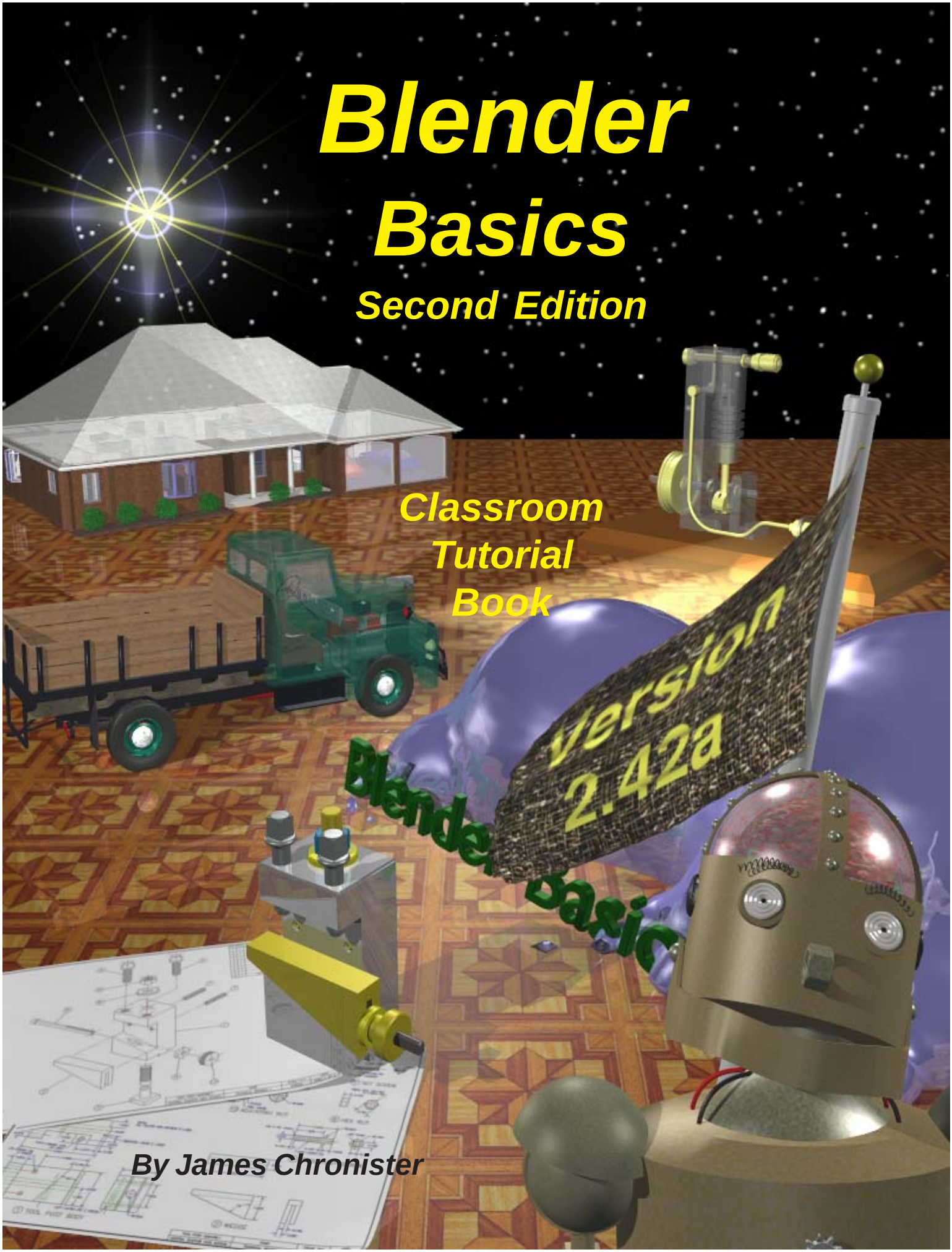
Blender Basics

Second Edition



By James Chronister

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.

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PRACTICE EXERCISE

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:

- To organize a fund raising campaign in order to finance the €100,000 one time license fee
- To give the worldwide Internet community access to 3D technology in general, with Blender as a core
- To establish services for active users and developers of Blender
- To maintain and improve the current Blender product via a public accessible source code system under the GNU GPL license
- To establish funding or revenue mechanisms that serve the foundation’s goals and cover the foundation’s expenses”

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.elysiun.com 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 2.42a. 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 individuals contributing to Blender, major changes can occur between releases showing substantial improvements.

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 they way an object appears by applying color and textures. Materials provide realism with added effects. You an control glossiness (specularity), self-emitting lighting characteristics, transparency and pattern repetition. Textures can be made from any scanned photograph or drawn object in paint. The file needs to be saved as a jpeg or bitmap in most cases, depending on the program. For Blender, the image should be square and based off of 8 x 8 pixels (16x16, 64x64, 256x256), however, off size and rectangular images usually work also. Higher pixel images provide sharper images, but increase file sizes. As Blender has evolved, rectangular images work fine and don't need to be square, but still a good rule to follow.

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.

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 *keyframing.* 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
Custom- set your own 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 15 fps, place 2 keys 30 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 AVI format for windows. This type of file plays easily on most media players. Compression agents allow us to control file size to a degree. However, animations can be rather large in size and may take up to several hundred megabytes of disk space. A compression agent, which we found to work well with most computers, is Indeo 5.1. For good output size, we typically use a resolution of 640 x 480 pixels. This is considered low resolution for computers and produces good full-screen quality when played.

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.

The current version of Blender is the first version to allow 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 and tutorials

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.

"O" key- The "O" key (not zero) will put you into proportional vertex editing while in edit mode.

"A" key- While in edit mode it's good for selecting all vertices for commands like remove doubles and subdivide. "A" twice will clear selected and reselect.

"B" key- Gives you a box (window drag) to select multiple objects. In edit mode, works the same to select multiple vertices, but hitting "B" twice gives you a circle select that can be sized by scrolling the mouse wheel.

Space Bar- 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, right to select, 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.

"R" key- Rotates an object or selected vertices.

"S" key- Scales a selected object or vertices.

"G" key- Grabs or moves the object or selected vertices.

"P" key- While in edit mode, selected vertices can be separated into a single object by pressing P.

Shift-"D"- Duplicates or copies selected objects or selected vertices.

"E" key- While in edit mode, selected vertices can be extruded by pressing E.

"U" key- In Object Mode, brings up the Single-User menu to unlink materials, animations (IPOs), etc. for linked or copied objects. Undo command. Only works in edit mode and can now go back multiple steps. Sorry, no system-wide undo command.

"M" key- Moves selected objects to other layers. **Mirror-** while in edit mode, "M" will give you a mirror command.

"Z" key- Toggles view from wireframe to solid.

Alt "Z"- Toggles a rough texture/shaded view.

"P" key- Starts 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.

"N" key- Brings up the numeric info. on a selected object (location, rotation and size). Info. can then be changed in the window.

Ctrl "J"- Joins selected objects together.

Alt "A"- Plays animation in selected window. Your cursor must be in that window for it to play.

"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.

"W" key- Boolean expression to union, create a difference, or subtract objects from one another. "W" will also give you a "**specials**" menu while in edit mode.

"X" or Delete- Delete selected objects, vertices or faces.

Function Keys- F1-Load File; F2-Save File; F3-Save Image; F4-Lamp Buttons; F5-Material Buttons; F6-Texture Buttons; F7-Animation Buttons; F8-Real Time Buttons; F9-Edit Buttons; F10-Display Buttons; 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 there of. If your cursor is down in the buttons portion of the screen, animation keys can be added to lights, materials and world settings.

"Alt" "U"- New to Blender, a **Global Undo Command.** Pressing "Alt U" will give you a list of commands that can be undone. By default it is set for 32 steps, but can be changed in the User Preferences panel at the top of the screen.

"Alt " "C"- Used to convert meshes, text and curves. For example, if you create text and would like to convert it into a mesh, Alt-C will convert it into a curve, then Alt-C again will convert it into a mesh.

"Shift" "Space" Toggles between multiple screens to full screen of active viewport.

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 the armature in Pose Mode.

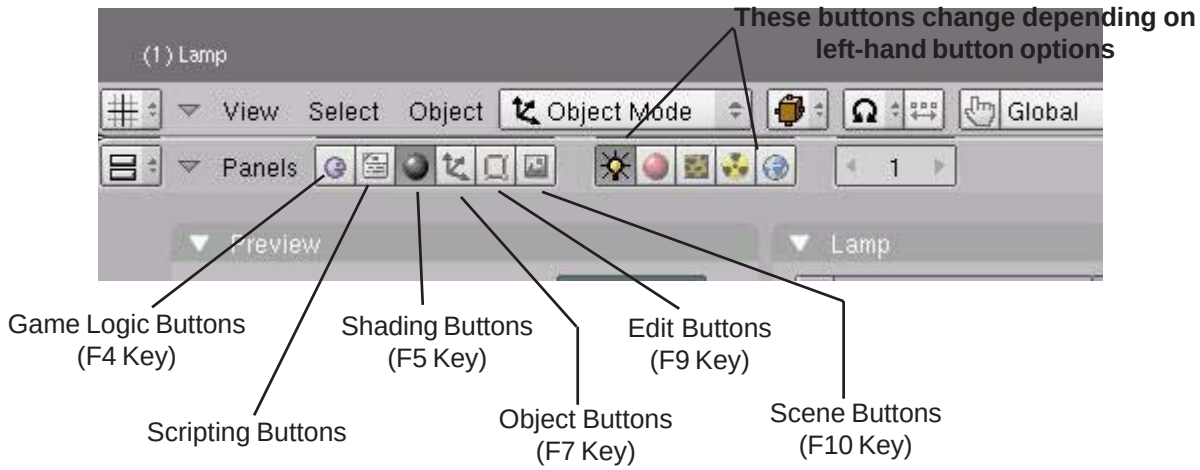
Ctrl-Tab- Puts you into Pose mode for manipulating armatures.

Import/Export- Blender accepts .DXF and VRML(.wrl) files. Just use the OPEN option from the file menu to insert these types of files into an already existing scene. 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.

Springs/Screw-Blender can create these objects in the edit buttons. You need a profile of the object, the cursor at the center of revolution, and 2 vertices to show the length of the revolution. The profile and the length vertices need to be in the same object. All vertices need to be selected when performing the operation. You will also need to be in the front view. There are several tutorials to help with this operation. Results are great!

Multiple Viewports- To create multiple viewports, move your cursor over the edge of the viewport (to start, you only have the drawing window and the button window-move your cursor to the break between them). Right click on the break and select split area. Blender will break the area that you brought the cursor from

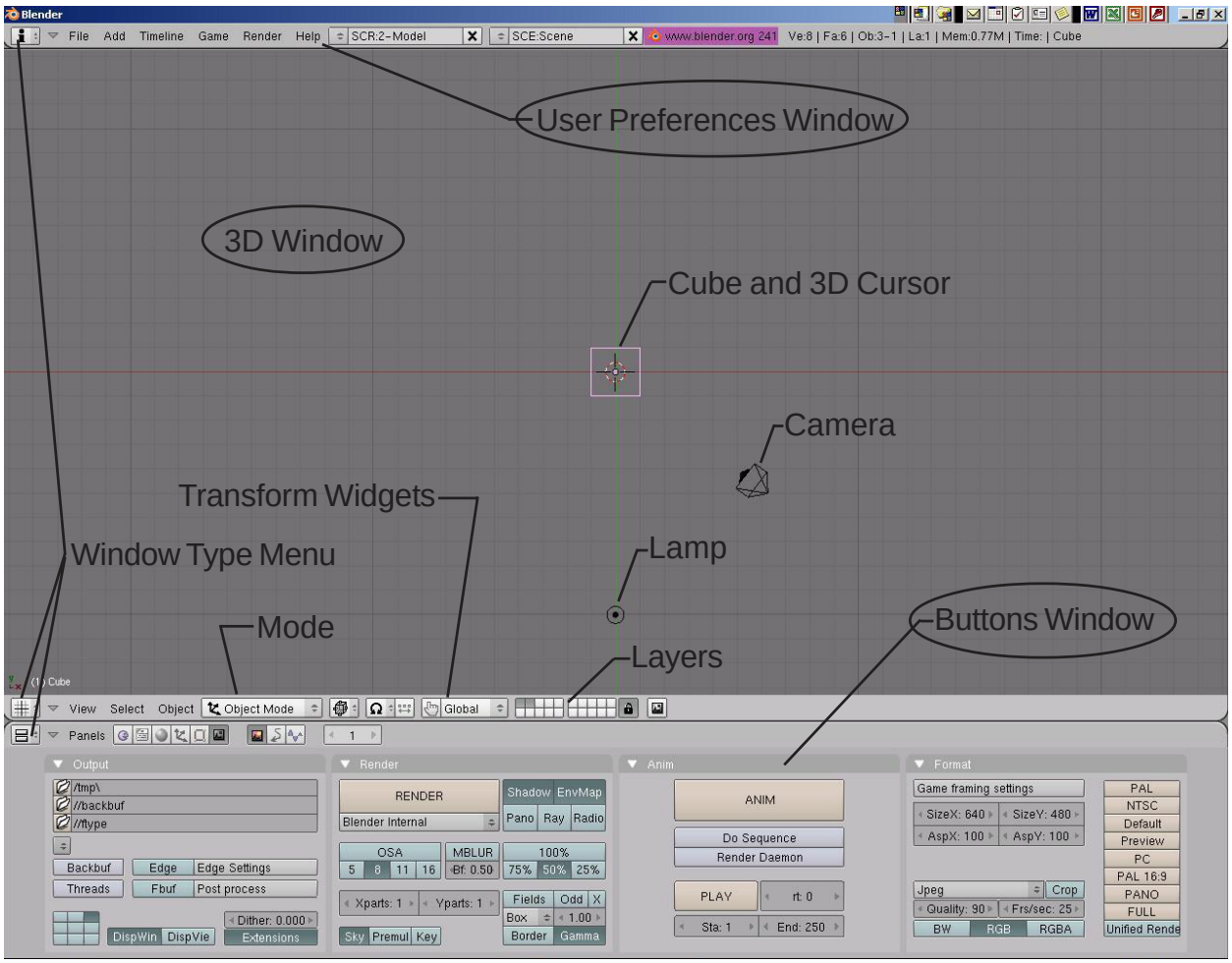
Basic Button Panels



Chapter 1- The Blender Interface

The Blender Screen

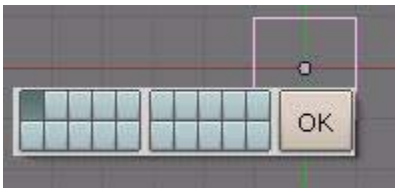
When I first looked at Blender and read some tutorials I thought that this looked easy and made sense. After taking the program for a test run, I decided to forget about it for a while because I couldn't make anything. The interface is different than any other programs I've experienced before. I thought I'd try again and after a few week however, things began to make sense and I realized the potential of the program. Here's what you are looking at when you open the program:



You are looking down at a scene consisting of a cube, lamp and a camera (top view). 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 (a plane instead of a cube and a light), 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 a viewport along the bottom that changes every time you select a different button. This "Buttons Window" can be changed around, but for now, lets keep it where it's at.

