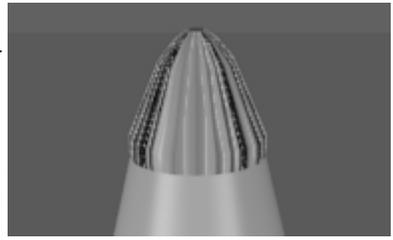
When finished, the shape should look something like the image to the left.

The final step is to convert the *NURBS Surface* to a mesh. This is done by pressing "Alt-C" and selecting "Mesh from Curve/Meta/Surf/Text". Set *Smooth* and *Auto Smooth*.

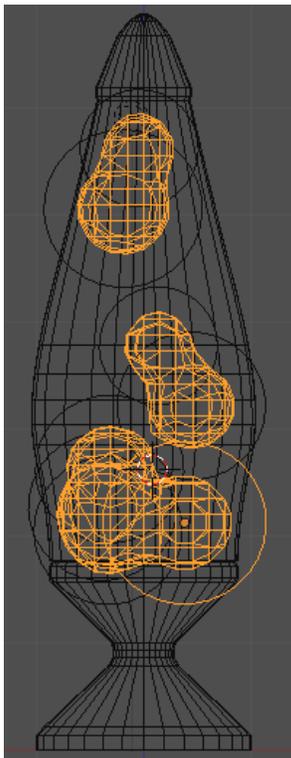


Meta Shapes- Lava Lamp Practice Exercise

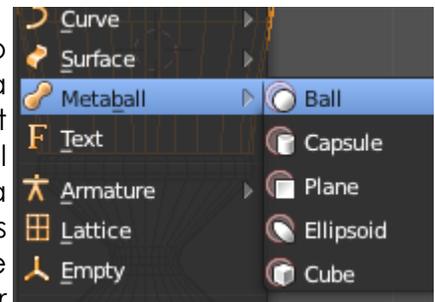
The next step is to create a top for the lamp. Do this the same way we made the base, using a *Circle* mesh. After shaping the mesh and applying *Smooth* and *Auto Smooth*, it may look something like the image to the right. To correct this, we need to change the *Normal* settings of the faces. Enter *Edit Mode* and select all vertices. In the *Tool Shelf*, find the options for *Normals*. Try pressing both "*Recalculate*" and "*Flip Directions*". This should correct the problem.



It's now time to get a nice render of your lamp. Apply a nice material to all 3 objects, using *Ray-transparency* on the glass bottle. Experiment with your *Fresnel* and *IOR (refraction)* settings. You may also want to take the *Depth* setting up a bit.



With the lamp finished, it's time to add the lava. Start by adding a *Meta Ball* shape. Remember that this first shape controls the material and action of the other meta shapes. Add as many meta shapes as you wish. Scale as needed. Use all 3 principle views to get your locations correct and all shapes are in the bottle. Add a material and render an image.



Meta Shapes- Lava Lamp Practice Exercise

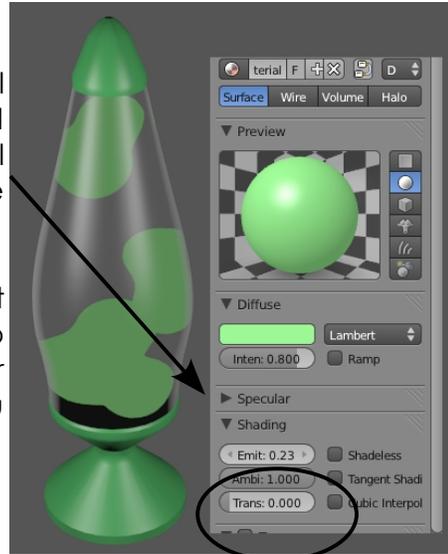
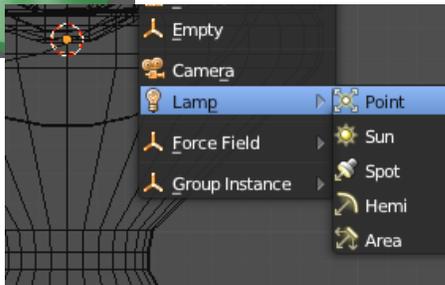
P
R
A
C
T
I
C
E



Your lava lamp should look something like the image to the left. Even though you applied a material (I used green), the meta shapes will probably appear black. This is due to the lighting effects and the ray-tracing on the bottle.

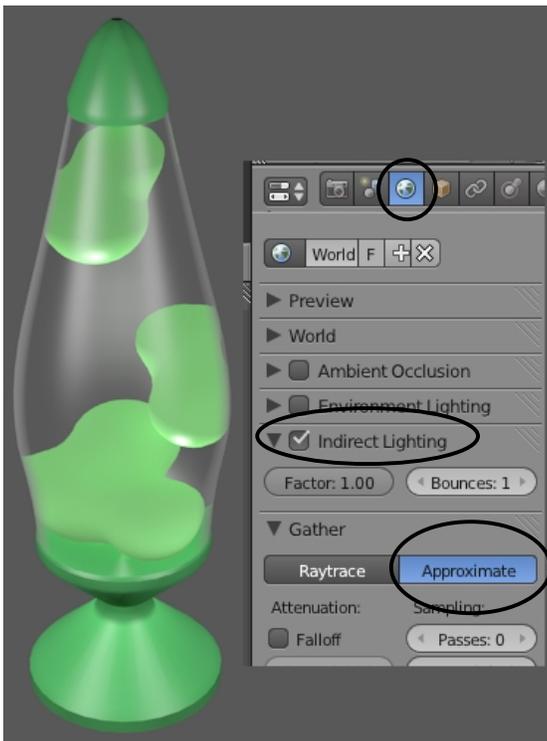
To fix this, go back to your *Material* settings on the meta shapes and find the *Emit* slider under *Shading*. This will now give you a green color, but the shapes will look flat.

Our next step is to add a *Point Lamp* at the bottom of the bottle. In the lamp settings, turn off all shadow effects for this lamp. At your next render, you should see some effects on your lava.



Looking better, but we can make use of the Indirect Lighting features discussed back in chapter 6. Because we used the material *Emitter* feature on the lava, by making some changes in the World buttons, it will glow.

E
X
E
R
C
I
S
E



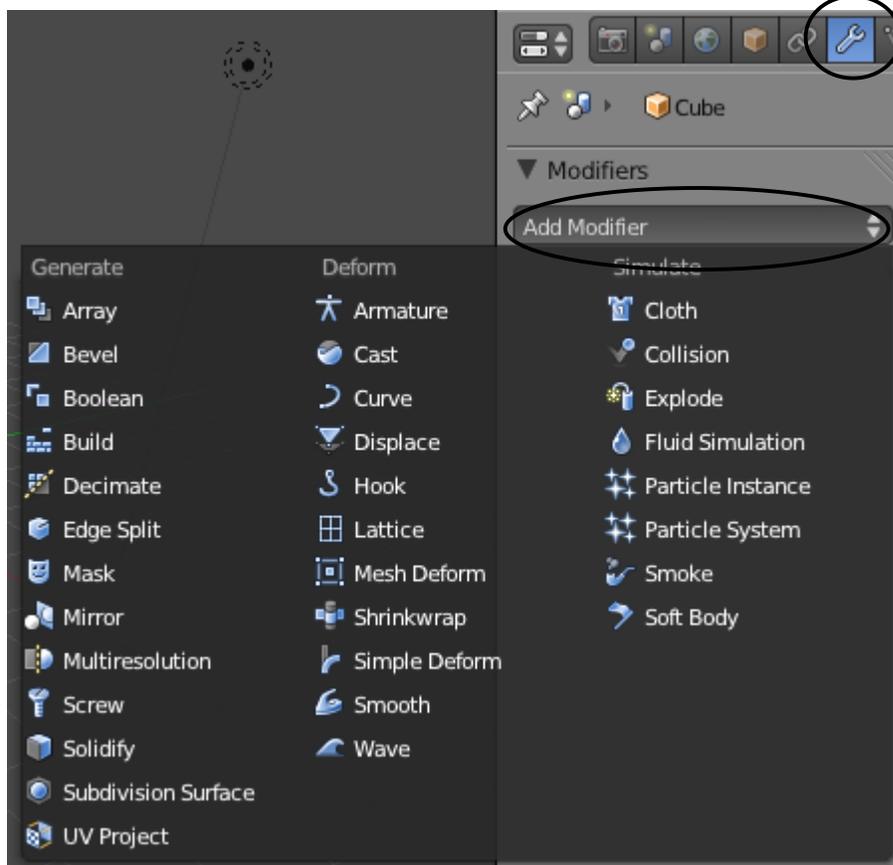
Go to the World button and select "*Approximate*" in the *Gather* panel. Check the box in the *Indirect Lighting* panel to use the feature. Render an image and check your results. Fine tune your adjustments if needed.

If time allows, animate your lamp and make a movie.

**** Call the instructor when finished****



Modifiers have been reorganized in version 2.5/2.6 and placed in their own setting panel. We have already discussed the *Subdivision Surface (SubSurf)* modifier in previous chapters and will now look at some of the other modifiers. Others will be discussed in later chapters. Depending on the type of object selected, the modifiers fly-out may display different options. For basic meshes, here is what you see:

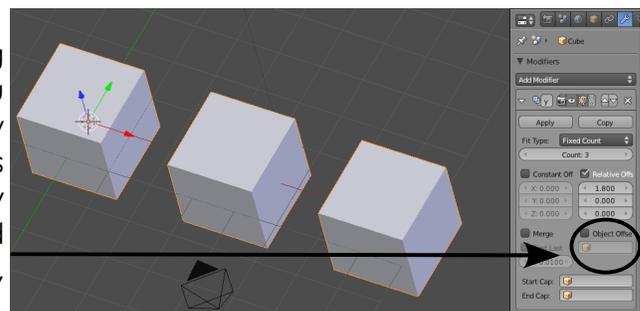


Generate Modifiers

Some of the Generate modifiers are self-explanatory while others need more discussion. Here are some of the basic options:

Array

The Array modifier works great for making patterned copies of an object. If you need rows and columns, add 2 Array modifiers and set the X,Y,Z Offsets as needed to obtain your pattern. By checking the "Object Offset" button and selecting a control object (like an Empty), you can spin and scale the array.

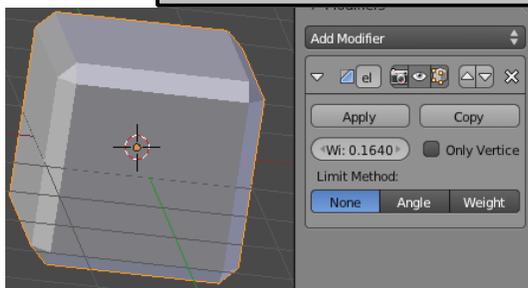


Chapter 12- Modifiers



RoboDude Asks: What does the "Apply" button do in a Modifier panel?
Until you hit apply, you can always change the settings of the feature. Once you hit the apply button, the modifier panel disappears and the feature becomes fixed and unchangeable. For example, applying a bevel modifier will then fix the bevel, changeable only in edit mode by moving vertices or faces. Same effect as applying the mirror modifier.

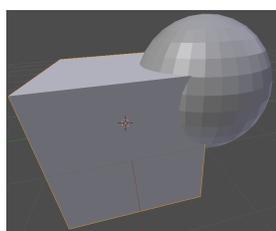
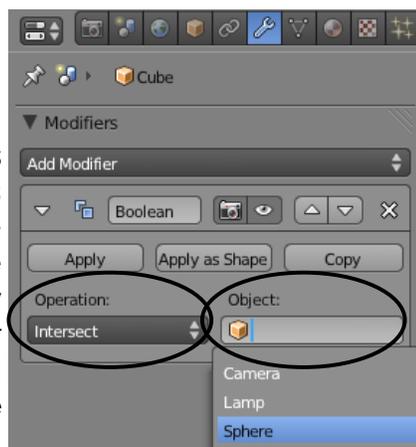
Bevel



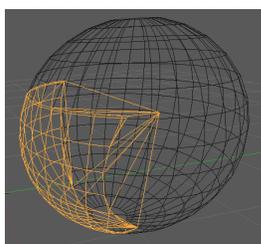
The Bevel modifier will apply a bevel, or chamfer, to the edges of simple meshes. There are a few options that can be set.

Boolean

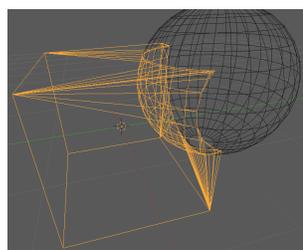
The Boolean modifier is an important feature. It allows you to cut holes, join meshes that recalculate vertices and create new shapes from shared areas. To use the Boolean modifier, create 2 shapes- one that will be effected and one that will cause the effect. For my example, I've created a cube and a sphere. If you want to see the effect on the cube, select the cube and add a Boolean modifier. In the "Object" box, select the "Sphere". Under "Operation", select "Intersection", "Union", or "Difference". When you get your desired results, hit "Apply". Sometimes, you don't get exactly the results you desire and need to erase some faces or move some vertices in edit mode. See results below:



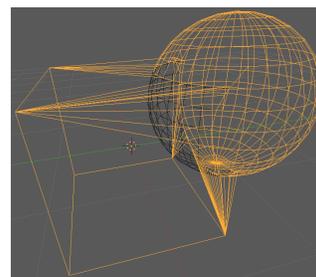
Basic Shapes - Cube selected



Boolean Intersection (shared area)



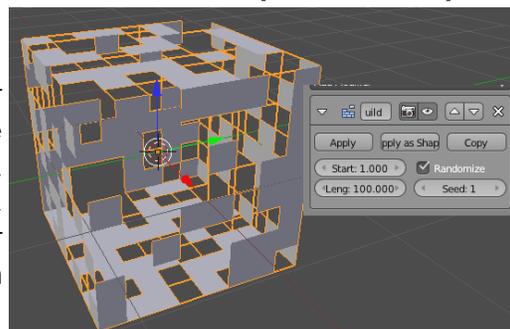
Boolean Difference (subtracted area)



Boolean Union (combined area)

Build

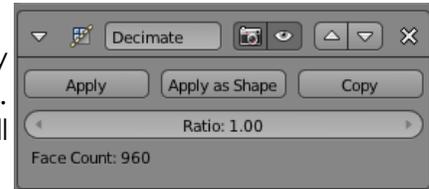
The Build modifier will take a mesh and build, or create, it over a specified time. Use the subdivide command to add more faces for a better effect. You can control the start and end frame times, randomize and seed pattern. A useful effect for having something appear and build in an animation.



Chapter 12- Modifiers

Decimate

Let's say you made an object and subdivided it too many times or need to simplify it for using in the game engine. Changing the "Ratio", then hitting the "Apply" button will simplify the mesh.



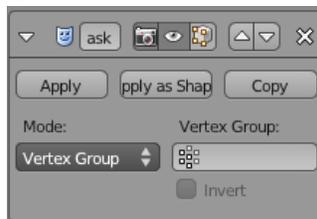
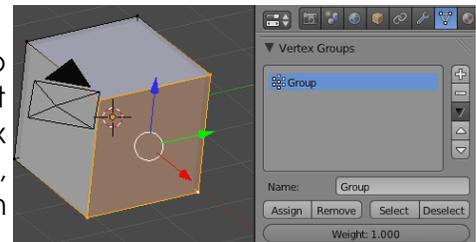
Edge Split



Edge split allows you to split a mesh into individual faces. Basically, you are taking the shared vertices at intersections and duplicating them so all faces have their own set of points. Edges are split depending on the angle setting. Hit "Apply" to see results, then enter "Edit Mode" to select those faces.

Mask

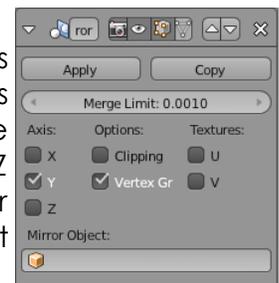
The Mask modifier allows you to select a vertex group previously created for the selected mesh and filter out everything else, or just that group. To create vertex groups, you need to go to the "Object Data" panel, create a new group and assign selected vertices to that group.



Vertex groups are used for many features in Blender, some being demonstrated in later chapters. After the group has been created, you can add the Mask modifier, select the group and any other desired features like the "Invert" option.

Mirror

When modeling a symmetrical object (like a face, body or car), it is useful to only model half the object. To do this, move the object's center point to the object's mirror axis and keep all vertices to one side of the mirror axis. Add a Mirror modifier and select the X, Y, or Z (or multiple) axis planes and other options. You can also use another object to mirror around. After you have shaped the object, hit "Apply" to set the mesh.

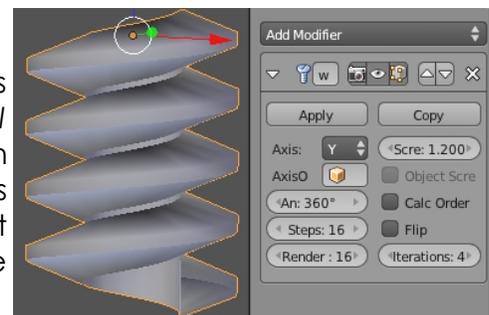


Multi-resolution

Multi-resolution allows you to add different levels of resolution quality to a mesh as rendered and displayed on the screen. Useful for speeding up working and rendering.

Screw

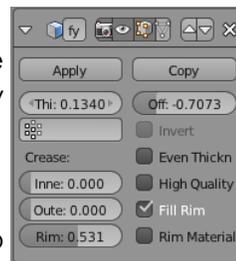
The Screw modifier allows you to create spiral objects differently than the "Screw" option found in the *Tool Shelf* in edit mode. The screw modifier works best with flat 2D objects like planes. By default, the feature uses the object's center point as its spin reference, but other objects can be selected. You can select the spin axis, angle, step quality, and turns (iterations).



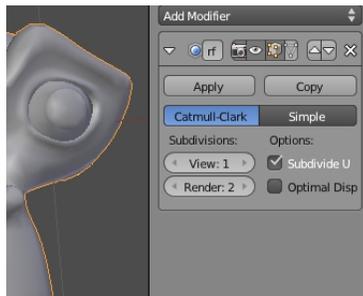
Chapter 12- Modifiers

Solidify

If you are making an object like a glass or mug, if you only extrude the outer face of the object, it will not have any thickness. The Solidify modifier allows you to give the object some wall thickness.



Subdivision Surface



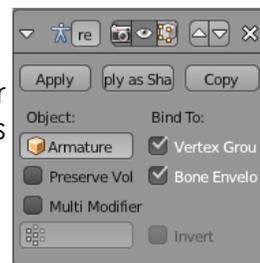
The "SubSurf" modifier allows you to keep your mesh simple with as few vertices as possible, but render as a much more detailed mesh. Try adding a monkey head mesh, hit "Smooth" in the Tool Shelf, then add a Subdivision Surface modifier. If you enter Edit Mode, the mesh is still simple, but SubSurf has divided the faces for more detail. Be careful not to take the setting too high or your scene will slow down.

Deform Modifiers

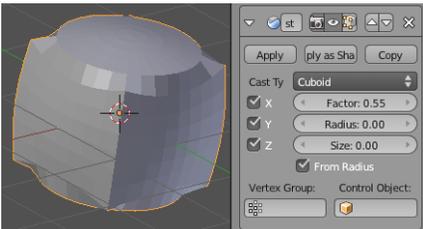
While the *Generate* modifiers allowed certain modifications to the object, the *Deform* modifiers are used to change the object or use other objects for control.

Armature

An armature is a skeleton used to deform a mesh. It can be used for creating characters, suspension on cars and much more. Armatures are discussed in more detail in a later chapter.



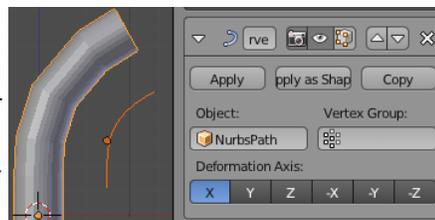
Cast



The Cast modifier can be used to round or square a mesh. The example to the left used a UV Sphere and a cast type of Cuboid. The sphere has started to take on the shape of a cube. Make sure you have plenty of vertices to get a desirable shape.

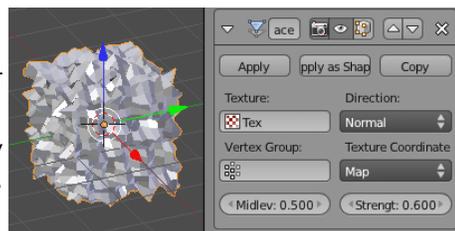
Curve

The Curve modifier allows you to use a curve to shape a mesh. Start by creating a mesh that is subdivided or extruded with enough vertices to "bend". Create a curve and apply the Curve modifier to the mesh (not the curve). Shaping the curve will bend the mesh.



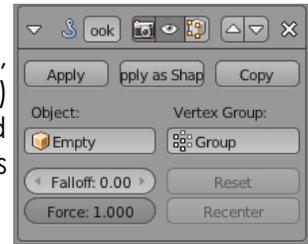
Displace

The Displace modifier works like the Displacement setting in the Textures panel (discussed in the *Materials and Textures* chapter). Create an object with many vertices, apply a texture and use it with the Displace modifier. The example to the right is a cube.

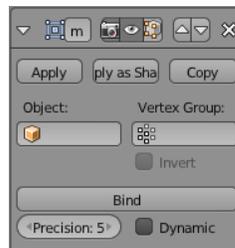


Hook

Hooks are used to animate an object using another object. Often, you will create vertex groups (discussed in Chapter 13 and 16) and tie them to an object, like an Empty. With the object selected and in *Edit Mode*, you can “Reset” and “Recenter” the mesh’s points for better interaction.



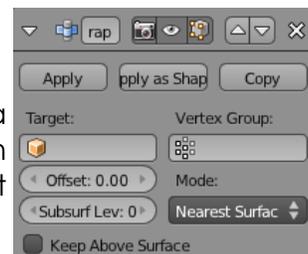
Mesh Deform



The Mesh Deform Modifier allows you to “Bind” one mesh to another and use it to control its shape. Vertex groups can also be assigned for control. In order to use it, the controlled shape (the shape with the modifier on it) must be contained within the control object and the control object must be a closed mesh. Depending on the complexity of the meshes, the computer may lag when the “Bind” button is pressed.

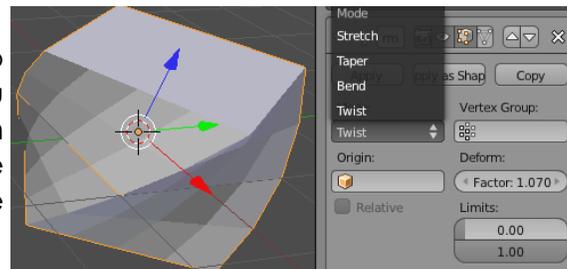
Shrinkwrap

Shrinkwrap is a relatively new modifier that allows you to wrap a mesh around another mesh. For example, a subdivided plane can be molded around another object. You can select a target object to wrap around and a vertex group to control the shape.



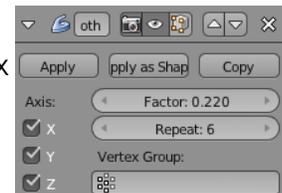
Simple Deform

Simple Deform is a handy modifier that can do a variety of simple modifications to a mesh. You can Stretch, Taper, Bend and Twist a mesh using the Mode and Deform settings. The complexity of the deform can relate to the number of subdivisions and vertex groups used.

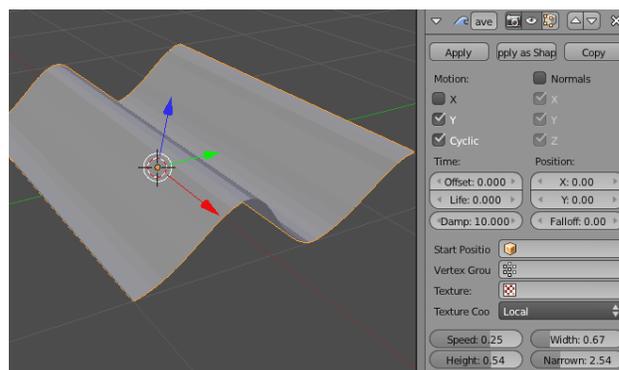


Smooth

The Smooth modifier will attempt to smooth out a mesh or vertex group that may be sharper than you wish.



Wave



The Wave modifier is a useful modifier for animating a simple oscillation effect. You can control the axis of the wave, speed, height, width and narrowness. If you start with a simple plane, you will need to subdivide it to see the oscillation. This is an animated effect so press “Alt-A” to see the results of your settings. A simple way to make a ripple.

Chapter 12- Modifiers

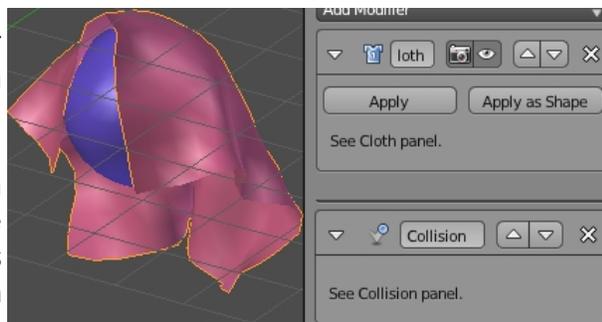
Simulate Modifiers

The *Simulate* modifiers work with Blender's physics engine in order to create animations dealing with particles (fire, explosions, strands), cloth, fluids, soft-bodies, smoke, forces and collisions. When applying most of these modifiers, you will need to go to the *Physics and Particles* panel to adjust the settings. All of these factors are discussed in later chapters, but here is what you can find in this modifier stack:



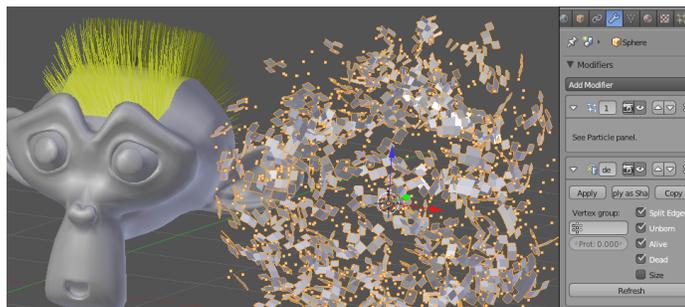
Cloth and Collision

The Cloth modifier can make a mesh act like fabric. The more vertices your mesh contains will make it appear more realistic, but at a cost of render time. The Collision modifier allows other objects to react with the cloth (also works with particles). The example shown uses a subdivided plane as the fabric and the sphere as the collision obstacle.



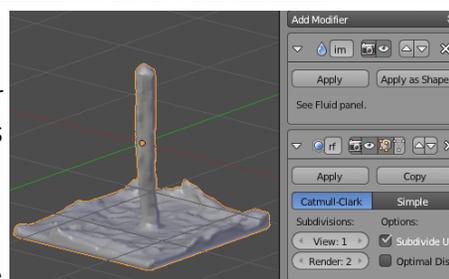
Particle and Explode

Particle systems are used to simulate many animation effects and discussed in their own chapter. Particles can simulate explosions, sparks, fire, smoke, grass, hair, and fireworks. After adding a particle modifier, you can then add the explode modifier to "explode" the mesh along with the effect.



Fluid Simulation

The fluid simulations have seen improvements over previous versions. You can create inflow or fluid masses that splash and react.

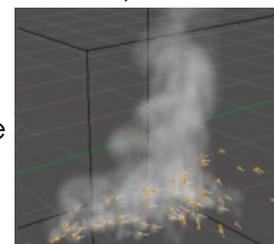


Soft Body

The Soft Body modifier existed before Blender had the Cloth modifier and was used to simulate cloth effects. Soft bodies can be used for fabric effects and "Jello" jiggle effects. You can control the elasticity between vertices.

Smoke

The Smoke modifier is new for Blender 2.5. It can be used to create realistic smoke effects in your scene.



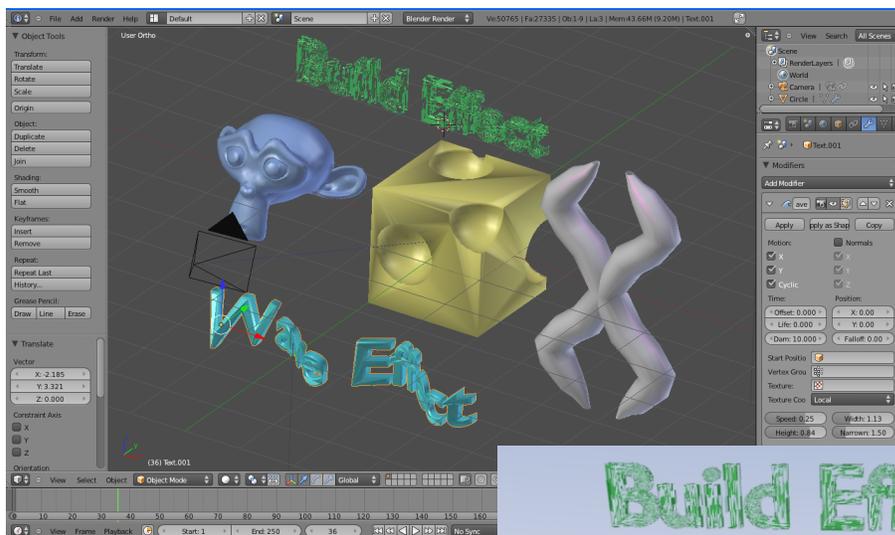
Modifiers Practice Exercise

Create a new file and call it *Modifiers*. Create a scene using any objects and materials you wish. Place at least one of each of the following modifiers in your scene.

- **Subdivision Surface**
- **Build Effect**
- **Mesh Mirroring**
- **Wave Effect**
- **Boolean Operation**

Feel free to experiment with any of the other *Generate* and *Deform* modifiers.

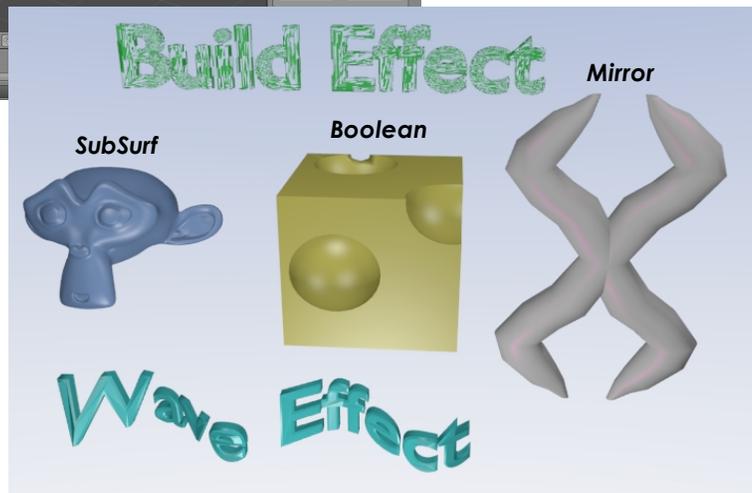
Render a 200 frame movie of your scene when finished.



Other useful commands:

"Alt-C" to convert a curve or text to a mesh.

Tool Shelf command: move the Origin to a better location when using the mirror modifier.



**** Call the instructor when finished****

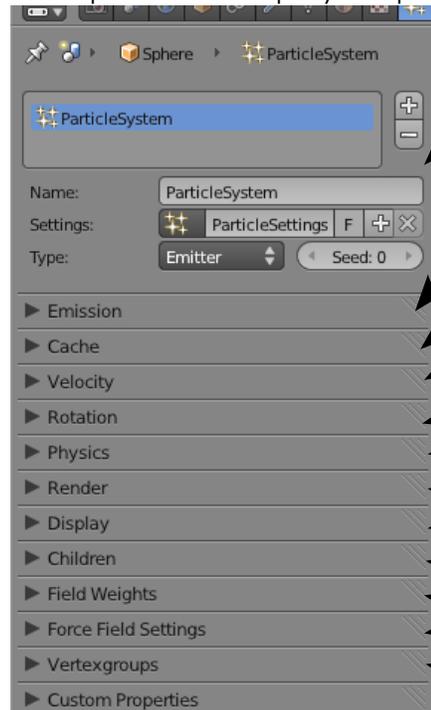
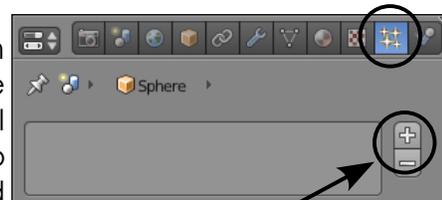
Chapter 13- Particle Systems and Interactions



Particles have received a lot of attention in Blender 2.5 This is probably the nicest and most flexible of the effects. When you turn an object into particles, it can be used to simulate *snow, fire, smoke, clouds, sparks, hair, grass and much, much more*. When an object is turned into particles, it no longer exists as a solid shape and releases particles as per the settings you used on it. With particles, you can set the size (using halo), texture, color and transparency through the material buttons. You can set the particles to come off the object in a **sequence or randomly** by using **random** setting in the particle panel. Particles can be set to be pulled using X,Y, and Z forces or gravity. You can control the number of particles, how long the particles live, when to start and end, if they have a starting speed and much more than we will describe in this chapter. Like all of the other features we've discussed, experimentation beyond this chapter is the best way to learn.

Particle Settings

At first glance, the particle setting in Blender can seem overwhelming! Because particles are so versatile, there are many things that can be changed for them. We will first look at the basic setting, then apply these settings to a few examples. With a mesh object selected and going to the particle settings, the first thing you need to do is press the "+" button to add a particle system. After pressing the "+", you see several panels with options. The example below displays all panels collapsed for easier viewing:



Basic Settings- This is where you name your system for easier reference, add additional systems and choose the particle type (*emitter or hair*) Hair is useful for any type of strand, like grass.

Emission- Number of particles, when they emit and how long they live when emitted.

Cache- In order to save computer processing time, you can "Bake" your particles so they are remembered.

Velocity- Sets an outward, normal (exploding) or directional force to start the particles.

Rotation- Gives your particles a spin.

Physics- Choose your physics calculation type, mass, size and drag.

Render/Display- How the particles look on screen and rendered.

Children- Saves render time by copying particles.

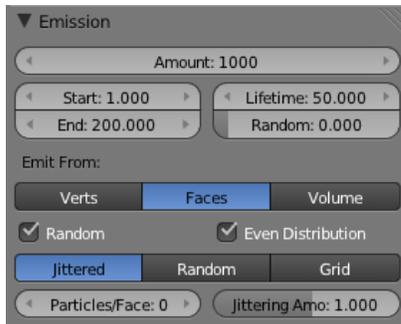
Weights and Force Fields- Controls factors like gravity, wind, turbulence, and drag

Vertex Groups- Setting groups to control distribution.

Chapter 13- Particle Systems and Interactions

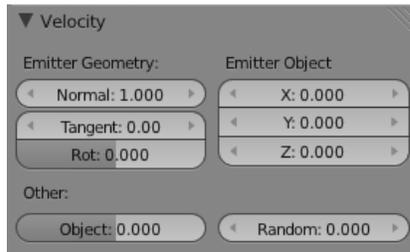
Particle Panel Basics

Some of the panel basic settings are explained below:



When adding a particle effect to a mesh, think of the mesh now acting like a collection of small parts, being created at various points in time, living for a while, then dying. In the **Emission** panel, you set the total amount of particles, when the particles start in time, when they end, how long each particle will live after birth and if you want some randomness to their lives. This is where you can also select *Random* for how they are emitted from the mesh, otherwise, they may appear to come off in a sequence.

The **Cache** panel is useful for saving you particle calculations so working and rendering can run faster. Every time you make a change to your particle settings, the computer needs to recalculate those changes over time. Saving this data in a folder or file will help a lot. This is called *Baking*. When you press "Alt-A" to see an animation on screen, Blender will temporarily Cache the data in memory while you work, but won't save it for a future session.



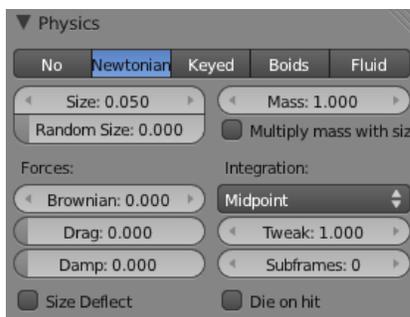
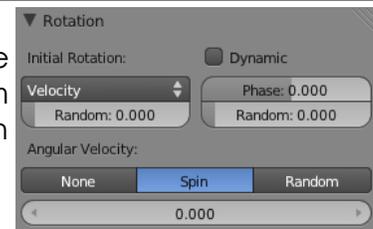
The most important settings in the **Velocity** panel are "*Normal*" and the "*X,Y,Z*" settings. Normal controls the outward force of the particles while X,Y,Z control the directional push. You also have a few other setting to adjust. The *Random* setting is also important to make the effect look more real.



RoboDude Asks: *There are a lot of settings- how do I keep them straight?*

It is best to only make one or two changes at a time and test them out by pressing "Alt-A" to see the effects in the viewport. You can always "Ctrl-Z" to undo- and practice helps.

The **Rotation** panel gives you options related to how the particles spin when released. If you are looking at random spinning and dynamics, it's good to set these high. You can also change what effects the spin (by default it is velocity).



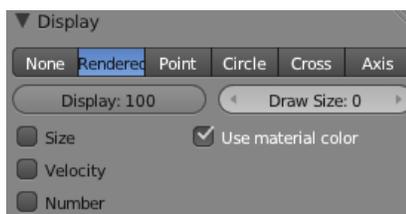
The **Physics** panel is where you can make some basic adjustments in the physics model used (default is Newtonian), size and randomness of particles, mass (when dealing with gravity and reactions) and dampening.

Chapter 13- Particle Systems and Interactions



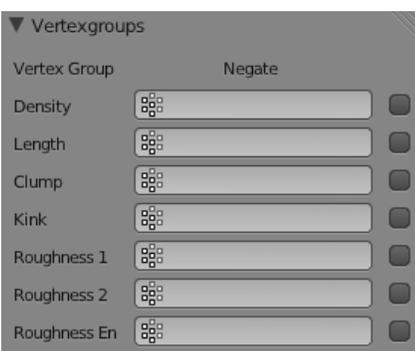
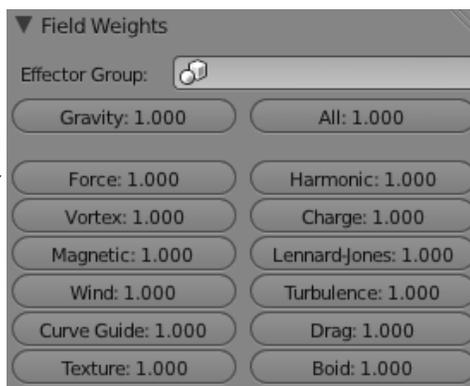
The **Render** panel provides setting for what the particles look like rendered (F12) or animated. If the *Emitter* button is not checked, you will see the particles and not the mesh that they are emitted from. You can also chose to see *Unborn/Died* particles. Particles can also be represented different ways such has *Halo* (material settings), *Line*, *Group*, or an actual *Mesh* Object.

The **Display** panel basically controls how your particles look on the screen. You can have them display what is actually rendered, Points, Circles, Crosses and also the percentage of the particles (helps with work flow).



In the Emission panel, you set the amount of particles you want for your scene, but by setting the amount to a high setting (especially for hair or grass), you can greatly increase render time and slow down working on screen. The **Children** panel can help solve these problems. Basically, children are copies of a given particle so calculations only need to occur for each particle, then copies are made and grouped around that particle to make the scene more full. You can set the clumping, randomness, amount of children per particle and shape.

The **Field Weights** panel allows you to set useful features like *Gravity*, *Wind* and *Turbulence*. For example, if you are making a fire effect, You would want gravity at 0 and give "Z" an amount in the *Velocity* panel. For fireworks, only a slight gravity would be needed.



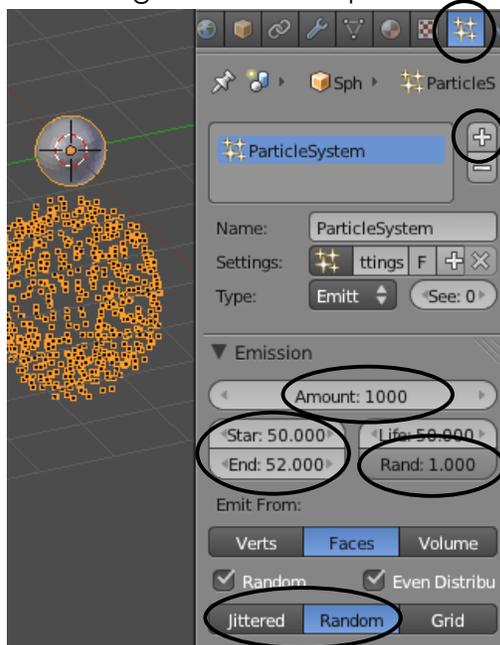
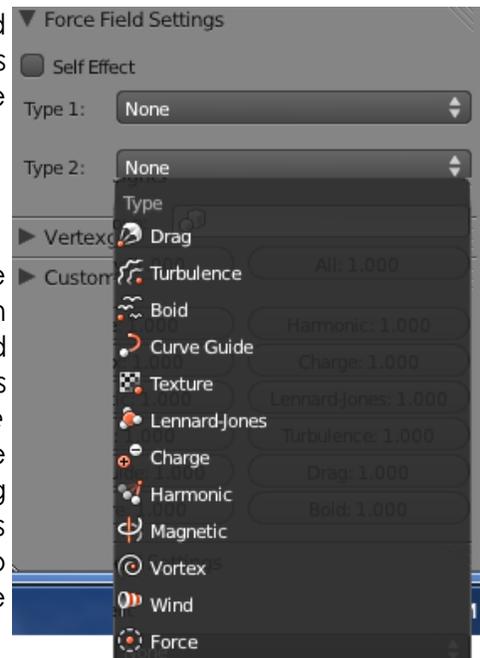
Vertex Groups can be used to control many aspects in particles. You can develop weights for density and other things. We will look at using groups later in this chapter when we use particles for hair and grass.

Chapter 13- Particle Systems and Interactions

The **Force Field Settings** panel allows you to add additional features to your particle system. Features like Drag, Turbulence, Wind, Vortex, etc. can be added and animated.

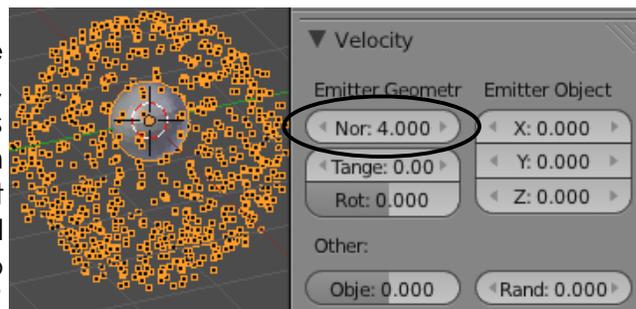
A Simple Particle Explosion (Fireworks):

Let's take some time to set up a simple particle explosion for practice using particle settings. Start with a new Blender scene, erase the initial *Cube*, then add a *UV Sphere*. Scale the sphere down to about ½ its original size. In the *Properties* window, add a *Particle System* for the sphere. Press "Alt-A" to see the animated particles. You should see particles dropping off the sphere (spin your view to see the effects). Press "Esc" to exit the animation and use your arrow keys to move up in time to about frame 30. You should see something like the example below:



The particles are dropping because the gravity is set by default. We now need to make some changes to resemble a firework. First, start in the *Emission* panel and change the total *Amount* to about 300. No need for 1000 particles for a firework. Next, since a firework explodes over a short period of time, we need to change the *Start* and *End* frames to something much less. Try a *Start of 50* and an *End of 52*. This will cause all 300 particles to be release in 2 frames. Since firework particles die randomly, keep the Life at 50, but change the *Random* to full (1.000). Finally, change the Emit option from *Jittered* to *Random* to make the release of particles more random. Test it our with "Alt-A". The particles still drop so it's time to look at some other settings.

Next, in the *Velocity* panel, change the *Normal* setting to a much higher number, like 4.00. This will blast the particles outward. The gravity still pulls them



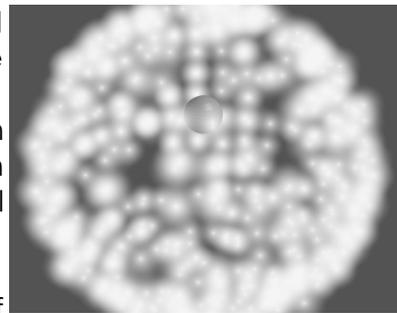
downward a bit to much, so we'll fix that next. Go down to the *Field Weights* panel and set *Gravity* to about 0.40. Feel free to experiment with these setting for different effects.

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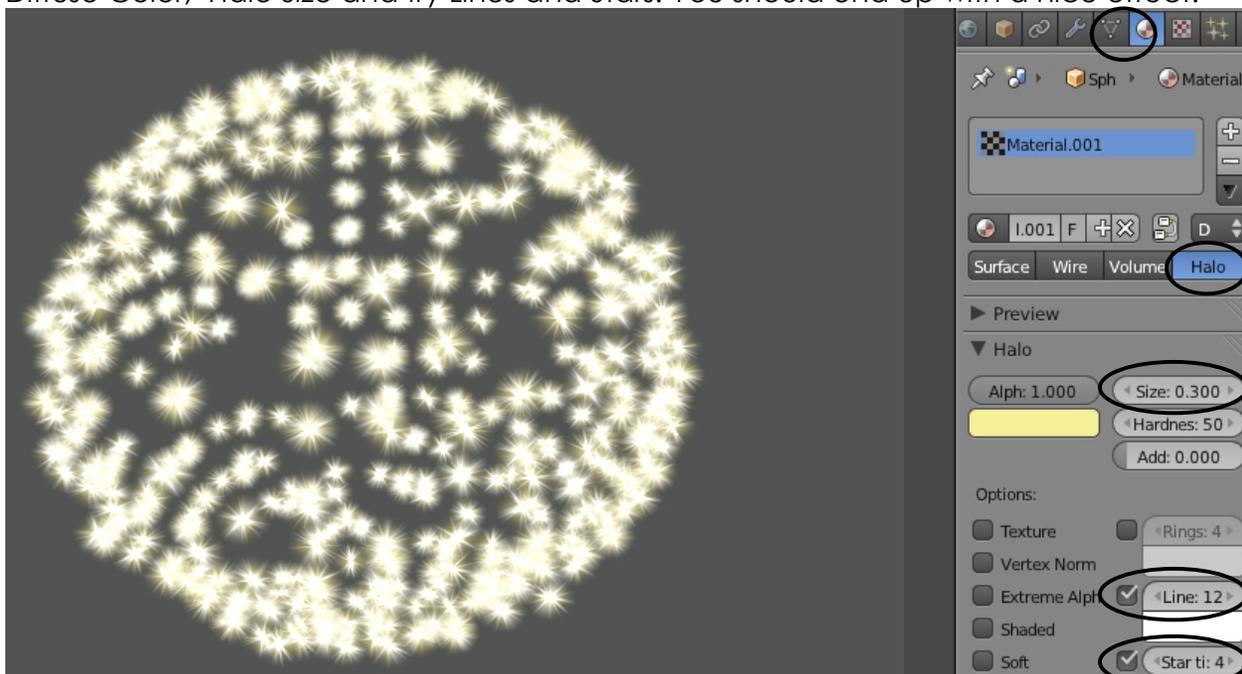
It's now time to put the camera in a good place and render an image. Advance to a frame where you see the particles well and hit "F12". You will see something like this:



You may see the actual sphere in the center of the explosion. To turn this off, go to the Render panel under particles (if you had the camera selected from before, select the sphere again) and turn off "Emitter" so the actual mesh doesn't render. You could also experiment with Trail Counts for a second release. To improve the explosion, add a material and adjust the Halo setting. (review chapter 4) Adjust the Diffuse Color, Halo Size and try Lines and Stars. You should end up with a nice effect.

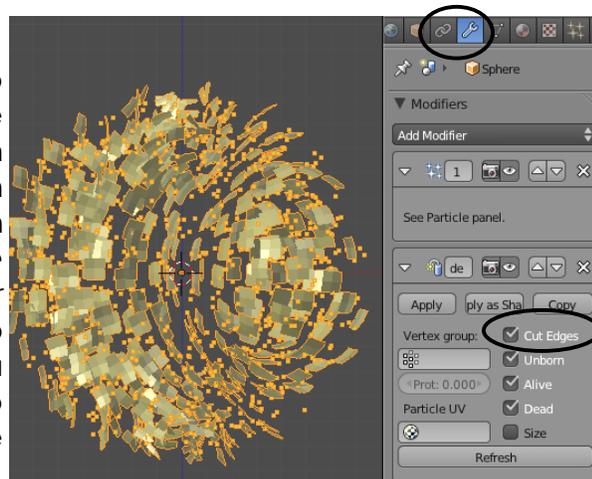


To improve the explosion, add a material and adjust the Halo setting. (review chapter 4) Adjust the Diffuse Color, Halo Size and try Lines and Stars. You should end up with a nice effect.



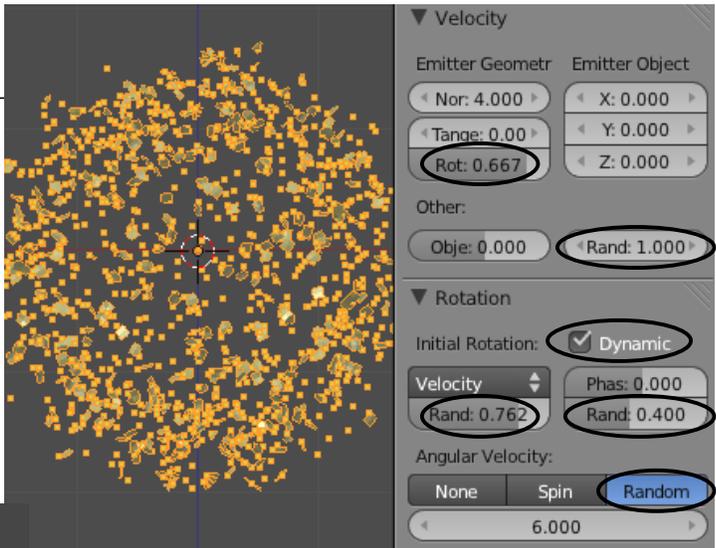
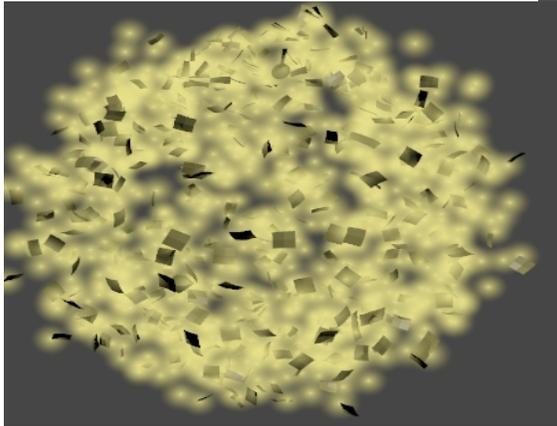
Using the Explode Modifier

The Explode modifier adds a nice touch to making something explode. We will use the firework example above to illustrate an explosion. In the Render setting, turn on Emitter. First, turn off Halo Lines and Stars in the Material settings and set Halo Size smaller, about 0.10. Add an Explode modifier in the Modifiers panel. You may also want to check the "Cut Edges" box. Move to a frame where you can check the results. Also try "Alt-A". It's a nice start, but needs some work to look more believable.



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Now it's time to move back to the Particles settings panel. In the *Emission* panel, you will want to set the *Life* of the particles to 250 (length of the animation) and the Random Life slider back to 0. To set the rotation to look more random and real, set the *Rotation* and *Random* setting to numbers between 0.500 and 1.000 in the *Velocity* panel. In the *Rotation* panel, check the *Dynamic* box, add a *Random* to the *Velocity*, *Randomize Rotation Phase*, and change the *Angular Velocity* to *Random* with a number like 6.00. The key to a good explosion is setting most random settings high. Feel free to experiment with other settings, but this should give you a nice result.



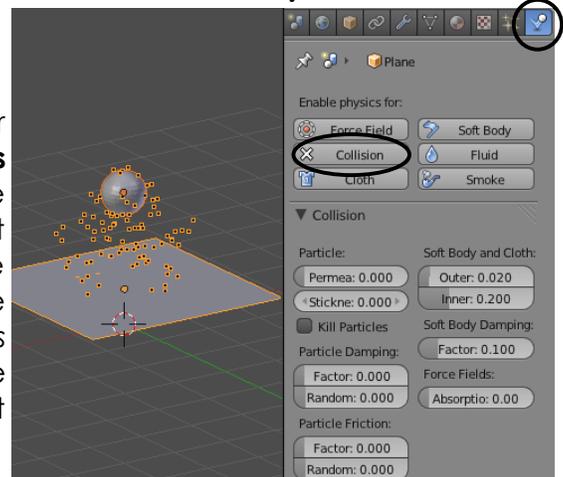
If you want an explosion without the halo particles displayed, trying setting the halo size in materials to 0. To add more depth to your animation, try adding a second mesh with a different color and particle settings. This will add levels and complexity to your scene.

Particle Interaction With Objects and Forces

So far, we've looked at basic setting to get particles moving, but how can we add interactions to them? What if we want them to bounce off other objects or have wind blowing them?

Interaction with Other Objects:

You can make particles bounce off other objects using the *Collision* setting in the *Physics* panel. For the example shown to the right, I've created a sphere with a simple particle effect applied and a plane below it. In order to get the particles to bounce when they collide with the plane, select the plane and go to the *Physics* panel. Select *Collision* and experiment with the settings under the *Particles* column. You can set them to bounce, die or partly pass through.

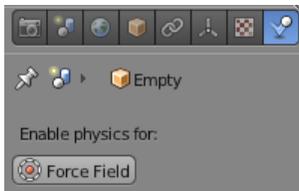
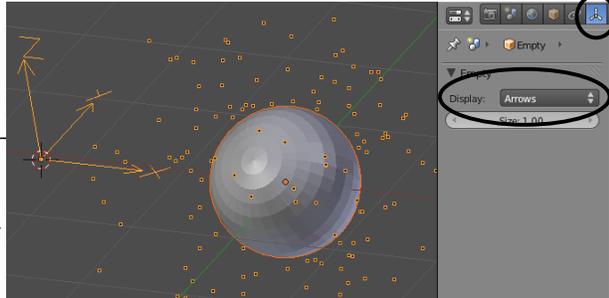


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Interaction With Forces:

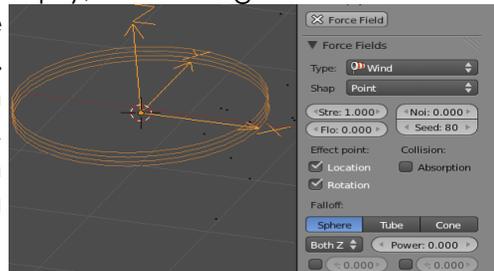
Particles are able to react to forces like wind. They can now be applied directly to the particle system (see *Force Field Settings* panel) or added to another object. By applying the effect to the particle system, it can effect itself or effect other particle systems. By applying a wind force to another object, it can be animated to simulate wind changing directions.

For the example to the right, we will be using an *Empty* as the wind force and a *Sphere* with a particle effect with zero gravity. The Empty's display has been changed to "*Arrows*" representation for better understanding.



With the Empty selected, go to the *Physics* panel and enable "*Force Field*". Select wind in the "Type" option and you will see several circles form on the Empty, indicating the force and direction. By default, the force will travel in the Z-direction.

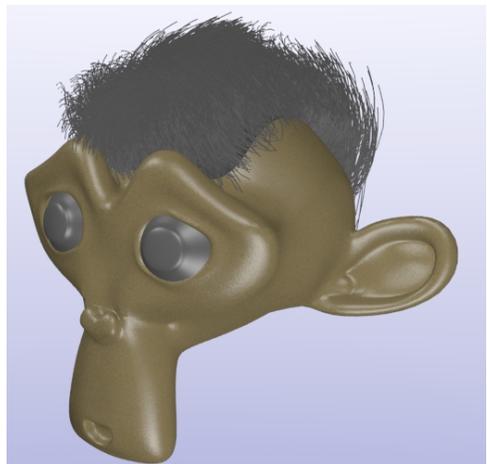
Rotate the Empty to point in the direction you wish the wind to blow. You can then adjust the strength, noise and other settings. For more change, you can also animated these setting by pressing "I" over a setting and changing it over time.



These setting are similar to many of the other forces that can be used on an object. These forces can also be used on many of the other physics features that will be discussed in a later chapter (cloth, fluids, softbodies).

Using Particles and Vertex Groups for Hair and Grass

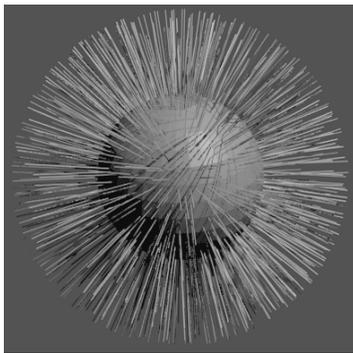
At the beginning of the chapter we mentioned that particles can also be used to represent hair and grass. These features can be animated to react with forces and other objects. Hair can even be combed!



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Basic Hair Settings:

For this basic setting discussion, I'll apply a particle system to a UV Sphere and switch from "Emitter" to "Hair" in the particle properties. You will probably get something like the scene below with long strand radiating out from the sphere. It's now time to adjust the Hair length under the Emission panel. I will set this example to 1.00. We'll keep the Amount at 1000.



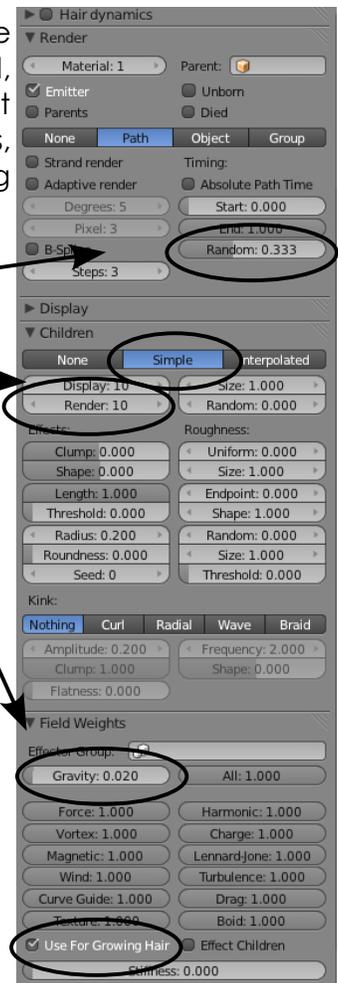
The result should be a render something like the one to the left after reducing the length. There are many settings that can be adjusted, but let's keep it simple. In order to get something more full, random lengths, and effected by gravity, try adjusting the following settings:

Render panel- Adjust the Random slider to randomize the hair length.

Children panel- Select "Simple", then adjust the Render amount to something like 10 for less children. This will fill in the sphere and give more strands without adding more particle hairs to calculate. There are also many more settings for different effects.

Field Weights panel- Check the box at the bottom of the panel "Use for Growing Hair" and adjust the Gravity low (about 0.020).

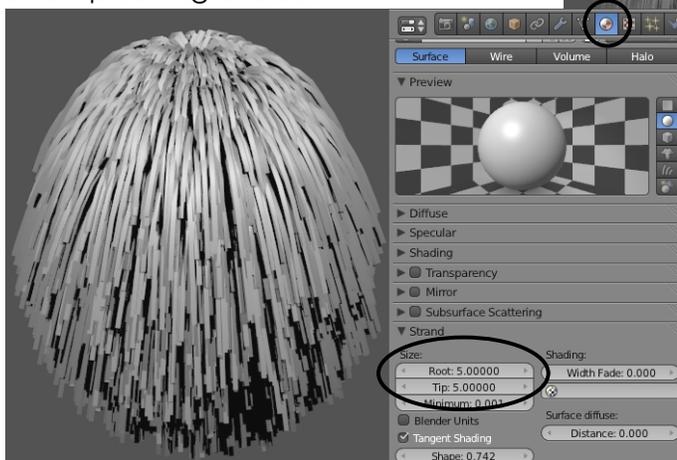
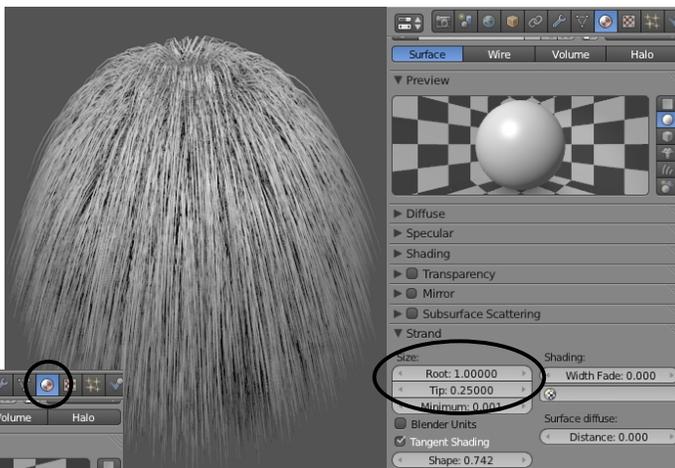
These setting should give you a result something like this. Feel free to experiment with other settings.



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Material Strand Settings:

The shape of the strand can be controlled in the material settings. Put a material on the sphere and open the "Strand" panel. Under Size, you will see a "Root" and "Tip" setting. The 1st example uses a Root size of 1.00 and a Tip size of 0.25. This creates a tapered strand. The 2nd example used a Root and Tip setting of 5.00.

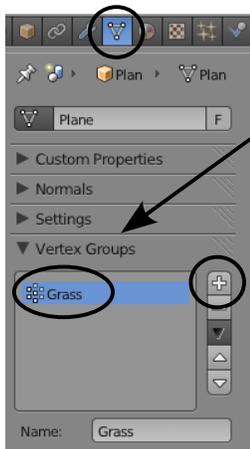
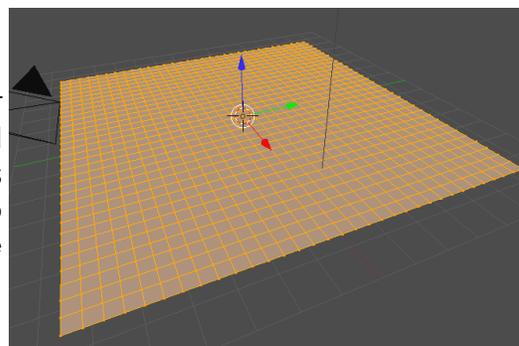


RoboDude Says:

Just like basic particles, force fields like wind can be used to move strands.

Creating and Using Vertex Groups:

Let's say you want to make an object with grass or hair, but don't want the particles distributed evenly over the entire object. We can control this with vertex groups that assign different weights to vertices. For an example, we'll start with a plane that has been scaled up a bit and subdivided about 5 times in edit mode.



Next, we'll go to the Object Data buttons and press the "+" button in the Vertex Groups panel to add a vertex group. It might be helpful to change the name from "Group" to something more meaningful.

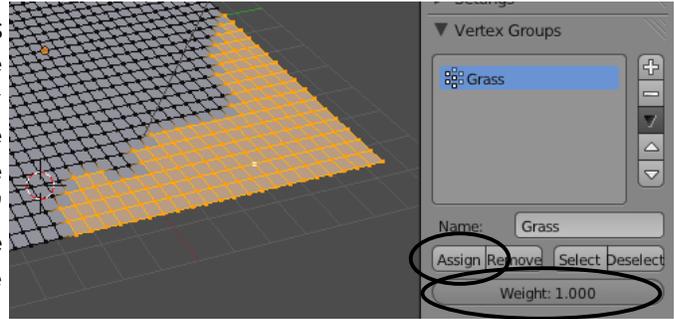
It's now time to assign different weights to the vertices. This can be done 2 ways:

- Assign weights in Edit Mode
- Assign weights using Weight Painting

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Assigning Weights in Edit Mode:

Enter *Edit Mode*, deselect all vertices and select all those that will have the highest density of grass (use the “B” or “C” key). In edit mode, you will notice that a few options will show up in the *Vertex Groups* panel. Take the “Weight” slider to 1.000 and hit “Assign” to give the selected vertices a weight of 1, the highest density. For areas without grass, assign them a weight of zero, and areas with middle density, a weight in the middle. To see your results, you can change from *Edit* mode to *Weight Paint* mode (discussed below). Weights will display as different colors.

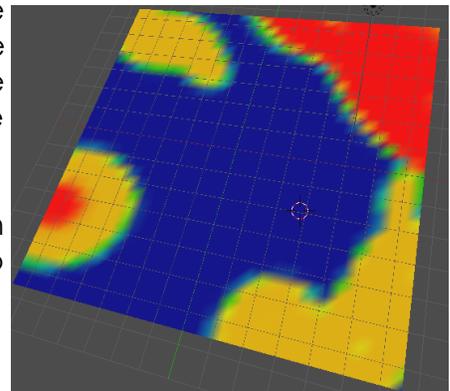


Assigning Weights in Weight Paint Mode:

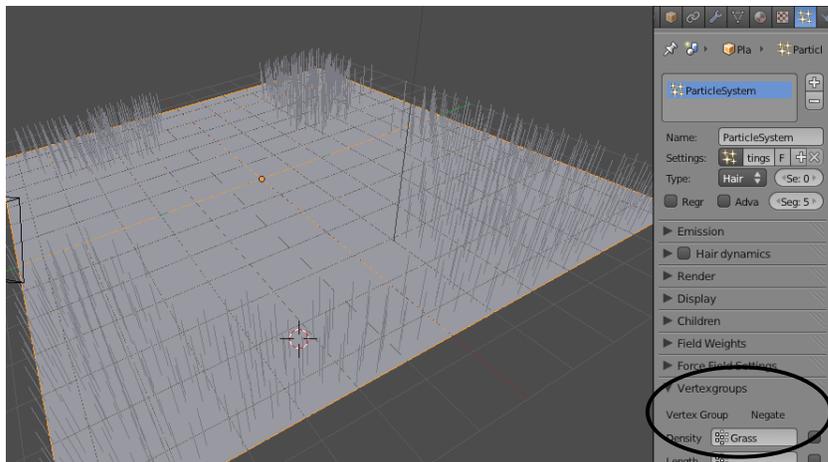
Weight Painting allows you to “brush” different weights onto your object. You still need to create your vertex group as discussed on the previous page first, then change to *Weight Paint Mode*. Your plane will change to blue (indicated everything at a weight of zero), your cursor will be displayed as a circle, and the *Tool Shelf* will display the Weight Painting tools. Much like assigning weights to vertices, you need to set the Weight you plan to “brush” onto the mesh. You can also set the brush Radius size and Strength. The strength determine the fade of the brush. To paint the full weight, set the strength to 1.00.



For our example, I've painted the mesh as shown to the right. Blue is a zero weight and red is a weight of 1.00.



Return to *Object Mode*.

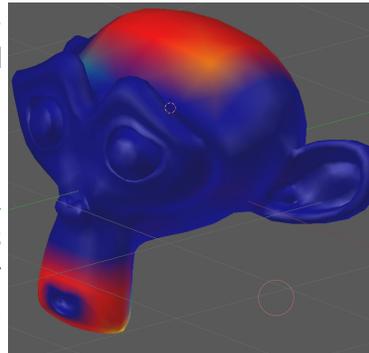


It's now time to apply a *Particle* system and set it up for hair as discussed earlier. In order to make the particles generate using the vertex group we created, select your vertex group for “Density” in the Vertex Groups panel. Vertex groups can be used for many other features in Blender.

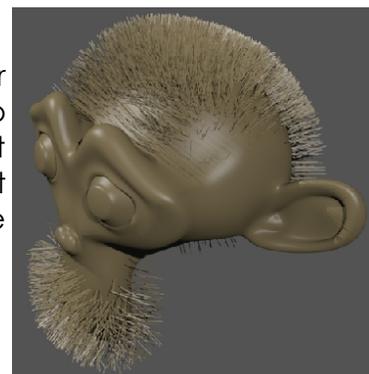
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Other Hair Effects:

We need to discuss a few other options useful for particle hair. These are shaping the hair in *Particle Mode* and assigning colors to the strands other than the main material color of the mesh. Starting with a new Blender file, We will add a Monkey head, set it smooth and apply a *Subdivision Surface* modifier to it. The next step is to add a *Vertex Group*, then enter *Weight Paint* mode and brush weighted areas where you wish the hair to grow. Painting may be difficult due to the monkey not having many vertices. My example is shown to the right with the monkey having a Goatee and a Mohawk:

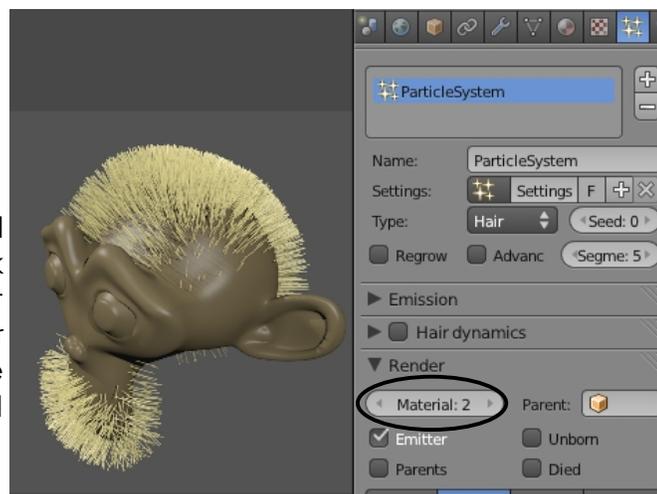


Now go to the *Materials* panel and put an appropriate color material on the monkey. I used a brown color. The next step is to apply a hair particle system as previously discussed. Set hair length, amount, and children to desired appearance. At this point, you should be able to render an image and see results similar to these.

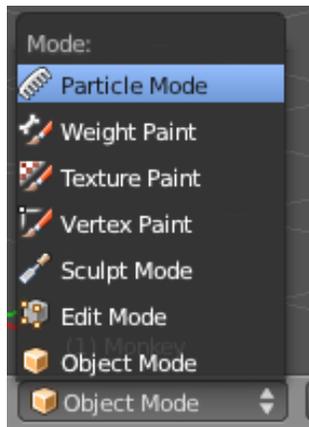


Looks good, but I would like to have the hair a different color. To do this, go back to your *Materials* panel and click the small "+" to the right of the materials list. Give it a name in the block below it and set the diffuse color. I chose a shade of yellow. The material list will show 2 materials set for this object. The 1st material channel is used for the mesh color while we will use the 2nd material channel will be used for the particles.

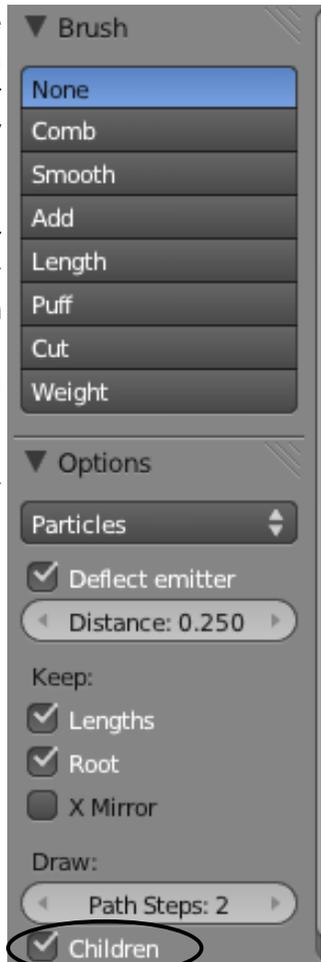
Now go to the *Particles* panel and find the *Render* settings. You will see a block where you set the particle material. Set it for *Material 2*. This should force Blender to use your second material for the strands. Hit F12 to render an image and you should see something like this:



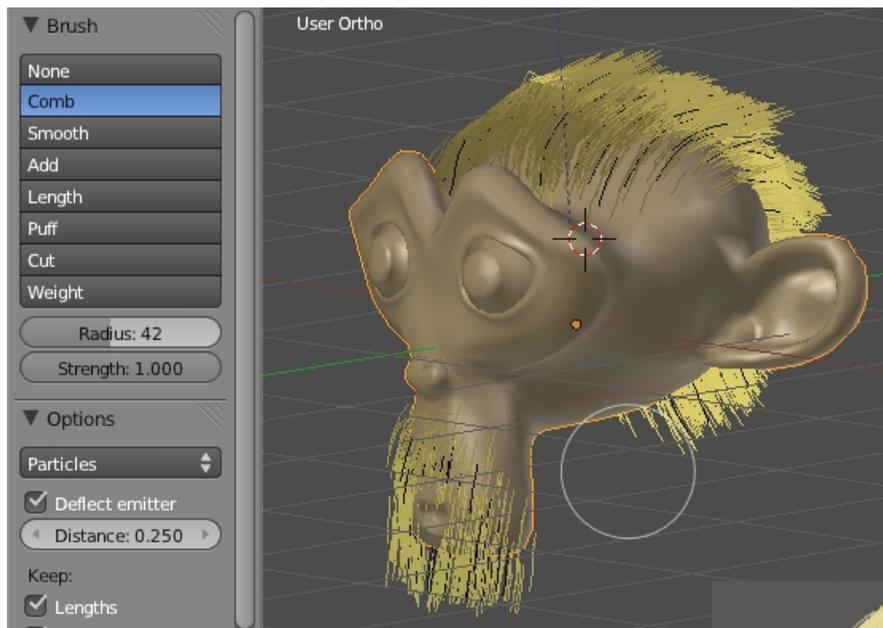
Chapter 13- Particle Systems and Interactions



It's now time to comb and shape the monkey's hair and beard. Switch from *Object Mode* to *Particle Mode*. A new set of options will display in the Tool Shelf. By default, you may only see the original strands without the children on the screen. You can check the "*Children*" option at the bottom of the Tool Shelf. Experiment with the different options available in Particle Mode. By using the Comb, Cut, Smooth and Puff commands, you can modify the hair quite a bit.



With a little practice and patience, you can create some great effects!.

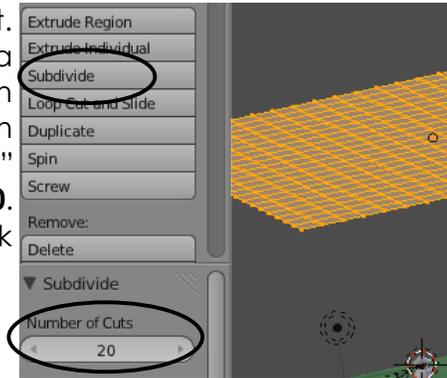
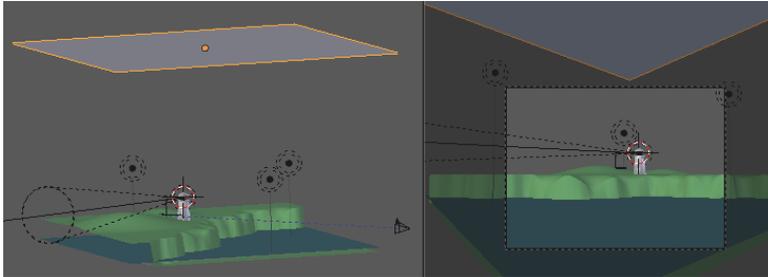


To summarize the particles unit, by adjusting the basic settings discussed here and experimenting with others, you can use particles for a variety of effects in your scenes. Need a dusty, blowing scene? A fire with flames and smoke? Grass blowing in a field? By browsing the forums, you can always find someone doing something new.