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

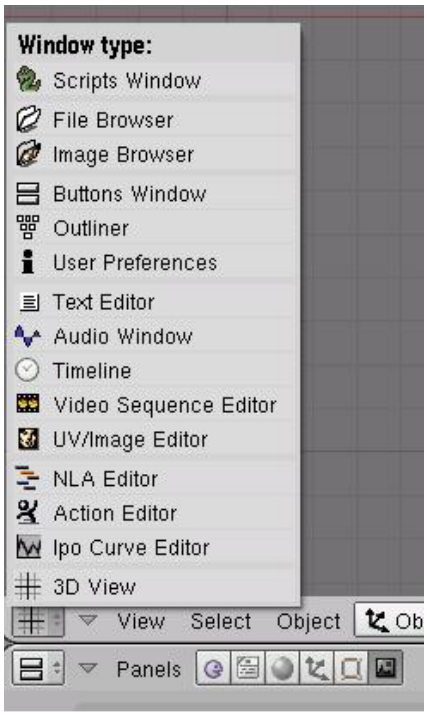
your scenes get bigger, turning layers on and off help with the speed of your work and being able to see things better. To change things between layers, select the object with the **Right Mouse Button (RMB) and type "M" for move**. Try it with the plane and change layers. By the way, if you put it in a layer that's turned off, it will disappear. To turn that layer visible, click on that button. To turn on multiple layers, hold down "Shift" and click on the buttons.



***Quick Tip*: To 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 3 windows, the top one with the toolbars, the 3D window, and the bottom buttons window. You can set all 3 of them to display the buttons if you like (but I'm not sure why you would want to). The various window types are as follows:

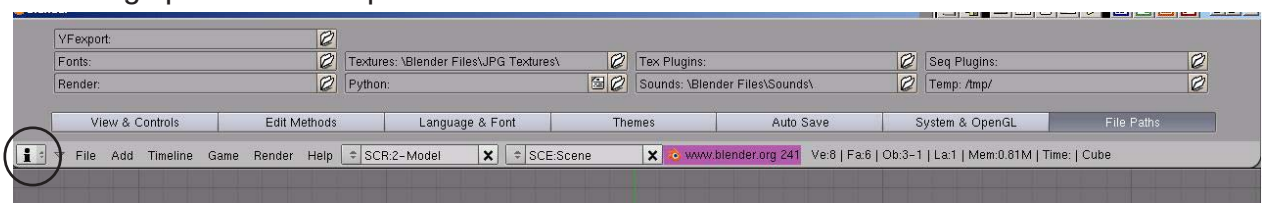


The window types that we are most interested in right now are:

- File/Image Browsers- comes up automatically on demand in most cases
- Buttons Window- for commands
- User Preferences- menus and options
- Video Sequence Editor- join movies and effects
- UV/Image Editor- for applying game textures
- Action Editor- for animations
- Ipo Curve Editor- also for animations
- 3D View- to see our work and model items

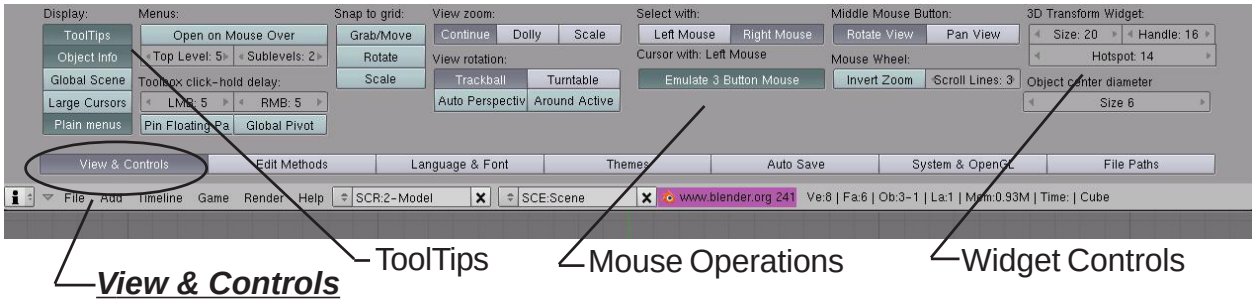
The User Preferences Window

If you place your mouse on the line between the 3D window and the User Preferences Window (at the top), hold down the Left Mouse Button (LMB) and drag down, you will expose a number of setting options at the top of the screen:



Settings of interest to us at this time in the **User Preferences** window-

- View and Controls- tool tips and mouse settings
- Edit Methods- how things are linked and duplicated, undo settings
- Language and Fonts- text style and sizes
- System and OpenGL- change some system settings
- File Paths- tells Blender where to look for certain things



ToolTips

Mouse Operations

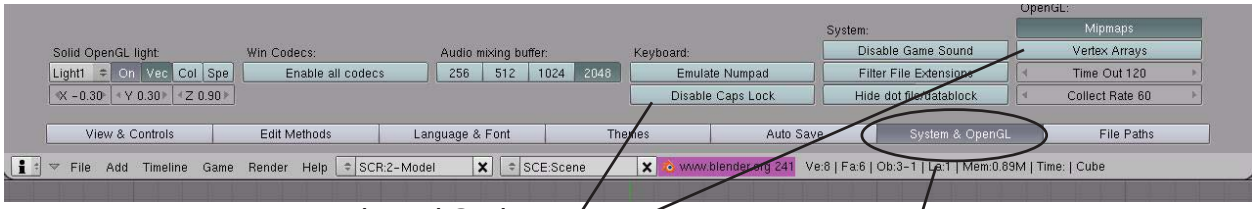
Widget Controls

View & Controls

Edit Methods

Global Undo (Alt-"U" keys)

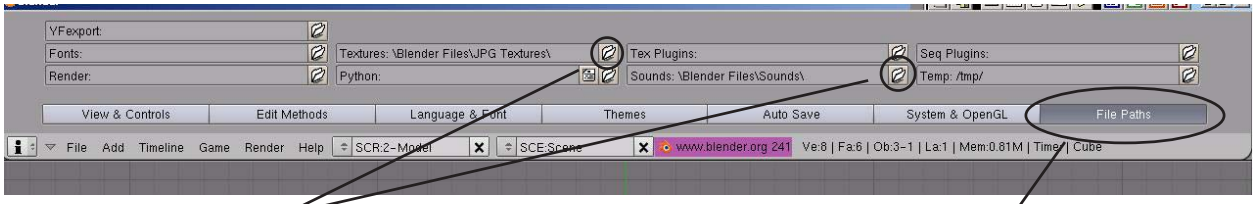
Linked Data



Keyboard Options (for laptops)

Vertex Arrays- (improve graphics)

System & OpenGL



Click on folders to set paths-

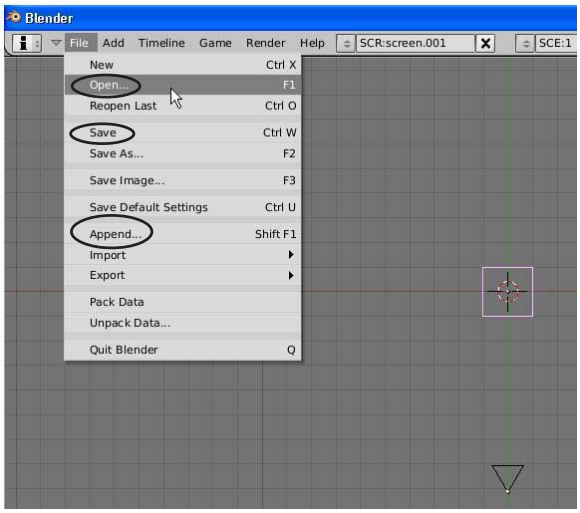
This will help later so Blender goes straight to these folders when needed.

File Paths

If you would like these changes to always be in place whenever you start Blender, press the **Ctrl- "U"** keys and save as **User Defaults**. You will need to use the LMB and click on the actual words "Save User Defaults" for the save to occur.

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!

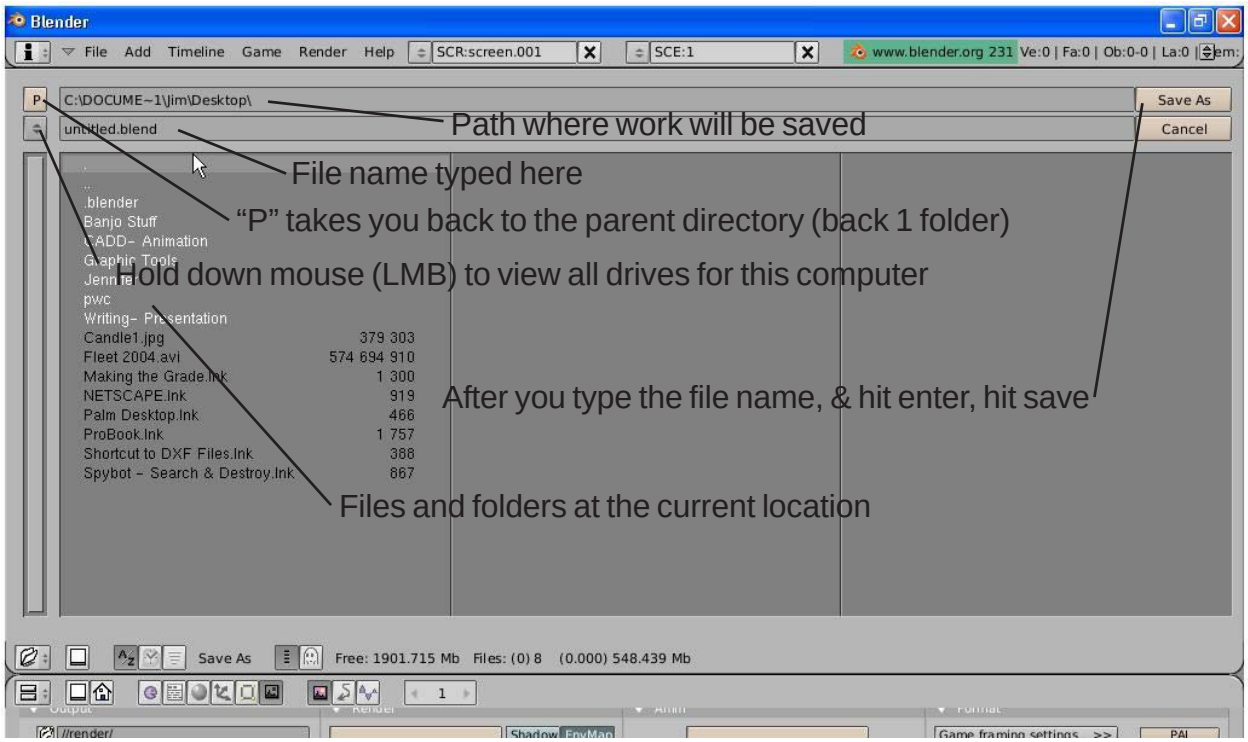
Open, Saving and Appending Files



Blender utilizes commands similar to other programs when it comes to saving and opening your work with a few exceptions. Other programs use "import" and "insert" commands to bring other files together. Blender just uses "**Open**" and "**Append**". If you are bringing elements in from another Blender (.blend) file, you use "**Append**". If you are bringing other types of files into Blender, you only need to use the "**Open**" command and this will insert the other file types into your Blender file. Blender accepts VRML (.wrl) and .DXF files into the program. This is ideal because most 3D drawing programs (like all our applications) use these types of files to export work. Blender does an excellent job of accepting work from other programs. We rarely see any problems with our imported models.