Adding Rain to Your Landscape

PRACTICE EXERCISE

Now it's time to add some rain to your stormy night. Open up your "**Landscape Scene**". Start by adding a plane in the top view and scale it up a bit larger than your ground. Move it up high enough so it is not visible in the camera view. While in edit mode, select "**Subdivide**" in the Tool Shelf and set "**Number of Cuts**" to **20**. Returning to Object mode, your scene should look something like this:



Now it's time to add a "Particle System" to make it rain. Since we want it to be raining at frame 1, we need to start the

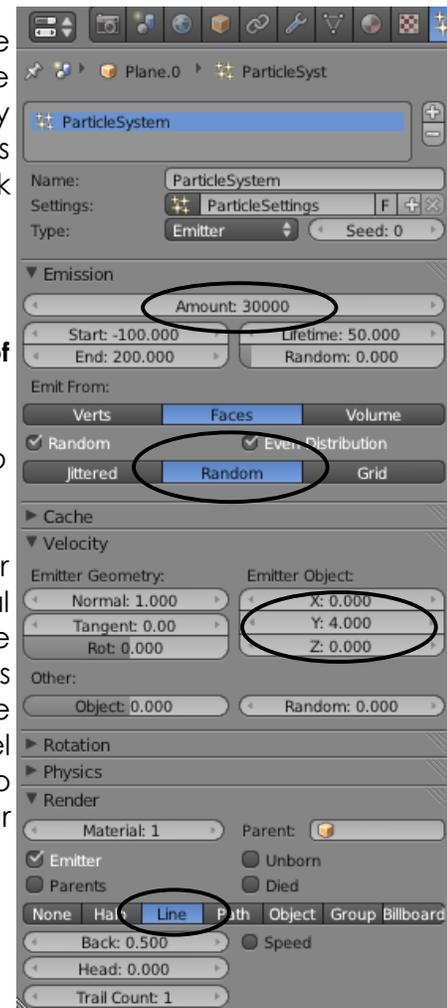
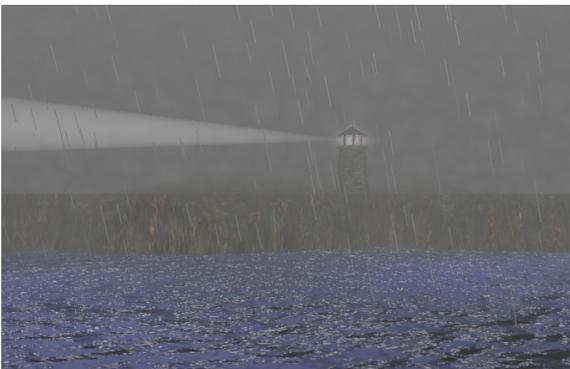
rain at some point before that (-100). We also want the rain drops to last the entire animation (lifetime), be random, and appear to be effected by the wind. Try these setting. Press "**Alt-A**" often to check your results (*remembering to always be on frame 1*). Place a dark gray diffused material color on it for a dark, rainy look.

Amount: 30000; Start: -100; End: 200; Random Distribution
In Velocity panel, Y: 4.000 for side movement

In Render panel, switch to Line. You can adjust the length of the line with the "Back" / "Head" settings.

Since your scene may be a bit different, feel free to adjust these as desired.

This is a pretty simple rain effect, but quick and easy for our scene and works well. Experiment with material setting for a nicer look. When finished, render an image and save it as a jpeg. If time permits, feel free to animate your scene.



**** Call the instructor when finished****

Chapter 14- Child-Parent Relationships

Using Child-Parented Objects

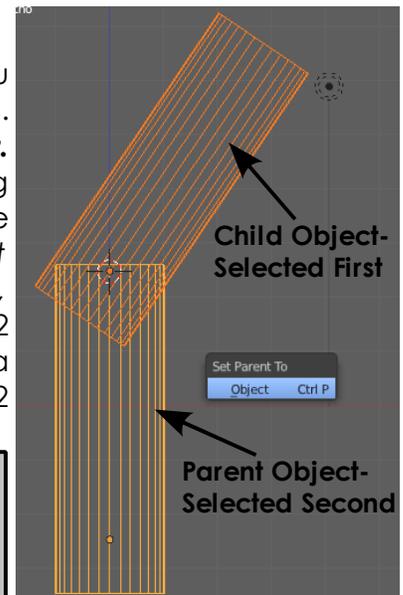
So far, we've talked about making and editing objects, making them look good and how to render and animate them, but how do we make things like humans or robots or anything else move about that have *several parts connected together*? This is where **child-parent relationships** become useful. It allows us to link things together without actually joining them. This allows the individual parts to move about, but still follow a "master" object.

The concept of child-parent relationships is used in all animation programs and it involves an object assigned the role of a **child** and an object assigned the role of a **parent**. If the **parent** moves, rotates or scales, the **child** must do so too. **On the other end, a child can move, rotate or scale without affecting the parent.** An example would be: a *hand* is the child of the forearm while the *forearm* is the child of the upper arm and the upper arm is the child of the torso. Therefore, if the forearm moves or rotates, the hand must follow and if the upper arm rotates, the forearm *and* hand both must follow. If the torso moves, the entire arm must go with it. This is how you keep a body or machine from going to pieces!

In order to make child-parent relationships in Blender, you need to hold down the "**Shift**" key to select multiple objects. **Select the child object FIRST, then select the PARENT object.** The child object is always selected first. If you have a string of objects that need to be child-parented together (like the arm example), you can only do 2 parts at a time so start at the end of the chain and do the hand and forearm first, then forearm to upper arm and so on. After selecting the 2 objects, press "**Ctrl-P**" to make parent. You will see a dashed line drawn between the pivot points of the 2 objects. This shows a child-parent relationship.

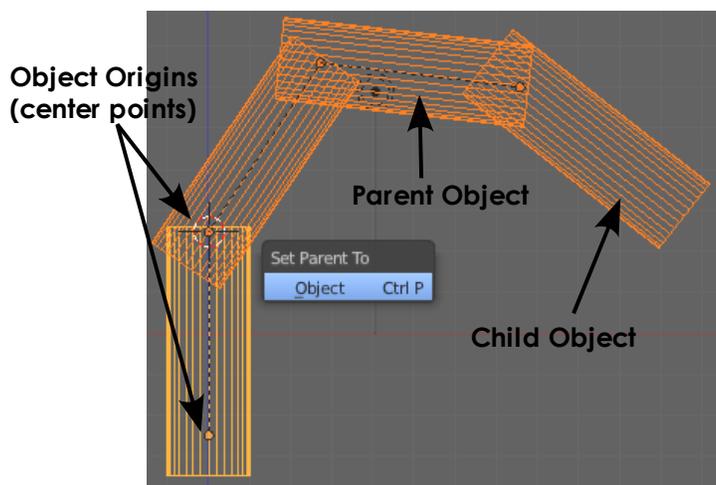


RoboDude Asks: *I did the Child and Parent selection backwards- How do I undo them? In order to delete a child-parent relationship, select both objects and press "Alt-P" to clear parent.*



Look at the example on the next page. If we want to child-parent a few cylinders together to make a robot arm, create a cylinder and stretch it out in edit mode by moving one end of vertices. **Remember to pay close attention to the object's pivot point.** If the object needs to pivot like an arm, you will need to keep the point at one end of the cylinder. *Always pay close attention to the object's pivot point in any case. It's easy to forget about it when moving vertices around in edit mode.* We'll look at moving center points next page. After you shape one cylinder, exit edit mode and press "**Shift-D**" to duplicate. Locate the cylinders and double check their pivot points. **We want to make sure center points are correct before child-parenting.** Start at the end and select the first 2 objects. Press "**Ctrl-P**" to make the relationship. Check it out to see if it's correct and go to the next set. In the next set, the previous **Parent** object now becomes the **Child** object. Make a simple animation to check the function.

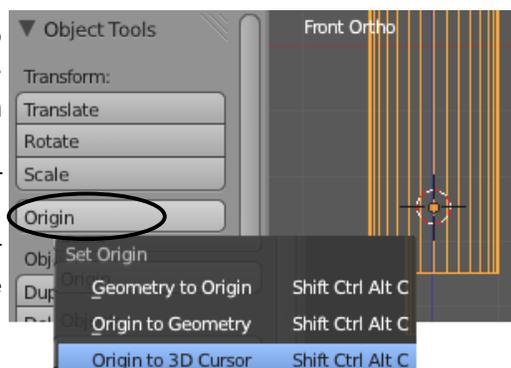
Chapter 14- Child-Parent Relationships



RoboDude Says: You can child-parent almost any object including cameras, paths, empties and lamps. Great for keeping a camera attached to an object!

Adjusting Object Origins (center points)

In the basic editing chapter, we discussed how to move origins (center points) of objects. You were also cautioned about moving an object while in edit mode because the vertices will move, *but not the object's center point*. To move the center point of an object, **select the object**, place the **3D cursor** (LMB) in the location you want the center point to go, and find the "**Origin**" button in the *Tool Shelf*. You will have 3 options:

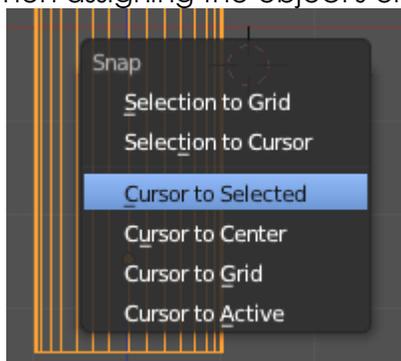


"Geometry to Origin" (*centers the mass around the object's current center*)

"Origin to Geometry" (*moves the center point to the object's mass*)

"Origin to 3D Cursor" (*moves the center point to the 3D cursor's location*)

In order to find a precise location, don't forget about the "**Shift-S**" command to snap to locations. It is useful for finding exact locations of object or selected vertices. Also useful for moving things around in 3D space. The *Shift-S* command is useful for finding an exact location to move the cursor, then assigning the object's origin to the cursor's location.



Creating a Robot Arm Practice Exercise

Create a new Blender scene and set up the views any way you wish. **Your job is to design a robotic arm that is child-parented together and animated.** Create all components using planes, cubes, spheres and cylinders. Locate your object origins to good logical pivot points. Place materials on all objects and develop a good scene with plenty of lighting.

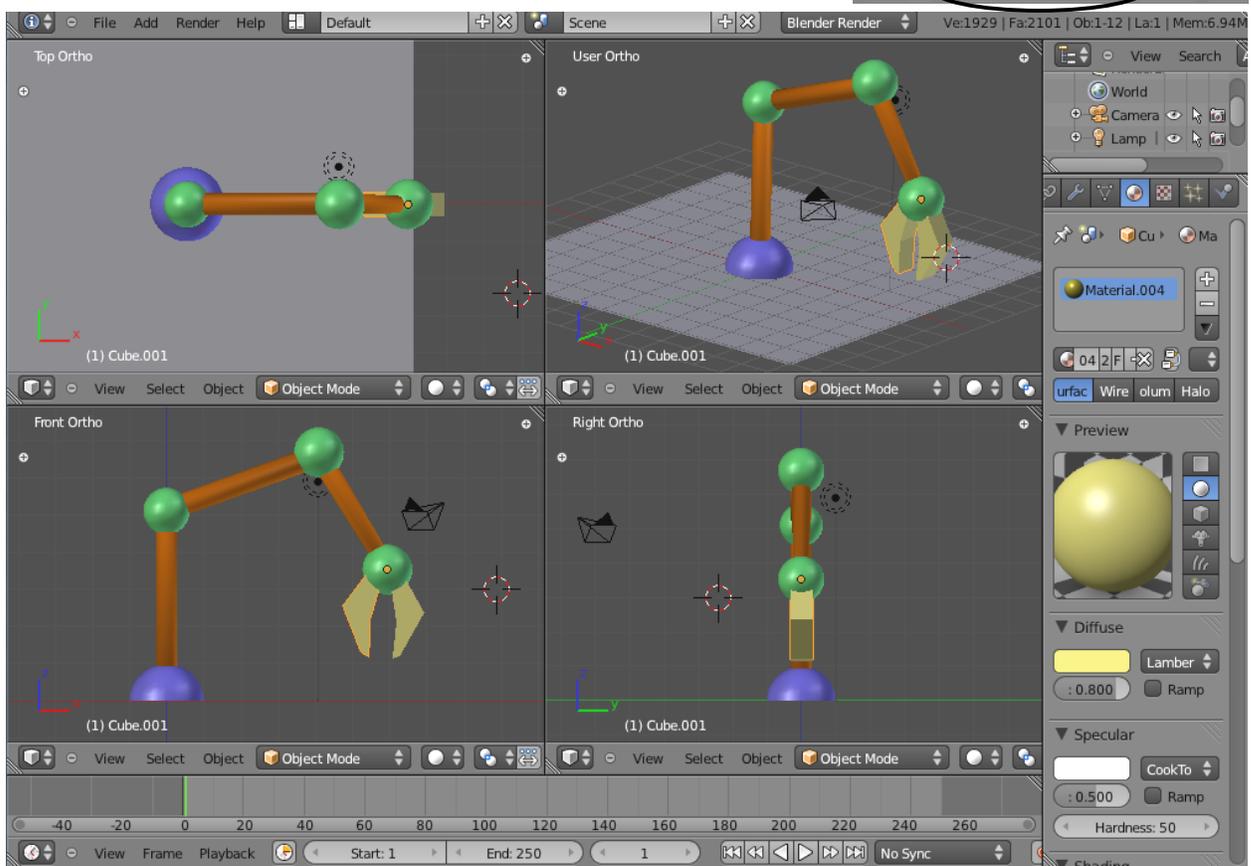
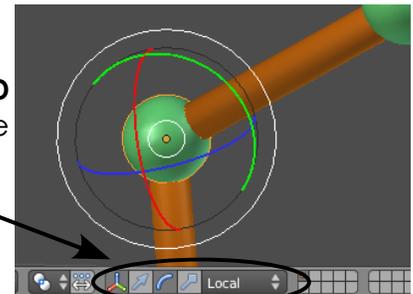
After you create your scene, develop a 150 frame animation of your robotic arm moving in all directions.

Challenge exercise:

Try to make your robot arm pick something up off the plane!

Helpful Hint:

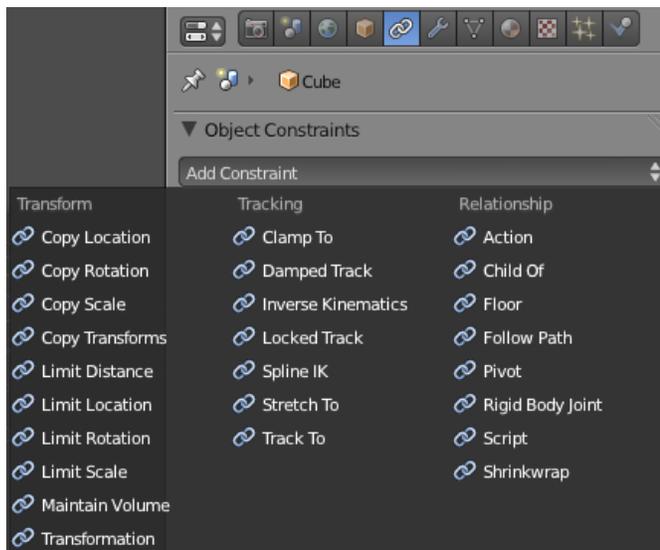
When animating, it may be useful to turn on the **3D Widgets**, switch to Rotation and set it to Local. It will make setting animation keys much easier!



**** Call the instructor when finished****

Chapter 15- Working With Constraints

Constraint Basics



Like *Modifiers* discussed back in chapter 12, *Constraints* are provided to help with animation. Like many other Blender features, constraints have changed considerable from previous versions and are divided into 3 groups- *Transform*, *Tracking*, and *Relationship*. Some of these we have already used through key commands like *Track To* (Ctrl-T) and *Child-parent* (Ctrl-P).

In this chapter, we will focus on some of the basic constraints like tracking to various things and working with paths.

Transform Constraints:

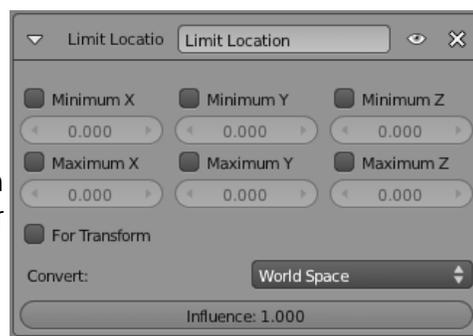


Copy Constraints:

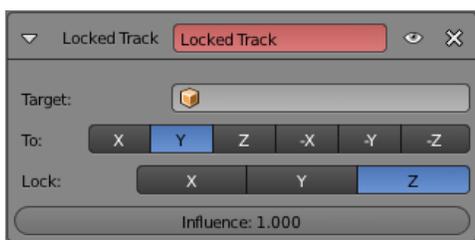
You can copy the location, rotation, scale, and transforms from one object to another using these constraints. You select the *Target* object to copy from, select the axis (or inversions) and choose to use world or local space for the axis reference.

Limit Constraints:

Like the copy constraints (*location, rotation, scale, distance*), you can set axis limits for motion on an object. Great for giving an object limited motion or motion on a specific axis.



Tracking Constraints:



Tracking Constraints:

There are several different tracking constraints that give slightly different options relating to how an object follows a target and if an axis stays upright at all times. In past chapters, we have accessed these using "Ctrl-T".

Armature Constraints:

There are several constraints in this category related to Armatures that will be discussed in a later chapter (*Inverse Kinematics, Spline IK*).

Chapter 15- Working With Constraints

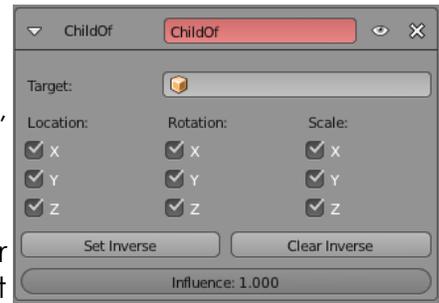
Relationship Constraints:

Child Of Constraint:

Works exactly like what we did in the previous chapter, but with visual controls.

Locking Relationship Constraints:

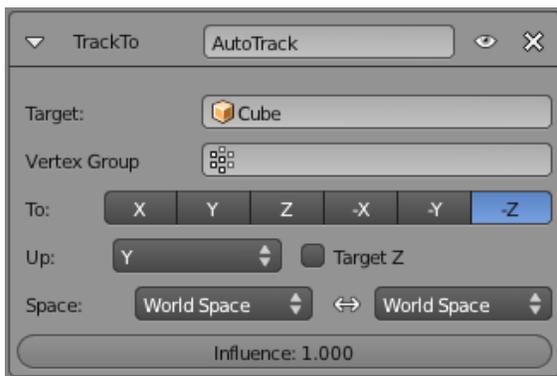
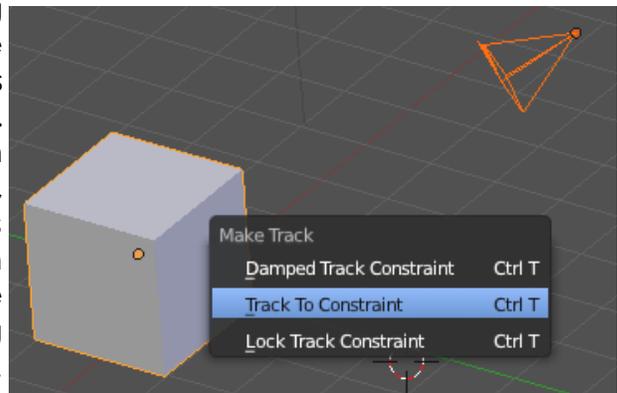
Several other constraints in this category lock to another object such as providing a floor level, providing a pivot point and following a path.



Tracking To An Object

There are times you want to “constrain” or “follow” a certain object in your scene. New constraints are being developed in Blender, but for now, we will just be talking about the most common one used to keep the camera focused on an object- the “Track To” constraint. The tracking constraint is useful in animating by saving you a lot of time and frustration trying to place location and rotation keys on the camera in an effort to try to keep your target centered. When used in conjunction with *Paths* (discussed in this chapter), you can create very smooth animation paths. *Objects besides cameras can also be used with tracking.*

To set up a simple camera tracking constraint, Select the camera first, then the target while holding down “*Shift*”. Press “*Ctrl-T*” and select “Track To Constraint”. Sometimes it’s convenient to target an *Empty* object (created in the *Add* menu, like we used in the lighthouse scene). This allows you to move your target around in your scene so the camera can focus on one object for a while, then move to something else by moving the target in that direction. You also have an *influence* option where the camera will track solidly to the object or allow some flowing of the camera.



The other way to apply the Track To constraint is through the *Constraints* panel discussed in this chapter. However, by pressing “*Ctrl-T*”, this constraint will automatically be placed in the stack. You can even choose to follow a vertex group, lock to specific axis and space, and even choose the amount of influence of the tracking.

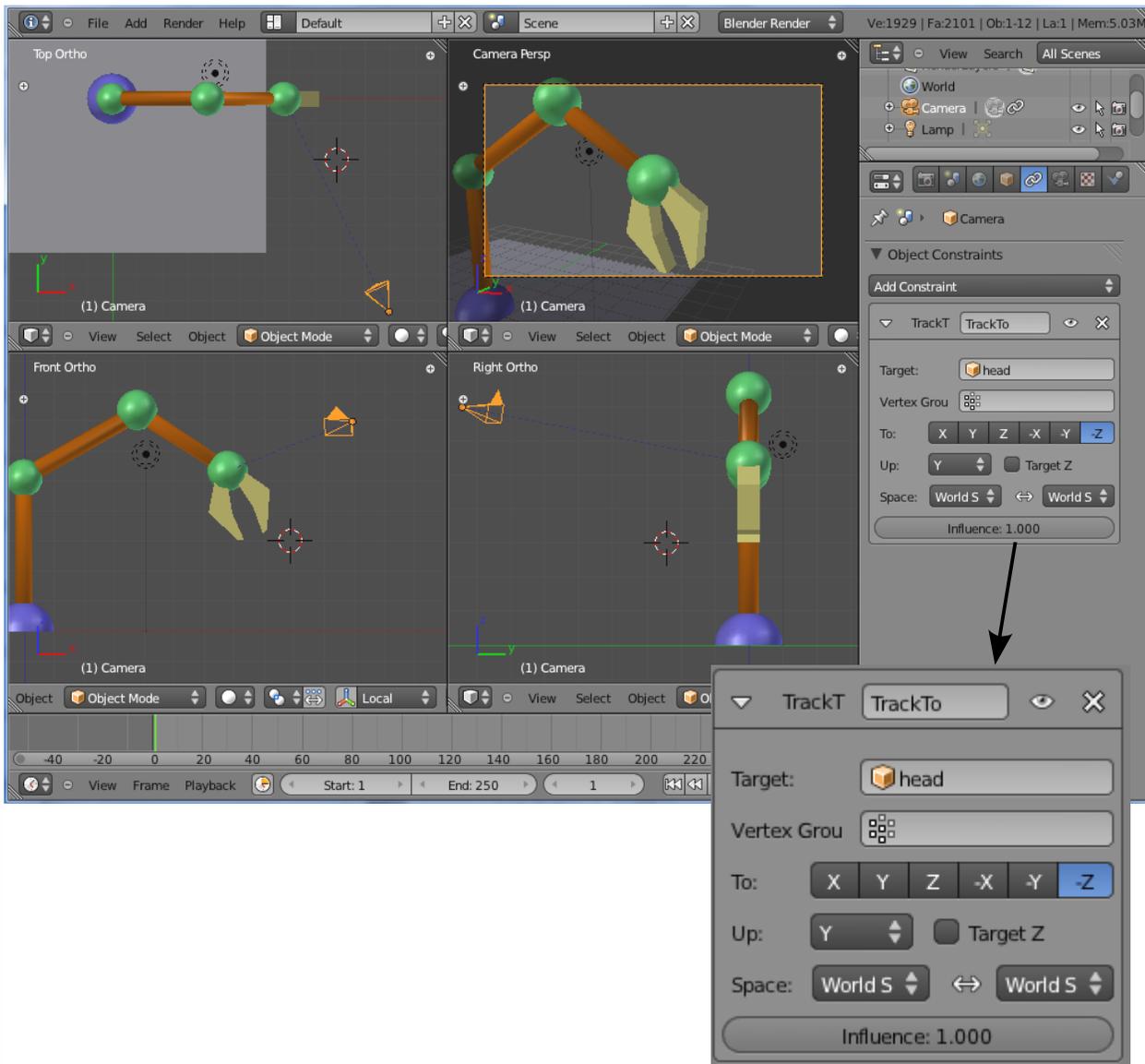
Camera Constraint Practice Exercise

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E
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Open the Robot Arm scene you made in the last exercise and add a camera constraint. You may target any part of the robot arm you like or create an Empty and target the camera to that. In the scene below, the camera was targeted to the gripper head. In the *Object* properties panel, I renamed the sphere on the gripper head to head. If needed, experiment with the axis settings to get the camera to point to the object.

After you create your scene, develop a 150 frame animation of your robotic arm moving in all directions with the camera also doing some movement.



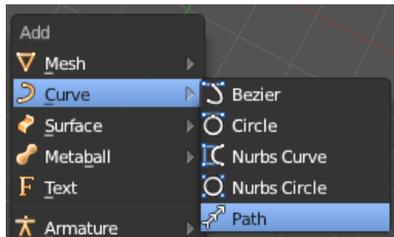
**** Call the instructor when finished****

Chapter 15- Working With Constraints

Following Paths and Curves

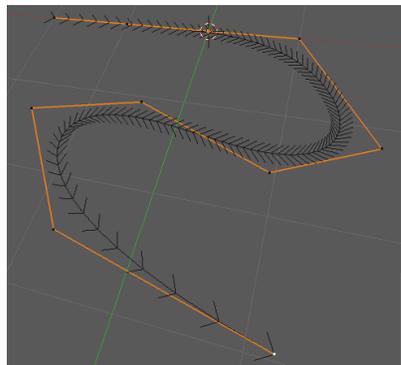
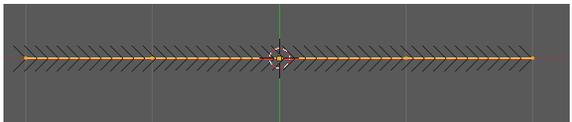
Sometimes you need to have an object flow along a smooth path in an animation. For example, it would be easier to have a spaceship flow along a line and angle and bank along that line then it would be for you to insert location and rotation keys throughout the animation. *Paths and Curves* are found in the same **Add** menu and can not only be used to create animation paths as discussed above, but can also be used to create extrusions. To create 3D extruded objects, you need to create a 2D sketch of a profile and a path for that shape to follow along. In this chapter, we will be working with both.

Following Paths:



Your first step is to create a *path*. Any type of **Curve** in the **Add** menu can be used as a path, but let's use the *Path* option. Hit the "Shift-A", select **Add, Curve**, then **Path**. You will then get a path on the screen. Enter *Edit* mode and you will see several points and arrows pointing the direction of the path. You will also see some options in the *Tool Shelf* related to the path, including "Switch Direction"- useful if

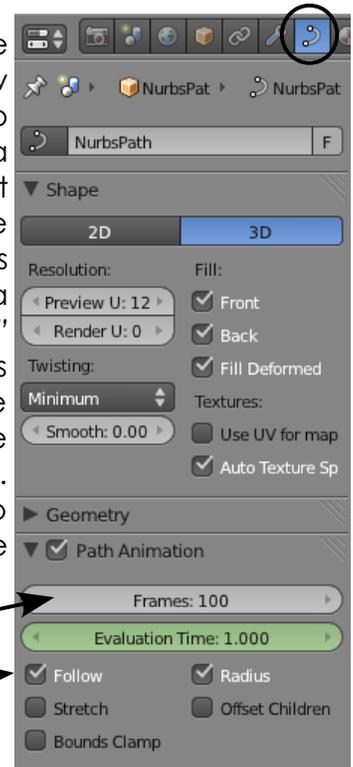
you shape the path in the wrong direction and find out after you place the camera on it. Shape the path as desired, add more vertices through *Subdivide* if necessary and exit *Edit*



mode. You can also select an end point and use "**E**" to *Extrude*.

There are several ways to get the camera, object or lamp to follow the path. For now, we'll stick to the traditional way by creating a *Child-Parent relationship*. Select the object first, then the path (the parent). With both objects selected, press "**Ctrl-P**" to make a

parent. You'll see several options- select the "Follow Path" option. You will see a dashed line between the 2 objects. Press "**Alt-A**" to see the animation along the path. In order to get the object exactly placed on the line, move the object and place it. Rotate the object to point in the correct direction as well. Right now the object's animation is exactly 100 frames long. To change this, make sure the path is selected and go to the **Object Data** buttons. here's what you see:



Frames- Adjust the time it takes to traverse the path.

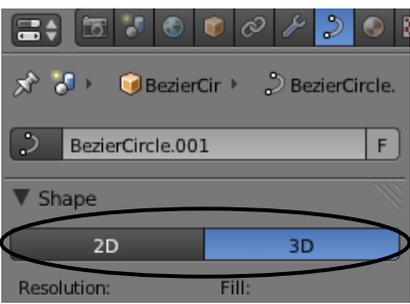
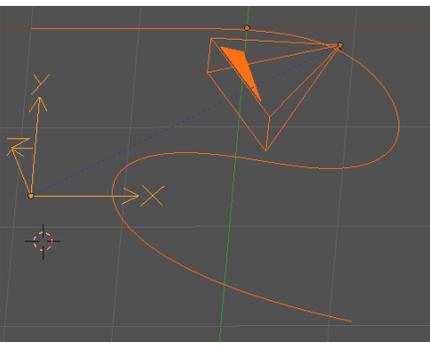
Follow- If selected, the object will rotate as it follows the path. If not selected, the object will follow, but not curve.

Chapter 15- Working With Constraints



RoboDude Says: You can close a path to make it a continuous loop. While in Edit mode, select the 2 end point and press "F" to fill the object. The path will now be closed.

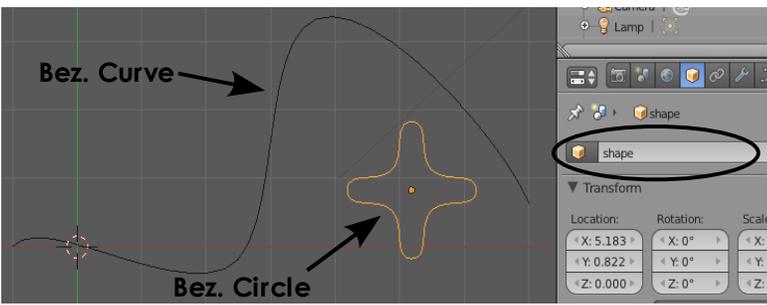
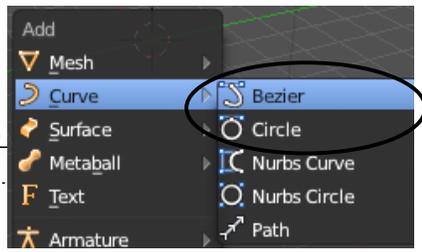
Sometimes you don't want the camera to follow along the path, but look at an object as it flows along the path. **This is where you would want to use the Path, but not the Follow option.** Instead, you would put a Track To constraint on the camera so it looks toward an object (empty) as it moves along the path.



Other Curve objects can be used as paths also. For example, if you want a circular path, select the Bezier Circle option from the Curve menu. **If the circle appears filled when rendered (F12), change it from 2D to 3D in the Object Data panel.**

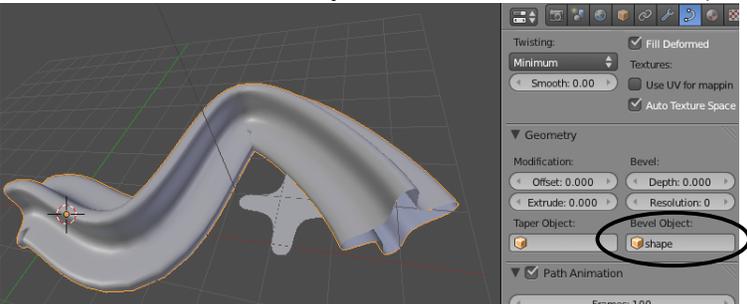
Using Curves for Extrusions:

You can create a shape and extrude it along a path in Blender. For our example, we will shape a Bezier Circle and extrude it along a Bezier Curve. First, create a Bezier Circle from the **Add-Curves** menu and shape it into an interesting object. Feel free to add more points with the



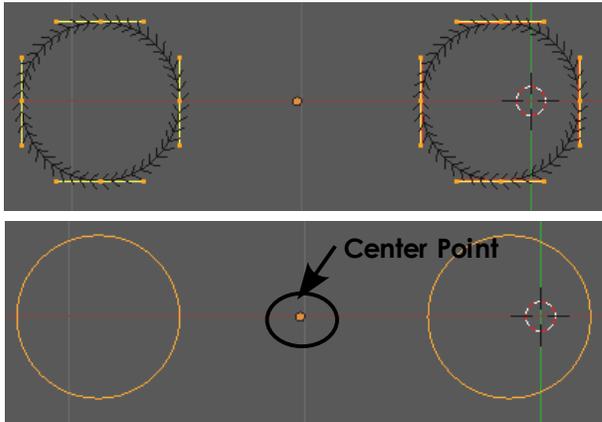
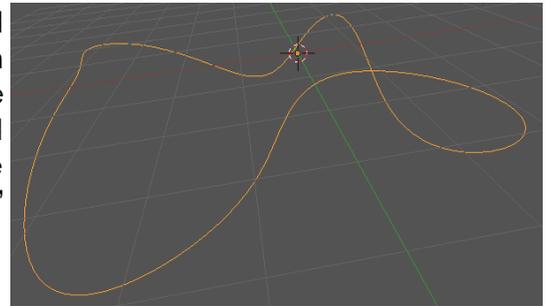
Subdivide command. Second, create a Bezier Curve and shape it into some shape. Bezier shapes form differently and use spline points. Experiment with them to get the feel of working with them. Go to the Object panel and name both objects in the data block.

Finally, select the Bezier Curve and go to the Object Data buttons. You will see a **Bevel Object** box in the Geometry panel. Select the circle object. You will see the shape extruded along the curve! You can still shape the circle and the curve (*in edit mode*) and scale the objects. Play with the Resolution setting in the Shape panel on both curve objects and hit "Alt-C" if you wish to convert it into a mesh.



Paths and Curves Practice Exercise

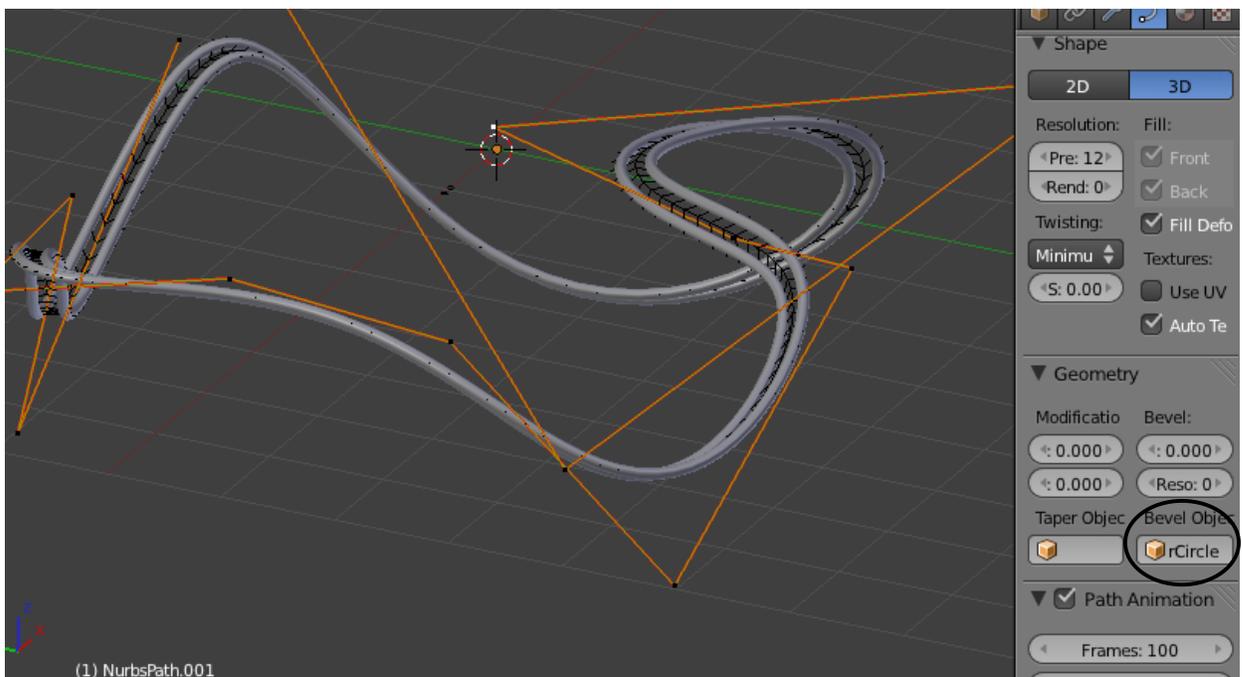
For this exercise, you will be using paths and curves to create a roller coaster track. Start with a new Blender file and create a Path from the Add-Curve menu. Shape it in both the front and top views so you have curves and hills. Close the path by selecting the end points and pressing "F" to fill.



Now add a Bezier Circle. Scale it down about $\frac{1}{2}$ size, enter **Edit Mode** and move the entire shape to the left of its center point. Press "Shift-D" to duplicate the circle (still in Edit Mode) and move it to the opposite side of the center point. These will be extruded as the track rails. Return to Object Mode.

At this point, select your track and hit "Shift-D" to duplicate it once.

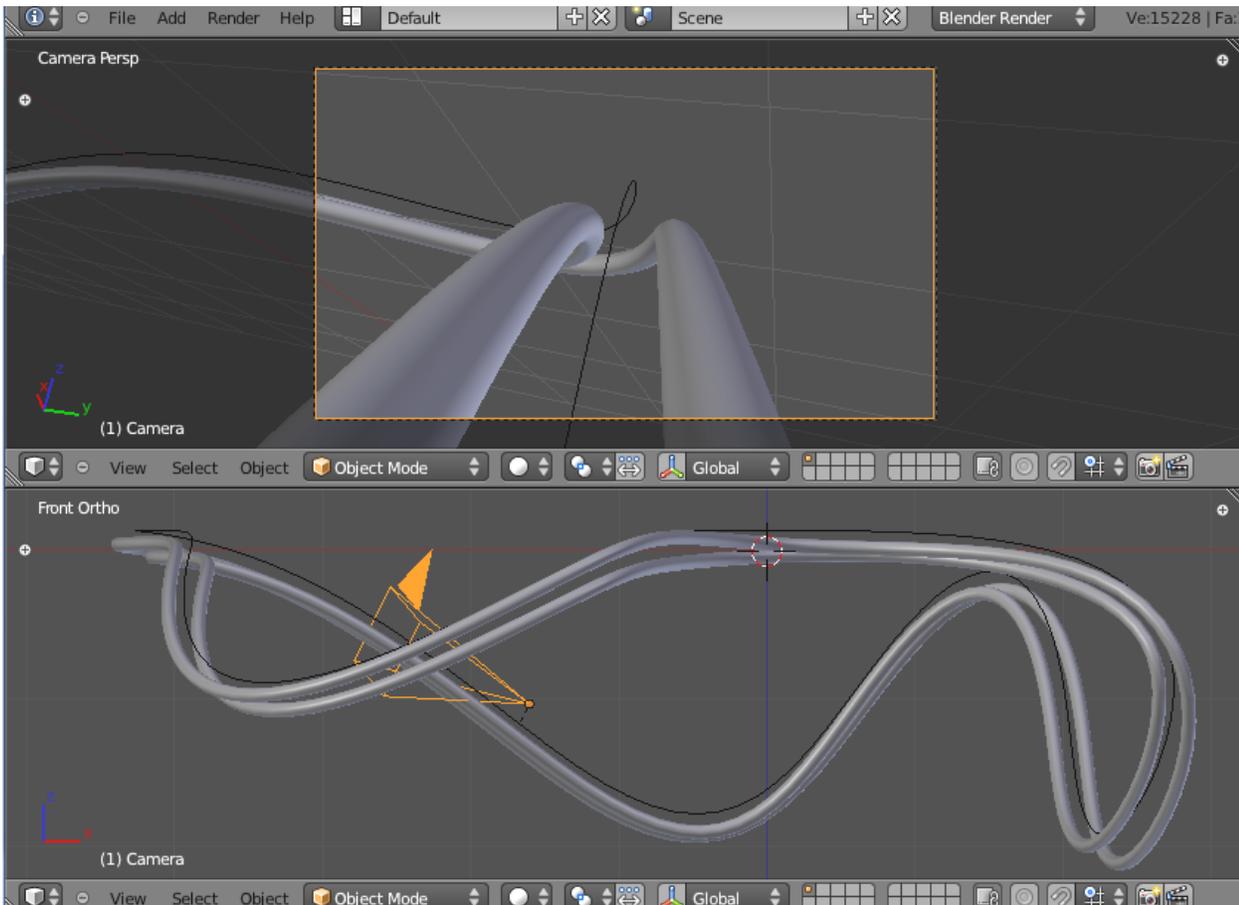
With one track selected, go to the Object Data panel and select the circle object under the "Bevel Object" option. You may need to select the circle object and scale it down considerable for it to look right. You may also need to enter Edit Mode for the track and use "Ctrl-T" on some points of the curve to twist them to a better curve.



If the rails are not centered over the path, the Circle's center point may not be directly between the 2 circles. If so, correct the issue.

Paths and Curves Practice Exercise

Now, select the other path that you duplicated earlier and move it up slightly so it is easier to select. Select the Camera, then this Path. Hit "**Ctrl-P**" to make a "Follow Path" constraint. A dashed line will display between the two objects. It may take some time to get this correct, but move the camera to the dashed line's contact point. Adjust the camera angle and test the animation with "Alt-A". Experiment with this until you are satisfied with the animation. If it is too fast, adjust the curve settings in the Object Data panel.



Add a world to your scene and animate a 100 frame movie.

Challenge Exercise:

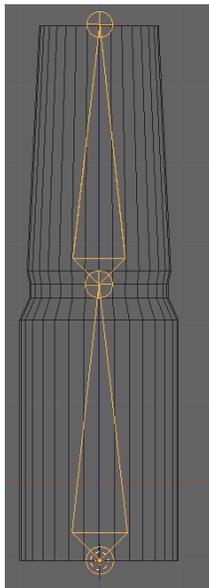
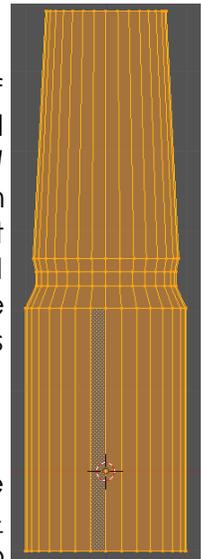
Duplicate the curve one more time and extrude walls around your coaster to make it into a mine tunnel. Add textures and animate.

**** Call the instructor when finished ****

Using Armatures to Deform Meshes

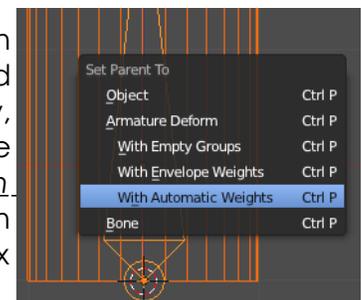
Blender's animation capabilities are great for most object animation except when you want to animate something bending like a person in motion or a tree bending in the breeze. This calls for a mesh to deform which can't be done with traditional modifiers. We can deform a mesh in 2 ways in Blender. One way is to create a skeleton and have it deform a mesh (*armatures*) and the other method is to move the mesh vertices in edit mode and create sliders that deform the mesh (*vertex keys*). This chapter deals with creating armatures. The armature feature in Blender is constantly under development. For this discussion, I will stick with the fundamentals. More information can be found at www.blender.org or at www.blenderartists.org.

The first thing you need to do is create a mesh that has a few groups of vertices where you would like the object to bend. Any mesh will work and to get additional vertices you can either **extrude** or **subdivide**. *Be careful not to create too many vertices*. It may slow your model down considerably. Let's use a cylinder to create an arm. I will use a cylinder set at the default divisions of 32. Next, I will change to a front, ortho view and box select the top set of vertices and *Extrude* them up. I prefer to use extrude rather than subdivide to keep the vertex count down as low as possible. As I extrude the vertices, I am also using *Scale* to shape them.

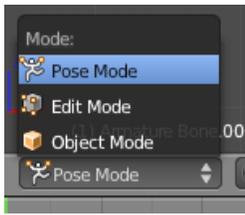


Next, place the 3D cursor directly at the bottom of the shape you just made. Hit "Shift-A", to add an "Armature- Single Bone". You will immediately see a bone begin to form at the cursor location. Enter *Edit Mode* and type "**G**" to *grab* the top of the bone and lengthen it to a desired size. Move your cursor up to lengthen the bone and click where you would like the joint to be. To create another bone at the top of the first one, press "**E**" to *extrude* another bone from the first one. If you run out of room to drag the mouse up, just click wherever and hit "**G**" again to move the end. To always adjust bones, you must be in *Edit mode*. Also, make sure you have the end of the bone select and not the entire bone. When finished, press *Tab* to exit edit mode. Double check the armature to make sure that the ends and joint are well aligned. To add more bones, enter edit mode again to extrude with the end bone selected.

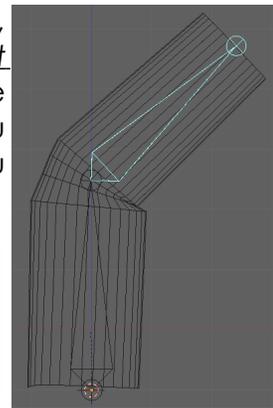
Your next step is to create a Child-Parent relationship between the mesh and the armature with the mesh being the Child and the armature being the Parent. While holding the "Shift" key, select the mesh first, then the armature. Press "Ctrl-P" to make parent. Select the option "Armature Deform" and "With Automatic Weights" so the computer will figure out which vertices to deform to which bones. If it's not right, we can fix this later.



Chapter 16- Armatures



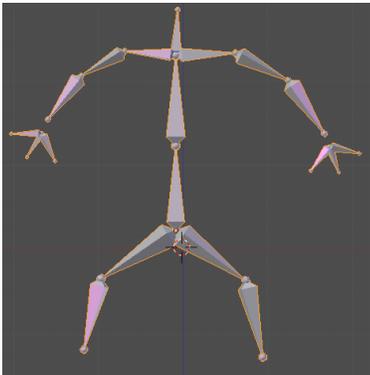
To test the armature system you just created, select the armature only and switch from Object mode to Pose mode. Right-click on the top bone and rotate it. It should deform the mesh as you rotate the bone. By rotating the lower bone, you will rotate the entire mesh.



RoboDude Says:

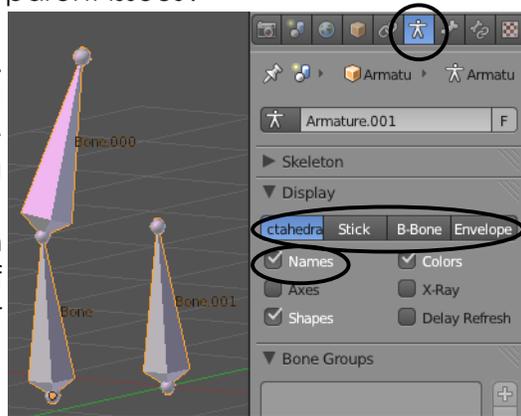
If you ever need to return to edit mode for the mesh or the armature after posing, they will temporarily return to their unposed states.

Creating Complex Armature Chains:

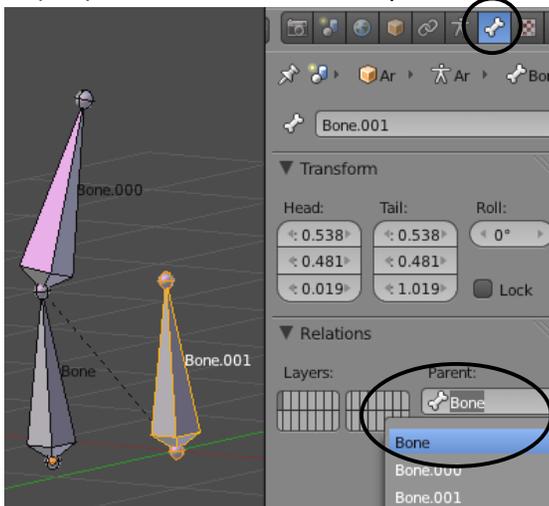


Extruding bones as we did works well for simple chains, but if you want to make more complex chains and skeletons, you'll need to know a few more things than just extruding from the end of a chain. You will notice that the 1st bone you created is the master parent for the system and you can also extrude from the bottom of that bone. The problem is that, in *Pose* mode, this bone will not be automatically parented to the master bone. You can also make entirely different armature chains, then *Join* them together using "**Ctrl-J**". In pose mode, these will also not function with the entire system. So how do you correct these child- parent issues?

First, you need to know the *Name* of each bone. In *Pose* mode, you can RMB click on a bone and the name will display, but you can have all the bone names display on the screen if you turning on an option in the *Object Data* panel (now displayed as an *armature*). The example shown



consists of 2 different armature objects that have

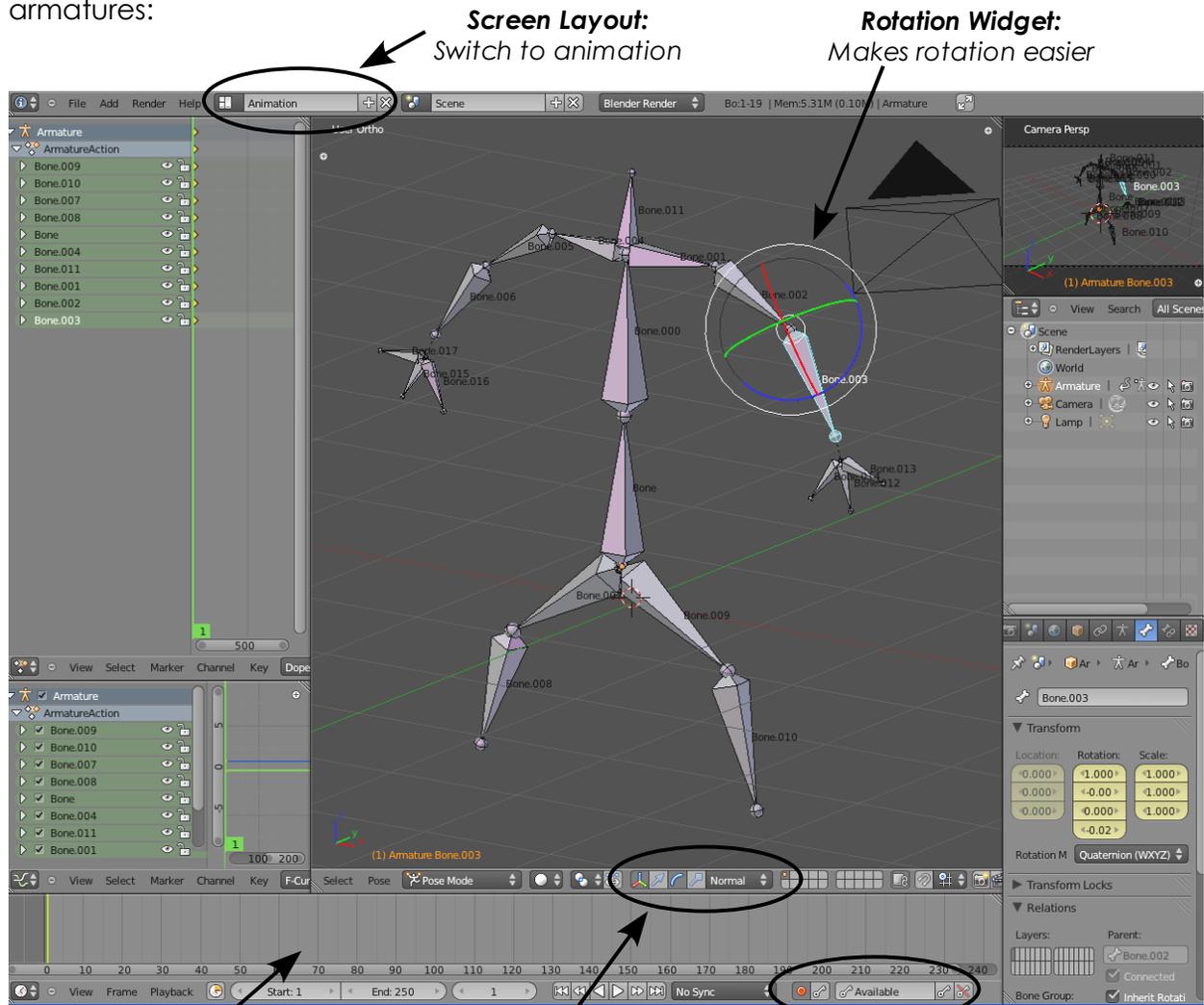


been joined together in *Object* mode using "**Ctrl-J**". When you enter *Pose* mode, they do not move together. In the *Display* panel, you will see an option to display the names on the screen. You will also see some options to change the way the bones look. To correct the parenting issue, go to the *Bone* panel, enter *Edit* mode and find the option for Parent. Select the bone you wish to parent to.

Chapter 16- Armatures

Animation Tips:

When animating an armature, there are a few techniques that can make your life easier and were discussed previously in the animation chapter, but will be reviewed here. Since you have so many bones to animate, it makes sense to use the Automatic key-frame feature. It is also helpful to use the Rotation transform manipulator and the time line to advance through time. It may be helpful to review the chapter on animation for assistance. Below are some of the basic setting that we use for animating armatures:



Time Line:

Can move to key-frames quickly with controls

Transform Widgets:

Turned on, set to Rotation and Normal alignment. Used to rotate bones by grabbing the right axis.

Automatic Key-frames:

Record button on and set for Available. Remember to turn it off when you don't need it!



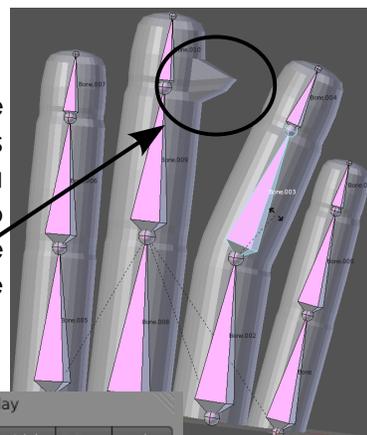
RoboDude Asks: Why doesn't my armature animation start correctly on frame 1?

When working with automatic key-framing, don't forget to move every bone a little at frame one to set the initial animation keys, then move up through time to make your next move. A lot of people forget to add keys to frame 1.

Chapter 16- Armatures

Creating Bone Vertex Groups

Using the *Automatic Weights* option works great for simple meshes and armatures, but when bones and mesh vertices are close together or far from the bone, Blender will have a difficult time deciding how to join them. In the example to the right, you can see that some vertices for one finger have been grouped with the bone beside it. We can alter these vertex groups.



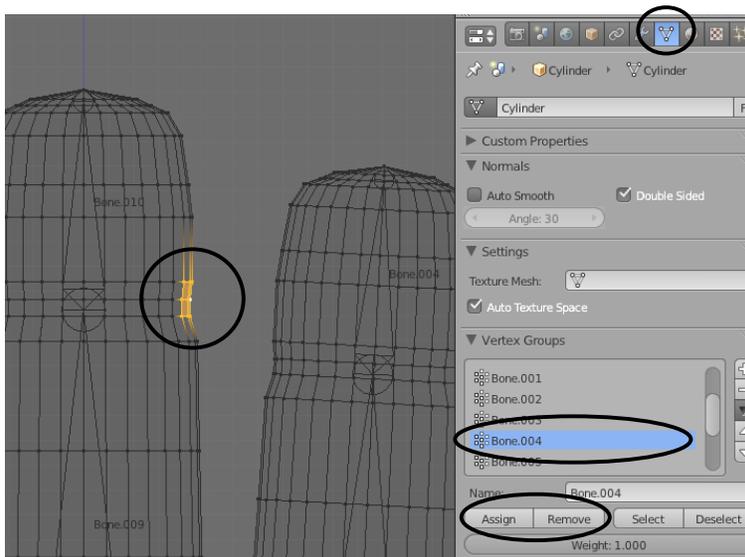
RoboDude Says: Notice how you can see the bones through the mesh in solid view in the hand example?

There is an X-Ray option in the Object Data-Display panel that makes viewing armatures easier!



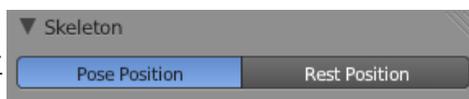
With The bone Names turned on so you can see which ones you need to effect, select the mesh and enter Edit mode. Editing bone vertex groups is similar to making normal vertex groups except that Blender already named a vertex group to match every bone for you when you made the child-parent relationship. If you go to the Object Data panel (*mesh selected in edit mode*), you will see the list of groups in the Vertex Groups panel. You will also see the standard "Assign" and "Remove" buttons below the groups.

To fix the problem, you will first need to select the vertices you wish to change, then select the vertex group that they are wrongly assigned to. Hit the "Remove" button to remove them from that vertex group. In this case, they are wrongly assigned to "Bone.004". Now select the vertex group they need to be assigned to (Bone.010) and hit the "Assign" button. Exit edit mode, select the armature and move the bones in pose mode to test your groups.



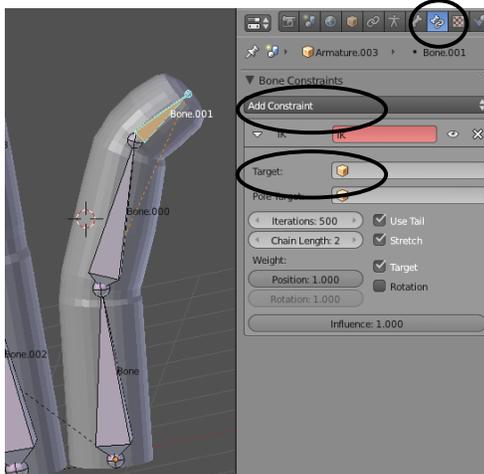
For vertices that are close to a joint, they can be shared between multiple groups. You can also use the "Weight" slider to adjust the bone influence for other effects, but normally, it is set to 1.000.

Need to take your posed armature back to its starting pose? Change it from "Pose Position" to "Rest Position" in the *Object Data*.



Using Inverse Kinematics (IK) and Constraints

Inverse Kinematics is used when you wish to manipulate a skeleton by simply grabbing (G key) the end bone of a chain and moving it with all of the connected bones following along. Inverse Kinematics is constantly under development and has a lot of options available depending on what you want them to do. Visit www.blender.org for more details and review the wiki documentation.



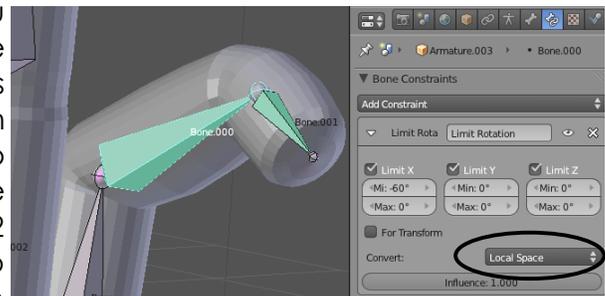
To use Inverse Kinematics, select the bone at the end of a chain, go to Bone Constraints and add an Inverse Kinematics constraint. You can control the number of bones in the chain (Chain Length) and even give it a Target to point to like an empty. There are a few other options available including Influence (amount of effect). Once applied, you can use the "G" key to move the bone around while all those in the chain below it move in relationship to it.



RoboDude Says: Press "Ctrl-A" to reset an object's rotation and scale. Works with individual bones in Pose mode. This help's a lot with these constraints!

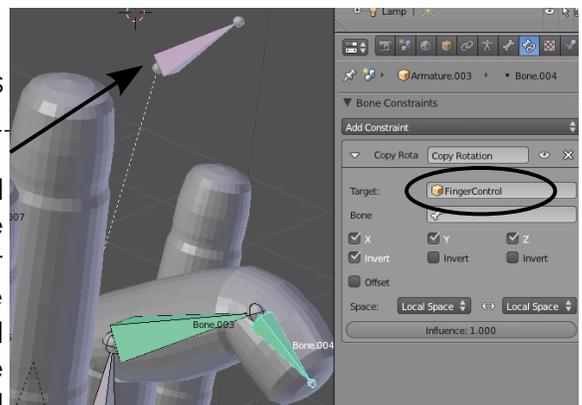
Using Rotation Constraints:

When animating an object (like a finger), you may want to limit the direction and angle the object can bend or some "unnatural" things may occur when you try to add animation keys. Using Limit Rotation constraints can help with that. For the example to the right, I've applied a rotation constraint to the top 2 bones of the finger limiting the Y and Z axis to a limit of 0 degrees while the X axis can rotate from 0 to -60 degrees. This works because I switched the "Convert" from "World Space" to "Local Space".



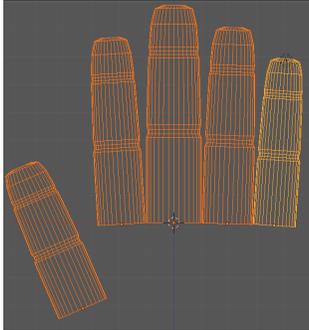
Copy Rotation:

Copy Rotation can make animating chains easier. In the example, I've created a single bone armature (not a bone in the existing armature) and child-parented it to the hand armature. This bone can be placed anywhere you wish. I have mine above the finger that it will control. Set it's rotation limits with the Rotation constraint discussed above, then add a "Copy Rotation" constraint to each bone that will copy it's movement. Select the control bone for the Target. In my case, I needed to Invert the motion to work correctly.

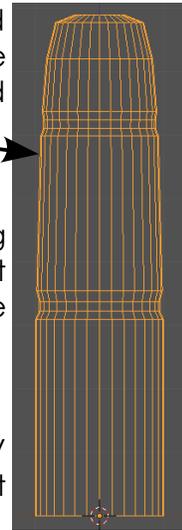


Creating a Skeleton Practice Exercise

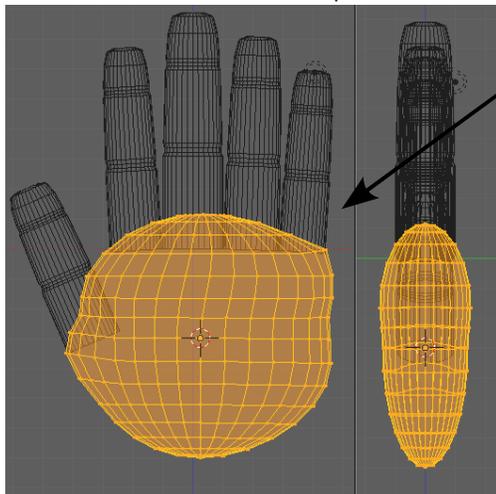
In this exercise, you will be creating a simple hand using meshes and armatures. Start a new Blender file and call it "Hand". As discussed at the beginning of this chapter, make a simple finger using a cylinder or filled circle. Extrude it to have 2 joints and looks something like this:



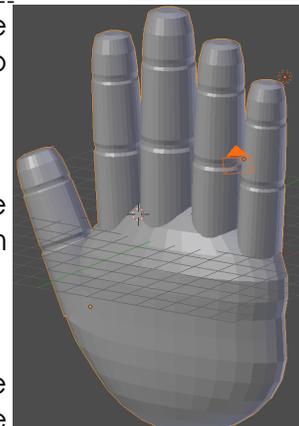
Now duplicate (*Shift-D*) the finger 4 times, scaling and rotating them into the shape of a hand. Don't worry if it doesn't look perfect- this is just a simple exercise. Try for something like the image to the left.



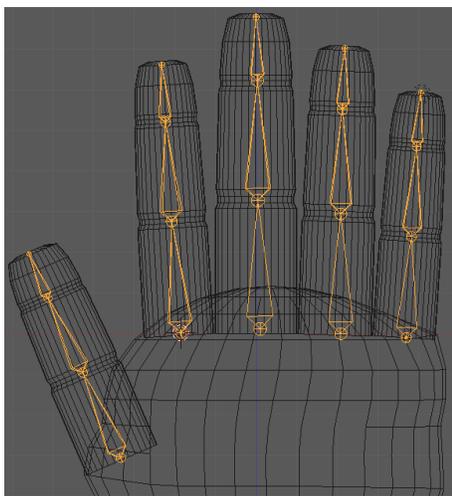
In order to add the palm of the hand, I used a UV Sphere and scaled it in the "Y" direction to make it narrow and used Proportional Editing to shape it to fit the fingers. Try shaping yours into something like this.



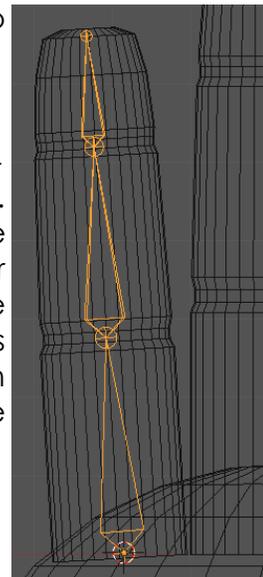
After shaping, select all of the meshes and Join them together (*Ctrl-J*).



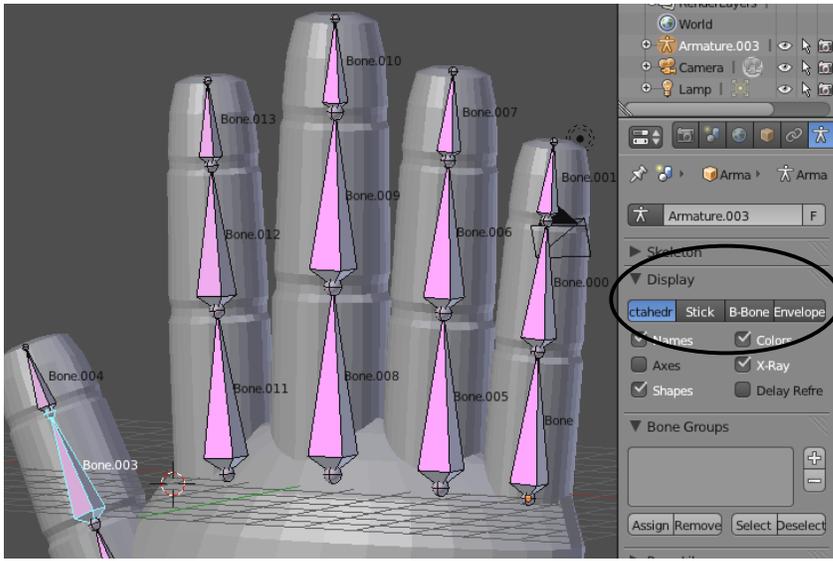
It's now time to add the Armature. We will only be animating the fingers opening and closing for this exercise so we only need bones in the fingers. Place your 3D Cursor at the base of one finger. As discussed in the chapter, add an Armature, then enter Edit Mode and pull the top end of the bone to align with a joint. Extrude (*E*) 2 more bones to fill the finger. Exit Edit Mode and return to Object Mode.



Now Duplicate the armature (*Shift-D*) and place it in the next finger. Enter Edit Mode and move the bone joints to match the mesh finger joints. Exit Edit Mode and continue duplicating and adjusting armatures until all fingers are finished. When finished, use Ctrl-J to joint all the armatures together.



Creating a Skeleton Practice Exercise



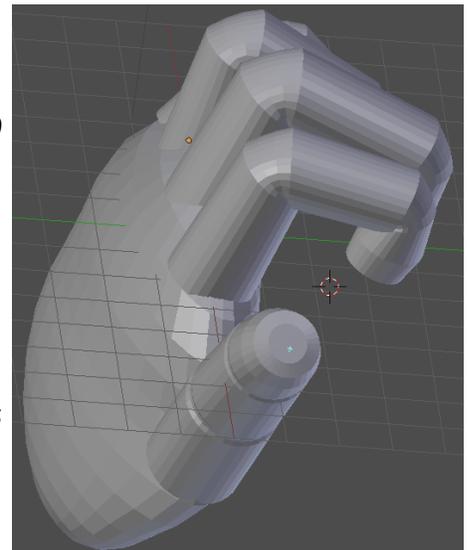
It's now time to create the child-parent relationship for the mesh to the armature. Use "Armature Deform" and "Automatic Weights" as discussed in the chapter when using "Ctrl-P" to make the relationship. Remember to select the Mesh first. It will also be helpful to turn on "Names" and "X-Ray" in the Object Data panel. Feel free to change the display type in that panel as well if you wish.

Enter Pose Mode and test your armature out to see if it works well or if you need to adjust vertex groups. If it needs adjustment, follow the steps of re-assigning vertices to the various bone groups discussed in the chapter.

When everything looks good, create a simple 200 frame movie of the hand moving.

Challenge Exercise:

Add constraints to limit rotation or control armatures with rotation copy constraints.

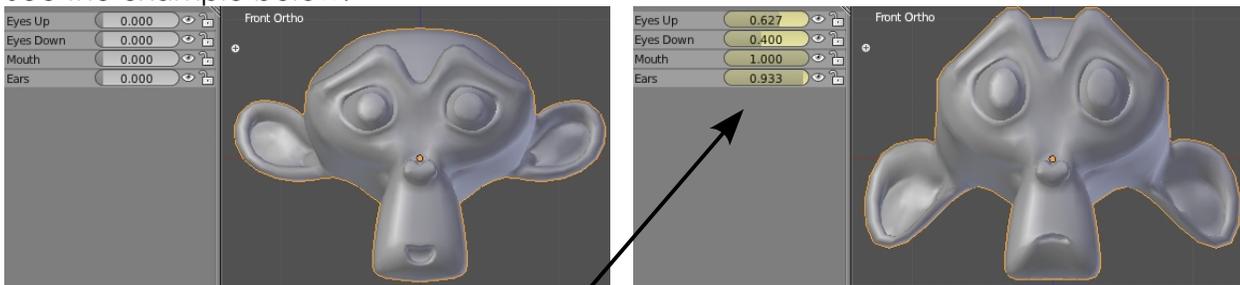


**** Call the instructor when finished****

Chapter 17- Mesh Shape Keys

Creating Mesh Shape Keys

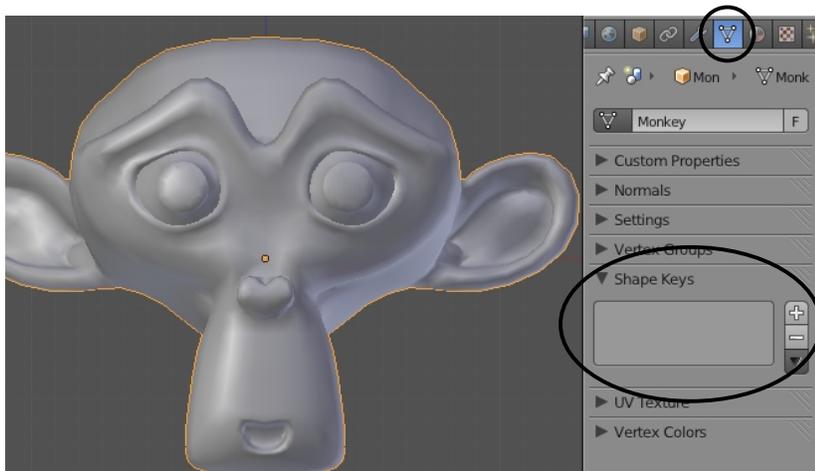
We've discussed deforming a mesh with an armature, but what if you want to deform a mesh in other ways like have it flatten, move a mouth, blink an eye, etc. and have a way of repeating that motion whenever needed? Some of these things can be done with armatures, but sometimes it's easier to set up a **slider** that at one end, represents the mesh in one form, and at the other end of the slider, shows the mesh fully deformed. See the example below:



Mesh deformation using *Shape Key* sliders (called *vertex editing* in older Blender) in the *Dope Sheet Window* can be a difficult process because it requires you to shape your mesh in edit mode moving vertices. With practice, this can become a worthwhile tool that will enable you to make quick and high-quality animation like the professionals do. If you notice in the above example, there are several sliders that cause different motions. By using combinations of them, a wide variety of motions can be produced (for example, *Eyes Up/Down* will combine the motions). These are great tools for making a character speak, blink and show expression.

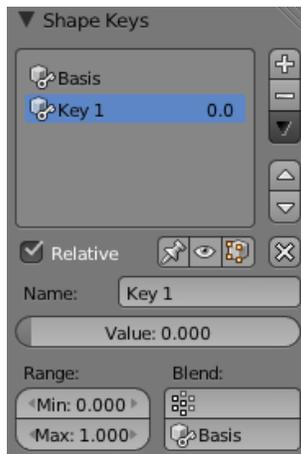
In order to start using shape keys, we'll start a new scene, delete the initial cube, then add a *Monkey* head from the *Mesh* menu. To make the monkey head look better, we'll hit "Smooth" in the *Tool Shelf* and add a "Subdivision Surface" modifier from the *Modifier* panel. I have also rotated the monkey head to be facing forward in the *Front View* in *Ortho* mode. Now, find the "Shape Keys" panel in the *Object Data* buttons.

In order to start using shape keys, press the "+" in the *Shape Keys* panel to add a "*Basis*" group to add keys under. This "*Basis*" is not an actual key, but contains all the keys you now create under it. This can also be renamed.



In order to add your 1st slider, press the "+" button again. You will have another key show up under the *Basis* called "Key 1". It's a good idea to rename these keys to something matching the motion that you plan to create. A good facial animation could contain dozens of slider!

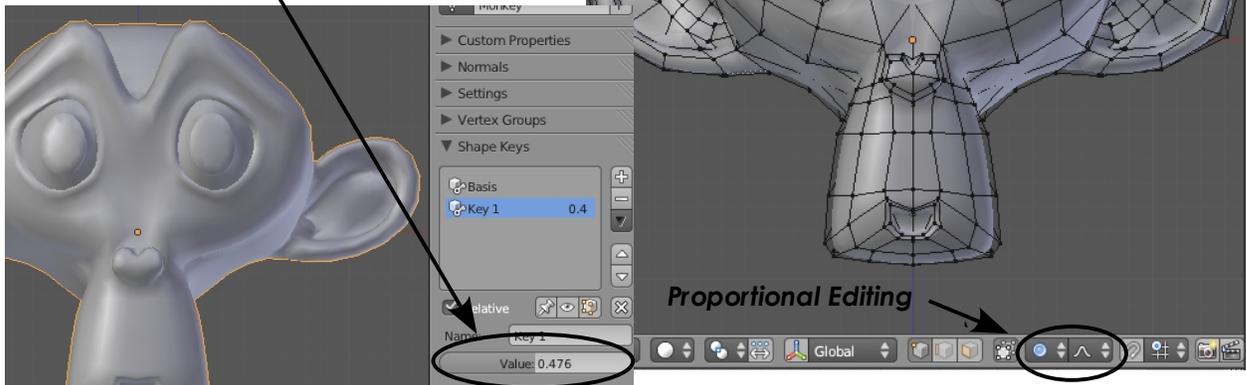
Chapter 17- Mesh Shape Keys



We will now create the motion for this "Key 1". You will notice a "relative" block checked by default, meaning that the motion we create is relative to this initial face shape. You will also see a block where you can change the key name and the actual slider under it. Right now, it doesn't do anything because we haven't deformed the mesh. There are also range settings and group references we won't be working with now. I usually keep the value of the slider set to zero at this point.

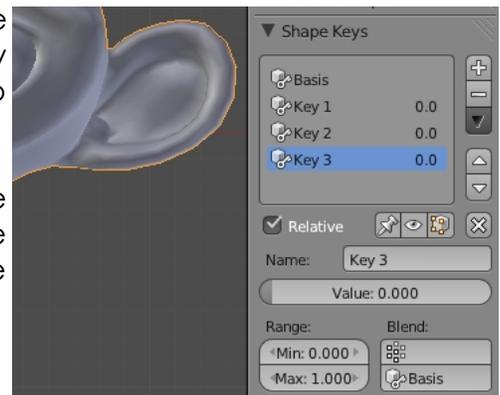
It's now time to enter Edit Mode and alter the mesh for our first key. I want to make the monkey look surprised for this key by just raising his eyebrows. To do this, I will select a vertex above each eye (total of 2 selected vertices), turn on "Proportional Editing"

and scroll the mouse wheel to change the selection circle while moving the vertices up. After you have the look you wish, go back to Object Mode. The mesh should return to its original shape. Test the slider for the shape key. It should transition from normal to surprised as you move the slider.



To add another slider, return the value of the previous slider back to zero, then press the "+" for the next key. By lowering the slider, the next key will start with the basic mesh in edit mode, otherwise, it will be deformed. Name the new key, enter Edit Mode repeat the process by shaping the mesh as desired, then returning to Object Mode to set the shape key. Test the slider.