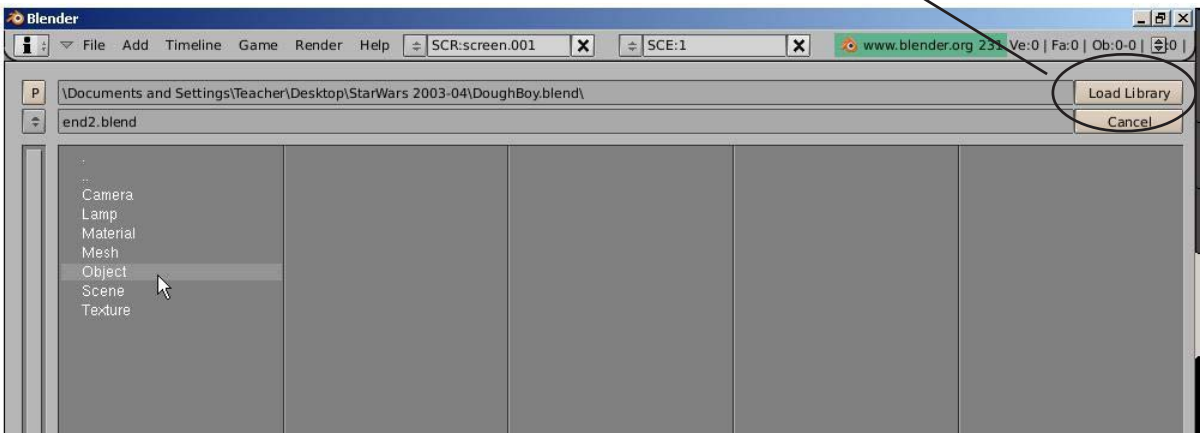
The Save Command

When you first start working with Blender, it seems almost impossible to figure out how to save your work. 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:

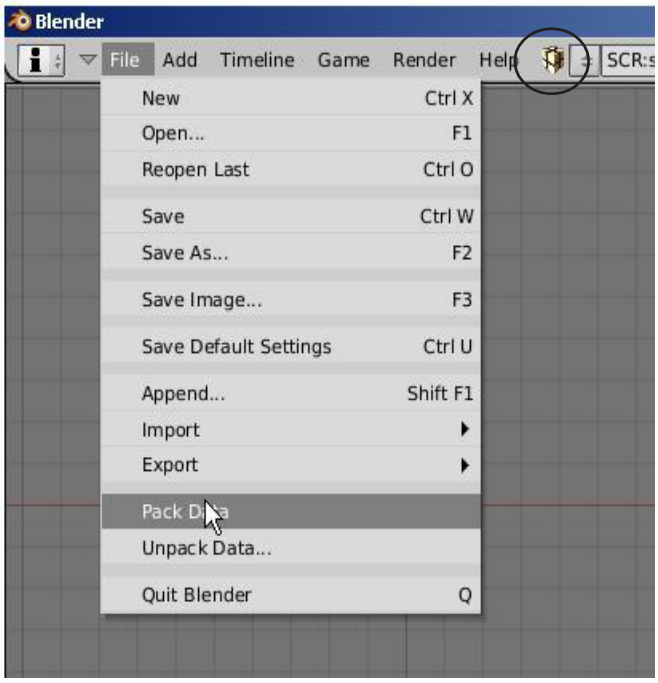


The Append Command

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. Right Mouse Button (RMB) clicking on objects will select\deselect them. Typing "A" will select them all. After you select all objects to append, click the "Load Library" button in the upper right corner of the screen.



Packing Data



If you plan to open this file on other computers, you will need to select the "**Pack Data**" option in the file menu. 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.* You can also unpack data to bring the file size back down.

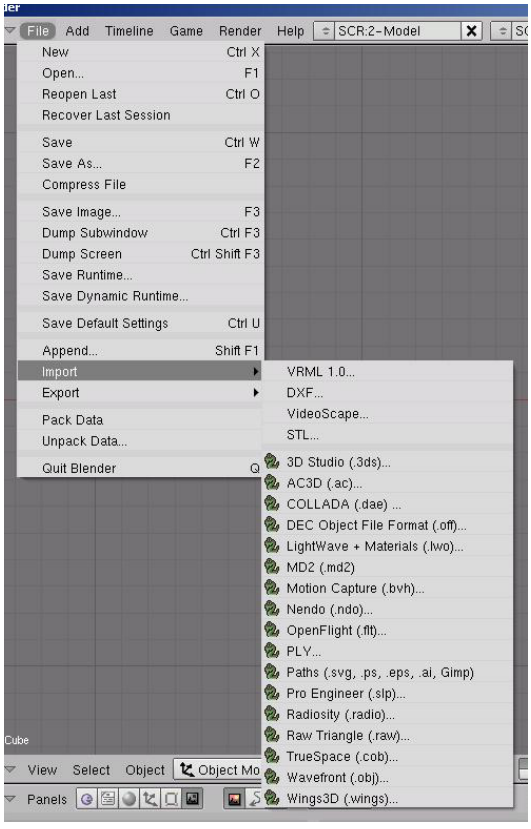
Importing Objects

One of Blender's strong points is the program's ability to accept several generic types of 3D files from other programs. 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 dependig 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 resized or rotated.



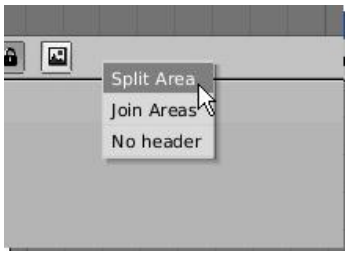
With every new release of Blender, the import/export format options list grows. This makes Blender much more compatible with a variety of other 3D modeling and animation software programs. You should be able to find a format in the list that will work with your other programs.

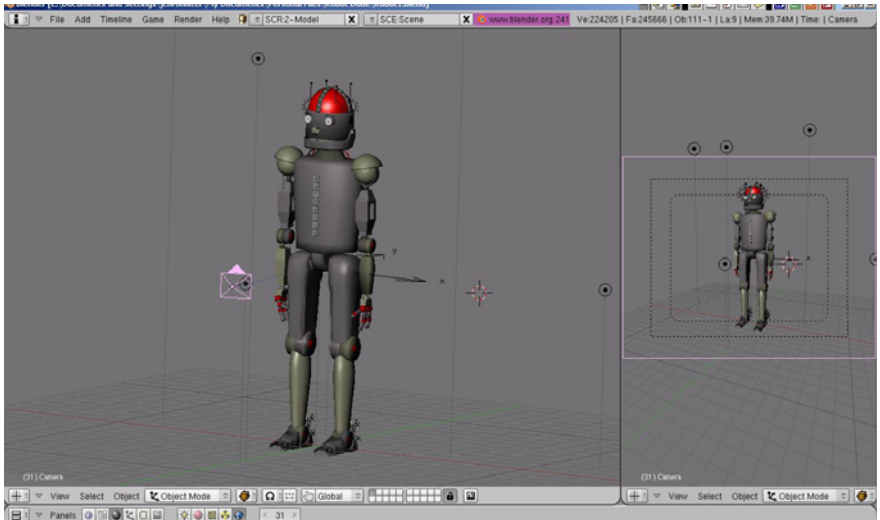
When importing Blender files into other Blender files, remember to use the **Append** command instead of import. In the Append command, select the file, then select what you would like to bring into the current file. You will usually want the "Objects" option.

Chapter 2- Working with Viewports

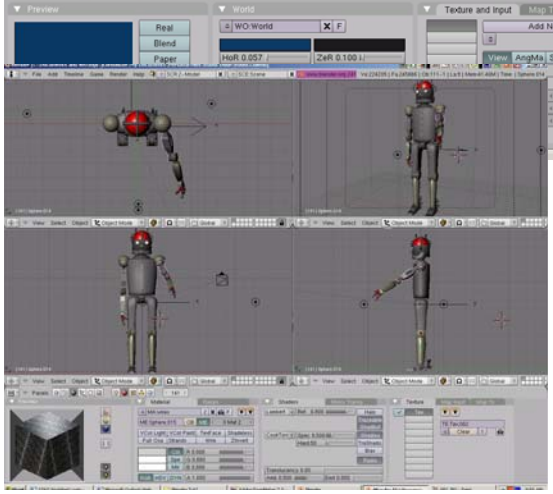
Creating Viewports (also called windows)

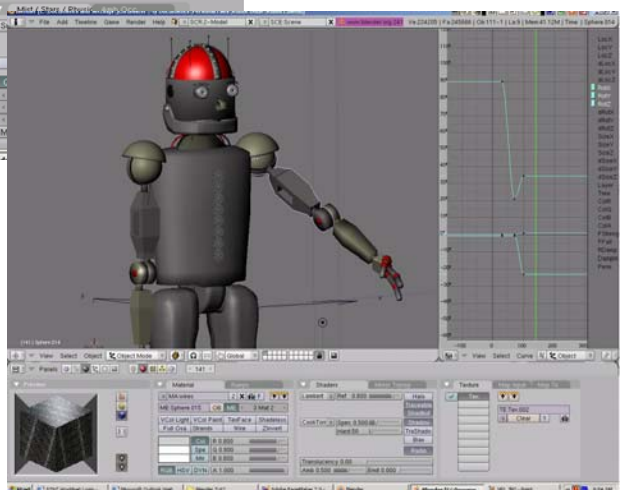
Most times, you need more than one 3D window to work with since you're trying to locate objects in three dimensions. Most rendering and animations programs allow for multiple viewports along with graphical views of various data. Blender allows the same. Remember that Blender starts with 3 viewports that are set to User Preferences, 3D Window and the Buttons Window. You can change the size of any of these windows by using the LMB and draging on the line between the viewports. You will notice the arrow pointer changes to a double headed arrow while over the line. **In order to split the screen and create another viewport, while the cursor is over the line, Right Click (RMB) and select "Split Area"**. Drag the line to a desired location and size. By moving the mouse to either side of the viewport line, you select the side to split. Joining viewports together works the same way. 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).



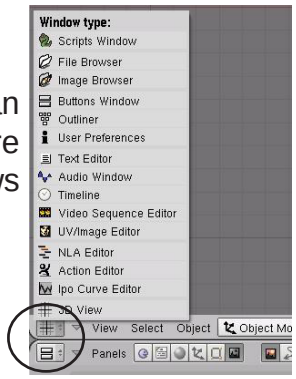


Windows can also be split along a vertical line. Some 3D programs traditionally give you 4 viewports that are set-up as front, top, right side, and perspective or camera views. Basically, it is up to what you want to work with.





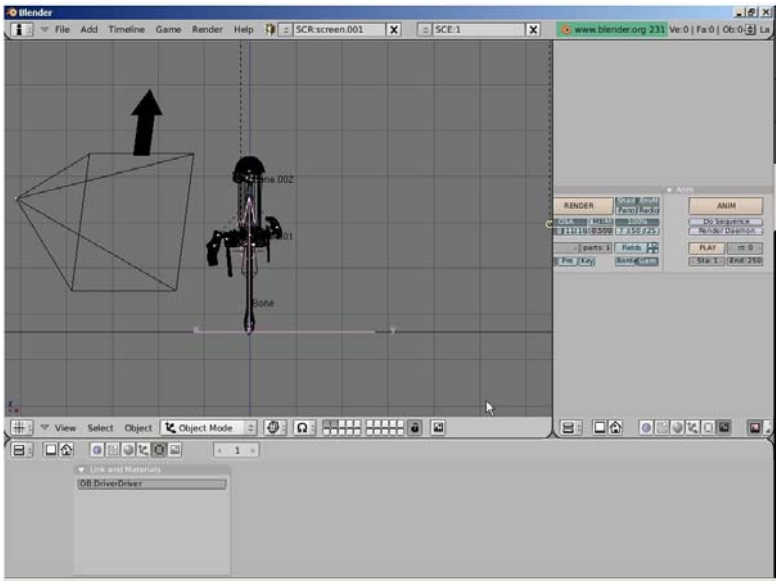
Changing Window Types



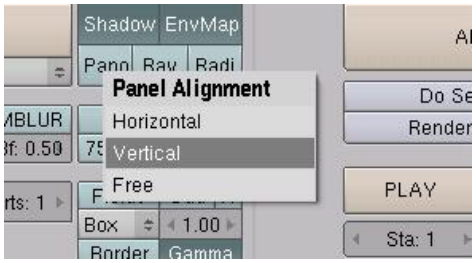
Now that you've added some viewports, remember that the viewport can be changed to a different type (refer to page 7). As you become more familiar with Blender, you will need to use the IPO, Action Editor windows and more.

The Buttons Window Option:

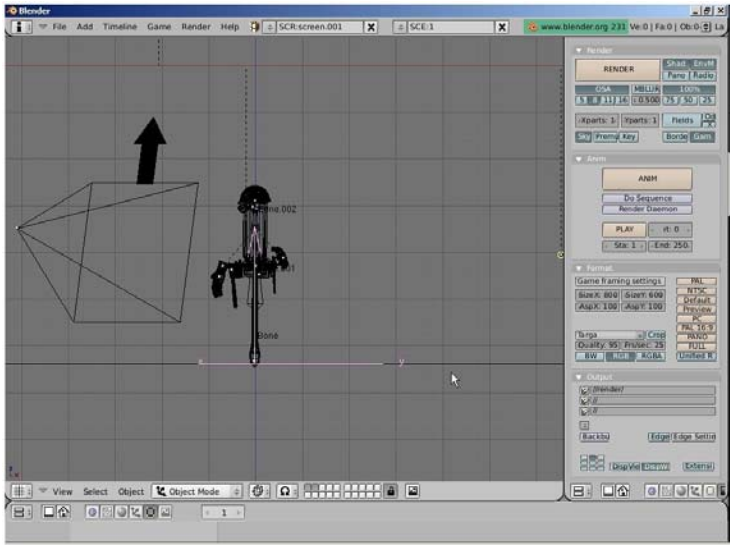
Traditionally, Blender has placed the Buttons Window at the bottom of the screen, but has recently given us an option to arrange them vertically on the side like some other 3D programs out there. This has been done in an effort to make learning the program easier for new users. You first need to split your 3D window in half, then select the Buttons Window type from the menu.