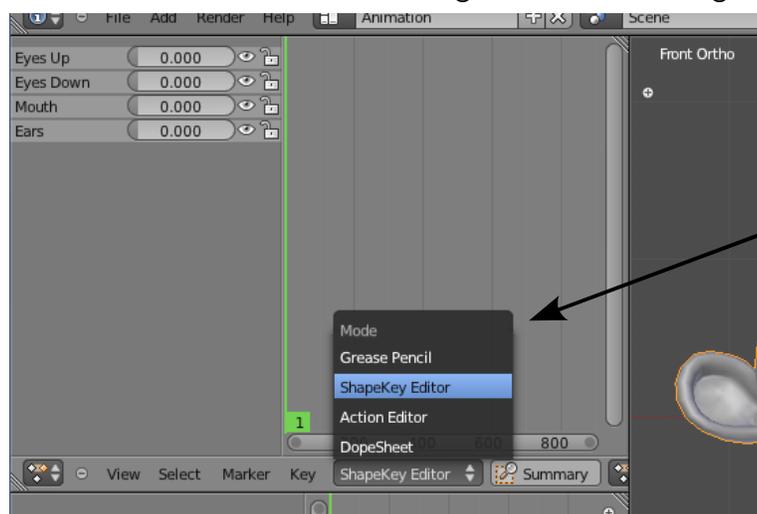
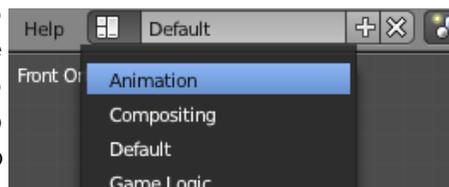
Repeat this process to add any number of shape keys. It is important to return all sliders to zero before adding a new slider if you want to create from the untouched original mesh.



Chapter 17- Mesh Shape Keys

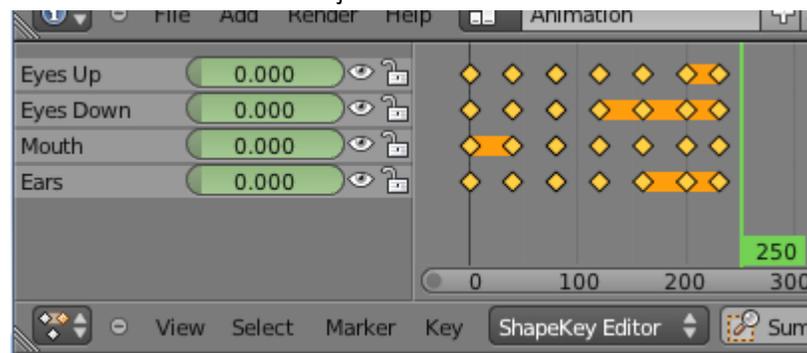
Animating Shape Keys

Now that you have created the sliders, it's now time to look at an easy way to animate them. If you review the animation chapter, you'll see a description on how to work in the *Dope Sheet* window. First thing we need to do is change our screen layout from "Default" to "Animation". Your screen configuration will change to



show a *Dope Sheet* window, a *Graph Editor* window, 3D window and *Buttons*. We're interested in the *Dope Sheet* Window. In order to see your shape keys, we need to switch the view from *Dope Sheet* to *ShapeKey Editor* at the bottom of the window. You will now be able to see all your shape key sliders in the window. You may need to adjust the size of the window so you can see everything.

Animation is as easy as moving a slider. As you move a slider, a small diamond will display on the time line to the right of the key. This diamond is an animation key at the current frame. After you set all sliders on the current frame, move up in time to your next desired frame and adjust the sliders. You are now animated over time. With a little



practice, you will be able to animate easily using this technique. After you have placed some keys along the time line, go back to frame 1 and press "Alt-A" to see the animation (or press the play button in the time line controls).

As you animate, you can select keys (selected keys are yellow) and copy, move and scale them using standard Blender commands for other spots along the time line. A key that doesn't change over time is shown by a bar between keys. Keys can also be selected and deleted easily.



RoboDude Asks: Why are shapes changing when I haven't inserted keys?

Remember that features change over time and begin changing from one key to the next. If a slider shouldn't change for, say, the first 50 frames, then change from frame 50-70, you will need to set a key at frame 50 and not just at frame 1.

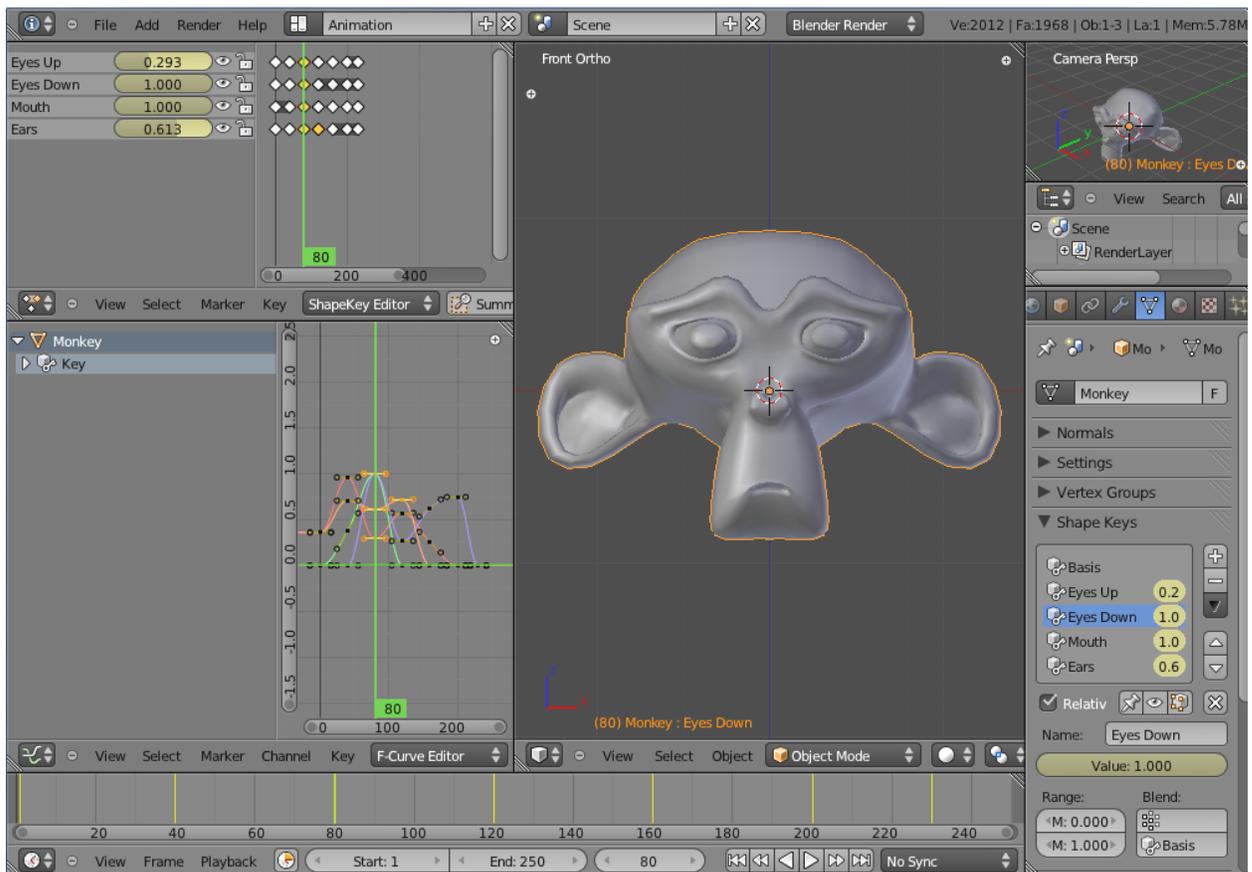
Vertex Keys- Cheesy Actor Monkey

To test your mesh shape key and facial expression skills, we are going to animate the monkey talking and making expressions. Start a new file and call it "Mesh Keys". Add a monkey head, rotate it to face forward in the front view. Add a Subdivision Surface modifier and press "Smooth" in the Tool Shelf. Create your Shape Keys as discussed in the chapter, then switch to the Animation view configuration.

Remember that you need to create the "Basis" group key first, then press "+" again to add the first slider. Enter Edit Mode and turn on Proportional Editing to make your first key. Try to go for a surprised look.

Continue adding mesh keys to bring the monkey to life using proportional editing. Add another slider to the eyes making him squint. Add a slider to move the ears. Add one to his mouth. In total, have at least 4 shape keys. Add more for more expression if desired.

When you are finished, animate a short 200 frame movie making expressions.



**** Call the instructor when finished****

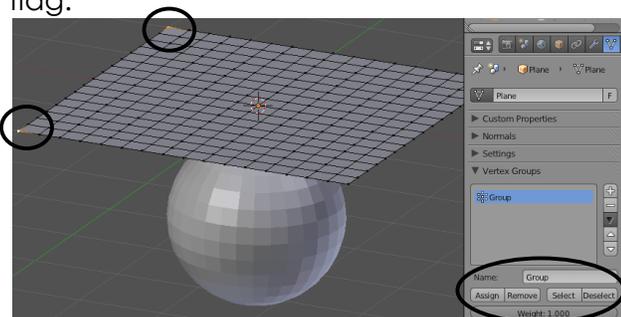
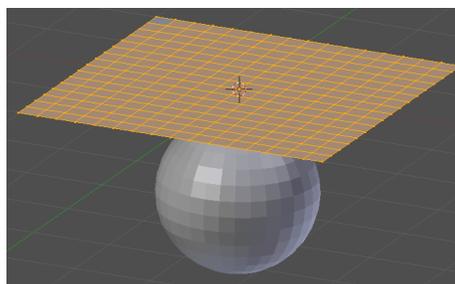
Chapter 18- Object Physics

Trying to animate water flowing or cloth blowing in the breeze can be a difficult feature to pull off using animation techniques covered previously. Just trying to make objects fall or bounce can be difficult enough. In chapter 21 we will discuss the falling and bouncing topic. For this chapter, we will be discussing some of the other physics factors of Blender.

Blender using the *Bullet* physics engine to handle simulations. Bullet has recently been used in Hollywood blockbuster movies to simulate buildings and debris falling and I expect to see it used more often, along with Blender, with recent improvements.

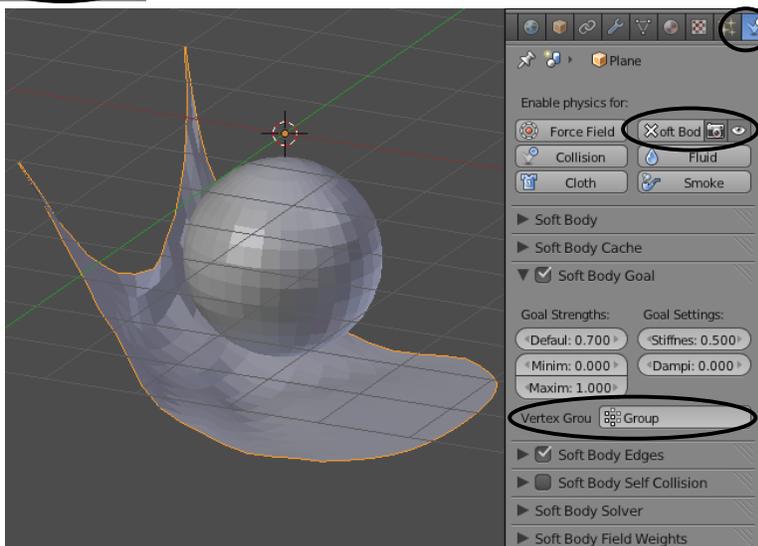
Using Soft Bodies

Soft Bodies was one of Blender's first simulation features after Particles. Soft Bodies are used to simulate fabric, "jello", and water. A mesh can deform a soft body mesh (clothing on a model or a boat in the waves). Even with newer features such as cloth and fluids in Blender, *Soft Bodies* still has a place here. In order to look at the basic settings of Soft Bodies, we'll start with a simple scene of a plane placed above a UV Sphere. Scale the plane up about twice the original size and subdivide it 4 times. We will "pin" 2 corners of this plane and have it drop down over the sphere like a flag.



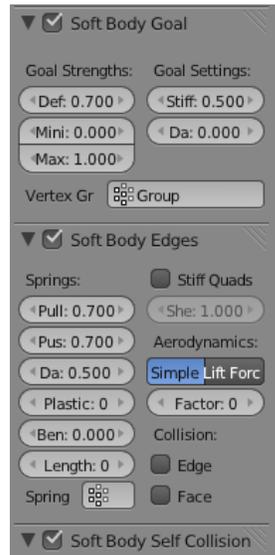
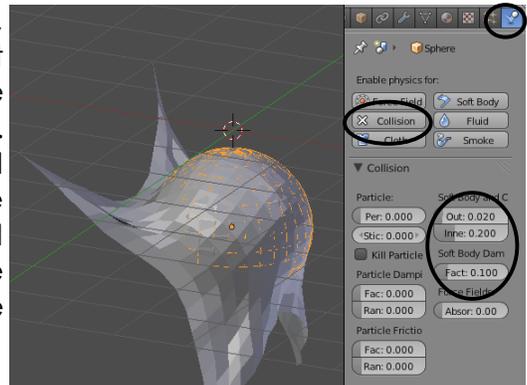
Our next step is to create a *Vertex Group* (like we did in the Particles chapter) in the Object Data panel. With all vertices selected, "Assign" a weight of Zero. Then, select only the 2 corner vertices and "Assign" a weight of 1.00 to them. These will be the 2 pinned corners we will use shortly. Return to Object Mode.

It's now time to go over the the Physics panel and enable "Soft Body". If you press "Alt-A" at this time, the plane will just bounce up and down, but if you tell it to use your vertex group in the "*Soft Body Goal*" panel and press "Alt-A", it should fall like a flag like shown to the right. It will fall through the sphere, but should fall. If it doesn't move, try checking to make sure you are on frame 1 when hitting "Alt-A".



Chapter 18- Object Physics

In order to have the Soft Body react to the sphere, we need to apply a Collision to the sphere. Select the Sphere and press the "Collision" button in the Physics panel. Press "Alt-A" to test out the physics. The plane should now react to the sphere. You will notice that you have a few settings that can be tweaked such as simulated thickness and dampening. Other things you can do to make the reaction look better is to *Subdivide* the plane higher, *Smooth* the objects or apply a *Subdivision Surface* modifier.



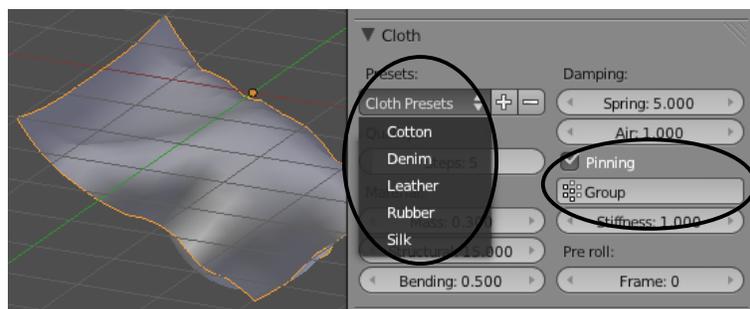
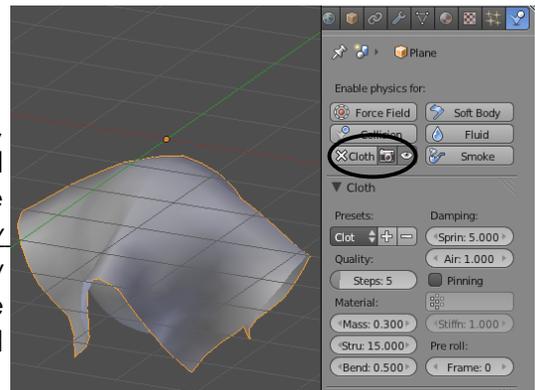
There are also many other setting that can be adjusted for the plane in the *Soft Body* panel. For example, if the plane appears too stretchy, you can adjust the *Pull*, *Push* and *Dampening* of the *Spring* settings under "Soft Body Edges". Pressing the "Stiff Quads" button will give you some rigid effects as well.

Some other setting of interest include setting *Self-Collision* factors to prevent the mesh from intersecting itself and *Field Weights* to control gravity. If you want wind blowing the mesh, add an empty and add a *Wind Force Field* to it as discussed in the *Particles* chapter.

If you find that things are not updating for you or you would like to create a Bake for the physics, these issues can be addressed in the *Soft Body Cache* panel.

Creating Cloth Effects

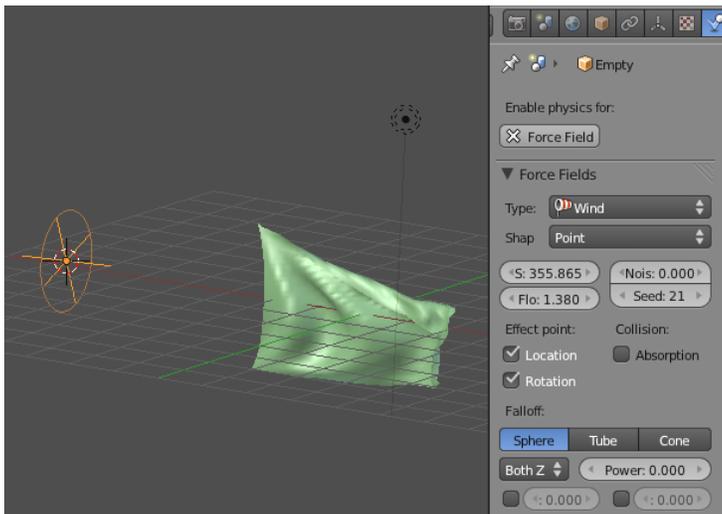
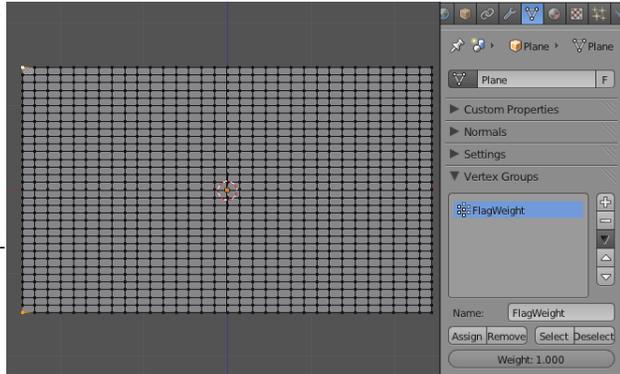
Although Soft Bodies can be used for cloth, Blender has made it easier by giving you actual cloth effects. We'll start by reusing the same object from above and removing the *Soft Body* effect and adding a Cloth effect. Without any vertex groups, the cloth will fall and react with the sphere (*still has Collision on it*) well. I've also used "Smooth" from the *Tool Shelf* for both objects.



You can also use groups as before by checking the "Pinning" box and choosing the *vertex group*. You can also select various material types to simulate. There are several other setting similar to what was discussed before.

Using Physics to Make a Flag

For this exercise, you can choose to either use Soft Bodies or Cloth physics to make a flag. Start by adding a plane and rotating it to face the front view. Scale it to match an appropriate size for a flag and Subdivide it a few times to give it enough vertices to flex well. Set the plane Smooth in the Tool Shelf. Add a Vertex Group in the Object Data panel as discussed in the chapter.



Apply physics to the plane as discussed before and adjust it to get a good effect. You may want to turn on "Self-Collision". Add an Empty to your scene and apply a "Wind Force Field" to it. Adjust the Strength setting to get a good billowing flag effect. You may need a high number with a cloth simulation.

Add other details to your scene like a world background, a flagpole and anything else you wish. *Animate a short 200 frame movie when finished.*

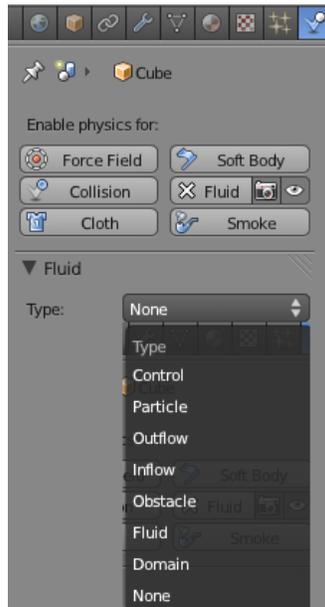


**** Call the instructor when finished****

Creating Fluid Effects

Blender fluids have received a lot of attention in version 2.5. You have the possibility of creating realistic fluid effects with these basic setting.

With an object selected and *Fluids* enabled in the *Physics* panel, you can set it as one of the following fluid object types (by order of importance):



Domain: Needed to contain all fluid physics. All fluid simulations must occur within the domain.

Fluid: An actual object that represents the volume of the fluid.

Obstacle: An object that the water can react with.

Inflow: An object that acts like water flowing into the scene (like a faucet). Used in place of the Fluid.

Outflow: An object that acts as a drain.

Particle: Allows fluids to work as particles. More work in this area is coming in future releases.

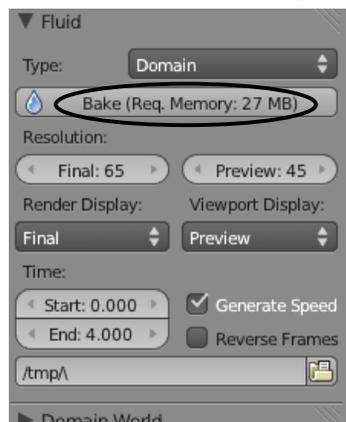
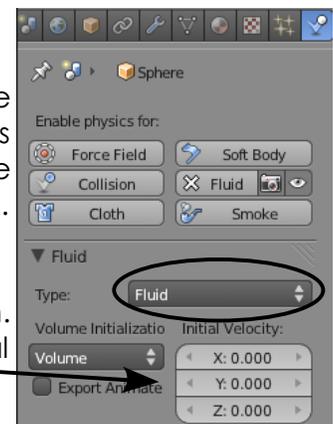
Control: Adds additional control over fluid effects.

We will be discussing the basics in this chapter. For more details, see the Blender documentation at www.blender.org.

A Simple Splash:

Our first example will just contain a *Domain* and a *Fluid*. The scene shown contains just a *Cube*, scaled up about twice its original size, as the *Domain* and a *Sphere* that will represent the *Fluid*. The larger the sphere, the more fluid the scene will contain. It is important that the sphere is completely inside the cube.

With the *sphere* selected, make it be the *Fluid* in the simulation. You will see a few options including the ability to give it an initial velocity, rather than just dropping due to gravity.



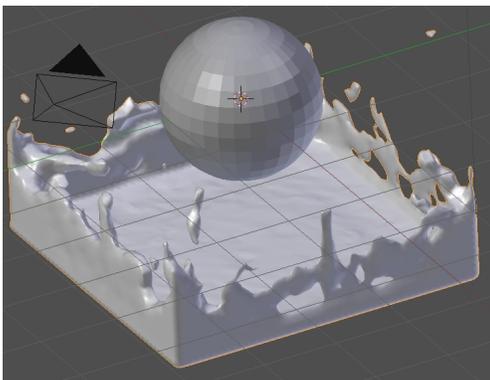
Now select the *cube* and make it the *Domain*. Remember that the domain contains the simulation and controls the baking of the simulation. Don't be concerned if the cube turns into a small blob due to previously cached baking. This will correct itself when you hit Bake. You can control render quality and time length in the domain. You can even specify a specific folder to save the baking into so it can be referenced later. Also, after baking, the cube is now represented by the starting fluid.

When everything is set, hit the "Bake" button and wait.

Chapter 18- Object Physics

During the Bake, you will see a status bar at the top of the screen. You may also need to delete files from the `/tmp\` folder where the bake is saved to get it to work properly. When finished, hit "Alt-A" to see your animation. To improve the appearance, hit "Smooth" in the *Tool Shelf* and apply a "Subdivision Surface" modifier. You can also experiment with the time setting in the Domain.

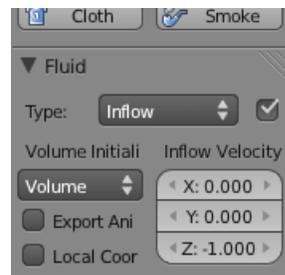
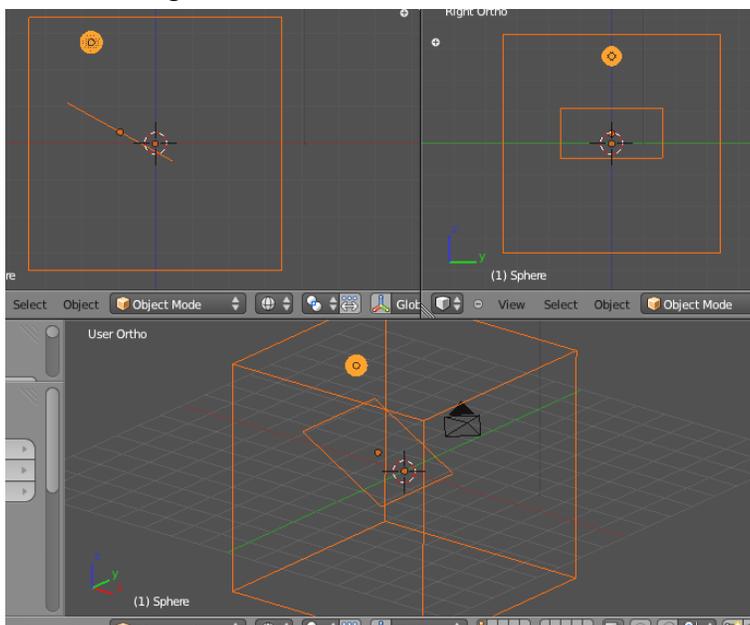
This time, we will create a scene that uses an *Obstacle* and an *Inflow* instead of a *Fluid*. Start by creating a Blender scene similar to the below. The cube has been scaled up about 3 times its original size and used as the *Domain*, an angled plane to act as an *Obstacle*, and a small sphere that will act as the *Inflow*. In the Physics panel, the 3 objects have been set up to reflect these items with special attention to the following:



The cube has been scaled up about 3 times its original size and used as the *Domain*, an angled plane to act as an *Obstacle*, and a small sphere that will act as the *Inflow*. In the Physics panel, the 3 objects have been set up to reflect these items with special attention to the following:

Sphere- Inflow Object:

Give it an *Inflow Velocity* to make it flow into the scene. I used a Z of -1.000.

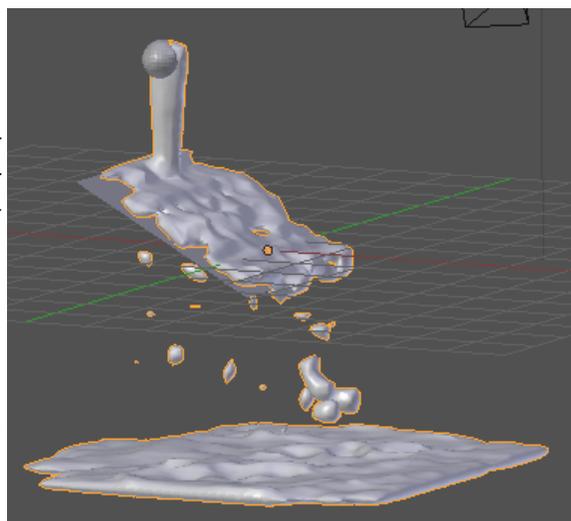


Plane: Obstacle Object:

Experiment with the *Slip Type* for a desired effect. This adjust how much fluid slips on the object. I chose *No Slip*. Select the *Domain Cube* and *Bake* your animation. Remember to watch the status bar at the top of the screen. It may take a while to bake.



Animating fluids can be time consuming, but with practice and experimenting, you can achieve some nice result.

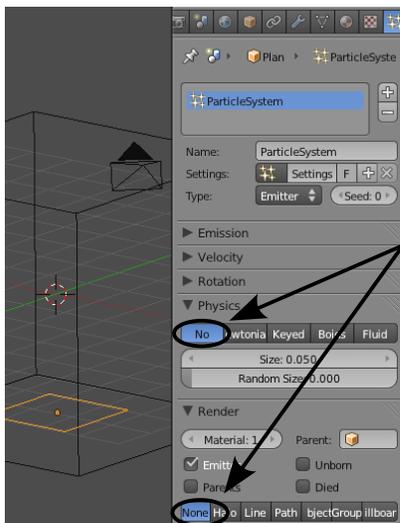
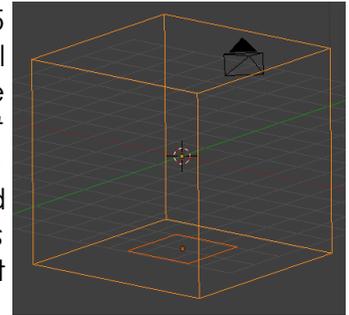


Creating Volume Smoke

Volume smoke physics is new for the 2.5 series and still needs a lot of work. With that being said, it is still worth an introductory discussion in this edition. You can find some nice tutorials and sample videos on the internet and the feature will probably be updated before anyone gets to this chapter of the book, but here it is:

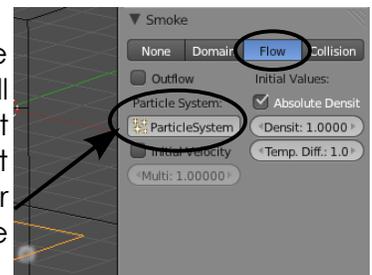
Volumetric smoke works similar to fluids where you create a Domain and an Emitter (Flow). In order to generate the smoke particles, you also need to add a Particle system and add materials and textures.

To start, we'll set up a new scene with a cube scaled to about 5 times the original size. Remember, all smoke that is created will not extend beyond the cube domain so it needs to be large enough for your scene. *It has also been recommended that you do not go into Edit mode and alter the vertices of the cube because of calculation issues.* Next add a Plane and place it to the bottom of the cube as the Flow. Make sure it is completely inside the cube! Any mesh will work for the flow, but we'll work with a plane for now.



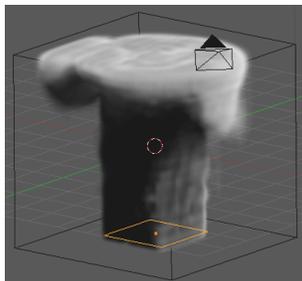
Let's now add a Particle System to the Plane. The reason for this is that the smoke is generated from the particles- not the plane. With the Plane selected, go to the Particles panel and add a Particle System. Since we want the particles to sit still and not move (just need them to emit smoke), we will turn off the Physics. Also, we won't need to see the actual particles, so turn off the Render visualization.

Time to work on the smoke physics. With the plane still selected, add Smoke Physics to it in the Physics panel and select "Flow". You will see a block for Particle Systems. Select the

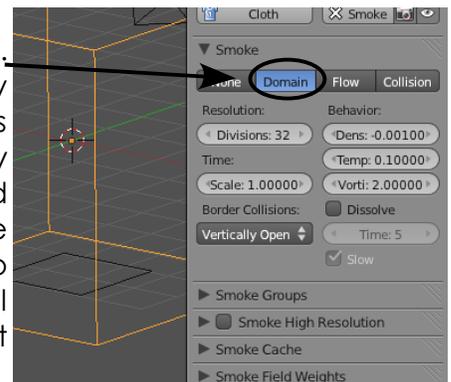


system you made if not already selected.

Now select the cube and enable Smoke Physics for it. Choose "Domain" for its property option. We're now

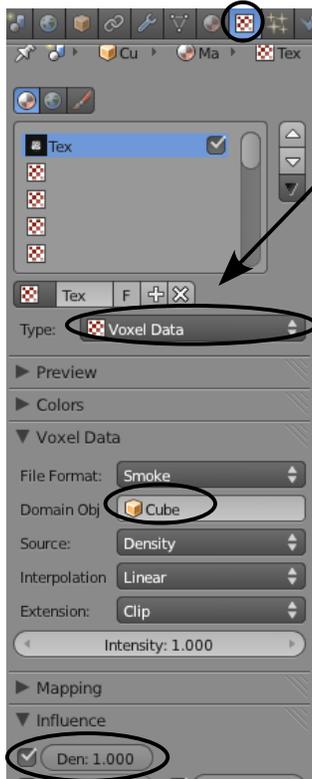
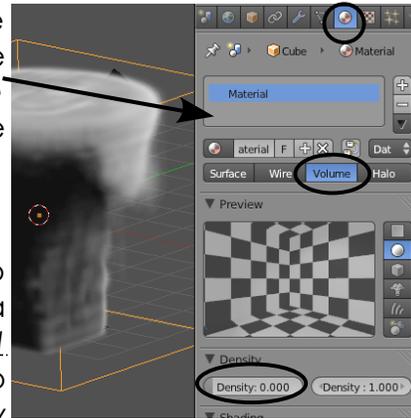


ready to take a look at our results by pressing "Alt-A". It will probably run through slowly, but you should see building smoke in the viewport window. If you try to render a picture at this point, all you will see is the cube and not the smoke. We'll fix that next.



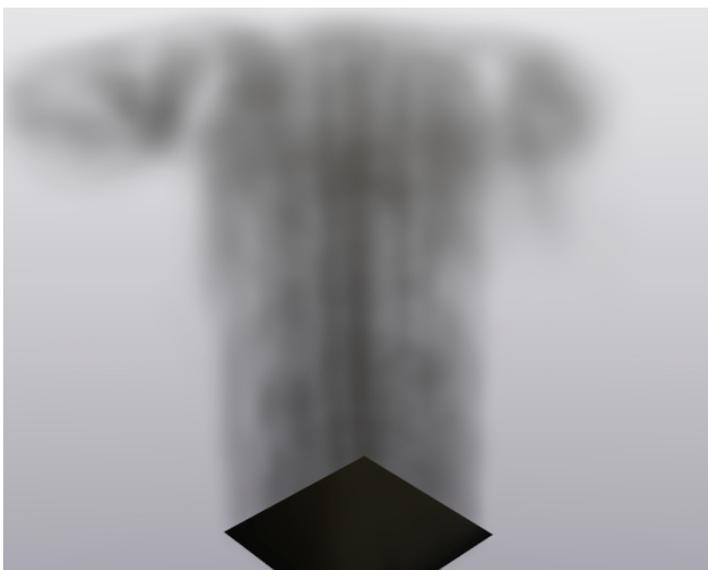
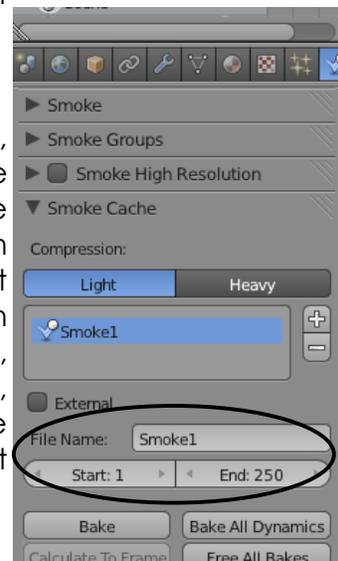
Chapter 18- Object Physics

In order to get a nice render, we need to do some *Material* and *Texture* work on the *Cube*. With the cube selected, add a *Material*, set it to *Volume* (we're filling the cube- not putting the material on the surface), and set the *Density* to 0.000.



With the cube still selected, go to the *Texture* panel and add a texture. Change the *Type* to "*Voxel Data*", the *Domain Object* to "*Cube*" (this object), and *Density* under *Influence* checked and left at 1.000.

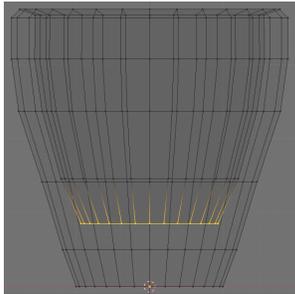
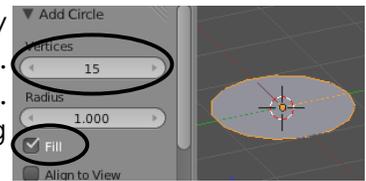
In order to animate your smoke scene, you need to Bake the data. With the cube still selected, go back to the physics panel and look at the settings in the *Smoke Cache* panel. You can set the frame start and end for the length and the *File Name* for the bake. Finally, hit "*Bake*" and let it run. When finished, you can create an animation using the same techniques we have in past chapters.



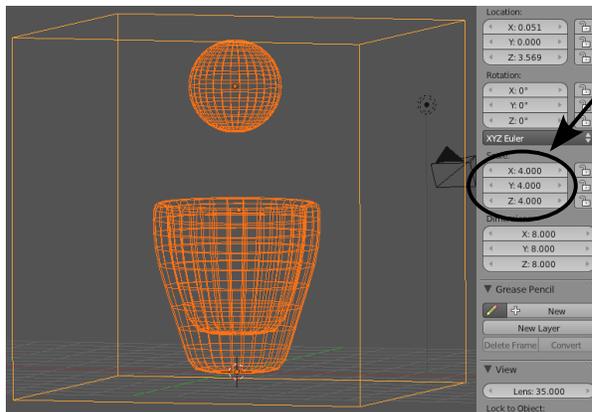
As with all other features we've covered, there are many other possible settings that can be experimented with. For example, particle settings can be adjusted in order to change density. You can also adjust the quality of the smoke resolution and field weights. Need a fire ball effect? Try child-parenting a sphere to your fire ball and use a smoke system for a nicer effect.

Make a Splash- Fluids Practice Activity

Let's make a new Blender file and call it "**Splash**". Start by deleting the initial cube in the top view and adding a Circle. Set the circle settings to 15 vertices and click the "**Fill**" button. We will be making a small cup using this circle and keeping the mesh simple will help with the fluid physics.

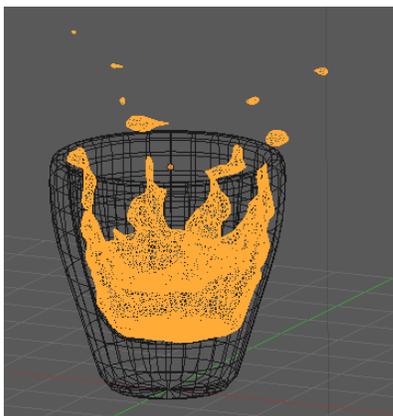


Switch to a front view and begin extruding and scaling the circle to shape a simple cup. When you reach the top, scale the vertices inward and shape the interior of the cup. Again, keep the cup simple so our fluids simulation remains relatively manageable. After you model the cup, go to the Modifiers panel and add a Subdivision Surface modifier, also hit "**Smooth**" in the Tool Shelf.



Now it's time to add a cube and scale it to 4.00 units using the "**N**" key. Center the cube up around the cup. After adding the cube, add another UV Sphere and place it above the cup, *but still within the cube*. Remember, all animation must remain within the domain (cube). Check all views to make sure the sphere is contained in the cube and over the cup.

Before we animate, go to the Render panel and change the End Frames of the animation from **250** to **70**. Now, go to the Physics panel and enable Fluids. Set the Cup as an **Obstacle**, the Sphere as the **Fluid**, and the Cube as the **Domain**. With the cube selected, press the "**Bake**" button and wait for the animation to calculate. After calculations, press "**Alt-A**" to check the animation. If it doesn't work well, hit "**Ctrl-Z**" to get back to the point where you see the cube again and experiment with some of your settings. If everything worked well, add some nice materials to your objects. Place the sphere into an unused layer (M key) and Subdivision Surface the water.



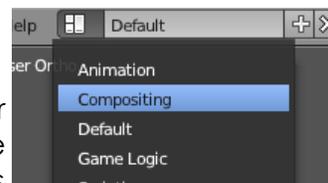
**** Call the instructor when finished****

Chapter 19- Working With Nodes

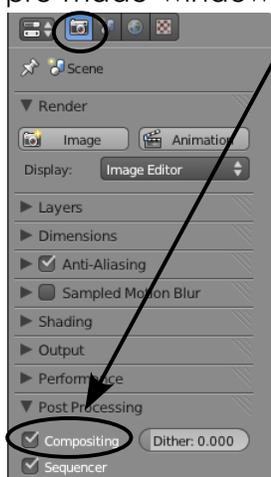
Nodes are relatively new to Blender and open the door to new rendering and post-production possibilities. Nodes are used as a way to add effects to your materials and renders in the final output. Nodes are changing quickly. For the most up-to-date information and detailed discussions of nodes, review the information at www.blender.org on the wiki.

Accessing Nodes:

In order to use nodes, you could always set one of your viewports to the *Node Editor* window, but it's easier to use the pre-made window layout in the drop down.

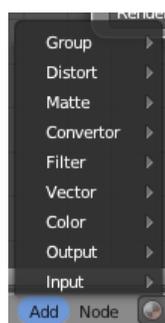


when you render an image, you will also need to press the "Compositing" button in the *Render* panel under *Post Processing*. At this point, you will see a big blank area in the nodes window. To turn nodes on, click on the "Compositing Nodes" button and "Use Nodes" at the bottom of the window.

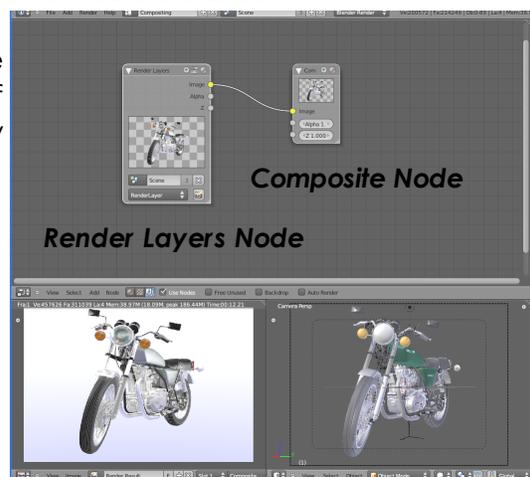


If you have rendered a picture (**F12** if not, do so now), you will see 2 boxes displayed in the window. A *Render Layer* block and a *Composite* block with a line connecting the two. This is showing how the render connects to the composite output. Right now, you won't see any difference because we haven't done anything yet. The job is to add blocks between the two, modifying the output to what you desire. *The options are limitless so here we will just review some basics.*

If you press the "Add" button at the bottom of the Nodes window, you will see several categories of nodes that can be placed in the sequence. They are:



- Group**- user-defined blocks of nodes
- Distort**- changing the shape of the image
- Matte**- mattes that can mask off image areas
- Convertor**- change formats, separates colors
- Filter**- enhance or blur images
- Vector**- changes intensity and reflections
- Color**- color, brightness, contrast, transparency settings
- Output**- displays results as a small image
- Input**- adds an image or a value to the node map.



New nodes are being added with every new release with greater potential for quality renderings. It's now time to break the connection between the "Render Layers" node and the "Composite Node" to look at some examples by adding more nodes.



RoboDude Asks: How do I erase the connection lines between blocks?

Just grab the line from the right-hand connection with the LMB, drag it off the node and release. The line will disappear.

Chapter 19- Working With Nodes

Before we begin making changes, you will see several "connection" points on the blocks. The basic output connections on the render layer block are:

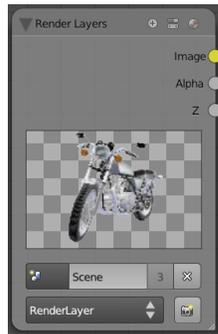
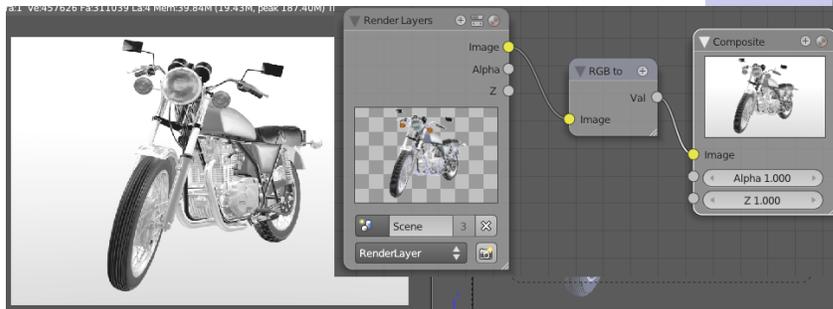


Image- this is the output connection from the render to the node composite.

Alpha- represents the transparency settings of the render.

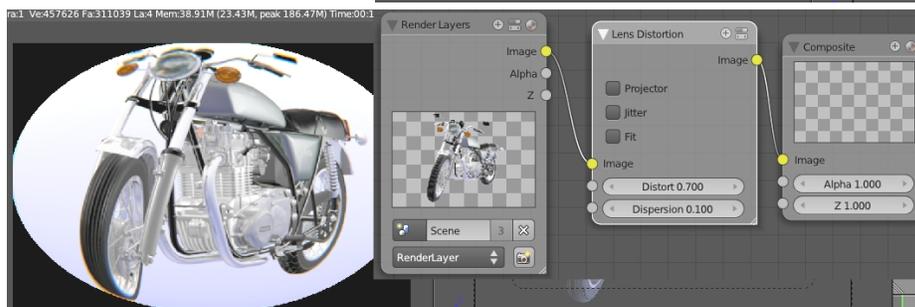
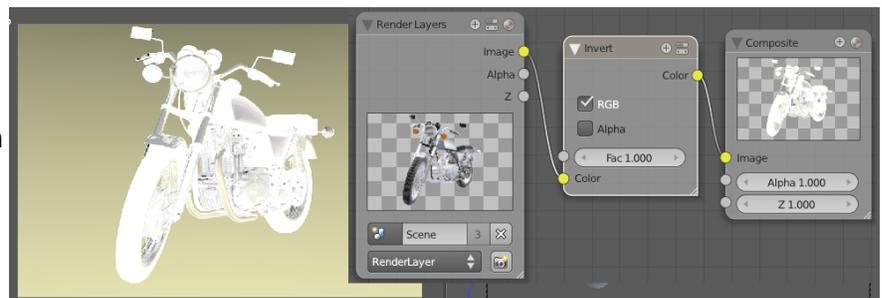
Z- represents depth of pixels from the camera.

To the right is a basic rendered view without any special nodes applied. Below are some sample nodes settings:



Black and White output using an **RGB to BW Converter** Node.

Inverted output using an **Invert Color** Node.



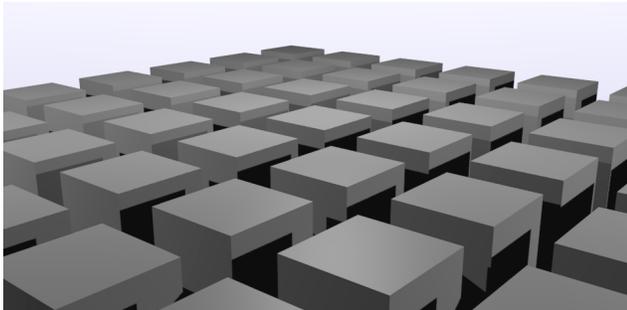
Camera lens output using a **Lens Distortion Distort** Node.

The possibilities are limitless using nodes. You can also create material effects with nodes. Search for some creative tutorials using nodes on the web.

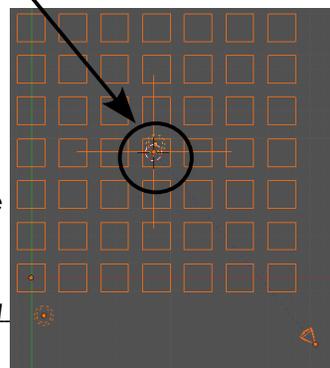
Chapter 19- Working With Nodes

Using Nodes for Depth-Of-Field Camera Effects

A great node feature is creating *Depth-of-Field* effects. Just like a camera shot using a low F-stop setting that creates blur behind and in front of what the camera is focused on, we can create in Blender.

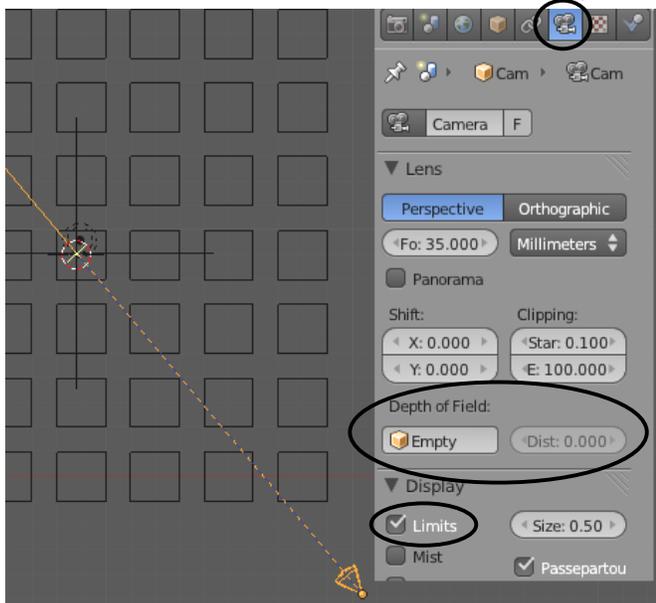


To start this scene, I've created a grid of cubes using the *Array* modifier. The camera is tracked to an *Empty*, placed directly on the center cube.



Notice everything is in focus above. We want to blur the foreground and background.

With the camera selected, go to the *Camera's Object Data* panel to set a few things.



You have 2 ways to set the *Depth of Field*. You can select an *Object* for the camera to target (*great for animation*) or you can set a *Distance*. In order to see the actual target point on the screen, turn on "*Limits*" in the *Display* panel. The target point will display on the dashed line. Remember that all numbers can be animated so you can change the distance during a movie, much like you would see done professionally. It's now time to work on the nodes.

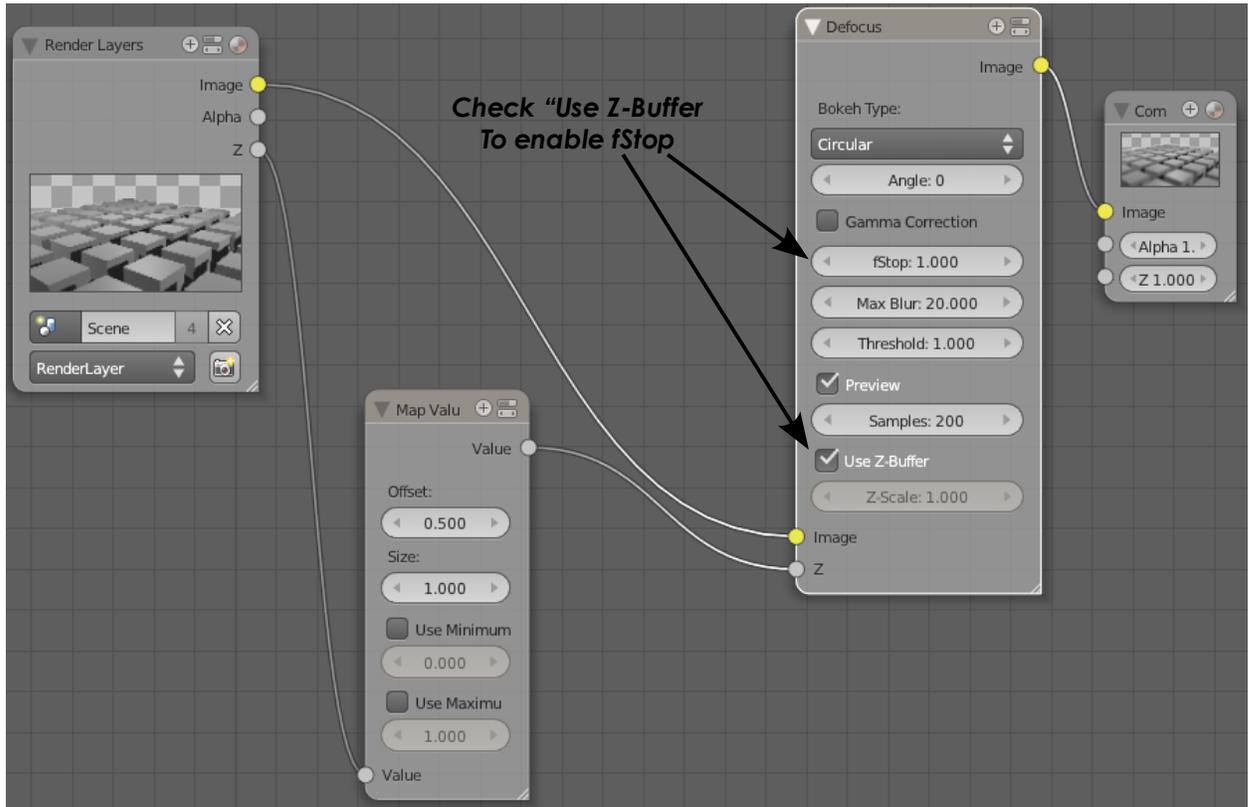
In the *Compositing* screen configuration, enable nodes by checking the "*Use Nodes*" button, also set for "*Compositing Nodes*" (discussed earlier in the chapter).



Delete the line connecting the *Render Layers* and *Composite* panels. We are now going to add 2 nodes. Add a "*Map Value*" node from the *Vector* node set and a "*Defocus*" node from the *Filter* node set.

Chapter 19- Working With Nodes

Set the nodes up as displayed below and match settings:

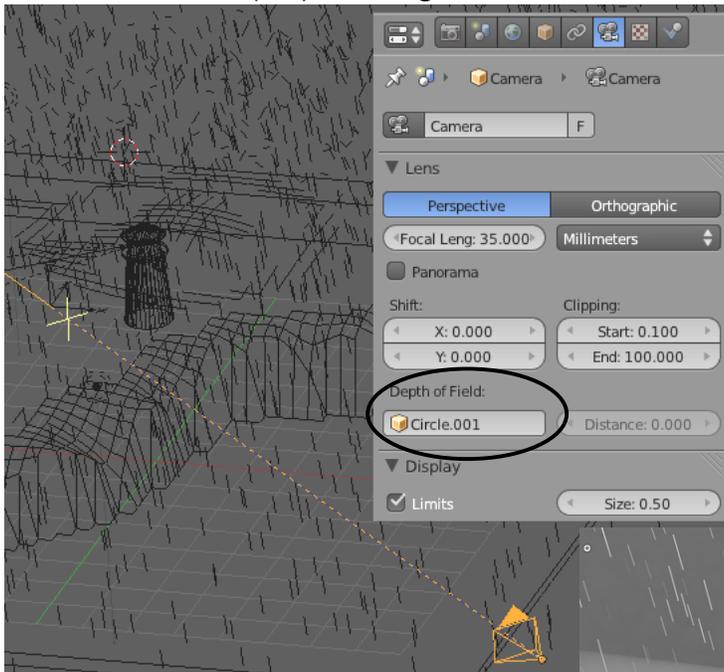


The "Map Value" panel is used to adjust the pixels related to distance from camera and connects to the "Z" on the *Render Layer* panel and *Defocus* panel. The image Out/Ins connect as shown. Adjust the **fStop** to a low number. Like a camera, a low fStop means little is in focus beyond the target. A larger number will give a larger focus range. **MaxBlur** sets the amount of blurring while a high **Samples** setting will give you a better quality image. Experimenting with these settings will give you different results.



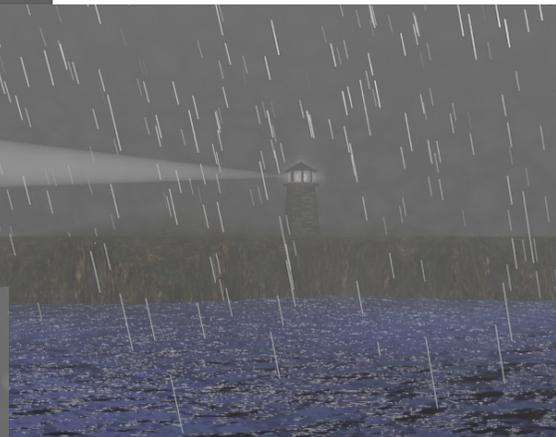
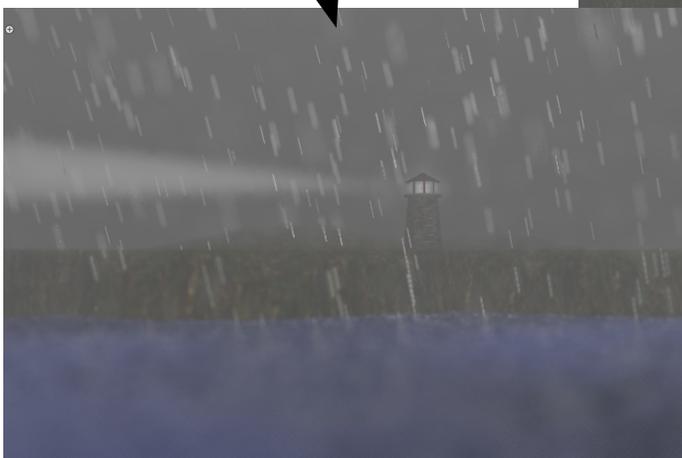
Depth of Field Practice Exercise

Open your "**Landscape Scene**" file for this exercise. Although we won't be seeing much blur in this scene, it will add a nicer effect to the rain. It will also show you how to set up blur for future projects. First thing we need to do is work in the top view, shading to wireframe, and camera selected. With the camera selected, go to the Object Data Buttons. Let's make the lighthouse be the depth-of-field focus throughout the animation. The other option is to set an actual distance, but since our camera is animated, that would cause the lighthouse to go out of focus. To focus on the lighthouse, you will need to know the Name of the lighthouse. Select the lighthouse to see the name displayed in the lower-left corner of the screen. Now select the camera again and chose the object in the DoF box. You will also want to show the "**Limits**" of the camera to display the target.



By following the example on the previous pages, set up the nodes to demonstrate depth-of-field. Adjust the depth to any settings you wish. Your goal is to blur the rain droplets that are close to the camera while keeping the lighthouse in focus. If you have time, create a short movie.

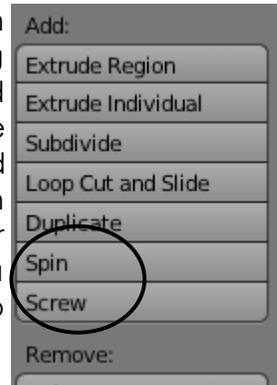
Before Depth of Field →
With Depth of Field ↓



**** Call the instructor when finished****

Chapter 20- Springs, Screws and Gears

So far, we see that Blender has many features that are found in almost all 3D computer programs like the ability to extrude along paths, subtract and add meshes through Boolean expressions and now we will examine **revolving-type, or spinning** commands. The commands used for these effects are found in the *Tool Shelf* and are visible when in *Edit Mode*. The Spin and Screw commands can be used to revolve around a center point with duplicate objects or smooth spinning. You can also provide an offset that will create a spiral. The process to get them to work can be confusing to beginners so we'll create some basic shapes.

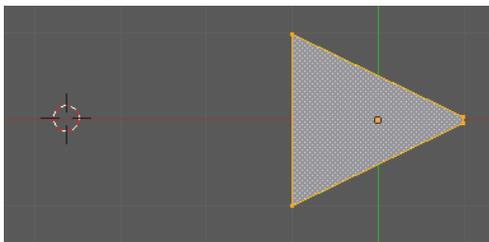


Creating Screws and Gears

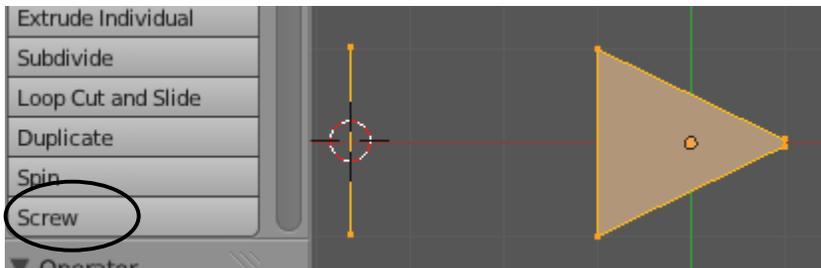
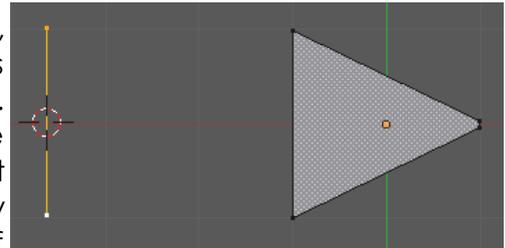
There are actually mesh add-on tools that can create both of these items easily that will be discussed later in the chapter, but for now, we will look at the traditional way to create these items.

Screws and Springs:

In order to make these items, you need a closed shape for the profile (ex. circle or triangle) and a 2-vertex line that controls the spacing from one coil to the next. We'll make a screw form for our first example. Start by adding a *Plane*. In *Edit mode*, select the 2 right side vertices and scale them down to make a triangle form that will represent the triangle thread. Move the 3D cursor to the left side and place it where you want the center of the screw to be.

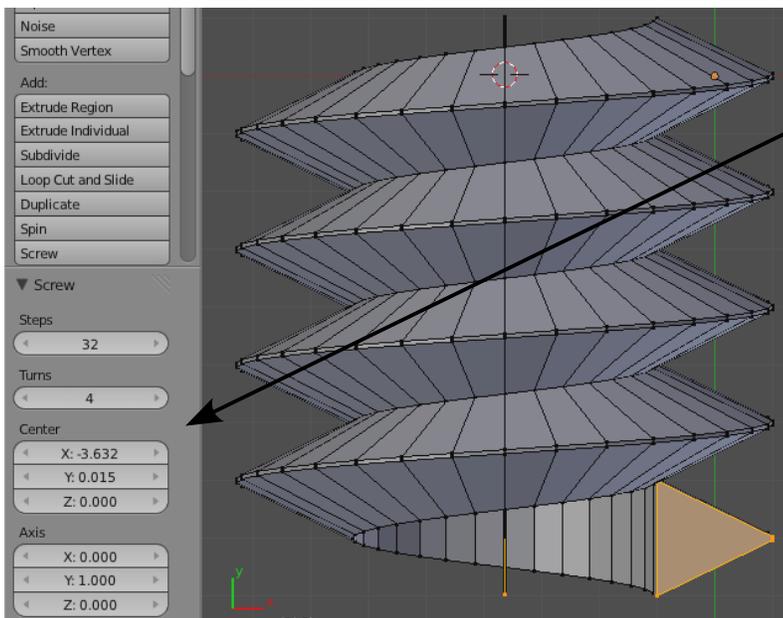


Now add another plane (*while still in edit mode*), delete the 2 right side vertices so that all you have is a line, and place those 2 vertices on the 3D cursor. These 2 vertices control the distance between the coils and must be part of the 1st mesh. If they are not joined together, use "Ctrl-J" to join them. My example has the line the same size as the edge of the triangle. This means that the threads created will be tight together. If you want space between the threads, make the line longer. I place these 2 point on the 3D cursor so it is easier to delete them later. Stay in *Edit mode*.



Now, use the "A" key to select All vertices. The line and triangle vertices should all be selected. Make sure you are in a principle view since the spinning will occur related to your view. Select the Screw command.

Chapter 20- Springs, Screws and Gears

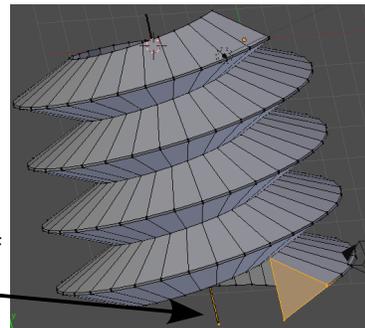


When you select the Screw command, additional options will display below the Tool Shelf.

Steps will control the quality of the circular curve (I used 32).

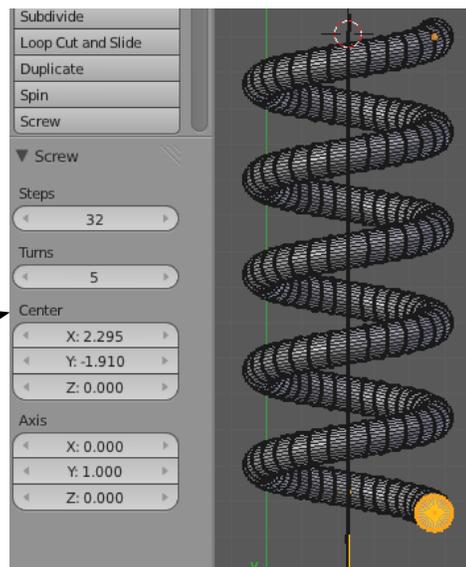
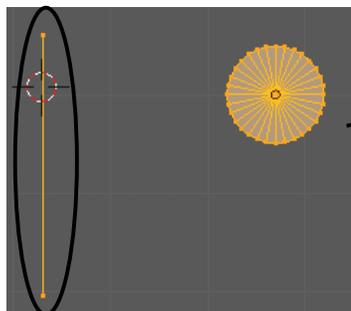
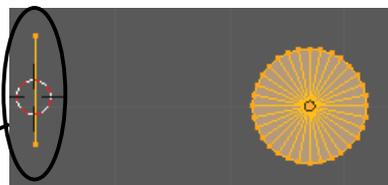
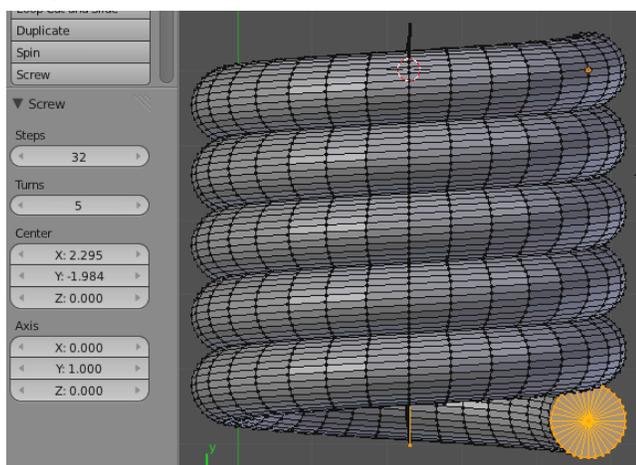
Turns is the number of coils.

Center and Axis will do some fine-tuning for you.



By spinning the mesh, you will be able to select the string of vertices created from the line down the center.

In order to make a spring, you do the exact same thing as the screw, except you use a circle instead of a plane. I will create 2 examples using a short line for close coils and a longer line for wider coils.



Chapter 20- Springs, Screws and Gears

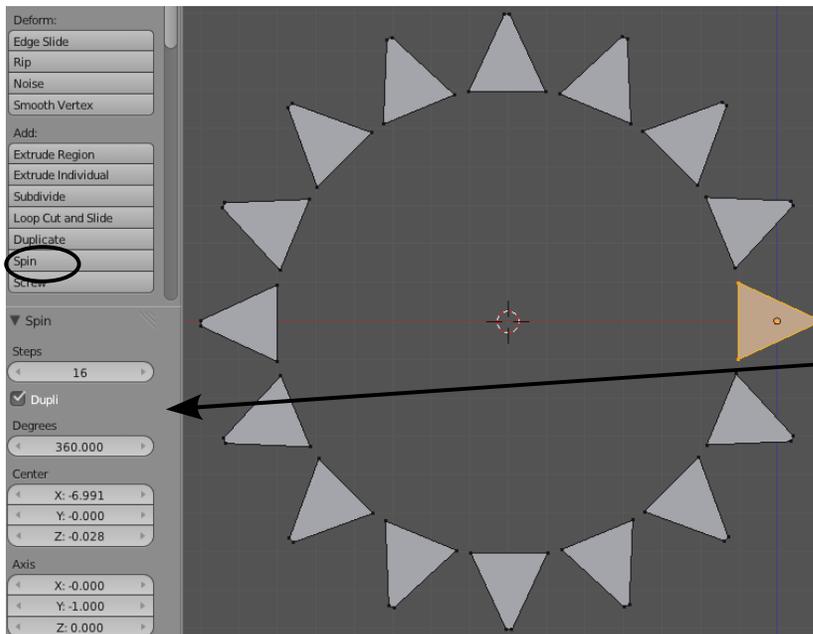
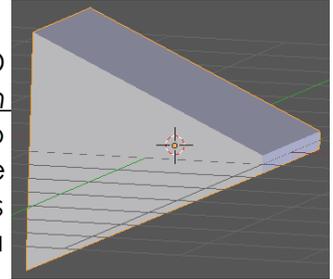


RoboDude Asks: How could I animate a spring stretching and compressing?

Remember how we made shape keys? Scale the shape along the axis and use the slider to animate it.

Gears:

Since a gear uses a 3D shape for the tooth and not just a 2D profile like screws and springs, we need to use the Spin command for that and duplicate the object as it is revolved. To start, add a cube, switch to a front view and shape the one edge to look like a wedge. I selected the 4 right edge vertices and hit "S" to scale and "Z" to scale on the Z axis only. This is a pretty simple gear tooth, but good for discussion.



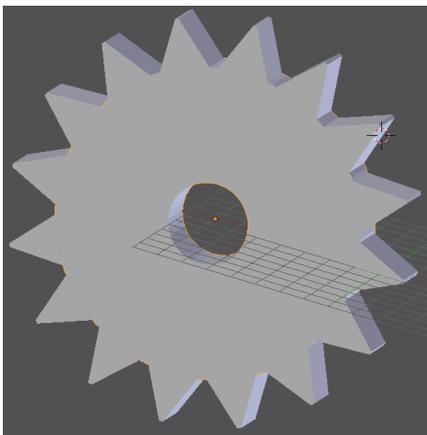
Now move the 3D Cursor to a location where you would like the center to be. (*still in the front view*). Enter *Edit Mode* and select all vertices. In the *Tool Shelf*, select the "Spin" command. You will need to adjust:

Steps to match the number of teeth.

Degrees to 360 (full circle).

Dupli may need to be checked to duplicate vertices rather than spin them.

RoboDude Says: After spinning an object, you will probably have a double set of vertices over the original tooth. Select all vertices and use the "Remove Doubles" command in the Tool Shelf.



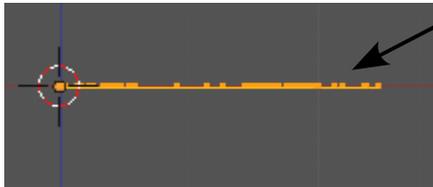
To finish off the gear, add a cylinder to the center and shape/scale it to fit the teeth. You could also use Boolean modifiers to cut holes for more detail. Join the meshes together when finished.

Chapter 20- Springs, Screws and Gears

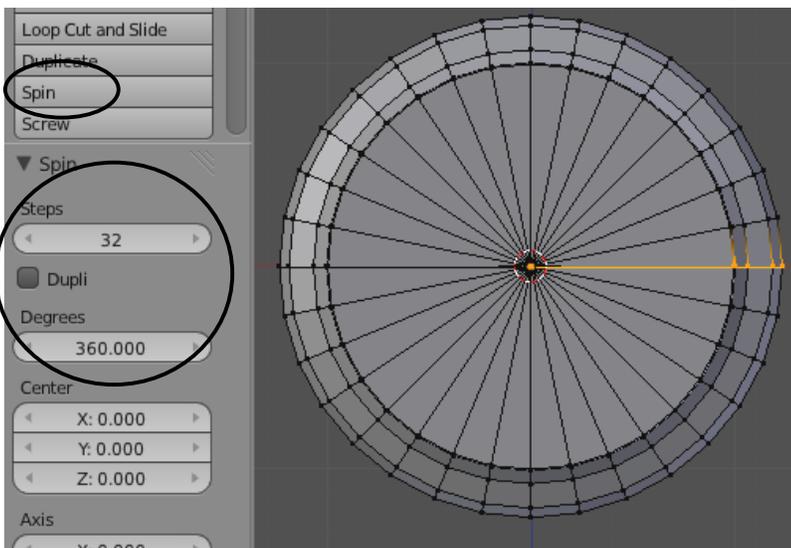
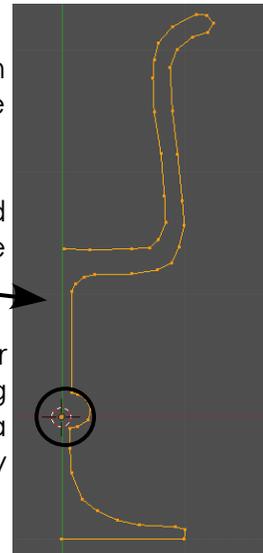
Creating Revolved Shapes

If you wanted to make a revolved shape, like a goblet or an alien flying saucer, you could start with a circle and extrude it to make the shape, but you could also use the *Spin* command.

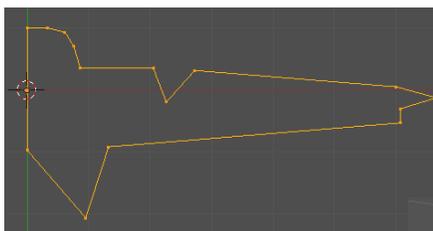
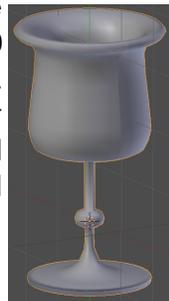
For this example, I started with a plane, deleted one vertex, and shaped/extruded the mesh into the profile of a goblet. Make sure the 3D Cursor is somewhere on the center axis line of the mesh.



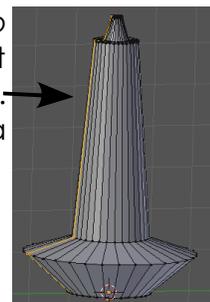
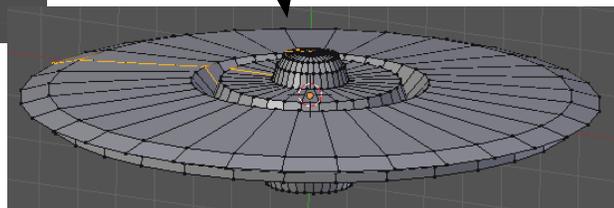
Switch to a front view (or whichever view you need) so you are looking down at the shape and displays as a line. Spinning is related to the view you are working with.



Just like we did for the gear, make sure all vertices are selected and hit the "*Spin*" command. You will need to change the "*Steps*" (I used 32), and the "*Degrees*" to 360 for a full circle. You will also want to select all vertices and "*Remove Doubles*".



To the left is a profile extruded in the top view. The examples show spinning that shape in a front view and a side view. The active view at the time does make a difference!



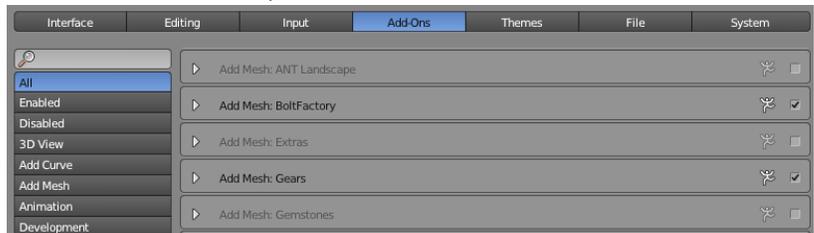
Don't forget- there are Modifiers listed that can do some of these features, only a bit differently. You can actually specify an object for an axis and a few other things. Feel free to experiment with them now that you have a better understanding of how to do revolves.

Chapter 20- Springs, Screws and Gears

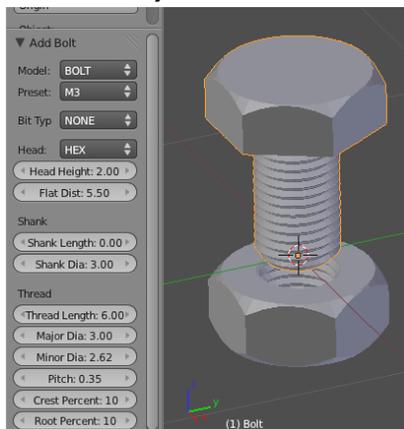
Blender Add-On Meshes

Using the above techniques have always been in Blender and can work well for making mechanical parts like screws, bolts and gears, but with version 2.5, there are now easier ways to do these things. For the past several releases, there has been a script included with Blender called *Bolt Factory*. It worked great for making bolts and nuts, but many users didn't know it existed. Now, you can have that feature (and others) appear in the "Shift-A" add menu by enabling the "Add-Ons" in the *User Preferences* menu. This has been discussed earlier in the book, but here are the details again.

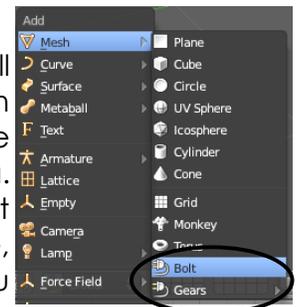
Go to the "File" pull-down menu and select "User Preferences". In there, you will see a tab called "Add-Ons". There are a lot of nice features you may want to use in there and by checking the box, the script will be enabled. For now, we are checking "Add Mesh- Bolt Factory" and "Add Mesh-Gears". If you want these enabled at all times, save the defaults. There are also many other mesh types that could be useful in the Add-Ons. These features are pretty simple and easy to figure out, but here are the basics:



Bolt Factory:

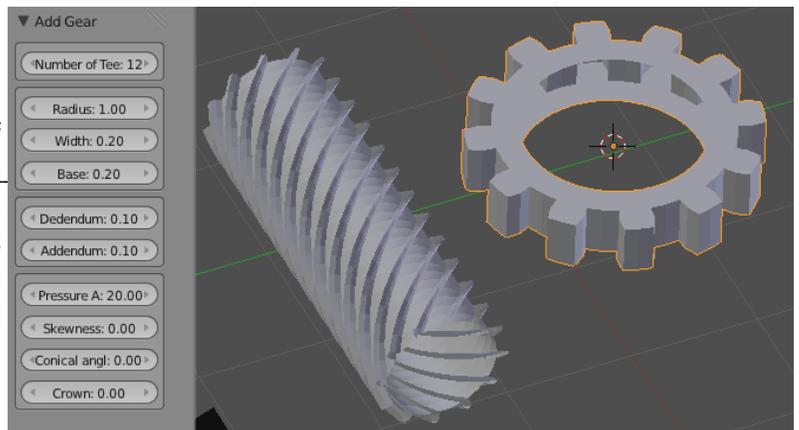


When you hit "Shift-A" now, you will see the 2 new options in the mesh menu. By selecting "Bolt", you will see a list of options in the *Tool Shelf* area. You can select bolt or nut, a preset metric size, head shape and type, lengths, etc. Almost everything you need for quick hardware.