Looks good, but needs some adjustment. The buttons are arranged horizontally and off the screen. To change the arrangement, Right Click (RMB) in the window and select "Vertical". Adjust the windows to a desired size and use the plus



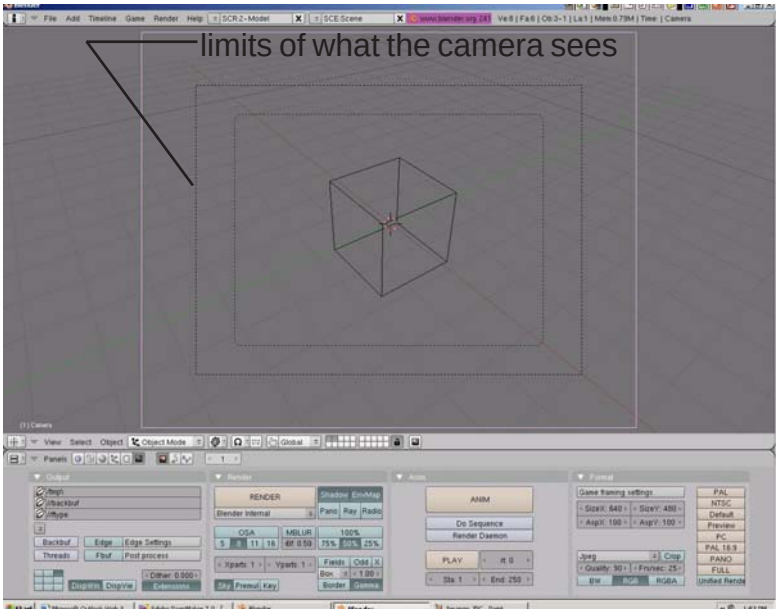
and minus keys on the number pad to zoom in and out on the buttons to get them sized to fill the screen. Hold down the mouse wheel (don't scroll) to move the buttons around. The only problem with this method is that the buttons at the bottom of the window are still off the screen. In order to access those buttons, you need to hold down the center wheel on the buttons and drag the buttons around. I still prefer the buttons window at the bottom of the screen, but this is another option available.



Chapter 2- Working with Viewports

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**. 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).



The camera is represented by 3 lines. The outer solid line is what you can click to select the camera. The outer dashed line represents the limits of what the camera can see. The inner dashed line helps with centering your scene.

The number pad 5 key will 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.

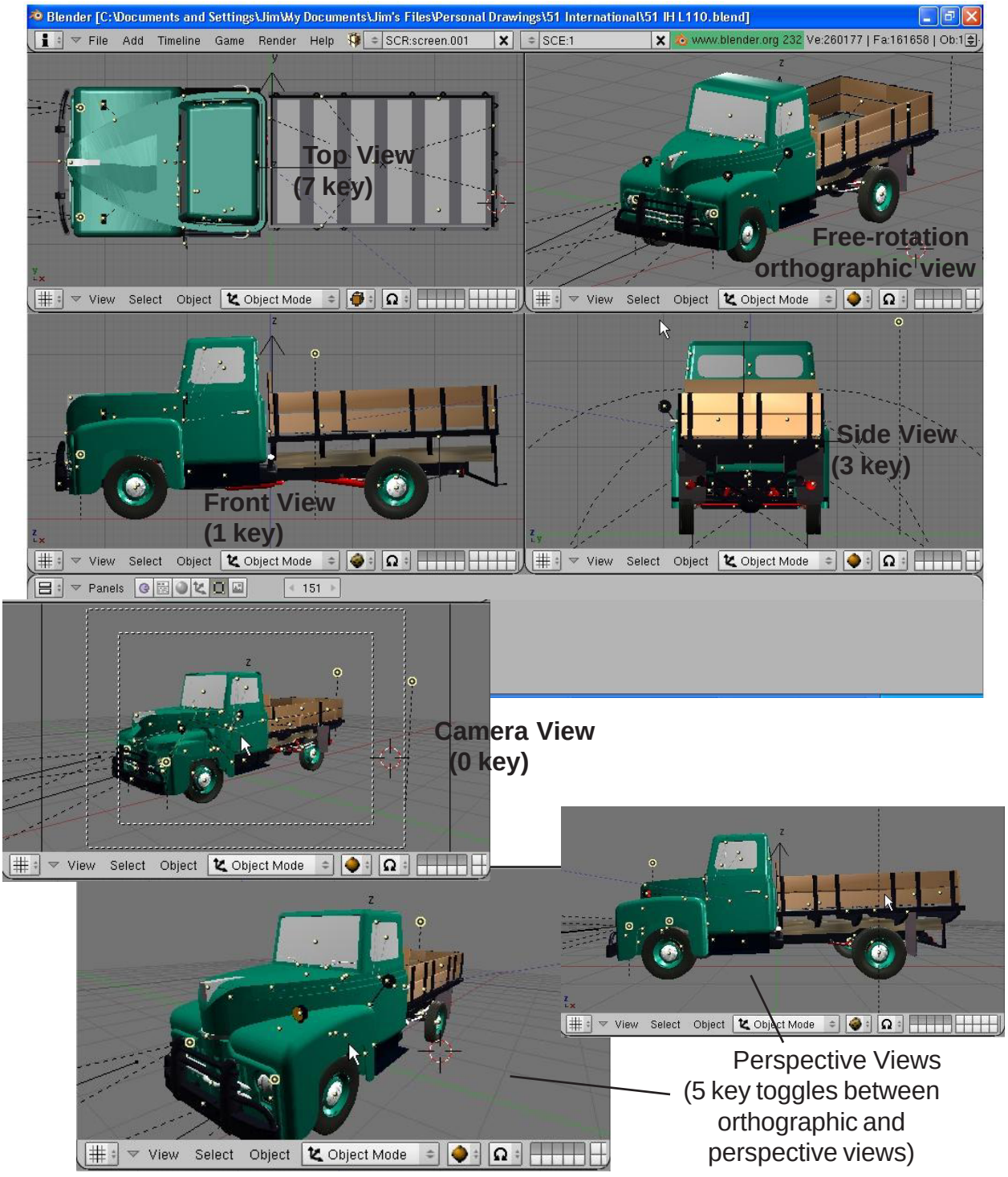
The mouse serves a number of functions. The Left Mouse Button (LMB) will move the 3D cursor around on the screen and for dragging windows for selecting objects. *Wherever the 3D cursor is located is where the next item you create will be placed.* The 3D cursor serves other purposes that we will discuss 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.

***Quick Tip:* 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.**

Now that you know what you're looking at and how to move around on the screen, we can begin making objects in Blender!

Typical Views and Buttons:

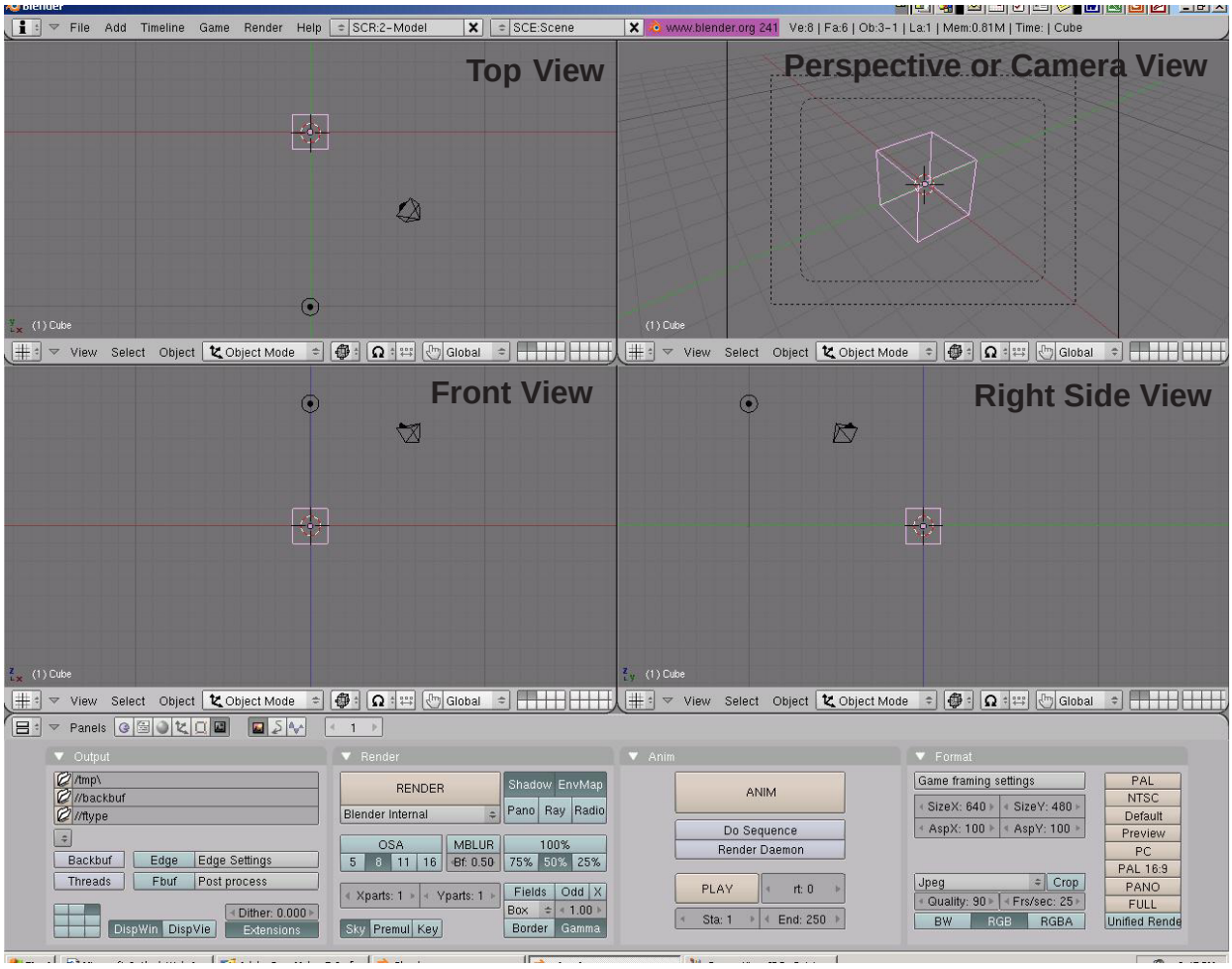
Here are some typical views used to model in 3D and the buttons on the number pad to go along with them. In order to make them work, you need to have the “Num Lock” button pressed. Get use to working with the principle views (top, front, side) in orthographic mode when locating the 3D cursor. You will usually need to check the location of the cursor in at least 2 views when placing objects.



Viewports Practice Exercise

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*
- *Zooming*
- *Changing window types*
- *Centering the view on a certain object*
- *Switching views (top, front, side, camera, free-rotate)*

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

Working with Basic Meshes

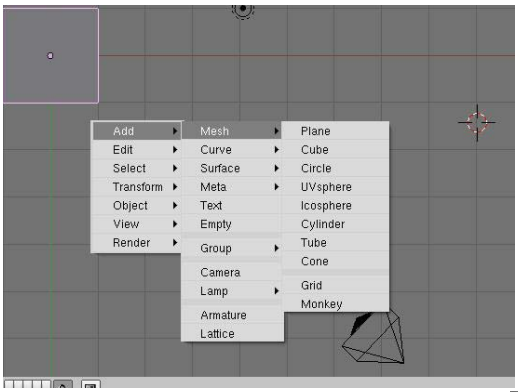
Now that we know how to move around in Blender, let's start doing some basic building and shaping. In this chapter we will talk about creating basic shapes and using modifiers to form them. There are a lot of different types of things to draw in Blender. Right now we will only discuss *Meshes.*

Start a new drawing in Blender and save it in your "My Documents" directory. Call it *Sculpture*. In Windows XP, in order to get to your "My Documents" folder, do the following:

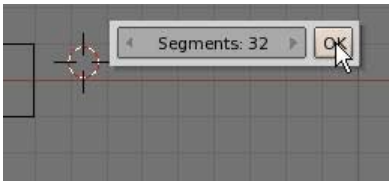
1. Go to File- Save
2. Select the C: drive (see page 9 in Open, Save, and Append section)
3. Click on the "Documents and Settings" folder, find your login folder.
4. In your folder you will find "My Documents"
5. Type in the file name (Sculpture), hit enter, then "Save"

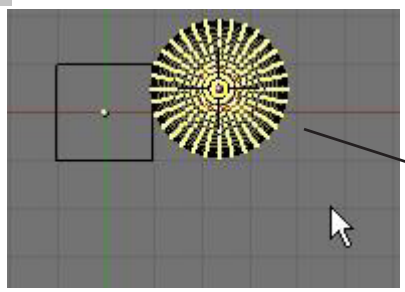
Quick Tip: Blender will not prompt you to save you file when exiting the program. Remember to always save your work often!