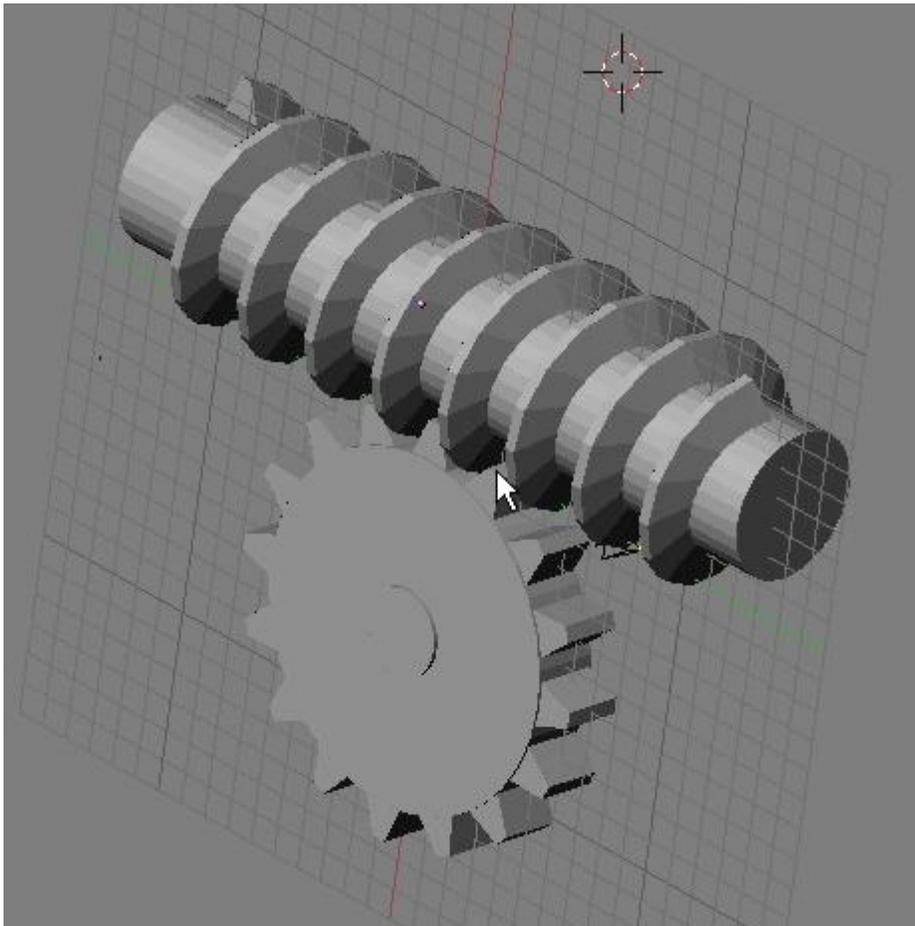
Gears:

There are 2 different types of gears you can add. A *worm gear* and a *gear (spur gear)*. You have many setting options that can be changed with terminology related to real gear development.



Gear Design Practice Exercise

Create a worm gear and a spur gear to mesh with each other using the information discussed in this chapter. You can use the "Spin" and "Screw" Tool Shelf commands or use the Gears Add-On in the User Preferences. Either method, try to keep the gear teeth equal on each part. Try using the copy command for the basic tooth shape. Add materials, textures and appropriate lighting. **Make a 200 frame animation of the gears turning.** Try to make them mesh perfectly! Remember the Linear Extrapolation options available in the **Graph Editor Window**. All you need to do is create a small section of the animation and let the computer do the rest! If you need a refresher, review the animation chapter and page 9-9 for animating the light in the lighthouse.



**** Call the instructor when finished****

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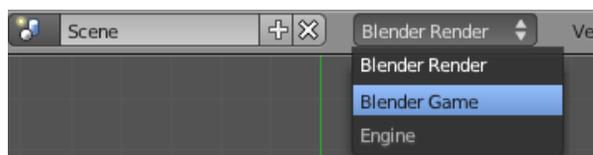
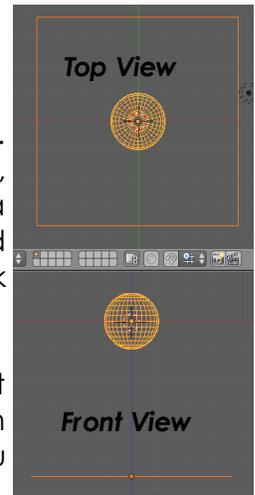
Chapter 21- Game Engine Basics

So how can you make 3D games with Blender? How can you use the physics in Blender to actually create animations for you? Have you tried to make dominoes fall realistically in Blender using traditional animation keys? It would be very difficult to do. Using the real-time features in Blender will do a much better job for you and with a lot less work. A blockbuster movie was just produced last year called 2012 that needed 3D animation of falling buildings and debris that looked real so they turned to the Bullet physics engine to do the work. Bullet is the same physics engine used for the real-time features in Blender. The Blender game engine uses a programming language called Python. Can you make nice games in Blender without knowing Python? The answer is "yes", but if you want to reach a more professional level, knowing Python is a definite. There is a lot of nice documentation on the web for learning Python.

Setting Up The Physics Engine

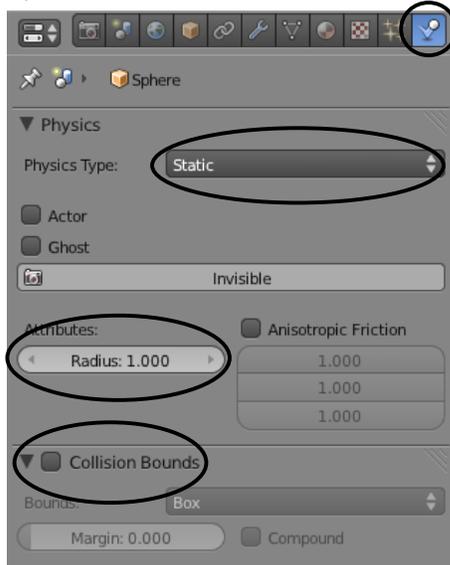
Let's say you want to use physics to make a ball bounce realistically. The 1st thing you need to do is set up the scene. For my sample scene, I have created a UV Sphere a few Blender units above a plane in a front view. Remember that this scene will be using gravity and reactions. If you make your scene in the top view laying flat, it will work just like real life.

It's now time to set up the real-time animation. When I first looked at Blender 2.5 I couldn't even figure out how to turn something into an actor because the interface changed so much! Here's what you need to do:



To enable the Game Engine physics, go to the top bar and find the box for the *Render Engine*. Change it from "Blender Render" to "Blender Game". This switches many of your property tool panels to game engine

options. We are interested in settings in 3 of these panels:



Physics Panel:

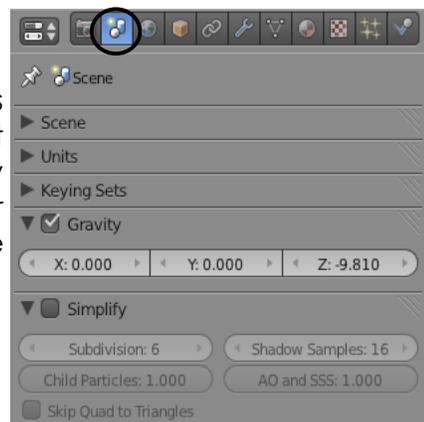
In the Physics panel, you control the Actors in your real-time animation. By default, everything is "Static", meaning that it doesn't react to the physics settings. It can still do things when logic blocks are applied to them, but do nothing otherwise. The other 2 main types we will discuss later are "Dynamic" and "Rigid Body" actors. You can also make something invisible here.

Two other important settings are "Radius" which controls the actor size and "Collision Bounds" which sets the shape of the actor. All of this will be addressed later.

Chapter 21- Game Engine Basics

Scene Panel:

The most important setting for the game in this panel is the “Gravity”. By default, it is set to real gravity, but what if you want to make a game set in space where gravity isn't an issue? You will want to set gravity to zero or something really low. Maybe you want to make a game where objects are pulled to something in the X axis.



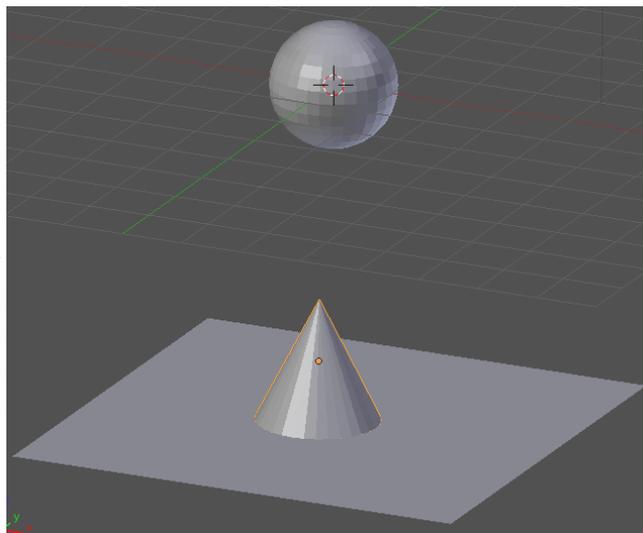
Render Panel:

Just like rendering a picture to see your output, this is where you enable the game to play. You can press the “Start” button here or just press “**P**” to play in a viewport.

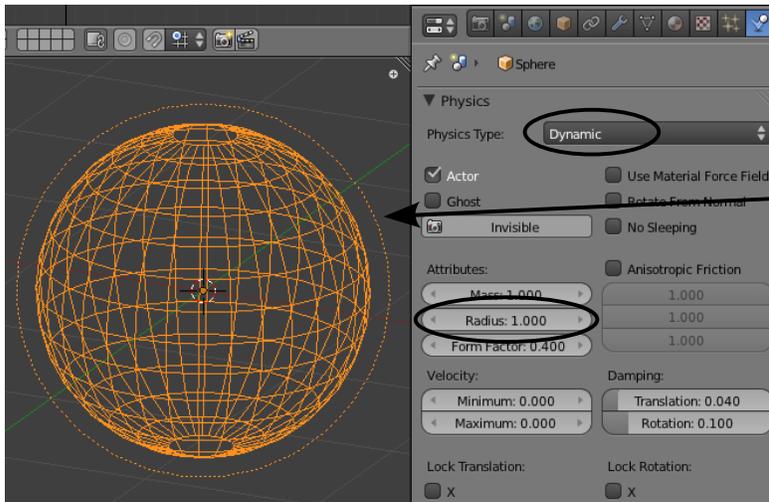
Your end result of making a game is for that game to be played as a standalone (*not in Blender*). This means saving the game as an executable that can launch itself, free of Blender. You can set the size of the game, the color depth, Frames-per-second (FPS), and full screen effects.

Since games rely heavily on sound effects, the game engine has setting features that deal with how the sound is played as well.

It's now time to apply some physics to the sphere. Add a Cone to the scene so the ball has something to deflect off of as it falls. Switch to a shaded view and select the UV Sphere. Rotate your view slightly so you can see what happens when we apply the physics. You want to see the ball drop and how it drops. Now go to the *Physics* panel so we can change some setting.



Chapter 21- Game Engine Basics

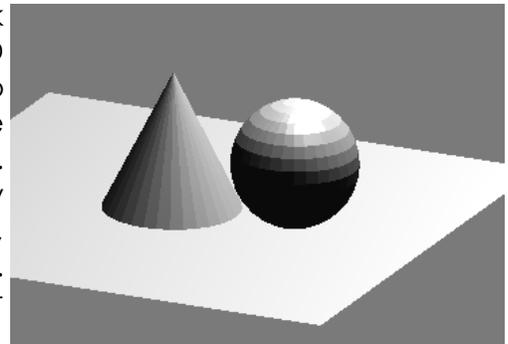


Change the *Physics Type* to "Dynamic". If you are in wireframe mode and scaled the sphere down in size, you will see a dashed circle around it. This circle represents the actual size of the actor. You will need to change the "Radius" setting to match the size of the sphere. If this circle is larger than the sphere, when you play the physics, the ball will hover over the plan and never touch it.



RoboDude Says: The game engine likes actors (radius) to be a size of one whenever possible. If you scale it down and also scale the radius circle to match, it may still not work correctly. Pressing "**Ctrl-A**" and applying a reset the Scale and Rotation can usually correct this problem.

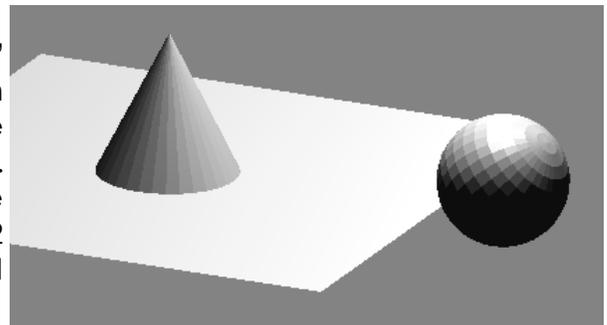
It's now time to test out the system. Switch back *Solid* display mode. With your cursor in the 3D viewport window, press "**P**" to put Blender into game play mode. The ball should fall and hit the cone, but it probably won't act like right. Depending on where you placed the cone, it may even balance on the top of it! If that happens, move the cone slightly to one side and try again. The ball hits the cone, then slides down. It doesn't rotate like a real ball. To exit game play, hit "Esc".



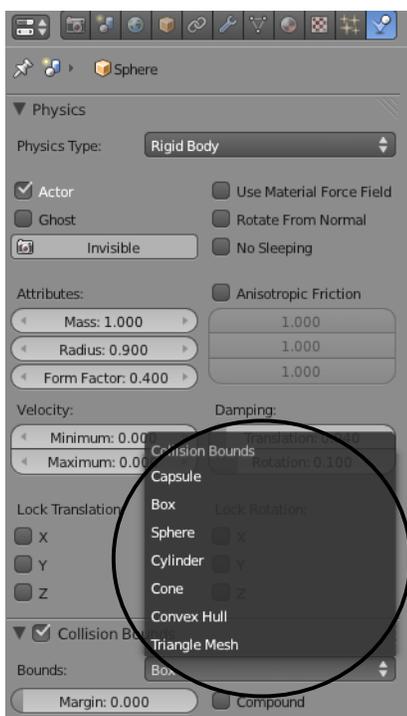
Dynamic and Rigid Body Actors:

A *Dynamic* actor allows you to use physics on it and can fall, bounce and be pushed by forces, but not act like a true solid (*rigid*) body. These actors are great for games where you need to drive or run around in a maze or other scene. A *Rigid Body* actor will like a real solid body. It will spin and deflect when it collides with other objects. Good for some things in the game engine, but better for creating animations like a brick wall collapsing and things bouncing around.

Now change the sphere into a "Rigid Body" actor and hit "**P**" to test out the systejm again. The ball should now roll off the plane and fall into nothingness. Press "Esc" to exit. Feel free to experiment with some of the other setting like Mass. Just like real life, if 2 objects collide with different masses, one will feel the effect more than the other.



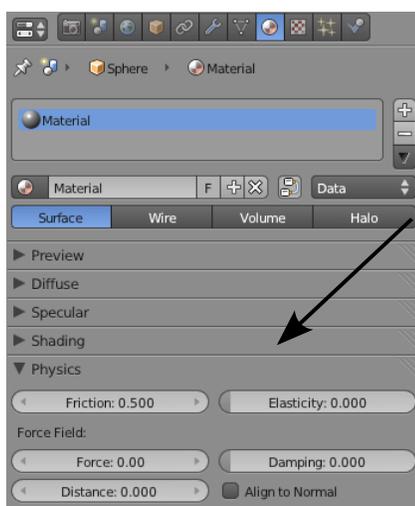
Chapter 21- Game Engine Basics



Since you are working with a sphere, you don't notice that even though we are using a rigid body, the actor physics are still calculating to the *Radius* setting in the *Attributes*. If you were to delete the sphere and use a Cube instead, it would roll off the plane like the sphere did. To fix this, you need to turn on "Collision Bounds" and choose a bounds option. "Box" would be good for a cube mesh while "Convex Hull" or "Triangle Mesh" would be better for a more complex shape. You would need to experiment to see which works best for your model.

As you watch your physics in action, you may notice some other reactions that seem a bit off. For example, the ball may slide a bit, or not enough. It may not bounce much or it may spin too much, or not enough. We have 2 places where we can control some of these factors. The first place is in the Physics panel. You will find a block for Dampening. The "Translation" slider controls the amount of sliding in a direction (like

being on ice) while the "Rotation" slider controls resistance to spinning. These 2 features will be discussed more when we talk about making a game.



The second place to make changes to reactions is in the *Materials* panel. Add a material to the sphere. And find the Physics settings. If you want something to bounce, adjust the "Elasticity" slider, "Friction" controls slippage. You can also provide *forces* and other *dampening* here as well. *For these to work properly, you usually need materials set on both interacting objects (ex. Elasticity on both the sphere and the plane).*

Materials in the Game Engine:

Some things that work in rendering do not work in the game engine while other features do. For example, a standard image texture may display in the game engine, but many adjustments to that texture may not work. There has been a lot of development in texture work for the

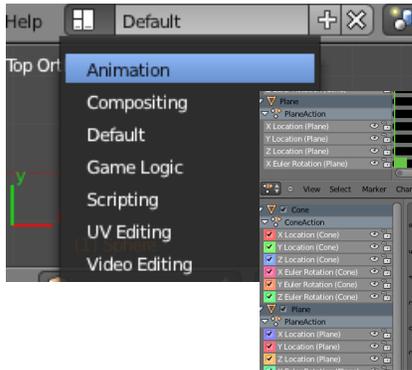
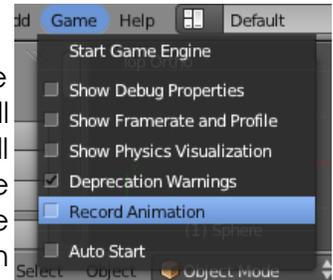
game engine and we will examine some of that in the UV mapping chapter. For now, just work with straight Diffuse material color. To see what things will look like in a game, change your view type from "Solid" shading to "Textured" shading. Press "P" and your view will reflect what will be seen in a saved game. Since the next section deals with applying game physics to an actual saved animation, texture can be handled exactly as we have in previous chapters.



Using Game Physics in Animation

So far, you have a ball dropping on a cone and rolling off the plane. It works when you press "P" to enable the game engine, but what if you want to use this reaction in a movie? If you press "Alt-A" to play an animation, nothing happens. That is because the reaction has not been written into an animation curve... yet.

Writing the game physics to an animation curve is a simple process. In order to write to a curve, go to the "Game" pull down menu and select the "Record Animation" option. This will enable the game record feature. Now, press "P" to run the game engine. Let the physics run through, then "Esc" the game engine. Go back to the "Game" menu and turn "Record Animation" off. You should also change the Engine back to "Blender Render".



Let's see if it recorded the animation. Switch your screen layout to "Animation". You should see animation curves in the Curve Editor window.

Press "Alt-A" to confirm the animation. You can now work with your scene exactly as you would for any other animation work including materials and textures.

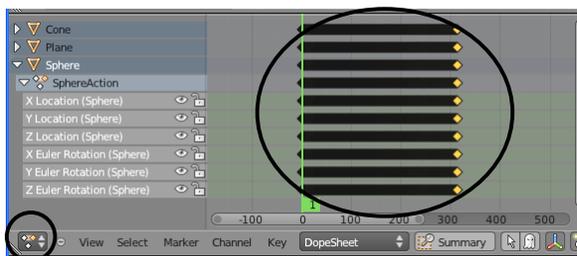
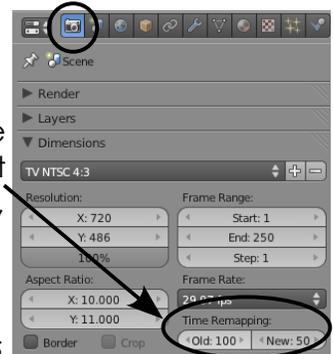


RoboDude Says: Remember to TURN OFF the "Record Animation" feature after you have recorded your motion. If you leave it on and accidentally press "P" again, it will try to over write your saved animation curves!

The only problem you may encounter when saving a movie file will involve the speed of the animation. The physics may be run slow in the final movie. This can be corrected in several ways.

Method #1: Remap the timing in the Render panel.

Find the "Old" and "New" mapping settings. If you need the movie to run twice as fast, set "New" map to 50 (50%) and adjust your end frame to half. If you need it to run slower, like 1/2 speed, try a new map of 200 and double your end frame.



Method #2: Scale Keys in the Dope Sheet.

Another method is to select All keys in the Dope Sheet window and Scale them in the "X" axis ("S" to scale and "X"- drag the mouse).

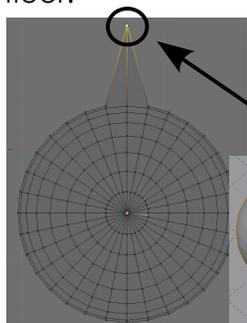
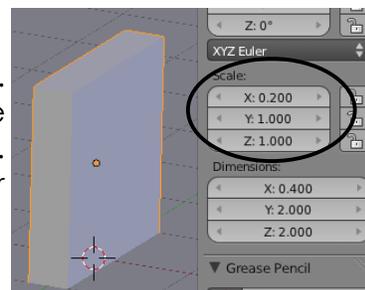
Chapter 21- Game Engine Basics

Using Logic Blocks

We have talked about using the physics for animation, but now it's time to look at using Blender for *Real-Time* animation like an architectural walk-through and yes, games.

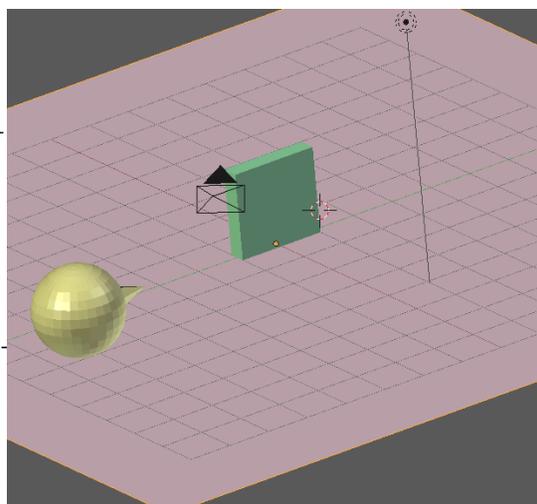
Scene Set Up:

Start a new scene and make a Cube resting on a plane. Using the "N" key to open the *Transform* bar, change the scale X of the Cube to 0.200. We'll use this as a wall block. For the Plane, scale the X and Y to 10.000. This will be our floor.



Now add a UV Sphere, enter *Edit Mode* and select a single vertex from the top view as shown. Use the "G" key to pull it out from the sphere. This will indicate the forward direction when we turn this into an actor and move it around with the arrow keys. Make sure that it is above and not touching the plane. This could cause it not to work when we turn it into an actor.

We now have a basic scene to work with. Add a Material to each object and change the Diffuse color for each so they stand out. You should have something like this scene.



Setting the Actor:

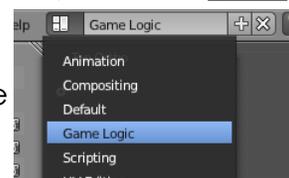
It's now time to turn the Sphere into a *Dynamic Actor*. Start by setting the Engine from Blender Renderer to Blender Game (page 21-1). Go to the Physics panel and select "Dynamic" for they



type. To keep the actor from sliding or spinning too much in the game, we'll set Translation Dampening up to 0.400 and Rotational Dampening up to 0.900. You may need to experiment with these later, but these settings should be good. If these settings are too low, you will notice that your actor "coasts" a lot after you take your finger off the key. This is also controllable in the materials settings with friction.

We shouldn't need to change the radius size since we didn't scale the sphere, but if you did, adjust the radius size to match, then hit "Ctrl-A" to reset scale and rotation settings.

It's now time to switch to the "Game Logic" screen layout so we can add some controllers.



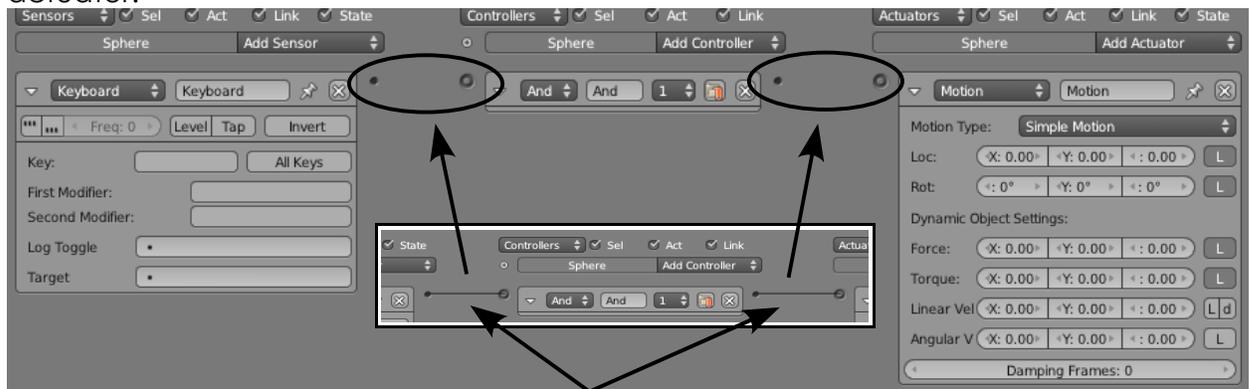
Chapter 21- Game Engine Basics

Logic Block Construction:

Now that you've switched to the *Game Logic* screen layout, you will see the logic block window at the bottom. Think of this as an "Input-Process-Output" model, but called "Sensor-Controller-Actuator". You will also see a place to add a *Property*.



There are a lot of different types of sensors, controllers and actuators that you can use, more than we will discuss here. After you get a feel for working with this chapter, there are many discussions and examples on the internet addressing practical examples of all these. To get started, let's add a "**Keyboard**" sensor, a "**Add**" controller, and a "**Motion**" actuator.



First thing, connect the blocks by dragging a line. To disconnect the, drag backwards.

The first thing we want to do is make the sphere move forward when we hit the Up arrow key. Click in the box by the word *Key*. It will say "Press a key". Hit the Up arrow key to assign it. There are other options, but we do not need them for this exercise.



Think of the *Controller* as the computer processor. By default, we hit "And", meaning that if we tie more than 1 sensor to it, all sensors must be in a true state in order for an actuator to function. There are other expressions available in the controller.

The Motion actuator works for dynamic and static objects. When moving a *Static* object, you will want to use the *Loc* and *Rot* motion outputs. You are setting a step movement or rotation. **You probably do not want to use these for Dynamic actors!** If you do, an actor might walk right through a wall. Think of this as real life. To move a *Dynamic* object, it needs a push (*Force*) or turning force (*Torque*). You will see columns for X, Y, and Z. **Let's set the Y Force to 5.00.** Hit "P" to test out your scene. Adjust the force if more or less is needed. If it goes the wrong direction, try a negative number or try the X column. Adjust actor *Dampening* to improve stopping.



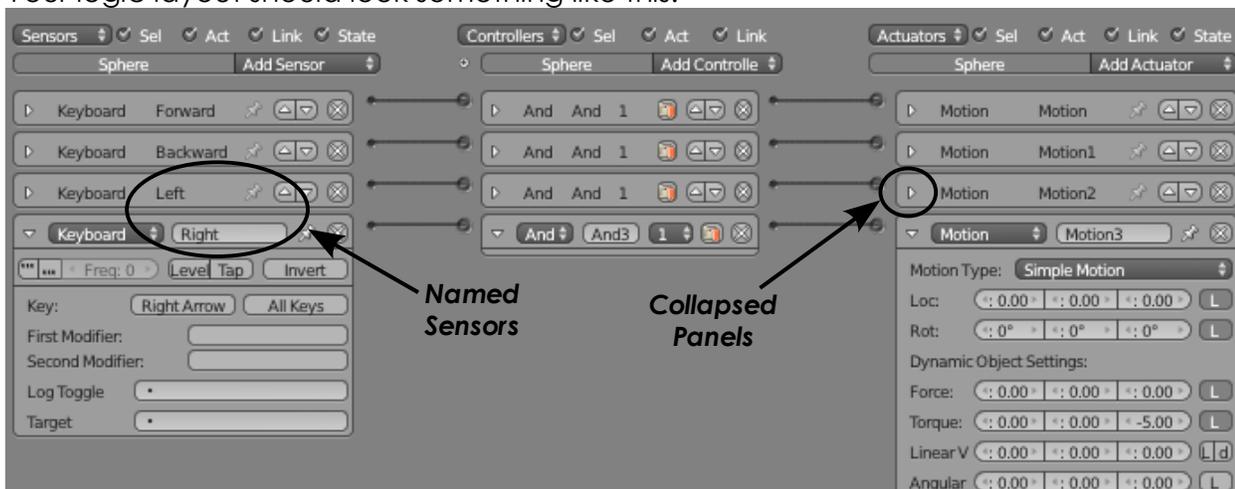
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Now that you have the sphere moving forward, add more sensors, controllers and actuators to make it move backwards. In my case, all I would need to do is give it a Y force of -5.00 (or any speed you wish). To make it turn, you will need to apply a Torque in the Z column. **A Torque of 1.00 may be enough if not, try higher.** You should now have 4 directional keys for the sphere. *It's also a good idea to name your sensors. You may have a lot of them. You can also collapse them by clicking the small triangle.*



RoboDude Asks: Having trouble with the sphere rolling strangely when moving forward? Try going to the Materials panel and reducing the Friction of the sphere or floor (page 21-4). If your actor spins when it hits the wall, also lower friction for the wall.

Your logic layout should look something like this:

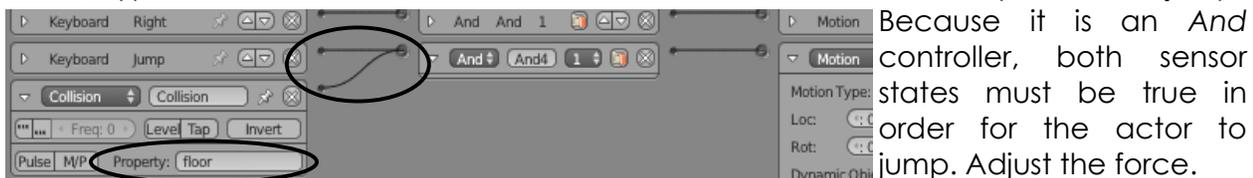


Let's add a **Jump** command using the Space Bar. Since you want him to jump and not fly, we will need to connect 2 Sensors to a Controller to make this work. One Keyboard sensor for the space bar and one Collision sensor with a named Property.



Select the Floor plane and add a Game Property (found to the left of the logic blocks). Give it a name called "floor". This is case sensitive.

Now go back and select the Sphere and add a Sensor-Controller-Actuator. Make the sensor a Keyboard and assign the Space Bar. Use an And controller and a Motion actuator. Give it a Force in the Z-direction of **100**. Since the force will only be applied momentarily when in contact with the floor, it will need to be high in order to have a good jump. Now, we need to add another Sensor and make it Collision. In the Property block, type "floor". Tie this sensor to the same controller as the keyboard for jump.

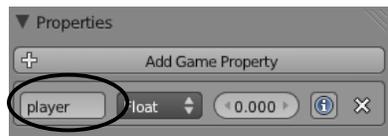
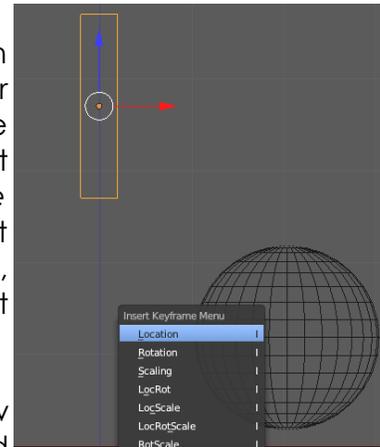


Because it is an And controller, both sensor states must be true in order for the actor to jump. Adjust the force.

Chapter 21- Game Engine Basics

Using Animation in a Game:

Now that we have basic motion down, let's try an animation in the game. We will make the Cube act like a rising door when the actor gets close to it. We first need to add some animation keys to the cube. With the *Cube* selected and at *Frame 1*, hit "I" to insert a Location key. Move up to *Frame 60*, raise the cube high enough for the actor to pass under it and hit "I" again to insert another Location key. If it helps, change back to the *Animation* or *Default* screen layout during this step, then return to the *Game* screen.



Back in the *Game* window layout, select the *Sphere* and give it a Property. Name it something like "player"

Select the *Cube* once more and add a Sensor-Controller-Actuator to it. This time, you will add a Near sensor, And controller, and an F-Curve actuator. Set it up as shown:



Distance-Reset:

Adjust for actor distance when trigger is activated. The reset distance (usually higher than distance) resets the trigger.

Start-End Frames:

Set these numbers to match the range of frames you wish to play during the action.

When the actor with the property name "player" gets within the sensor's trigger distance, the actuator occurs. There are several different playing options in the *F-Curve* actuator- Play plays the frames and stops; Ping-Ping plays frame forwards and backwards; Flipper plays forward, stops, then plays backwards during the trigger reset; and Loop occurs the entire time when activated.

These are just the basics of the Game Engine. With practice, experimentation, and a little research, you will be able to build some amazing games. Games are played through the camera's view so you will want to set the camera's location or child-parent it to the *Actor*. When you're ready to test the game outside of Blender, you need to enable exporting through the User Preferences in the File menu. Go to Add-Ons and select "Game Engine:Save As Run time". Now go to File-Export and save as a .exe file.

RoboDude Says: When making a game, try to keep face counts on meshes as low as possible. The game must actively count and deal with the faces in a game. Detailed meshes will slow things down considerably. The best way to simulate detail is through detailed textures, which will be discussed in the next chapter.



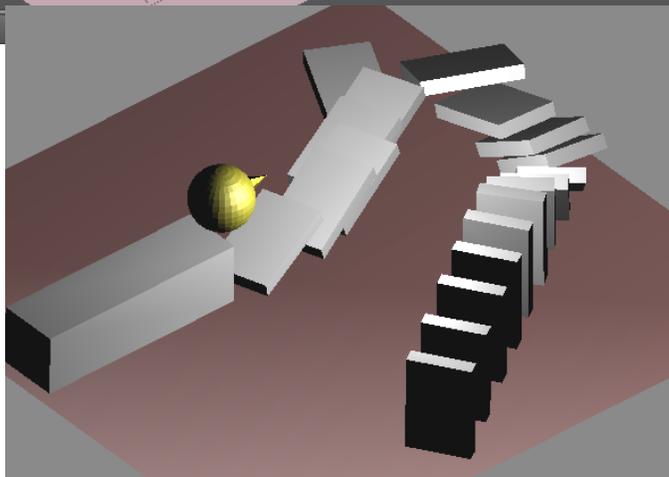
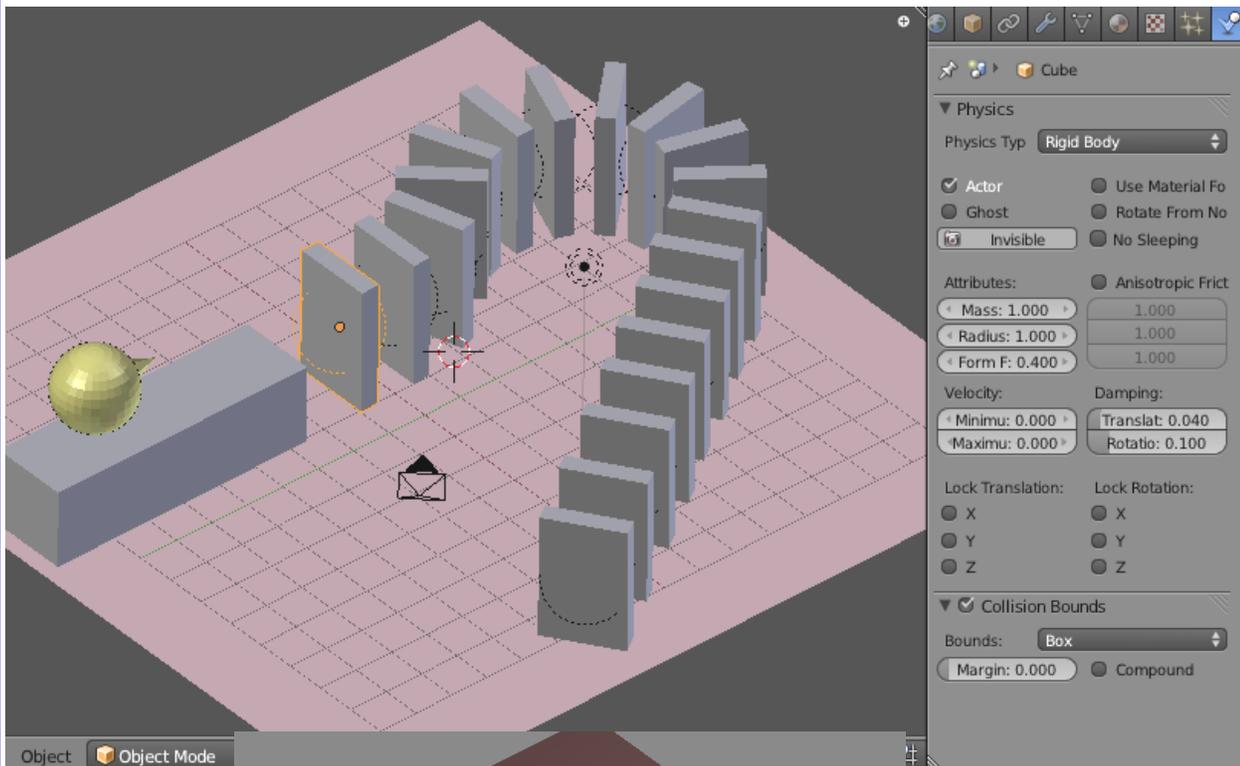
Real Time Practice Exercise

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For this activity, your job is to design a maze full of motion. Create an actor that can be moved around with the arrow keys as discussed in the previous pages and make him start by knocking down some dominoes. To make a domino, start with a cube, scaled into the shape of a domino. After shaping, hit "Ctrl-A" to apply scale and rotation (*reset settings*), then turn it into a "Rigid Body" actor and use "Box Collision Bounds". Duplicate it a few times and test it out to see if you can knock the first one over and that, in turn, knocks the others over. Add as much other detail to your scene as possible and more motion.