Placing Objects On Your Screen

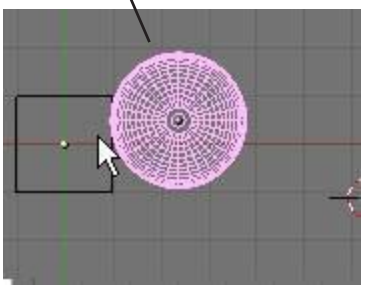


The 3D Cursor (bullseye) location is used to place new objects. Use the left mouse button to move the cursor in 3D space When you have it in a good location, press the **Space Bar** to bring up the insert menu. Select **Add**, then **Mesh** and select **UV Sphere**. You will then be asked how many segments and rings you want. You can change these by draging the mouse in the block or by holding down the **Shift** key and clicking in the box. This will allow you to type in a number. You can keep it at 32 for now. After that, your sphere will be displayed on the screen.





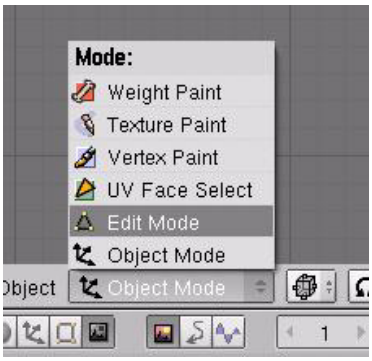
Object Mode



When you place an object in Blender, it comes into the scene in ***Edit 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. ***After inserting an object into your scene, press the Tab key to exit edit mode. Otherwise, the next object you create will be joined to that mesh!***

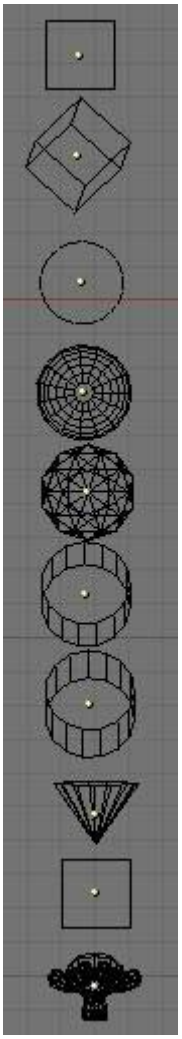
Chapter 3- Creating & Editing Objects

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 dicussed in later chapters.



Mesh Types

When pressing the space bar and choosing to add a mesh, you will notice several mesh types (often called primitives) available. They are:



Plane- A simple two-dimensional shape ideal for grounds. Can be sub-divided and used with proportional vertex editing to make nice hilly terrain.

Cube- Basic 3D shape. Nice object to start with to shape into rectangles and other shapes.

Circle- Won't display as a 3D object, 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

Cylinder- Like a can, closed with a top and bottom.

Tube- Just like the cylinder, except open at ends.

Cone- Basic closed cone shape.

Grid- Can be used and extruded like the plane.

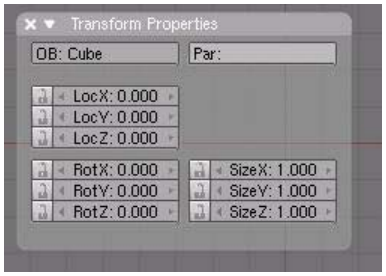
Monkey- A fun shape that someone decided to include in the mesh list.

Quick Tip: **Remember that whenever you create something new, it enters your scene in Edit Mode. *Any new objects you create while in edit mode for the previously selected object will be joined to that object*. After you create a new object, remember to hit the "Tab" key to exit edit mode. Also, remember that a new object will be created where the 3D cursor is located.**

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

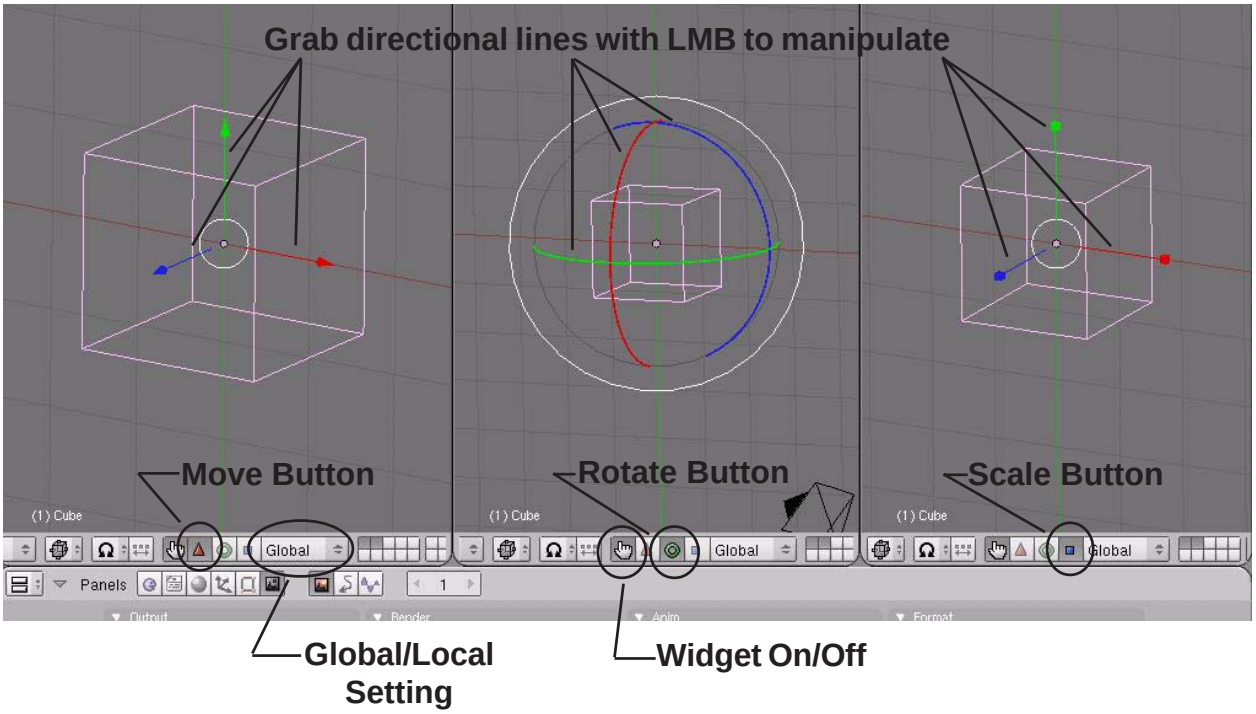


If you would like to do any of these operations through an exact number (i.e. rotate 90 degrees on the X axis or size something to a specific number), type the "**N**" key to bring up the **Numeric Window**.

Quick Tip: If you would like to move something along a stright 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.

Using the Transform Widgets

A relatively new feature to the program is the transform widget menu. 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) or Local (X,Y,Z planes in relation to the object) movement.



Creating Objects Practice Exercise

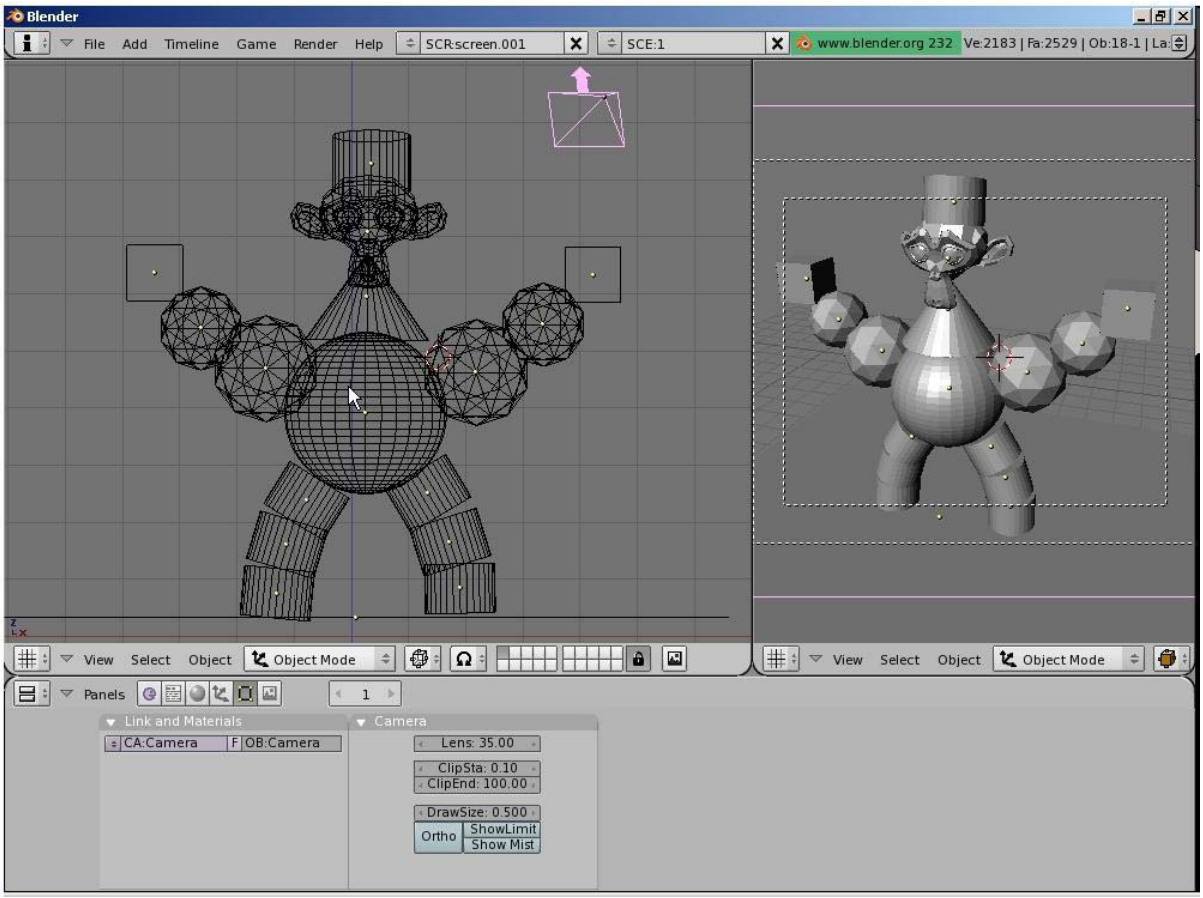
PRACTICE EXERCISE

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 exit edit mode (Tab key) after every object you create.*** 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.
Shaded	("Z" key)- used to toggle the window from wireframe to shaded view.

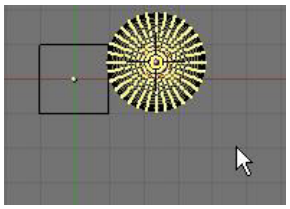
Remember to make use of the number keys 1,3 and 7 to change your principle views! Also play with the camera location and angle to get a nice view!

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

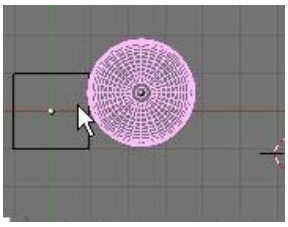


***** Call the instructor when finished*****

Edit Mode- Mesh Vertex Editing



Edit Mode for Sphere



Object Mode for Sphere

After you have created a mesh, you can go into **Edit mode** (Tab key) and change its shape. In edit mode, you can work with the shape's individual verticies (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 verticies while **yellow dots** are selected verticies.

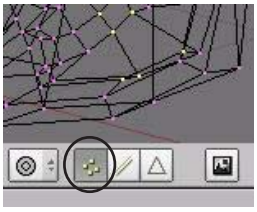
> ***Quick Tip:*** ***UNDO in Edit Mode- If you move or copy some verticies incorrectly in edit mode, pressing "U" for undo will take you back one step at a time!***

Selecting Verticies:

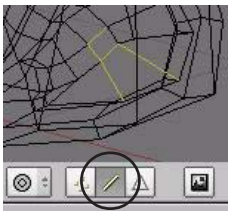
While in edit mode, to select a single vertex, RMB click on the vertex. To select multiple verticies, hold down the **Shift** key while RMB clicking on them. To drag a window around verticies, type "**B**" key and drag a window to select. Typing the **"B" key twice** will bring up a circular selection 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. Pressing "**Esc**" will get you out of the circular selection tool. **In order to select *all* verticies or deselect currently selected ones, hit the "A" key (for all) once or twice**.

New Selection Options:

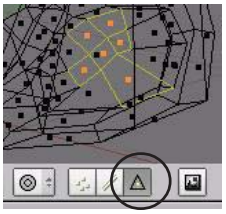
Blender now has other selection options. You can find these options at the bottom of the 3D window while in edit mode.



Vertex Select



Edge Select



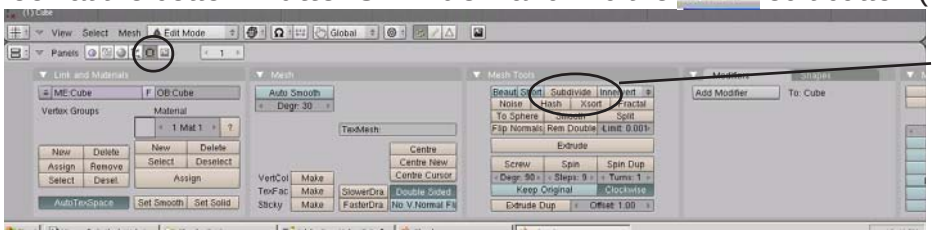
Face Select

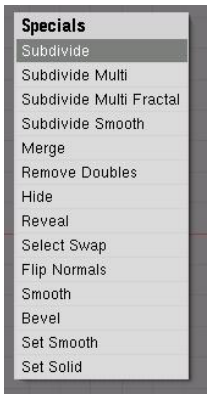
Basic Modifiers:

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

Creating More Verticies:

Sometimes you need to add more verticies to some or all of the mesh in order to manipulate it to your desired detail. To do this, you must first select all the verticies you wish to split, then look at the bottom **Buttons Window** and find the  edit button (looks like a plane in edit mode). Find the ***Subdivide*** button and click it as many times as you need to.