If time permits, save the motion to an animation curve and make a movie.



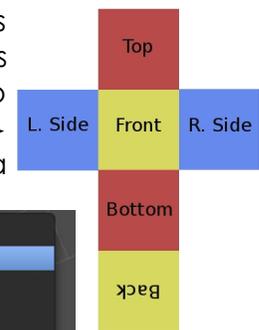
**** Call the instructor when finished****

Chapter 22- Textures in the Game Engine

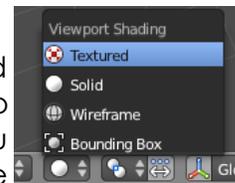
Since games need to be able to process operations as fast as possible, traditional rendering techniques (*specularity, ray tracing reflections and refractions*) cannot typically be processed fast enough for a game. For this reason, textures need to be mapped differently. There are also times when you may want to use mapped textures in an actual render. Blender does this through traditional *UV Texture Mapping* and a new system called *GLSL Shading*. There is a lot that can be done through both of these methods “beyond the basics” that will be discussed here. For more details, check out the Blender wiki.

UV Texture Mapping

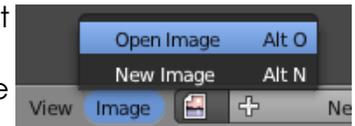
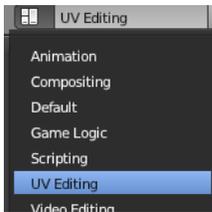
Think of *UV Mapping* like taking a box and cutting it to lay flat. The texture needs to match each side of the box. It is difficult to do that with traditional materials and textures. Let's say you want to model a dinosaur. The texture changes on various parts of his body and need to be mapped correctly. This is where UV Mapping come into play. For this example, I am going to map the following texture I made in GIMP on a basic cube:  This is just a jpeg image that would be impossible to map as a standard material/texture.



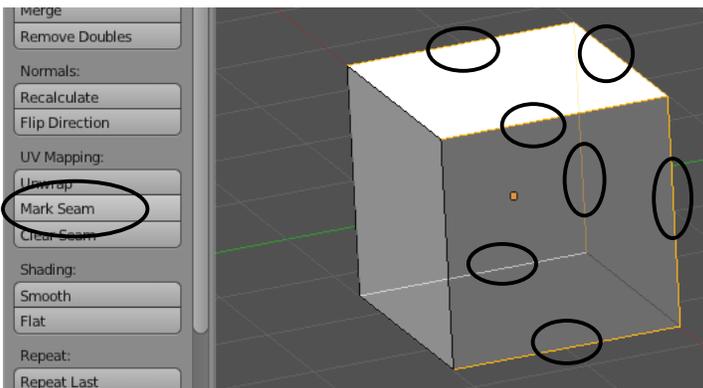
To begin, start with a basic scene with a cube and change your viewport shading type from *Solid* to *Textured*. This is the shading used during game play. You



will notice that, by default, textures are affected by the lighting so add some lights to illuminate your scene better and switch to the “*UV Editing*” window layout. This will give you one 3D viewport and one UV Editor viewport. At the bottom of the UV Editor viewport, hit the *Image-Open Image* menu option and find the texture you wish to use.



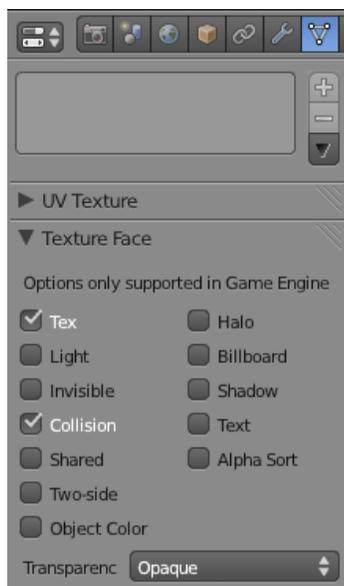
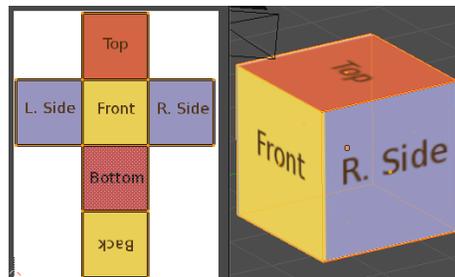
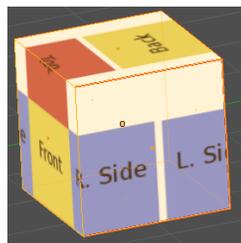
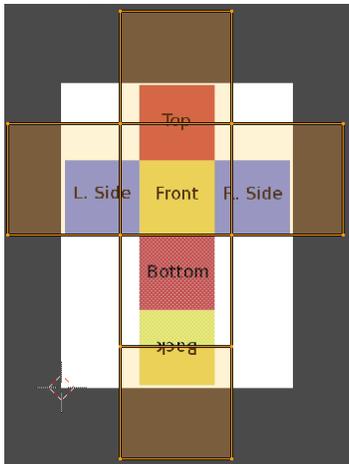
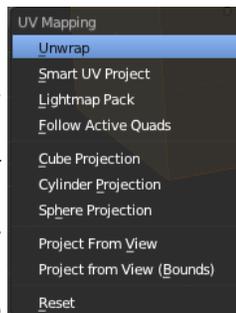
Now, enter Edit Mode for the cube and switch to selecting *Vertices* to *Faces* since this is a face applying process. You can select individual faces and put UV textures on that way, but let's “Unwrap” the cube to match our texture. This can be done for any mesh, but we need to mark the seams where we want a split to occur. If we look at the picture, we can see where seams should go. In order to mark seams, we need to switch from *Face* select to *Edge* select.



Select the following edges (*Shift-RMB*) and click “*Mark Seam*” in the *UV Mapping* section in the *Tool Shelf*. These will be the unfold edges. It should match the box layout.

Chapter 22- Textures in the Game Engine

Now go back to *Face* select mode, hit "A" for All twice to select all faces. Type "U" to bring up the *UV Mapping* options in the 3D window. You have several options. We want "Unwrap". You will now see the unwrapped faces in the UV Mapping window. You can select these vertices as you would for any other Blender object and move, scale or rotate them. You will also see the texture on the cube. By pressing "P" you will see the texture in game play. (*in object mode*) Adjust the vertices so it looks good on the cube.



By using this technique, you can select single or groups of faces on an object to assign textures. By switching back to the *Default* screen layout, you will find a panel in the *Object Data* buttons, in *Edit Mode*, that effect the texture faces. In the current version of Blender, you can only select one face at a time to change these options.

Some useful options here are:

Light: face is effected by light hitting it.

Invisible: good for adding planes along a track as guides.

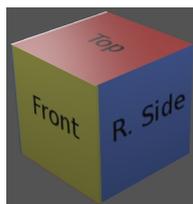
Collision: unchecked and the actor can go through it.

Two-Sided: by default, texture visible from one side only.

Transparency: options for visibility.

UV Textures in an Animated Movie:

Just like game physics can be written into an animation curve, UV can be used with materials and textures. After going through the steps above, add a material and texture to the object. Select "*Image*" for the texture type, select the picture you used, the under the "*Mapping*" panel, choose "*UV*" in the *Coordinate* box. Pressing **F12** should give you a rendered image of the map.



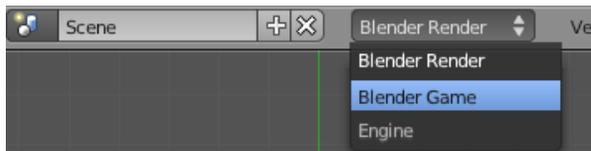
Chapter 22- Textures in the Game Engine

GLSL Shading

GLSL shading is very new to Blender and is an area seeing a great deal of development. It is an attempt to add many rendering-like features to the game engine, adding to a more realistic environment. As with the UV Mapping section, this unit will only cover the basics to get you started.

Not all video cards are supported for GLSL shading. Some machines will be unable to use this feature. See the Blender wiki for current specification.

To get started, we'll start a new scene and split the viewport, setting one to UV/Image Editor.



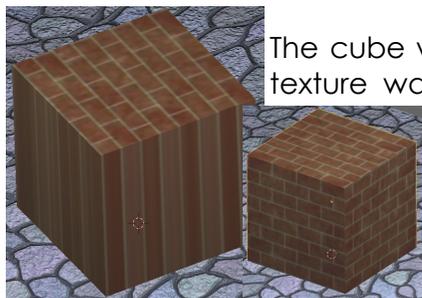
Set the Engine to "Blender Game" and viewport shading to "Textured". The last thing

you need to do is switch from "Multitexture" to "GLSL" shading in the Render panel. You are now ready to work with the GLSL features in the game engine. Not all texture and shading features are available in GLSL, but many are and others are being developed constantly. As mentioned before, we will only be looking at some of these features.

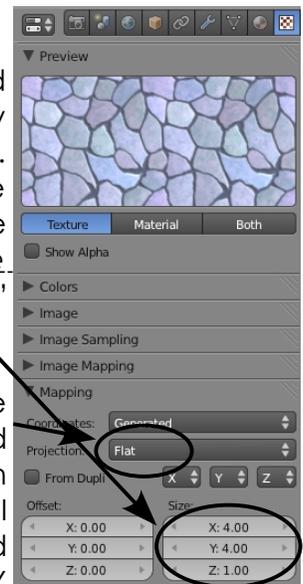


Adding Textures:

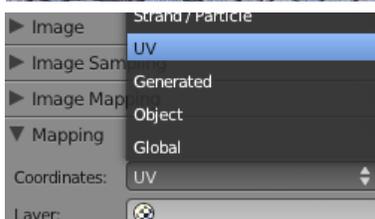
Basically, to add textures for the game in GLSL, you need to add materials and textures the way you do for any movie. For my example, I am working with a plane for the ground and a cube. I've added a material and texture to the floor, using a stone texture. The stones are too large so I need to repeat it a bit in the texture panel. You can't use the X and Y Repeat in the "Image Sampling" panel, but can change the size in the "Mapping" panel.



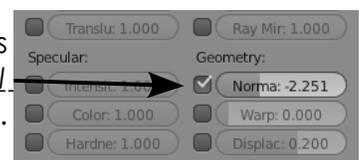
The cube was a bit more difficult. Because the texture wants to map as Flat by default and GLSL does not currently work with changing the mapping to Cube, I had to apply the texture as we did in the previous section using UV Texture Mapping and mapping the texture to each face. Remember to also switch the Mapping in the Textures



panel to UV.



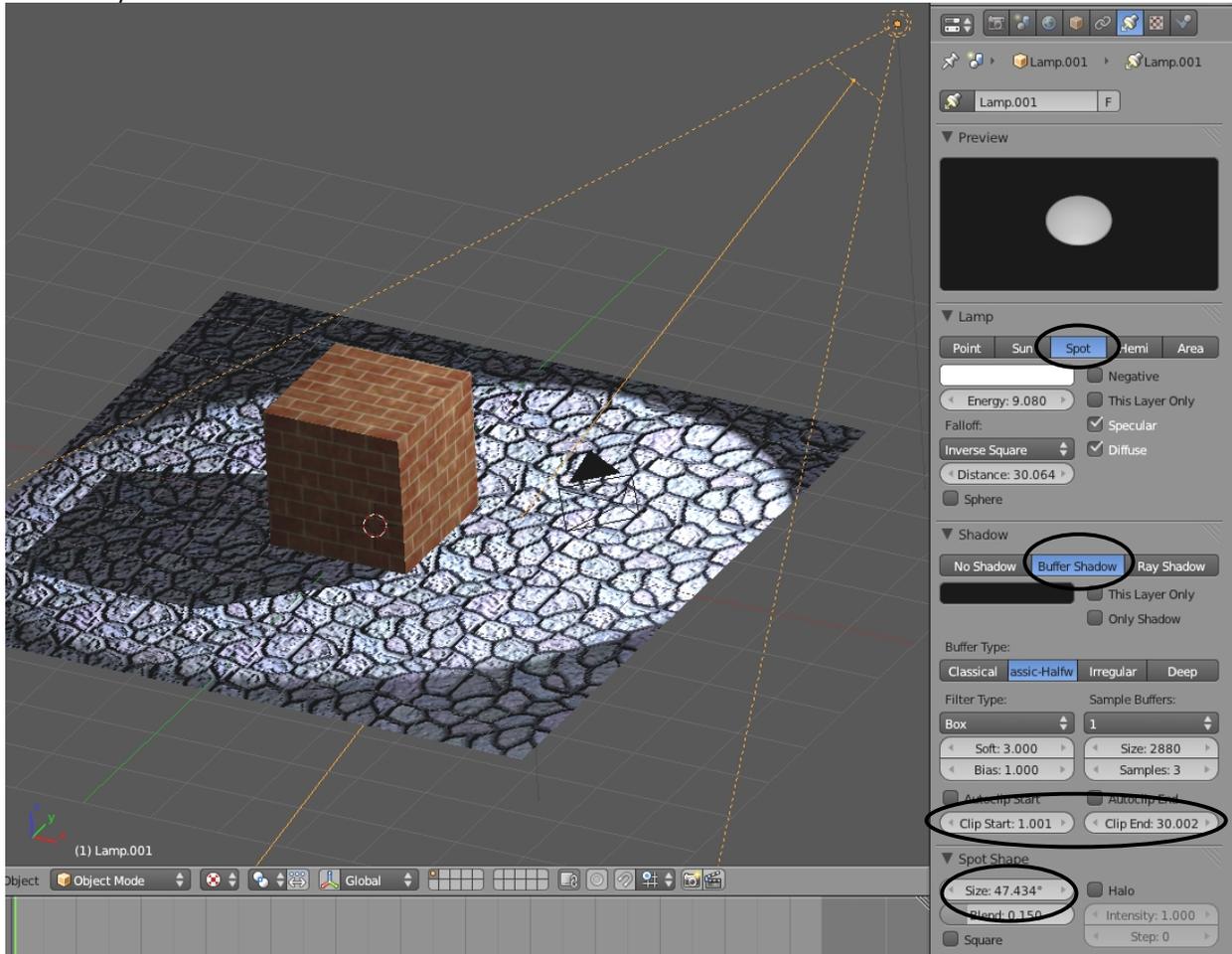
Another nice feature with GLSL is the ability to show Normal Geometry to give a texture depth. Looks best with a higher Specular.



Chapter 22- Textures in the Game Engine

Shadows in GLSL:

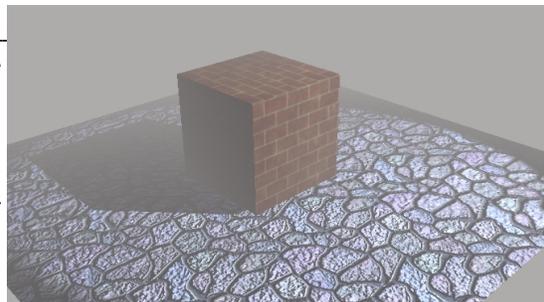
Another nice effect allowed in GLSL is the ability to cast shadows in game play. Right now, ray tracing is not supported so your only option is to use a Spotlight with a Buffer Shadow setting (refer to the lighting chapter for more details on setting the buffer shadow).



Currently, there is a lot of development in GLSL with new features constantly being added. There is also a lot of work in *Baking* settings to improve performance. There is work on support for indirect lighting, fluids, soft bodies and many more. For up-to-date information, follow the Blender wiki, YouTube, and the forums.

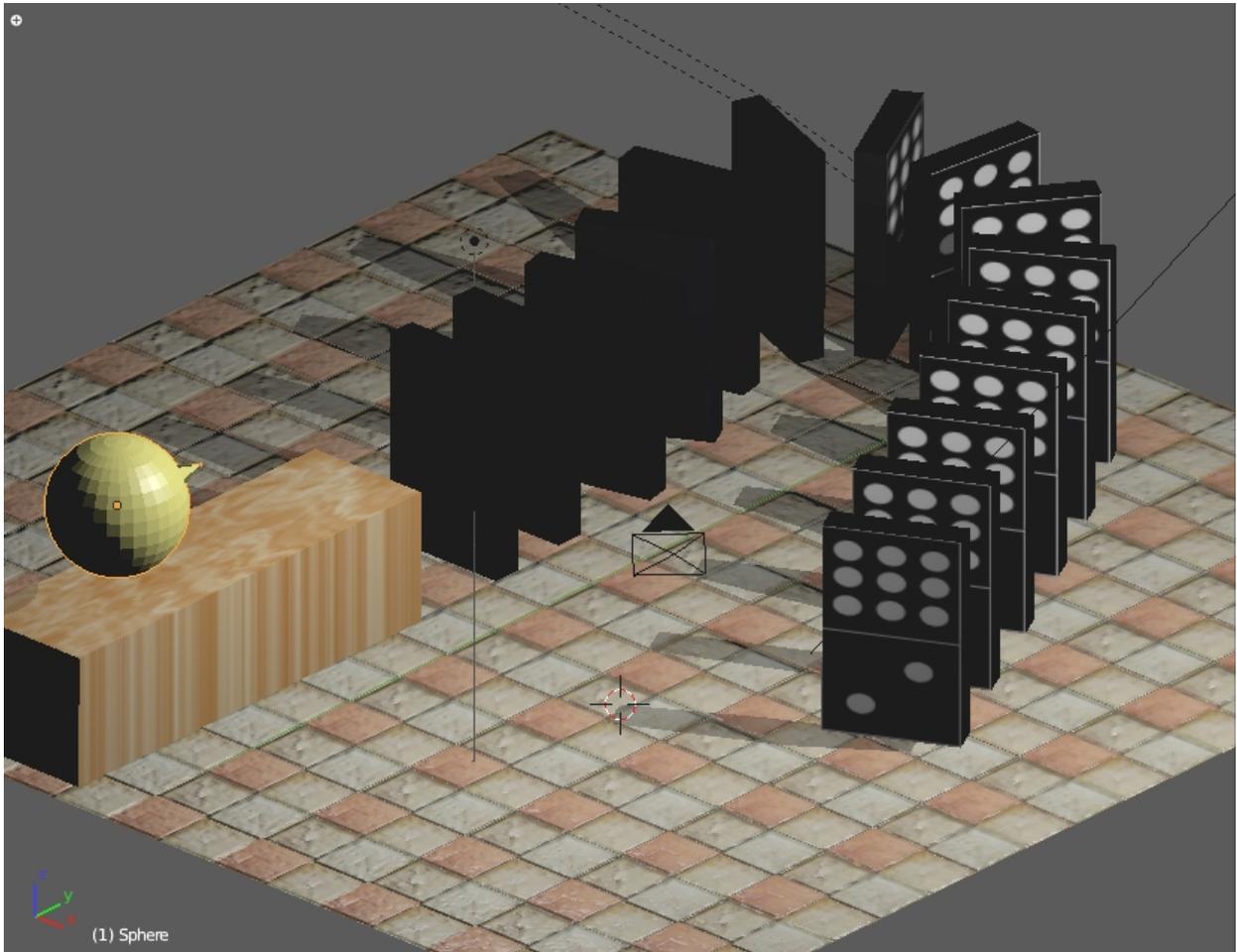
World Settings:

While some *World* settings work in *Multi-texture* mode and some work on *GLSL Shading*, Some features do not work in either at the time (*stars* for example). In Multi-texture shading, you can get a nice effect with the *Mist* settings to give a "foggy" feel to your game, but works a bit differently in GLSL. World Horizon and Zenith colors work differently as well.



Motion Maze Texture Exercise

Open your *Motion Maze* file from the last chapter. Your goal in this exercise is to make it look good while in game play. You may use *UV Texture Mapping* or a combination of *UV Mapping and GLSL Shading*. Find or create a nice domino texture along with appropriate textures for all other items. Remember that for a UV Mapped texture to work in GLSL, you need to switch to UV in the mapping panel in Textures.



**** Call the instructor when finished****

Chapter 23- Video Sequence Editor

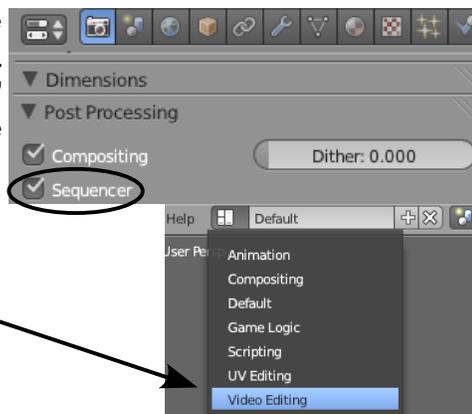
We've come to the last chapter and what better way to end this introduction to Blender than to compile all of your work into a final movie. Like other programs on the market (i.e. Adobe Premiere, Windows Movie Maker), Blender has its own movie editor. Combine the *Sequence Editor* with *Nodes* and you have everything you need to make a professionally edited movie with sound, right inside Blender.

Compiling Your Clips and Images

Think of all the work you've done in Blender. You probably have a lot of short movie clips and saved images. Let's put them into a movie. Most movies start with a black screen. To handle this, I typically insert a picture that has been saved as just a black filled image.

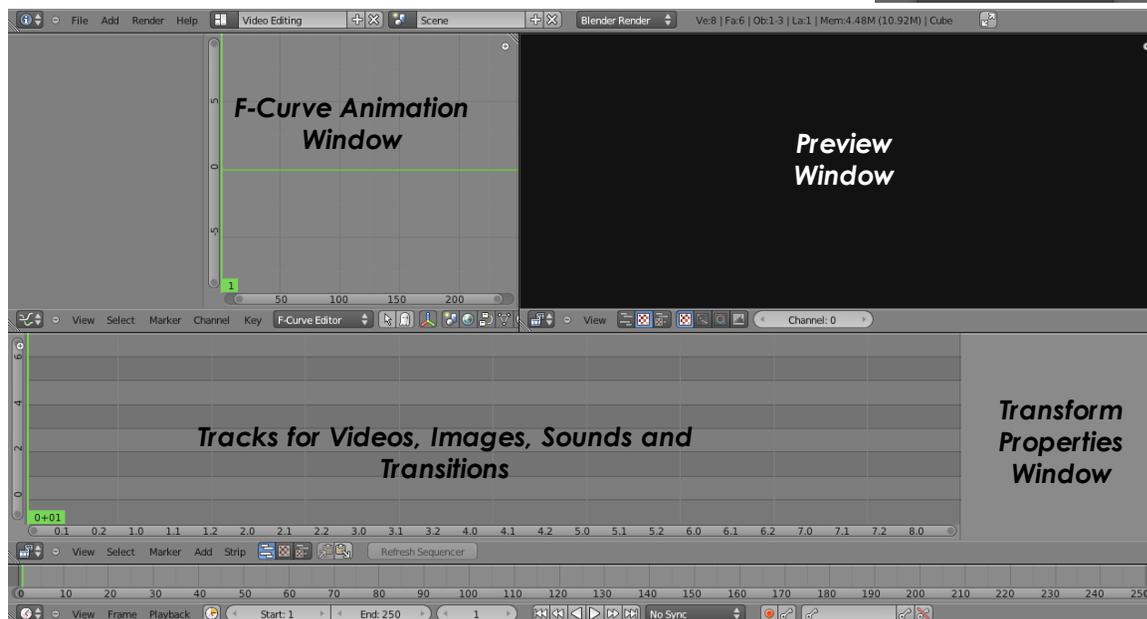
First thing, set up your scene for your final movie output. Blender can only compile sounds into an MPEG movie (*due to open source issues*). This is actually great because Mpeg2 movies output high quality and are DVD-ready. The settings are just a review of what we have done in previous chapters. *If you need a review, look at page 7-3.*

The only thing new is that you need to make sure the "*Sequencer*" box is checked in *Post Processing*. Without this being checked when you hit "Animate" Blender will only animate the 3D scene and not the sequence. *For best results, always animate at the same size and frame rate- mismatched sizes and rate could cause output problems.*



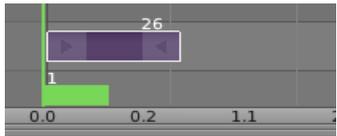
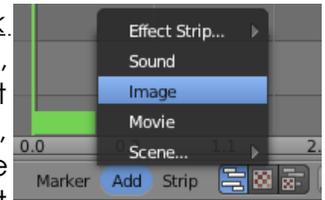
Now, switch the screen layout to "*Video Editing*".

Here is a look at the screen layout:



Chapter 23- Video Sequence Editor

Let's start by adding 2 images to our time line. We'll add a Black screen image and a saved image of our Lighthouse. To do this, click the "Add" button at the bottom of the window and select the "Image" option. You can add Effects, Sounds, Images, Movies and Scenes. Browse to your saved images. My 1st image will be a black screen. It doesn't matter which track you drop it

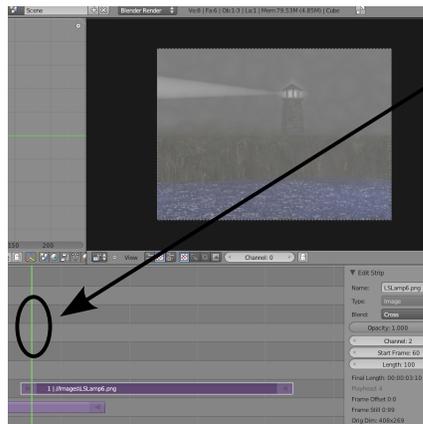
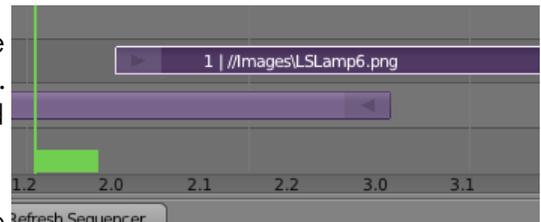


into, but I usually work with the bottom tracks for images and movies. Place the track to start at Frame 1. Items placed in the time line can be selected and moved using standard Blender commands (G key). You can also zoom and pan in the tracks. By default, my image came in only 25 frames long- not even a second. This is where you need to get a feel for how long an image should be displayed. I want my black screen to last for 2 seconds plus 1 second for the fade transition. *This would be a total of 3 seconds, or 90 frames.* To lengthen an image, **RMB** click on the end of the strip. Only the end frame of the strip will highlight and you can stretch it with the "G" key. You will also notice that the numbers along the bottom of the window represent seconds.



Only images can be stretched, videos cannot. They will give the appearance of being lengthened, but only the first or last frame will show longer.

It's now time to add the second image. Go to the "Add" button again and find the next Image. Place it on the track above the first one and overlap it about 1 second for the transition.



If you grab the green bar on the time line tracks (*represents current frame*) you can drag it with the **LMB** as you watch the Preview Window. You can scroll the mouse wheel in the Preview Window if you need to zoom in or out. You should notice a switch from black screen to the rendered lighthouse. Right now, it is an abrupt change. We want a smooth cross fade.

To add a Cross Fade, you need to select *Both* tracks that you wish to cross with the **LMB** while holding "Shift" (*standard Blender multiple selection command*) **It is important that you select the image that appears first in time (black image), then the second. Otherwise, the cross will work backwards.** With both selected, go to the "Add" menu, "Effect Strip" and choose "Cross". Place it in the track above the two. There are many options for different effects.



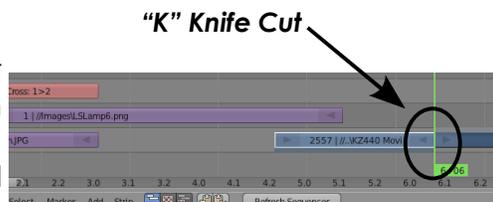
Chapter 23- Video Sequence Editor

Now when you scrub the time line with your mouse or press the play button (or "Alt-A"), you should see a smooth transition.

Now it's time to add a movie. Follow the same steps as before, but select "Movie" from the "Add" menu. When the movie come into your tracks, it will also contain an Audio track (even if your video contains no audio). You can delete this upper track if desired. Place the movie and add a transition as before.



If you need to shorten a movie track, you can select the end and shorten it, like we did to lengthen an image, or you can place the green "current frame" bar at the desired cut location, select the clip and hit "K" for knife cut. The movie is split at that point.

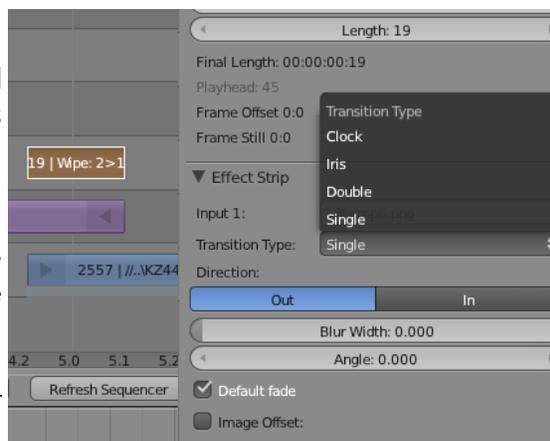


RoboDude Asks: When I press the "Play" button or press "Alt-A", why doesn't my movie play through? Check the End Frame of your movie- you probably need to adjust it.

More about Effect Strips:

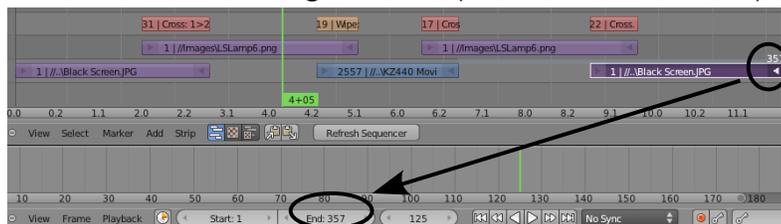
So far, we've used the most common type of effect- a Cross. Blender has several other useful effects.

Wipe: A wipe is another common effect and has been expanded to do other popular effects in 2.5. After adding the wipe across the 2 strips, look at the options in the right panel. You will see different types of wipe and a Blur option. Options include a Clock effect, Iris, Double (barn doors), and single. There is also an Angle option.



Alpha Over/Under: If you have an image or image strip that has a transparency channel, like a title overlay, you can use these effects to do composite work. Just place the image over the movie strip, select both tracks, then add an "Alpha Over or Under" effect to combine them.

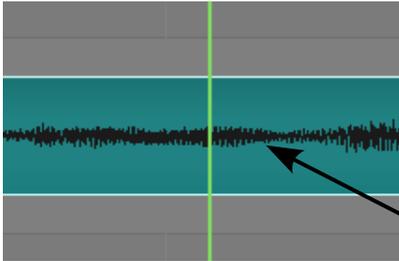
Continue to add images and clips to finish the video part of your project. Sticking to the bottom tracks keeps your project looking clean. I usually alternate between 2-3 tracks. Don't forget to match your End frame to the end of your movie.



Chapter 23- Video Sequence Editor

Adding an Audio Track

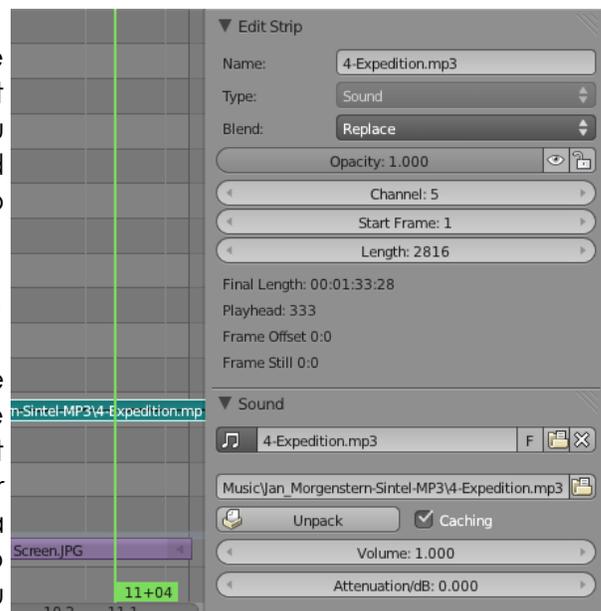
Adding an audio track isn't much different from adding images and movies. Many different audio track formats are accepted by Blender and the most common are WAV and MP3 files. Some files may need to be converted through an audio converter, many free on the internet. There have been some helpful upgrades to working with audio in the sequence editor. To add an audio file, go to the "Add" menu and select "Sound". Find your file and add it to an upper track. Trimming an audio track is accomplished the same way you cut or shorten a movie or image. (*grabbing the end or using the "K" knife tool*). To help you find a more exact point, you can zoom in on the audio track and see the waveform.



RoboDude Asks: When I press the "Play" button or press "Alt-A", why doesn't my movie play at a consistent speed? It is difficult to run everything properly on the screen. Transitions need to be calculated and audio added. You could try going into "User Preferences" and the "System" tab to try to increase sequencer memory. When you crunch the movie, it will play real-time.

With an audio track selected, look at the options to the right. The most important options are displayed at the bottom. You can "Pack" a sound into the Blender file and adjust its Volume and Attenuation if it is too loud or soft.

Need to fade a song in or out? Need to cross fade from one song to another? Remember that Blender 2.5 can animate any block. This means that you can animate the volume. Go to a frame where you want to start a fade out, place your cursor over the "Volume" block and hit "I" to insert a key, then move up in time, set the volume to zero and hit "I" again over the block. You now have a fade out.



The next exercise is our last exercise of the book. I hope that *Blender Basics* has been helpful in launching your experience with this sometimes difficult and powerful 3D modeling and animation suite. It has grown to something that can compete with the commercially developed packages.



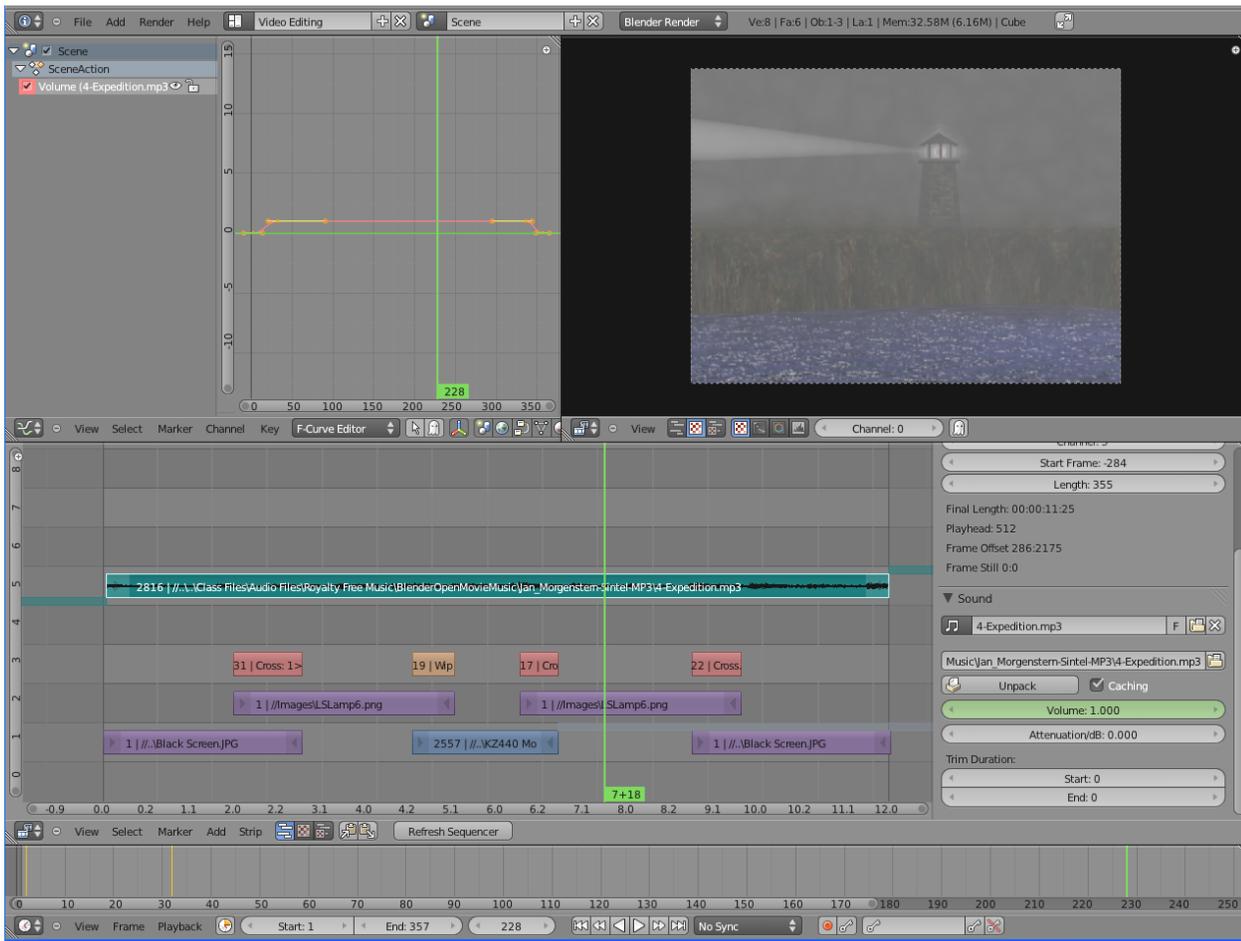
Where to go from here? We've only scratched the surface. The Blender foundation and community are always striving to make material available. All you need to do is search the internet. **Happy Blending!**

Movie Producer Practice Exercise

This is a great exercise to end the book with. Your job is to take all of the images and movies you have created through these exercises and produce a compiled movie. I recommend making a **Black JPEG image** to use for your **first** and **last** image (*start and end in black*). Images should be displayed for approx. 3-5 seconds with 1 second transitions. When finished, o back to the *Default* screen and hit "Animate".



RoboDude Says: *It is best to work with movie files that have all been rendered at the same size and frames-per-second. Problems may occur when Blender tries to convert files that are different from the output you have selected.*



**** Call the instructor when finished****

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