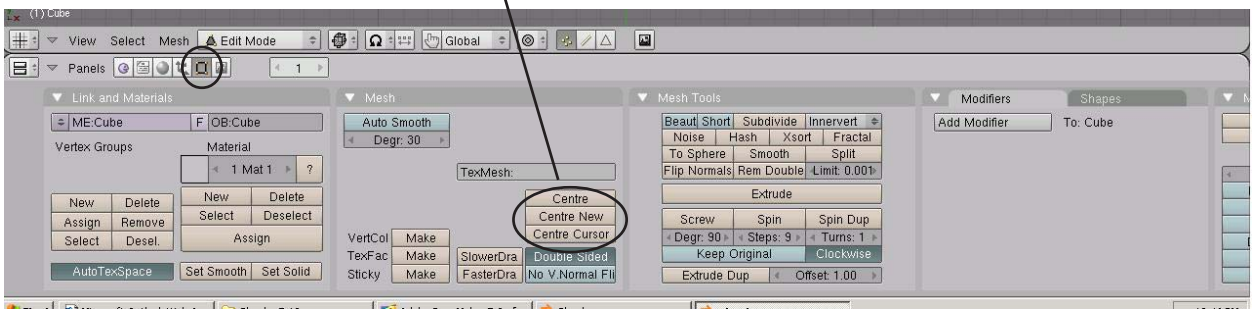


Specials Menu:

In edit mode, pressing the "**W**" key will bring up a shortcut menu that will give you a variety of editing options. Most of these options can also be selected in the edit buttons as discussed on the previous page.

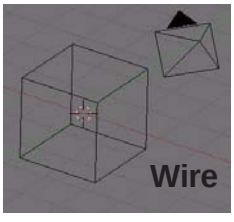
Center Points:

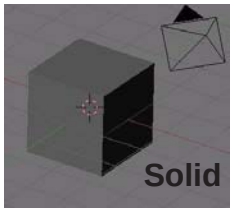
Every object you create in Blender has a small dot somewhere in the object (by default, usually in the center of that object). This is the **object's center**, or pivot point. Beginners in Blender often get these center points moved around to points other than where they want them. This happens because they move all the verticies of the object in edit mode, but the center point fails to move. **If you want to move an entire object, hit tab to get out of edit mode and into object select mode**. Using the "G" key to move the object in this mode will move the center point along with the object. If you ever need to relocate an object's center point, move the 3D cursor to the desired center location, then find the "**Centre Cursor**" button in the edit buttons. This will change the object's center location. If you select "**Centre**", The object's data (points and faces) will move to center around the object's center. If you select "**Centre New**" , the program will move the center point to the object data's mathematical center.

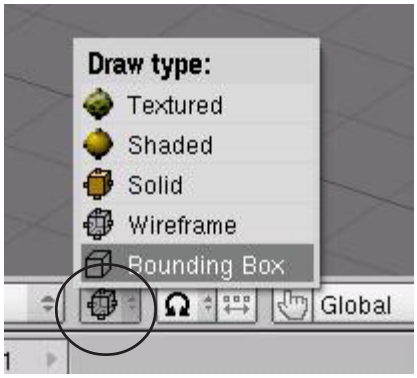


Viewport Shading

Usually by default, the viewport is set to **Solid** shading. Many times, you will need to work with your objects in **Wireframe** mode. All shading does is changing the way you see your objects. Shading also affects the way you can select verticies in edit mode. In solid shading, only visible verticies can be selected. In Wireframe, all verticies can be selected. **To change between Solid and Wire modes, press the "Z" key or select the shading mode from the toolbar.**

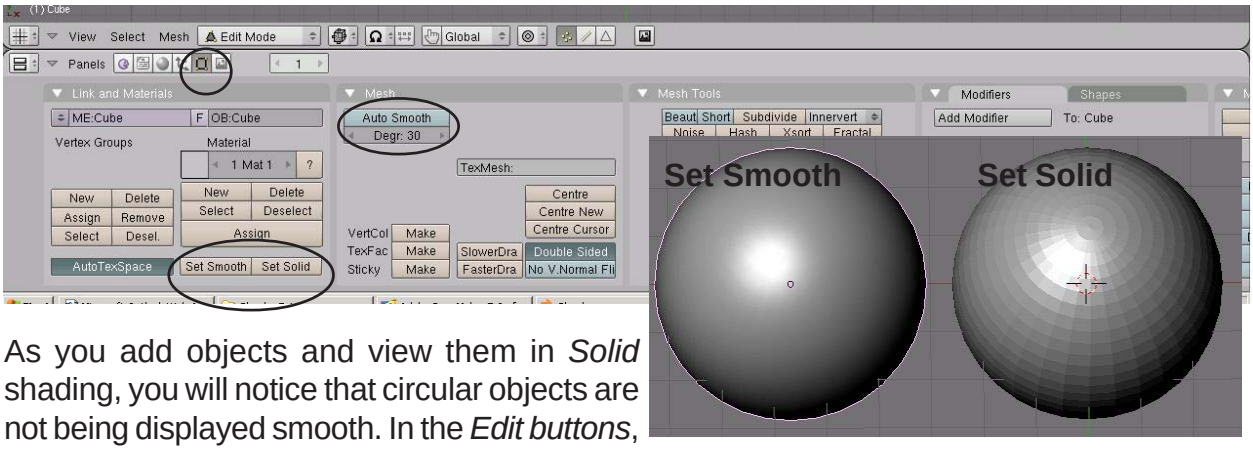




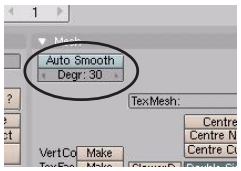


You will notice several other shading options in the menu. Experiment with the other options.

Using the Set Smooth-Set Solid Options and Auto Smooth



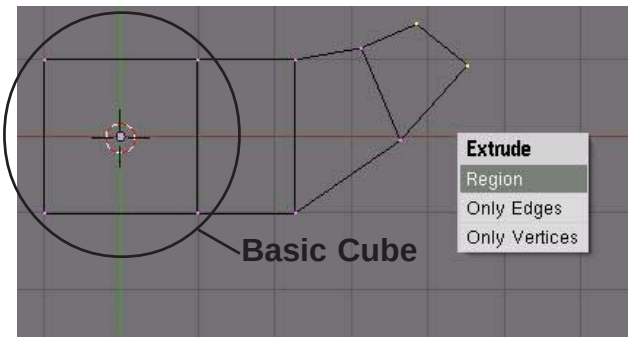
As you add objects and view them in *Solid* shading, you will notice that circular objects are not being displayed smooth. In the *Edit buttons*, you will see two buttons labeled **Set Smooth** and **Set Solid**. These 2 buttons not only effect the way things look on the screen, but how they will be 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.** The computer needs to conserve memory because 3D applications can be very memory intensive on your computer. There are other smoothing options available in the Edit panel, but they will be discussed in a later chapter. **Auto Smooth** is used

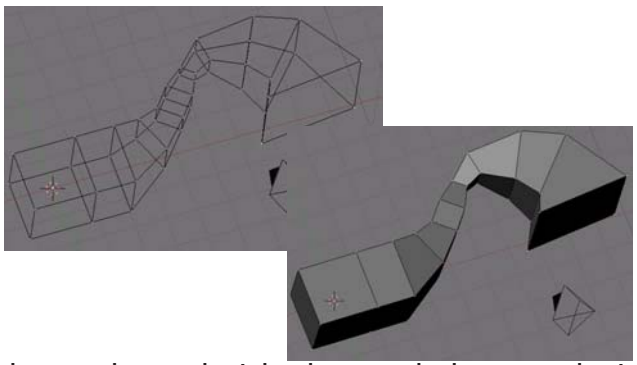


to smooth objects when faces meet at a certain degree or less. This is a great feature when *Set Smooth* does not work properly alone. To use **Auto Smooth,** enter **Edit** mode (*Tab* key), select **All verticies** *(or just the ones you want to Auto Smooth)*, then press the **Auto Smooth** button. Exit **Edit** mode, then press **Set Smooth**. Adjust degrees as needed and render.

Extruding shapes:

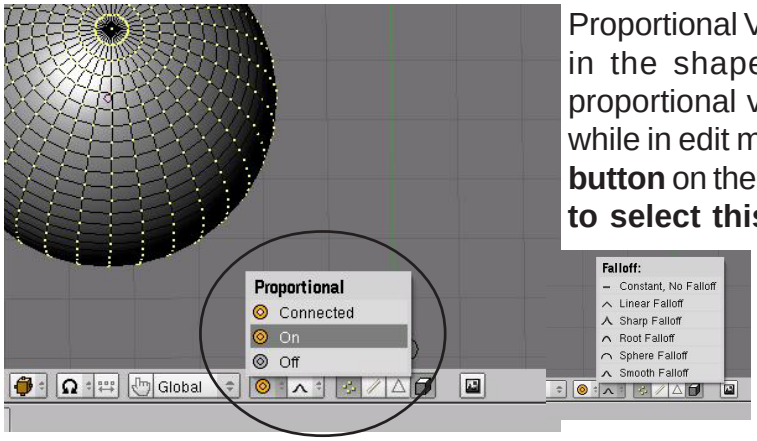
Shapes can be lengthened by selecting a group of verticies, then by pressing the "**E"** key and confirming by clicking "ok", you will make a duplicate of those verticies. They can then be "G" (moved), "S" (scaled), and "R" (rotated). Blender has added a few more options to the extrude menu. Feel free to experiment with them. The one that you will usually want to use is the **Region** option. When you select the region option, the verticies will be extruded along a locked axis. To free the verticies so you can move them in any direction you wish, **click the Center Mouse Wheel** once or twice (don't scroll, press the wheel like it's a button). Below is an example of a cube, extruded from the right side several times using scale and rotate.



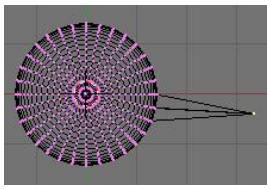


Extrude is a great command for making long tubes and tunnels. It is also good when you don't want to subdivide an object too much in order to add detail.

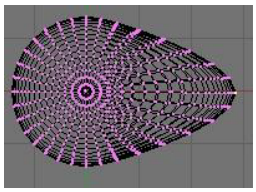
Proportional Vertex Editing:



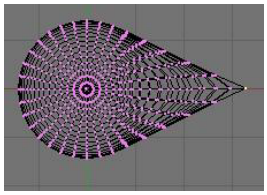
Proportional Vertex Editing is used to create a flow in the shape when editing vertices. To turn proportional vertex editing on, press the "**O**" key while in edit mode or by selecting the **small circle button** on the toolbar. **Note: you will only be able to select this option while in edit mode.** You have several options for effecting verticies in proportional editing. We usually use **Sharp** or **Smooth** falloff, but feel free to experiment with the other options.



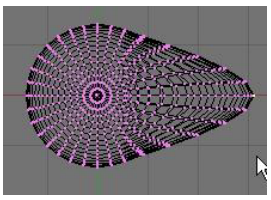
Proportional Vertex Editing "Off"



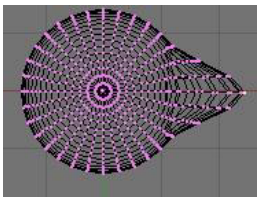
Proportional Vertex Editing "On"



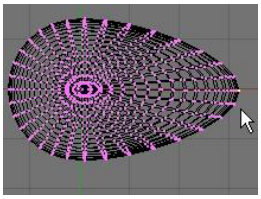
Sharp Falloff



Smooth Falloff



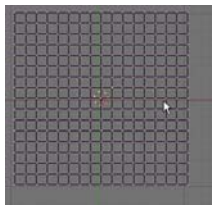
Small Area



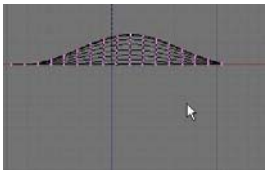
Large Area

The number of effected verticies is controlled by the "+ and -" arrows on the number pad or by scrolling the center mouse wheel.

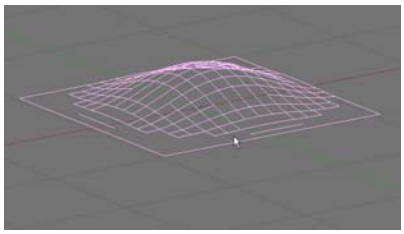
Creating Ground:



You can use proportional vertex 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 verticies are selected (verticies are yellow). You can use the "**A**" key to select them all. Press "**W**" key for specials menu, then select "**Subdivide**". Do this a few times. Select a single vertex somewhere near center.



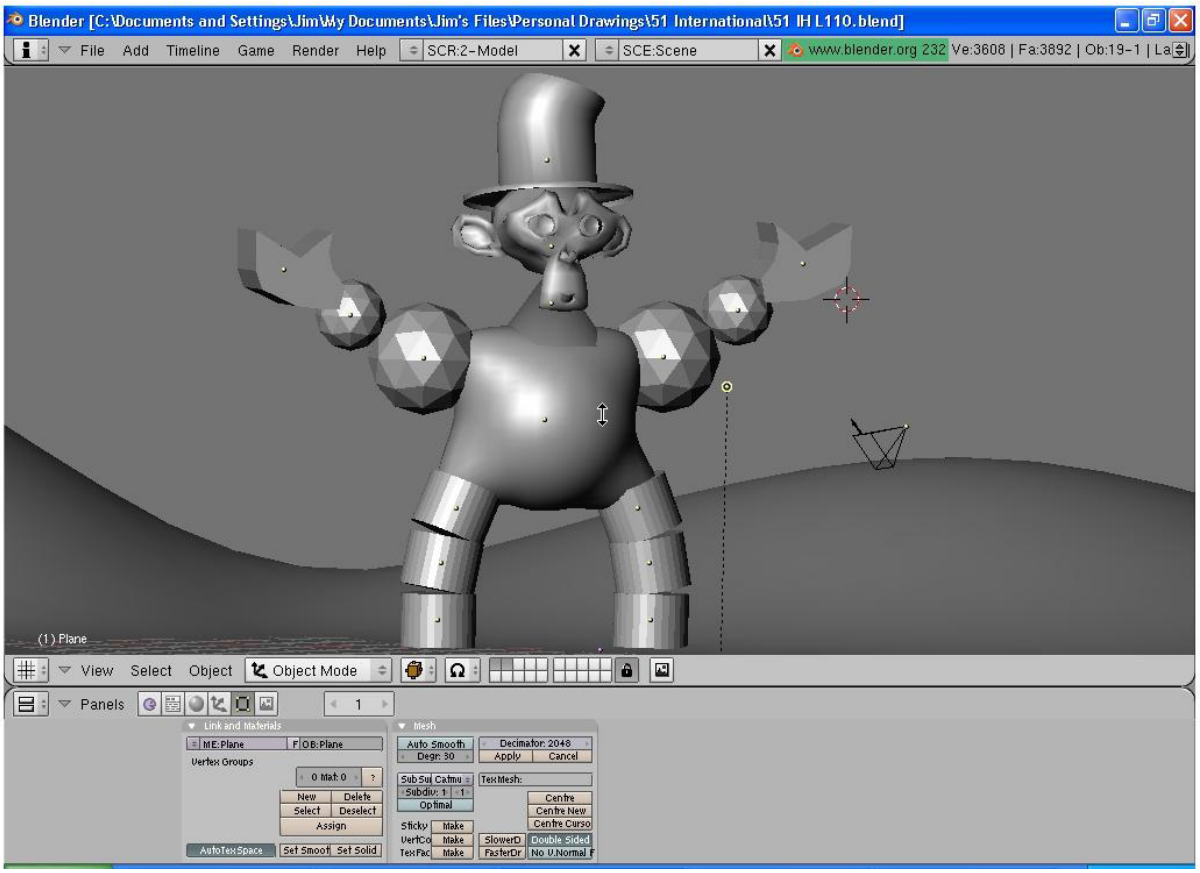
Next, switch to a front view ("**1**" key on number pad) and press the "**O**" key to enter proportional vertex editing mode. Select sharp or smooth falloff depending on what effect you want. Type "**G**" to grab (move) the vertex. Use the **"+ -" keys** on number pad or scroll mouse wheel to change the size of the selection.



Experiment with different size selections and different falloffs. To see your final work in a smooth display, exit edit mode ("**Tab**" key) and ,with the object selected, go to the edit buttons and find the "**Set Smooth**" button. This will smooth the mesh in display and final output. Finally, hit the "**Z**" key to shade your view.

PRACTICE EXERCISE

Open your **Sculpture** file from the previous exercise and modify it using the basic editing commands discussed in this section. Modify the ground that your sculpture rests on with the proportional vertex editing tool. Use extrude to add a new object or modify an existing object. Modify several of your shapes by subdividing, moving or scaling verticies in edit mode. Use the "**Set Smooth**" in the edit buttons to smooth several of your shapes in shaded view ("**Z**" key).

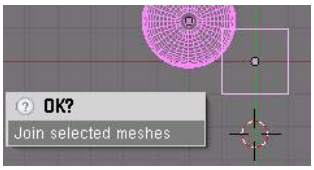


**** Call the instructor when finished****

Joining/Separating Meshes and Boolean Operations

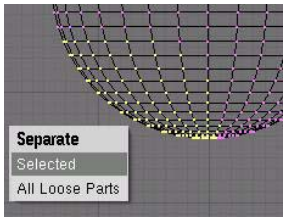
Now that you have some experience with basic editing, here's a few more options:

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.

Separating Meshes:

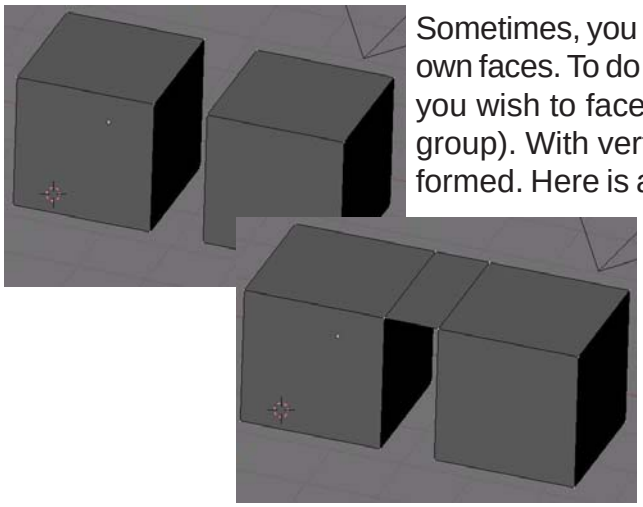


In order to break up a mesh, you need to be in edit mode (**Tab** Key) and select the verticies you wish to separate from the rest of the mesh. With verticies selected, type the "**P**" key (I like to think of it as partition) and select your option. The newer Blender releases give you an option to separate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

Deleting Vertices:

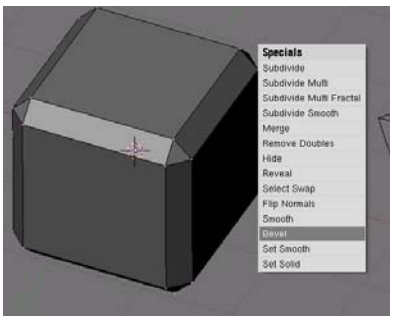
If you want to make a hole in a mesh, select the verticies you wish to remove, then hit the "**Delete**" key.

Adding Faces:



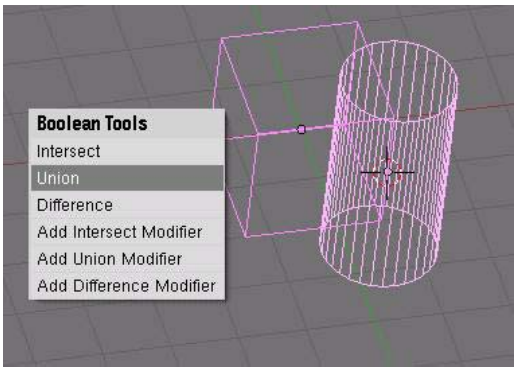
Sometimes, you need to fill in holes in a mesh by creating your own faces. To do this, go into edit mode and select the verticies you wish to face together (you are limited to 4 verticies in a group). With verticies selected, hit the "**F**" key. A face will be formed. Here is an example of 2 cubes joined together with a space that needs filled between them. In edit mode, select the 4 verticies (hold down **shift** key and **right click** on them), then type **F**. A face will be created.

Bevel Command:

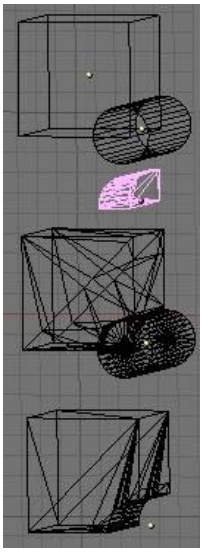


In edit mode, bevels (chamfers) can be applied to an object by bringing up the shortcut menu (**W key**) and selecting bevel. Bevel may not work on complex objects however.

Boolean Operations:



Boolean operations allow you to cut or join meshes by using other meshes. This is done by selecting the 2 meshes (not in edit mode), then typing the "**W**" key. You will see the options "***Intersection, Union, and Difference***". You will also see 3 **Modifier** options which will allow you to keep the 2 original objects, but will modify their shapes according to how they intersect each other. Below, you will see the results of each:

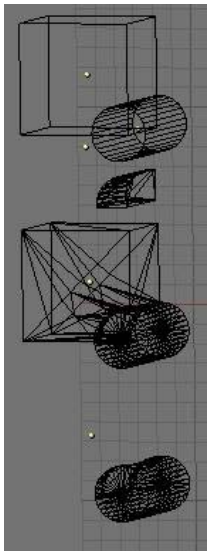


Basic shapes (before boolean operation)- Cube selected 1st

Intersection Option

Union Option

Difference option



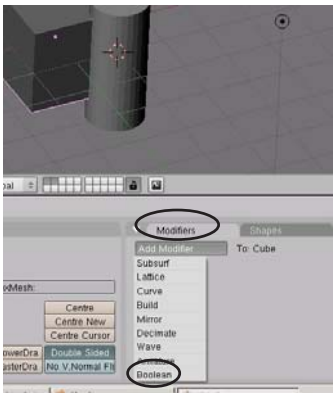
Basic shapes (before boolean operation)- Cylinder selected 1st

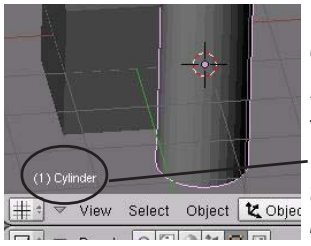
Intersection Option

Union Option

Difference option

Quick Tip: When using the Boolean operations, a new object is created while the original shapes are retained. You will need to delete or move the original shapes to view the newly created shape.

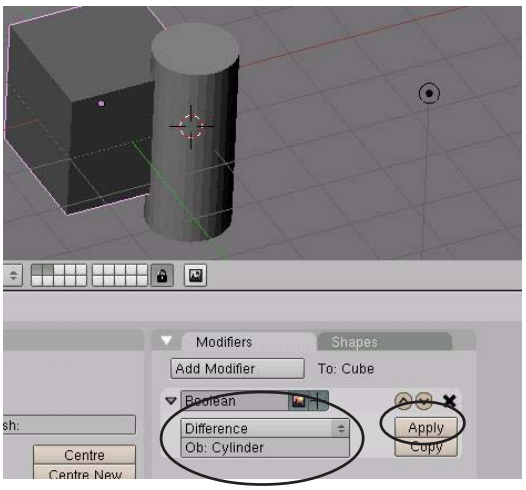




Boolean Modifier Option

New for this release of Blender is the Boolean modifier panel. This is just another way of creating a *Difference, Union or Intersect*. To add a modifier, select the object you wish to modify, then go to the **Edit buttons**  , **Modifier Panel**, then select **Boolean**. In the modifier panel, type the name of the other mesh, select *Difference, Union or Intersect* and hit **Apply**. The mesh should show the operation.

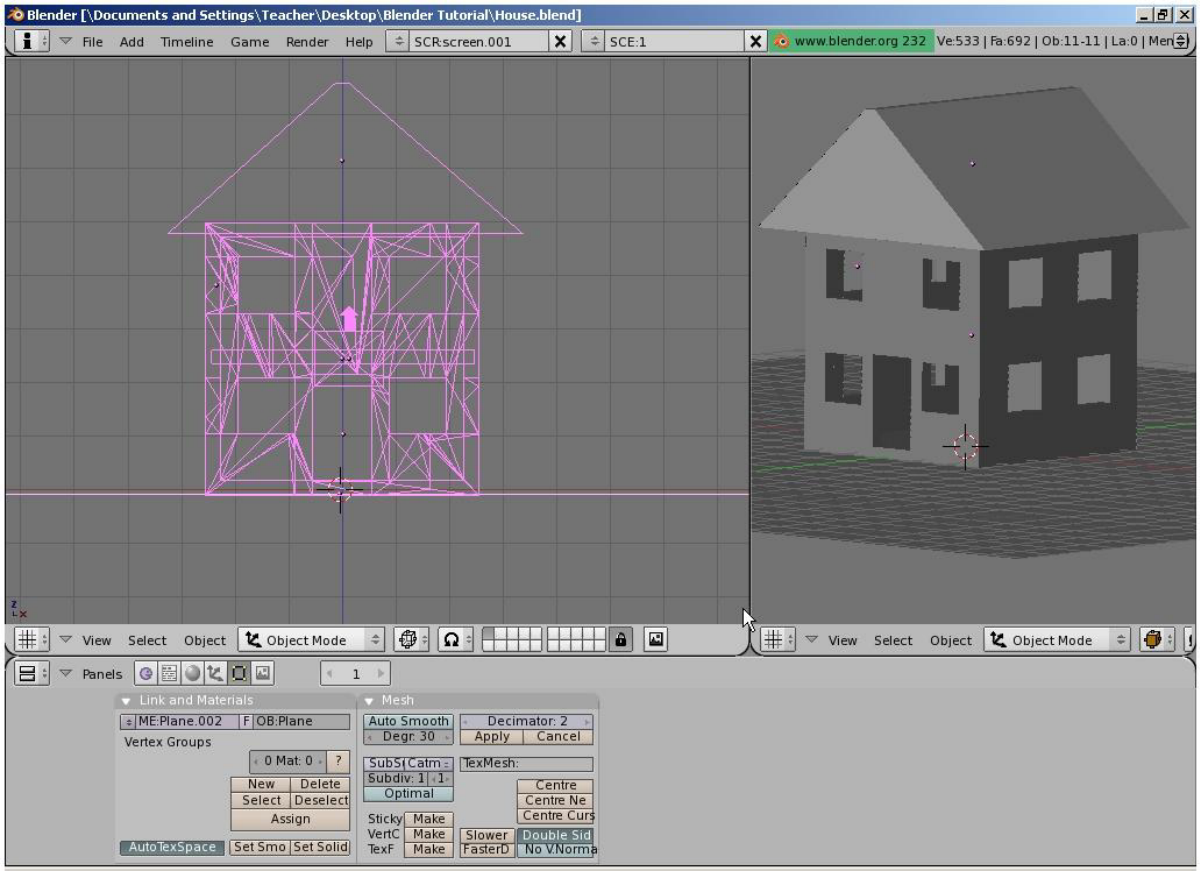
To find the name of a mesh, select the mesh. The name will be displayed in the lower left of the viewport. ***Names are Case Sensitive!***



Boolean Editing Practice Exercise

PRACTICE EXERCISE

Create a simple house model like the one shown below using all your editing skills. Save the file as ***House***. Begin by creating a cube. Create a slightly smaller cube inside the first cube and use boolean difference to subtract it from the larger one. This will make the house hollow. Create a roof using a cube and shape it in edit mode. Create smaller cubes to subtract out the doors and windows. Add a plane for ground. Feel free to add other details to the structure.



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

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. This will open a window that will display the rendered output of what the camera is focused on. 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:

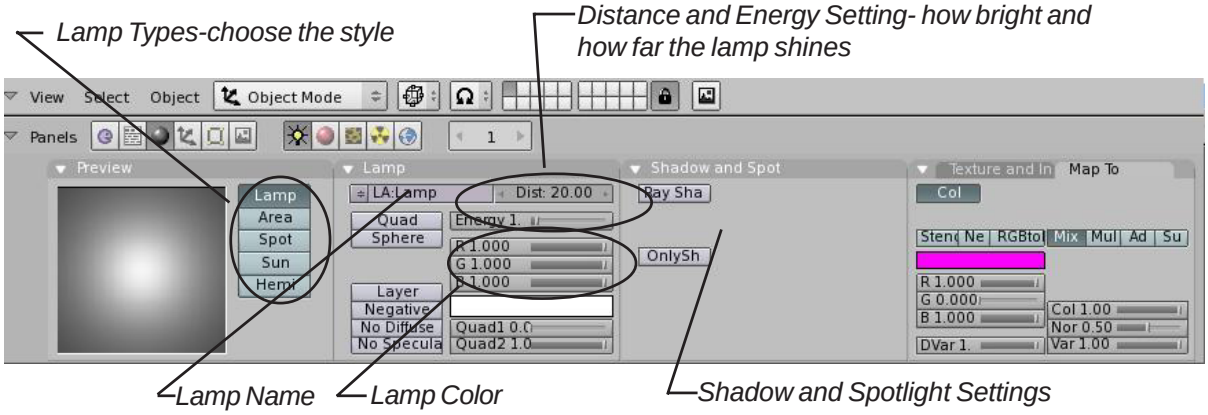
Lamp-	Basic Blender Lamp- shines all directions
Area-	New lamp type- provides large area lighting (like a classroom)
Spot-	Shines a direct angle of light
Sun-	Provides an even angle of light, regardless of placement from objects.
Hemi-	A wider light, much like area lights.

In traditional Blender rendering, only spotlights are able to cast shadows. However, with the introduction of Raytracing (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 the "**Space Bar**" 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 **Shading** button and **Lamp** button  to bring up the adjusting options. Here's what you see:

Quick Tip: Instead of adding too many lights, experiment with the Distance and Energy settings!



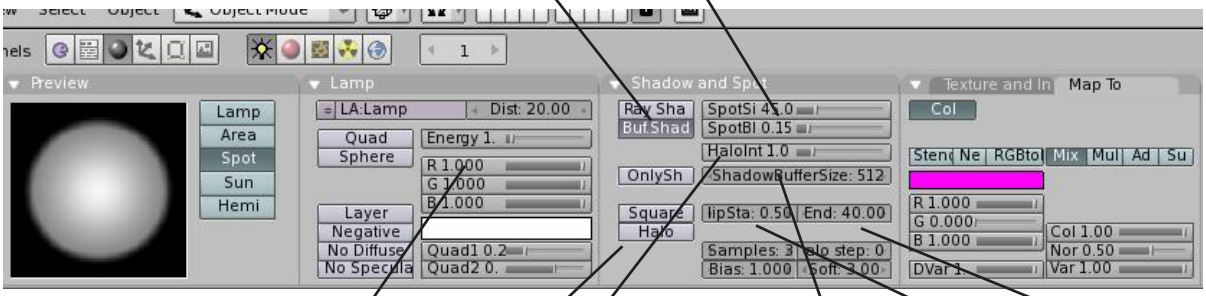
There are other lamp setting available, but for now, these are the basics.

Spotlight Settings:

Spotlights are unique in that you can simulate a foggy scene with them and cast shadows in the traditional Blender program. Raytracing (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 raytracing with reflections is not always used because of the rendering time. It is only used when needed. You can do the same thing. Here are your spotlight settings:

Select Buffer Shadow- traditional, faster spotlight settings

Spotlight Si and Bl- sets the spotlight beam angle and edge softness



Lamp Color, Distance, and Energy as before

Halo and Halo Intensity- gives and controls a smokey effect

Buffer Size-higher numbers mean smoother shadows

Clip Start and End- These need to be set to just include the objects that need to cast shadows. If clip start is too far above the objects or if clip end it too far away, shadows won't work.

In order for the shadows to display in your render window (***F12***), you need to tell the program to render shadows if it isn't set to do so already. Click on the **Scene** and **Render** buttons found in the bottom  and find the **Shadows** button. If **Ray** is turned on, turn it off at this time.

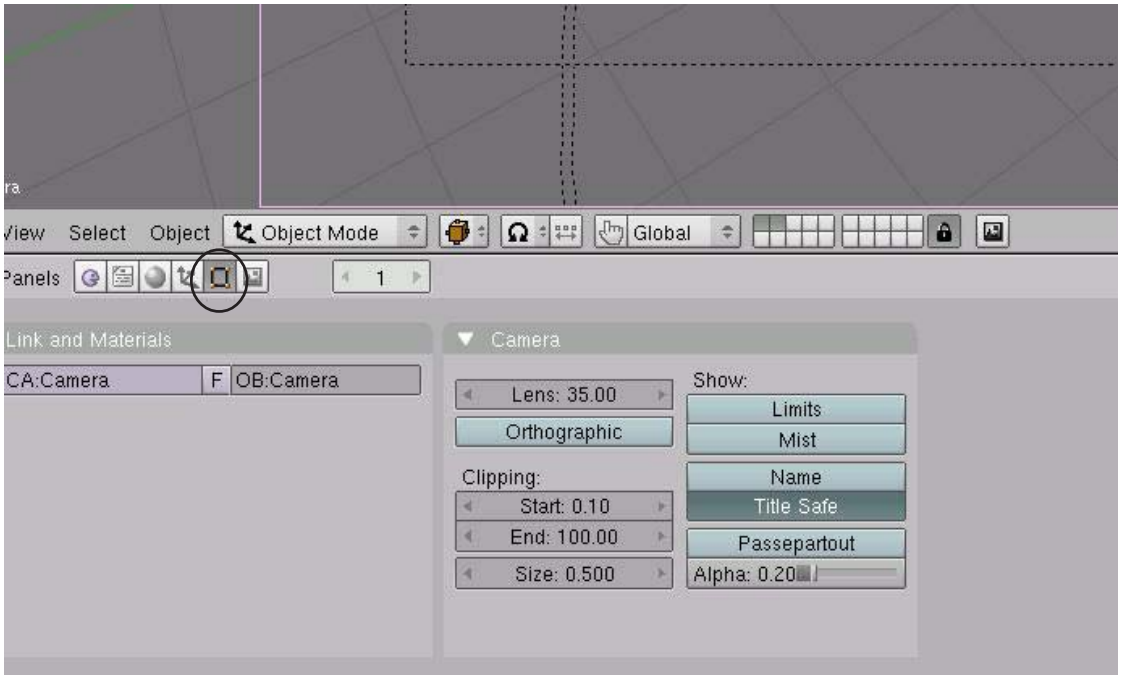
***Quick Tip*: If your shadows do not render well, experiment with the Clip Start, Clip End and Shadow Buffer settings**

Experiment with the different types of lights you have available. 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.

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 the *Space Bar,* 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 **edit button**.  Here are some of the settings options you have:



Lens- 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.

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

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

Draw Size- How big to draw the camera on the screen.

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

Show Mist- Used to give you a visual display of how far the camera sees if using Mist (discussed in Chapter 6).

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

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.

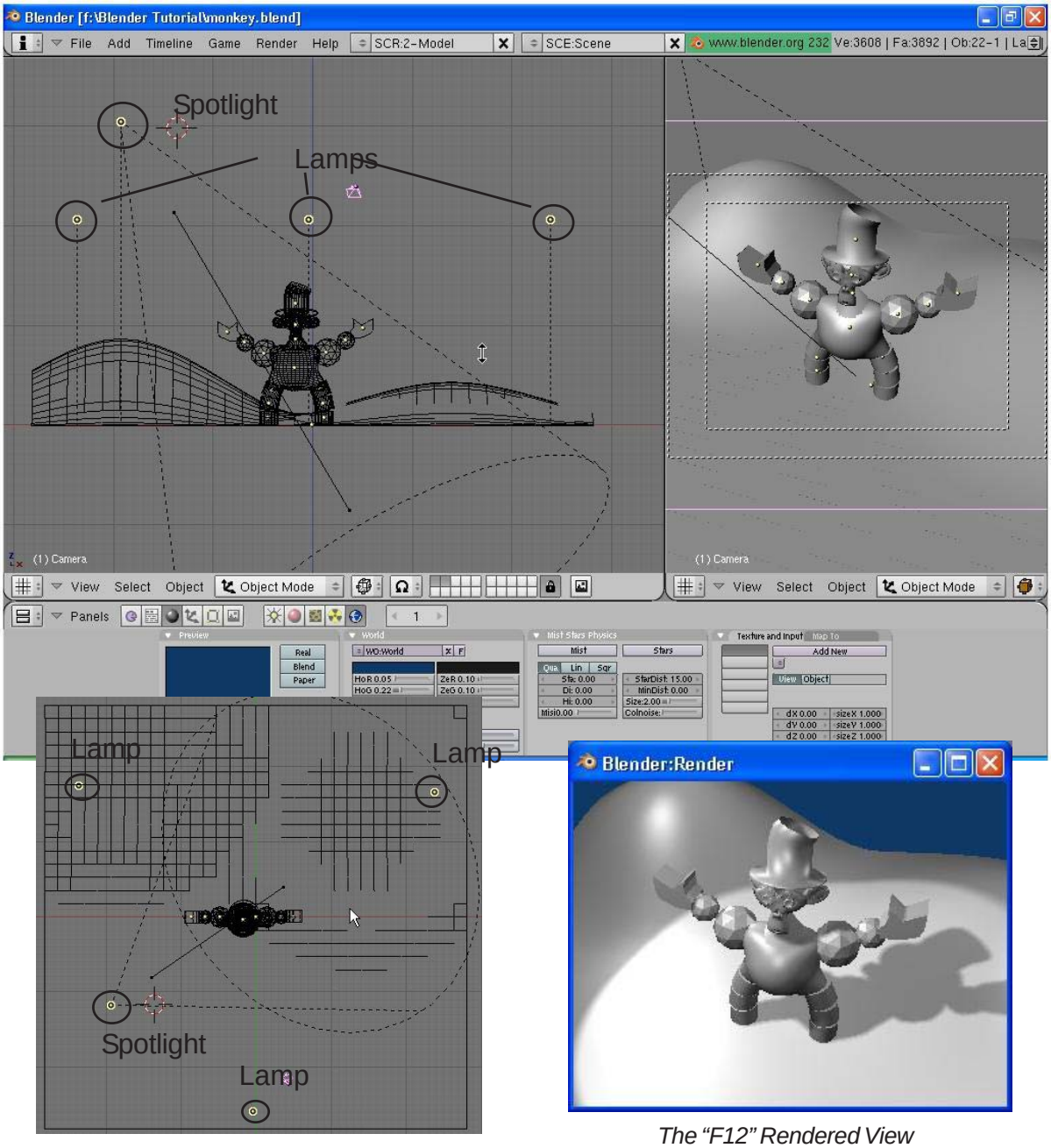
Title Safe- Displays the inner dashed box to help with placement of objects and text.

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.

Lighting and Cameras Practice Exercise

PRACTICE EXERCISE

Open your *Sculpture* file and add lighting and set the camera for a nicely rendered view. Create 3-4 lights for your scene and feel free to experiment with different types of lamps. Use at least one spotlight and enable shadows in the render settings (see page 30 for details). Practice placing lamps for good illumination on all sides. The example below could be used as a model.



The "F12" Rendered View

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