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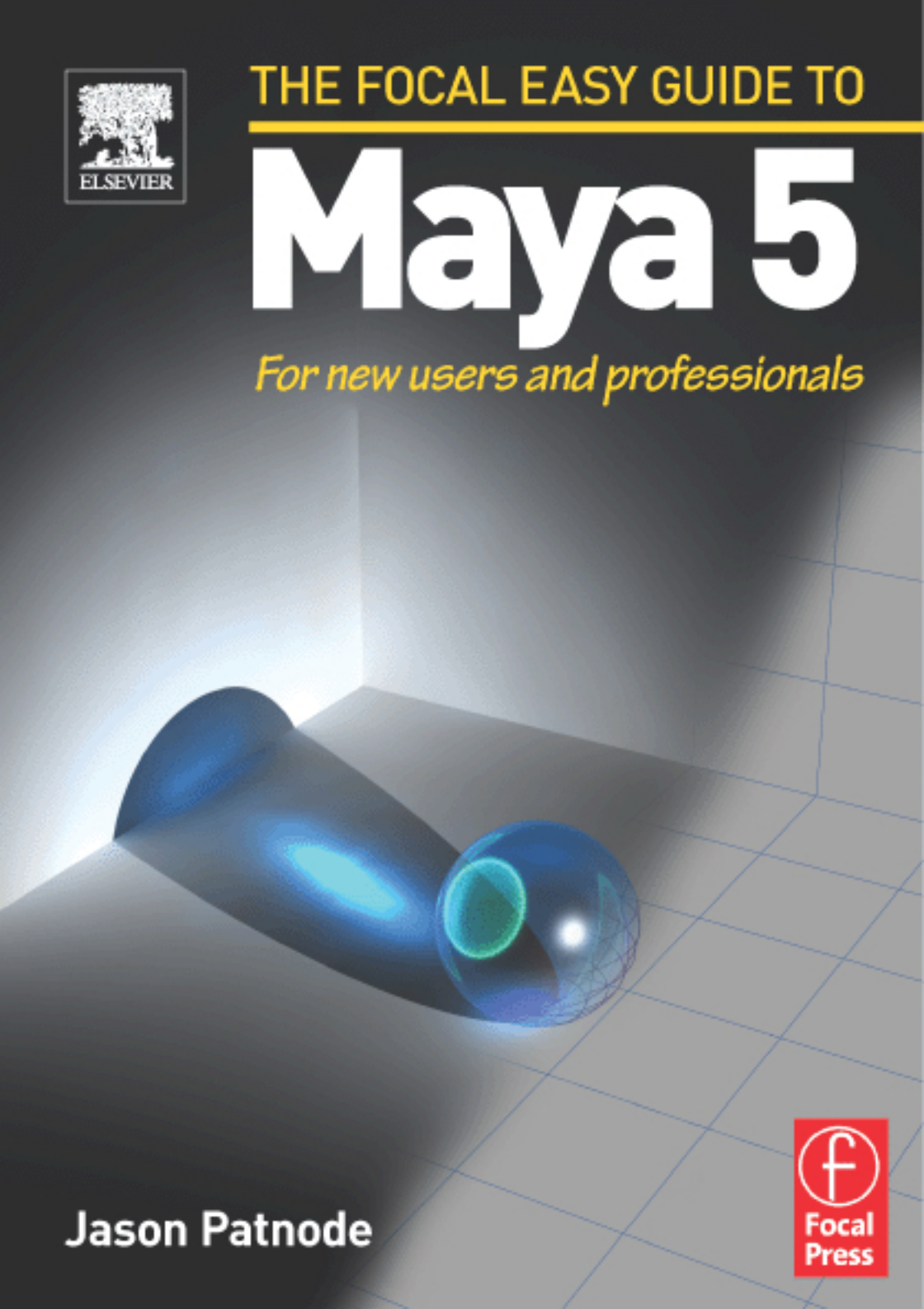
THE FOCAL EASY GUIDE TO Maya 5

For new users and professionals



Jason Patnode

Focal Press

THE FOCAL EASY GUIDE TO

MAYA 5

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Introduction

Alias' Maya 5.0 is an incredibly powerful and deep program. A person could work for months in the program and then one day accidentally stumble upon a feature that they had no idea was there. Often people working in Maya become so focused on one particular area that, if asked to work with a toolset different to those they are familiar with, they wouldn't be able to make head or tail of it. That is where this book comes in.

The purpose of this book is to show, by example, the many different work areas available in Maya 5.0; after following the examples, you will be able to navigate comfortably through these. The examples are designed to be open-ended; this means that the workflow from the tutorials can be applied to more complex scenes.

Follow along and soon you will have the knowledge to model your own characters, to light a world you have built, to animate a person talking to himself, or to do anything else you can imagine.

Jason Patnode

System Specs

Working in 3D is very demanding on your computer. Being such a robust package means that Maya has some fairly steep requirements. The requirements listed below are the minimum needed to use the program.

Maya 5.0 system requirements:

- Windows XP Professional.
- Windows 2000 Professional (Service Pack 2 or higher).
- SGI IRIX 6.2.15.
- RedHat Linux 7.3 or 8.0.
- Apple Mac OS X 10.2.4 or higher.
- Internet Explorer 4.0 or Netscape 7.0 or higher.
- Pentium II or higher.
- AMD Athlon or higher.
- 512 MB RAM.
- Hardware-Accelerated OpenGL graphics card.
- CD-ROM Drive.
- 3-button mouse with mouse driver software.
- 450 MB of hard disk space.

Maya Personal Learning Edition has different requirements:

- Windows XP Professional.
- Windows 2000 Professional (Service Pack 2 or higher).
- Apple Mac OS X (10.2.4 or 10.2.6).
- Internet Explorer 5.0 or Netscape® 6.0 or higher.
- Pentium II or higher.
- AMD Athlon or higher.
- Macintosh G4.
- 512 MB RAM.
- Hardware-Accelerated OpenGL® graphics card.
- CD-ROM Drive.
- 3-button mouse with mouse driver software.
- 450 MB of hard disk space.

Maya PLE also has the following difference from the commercial version of the program:

- A watermark appears in the rendered image.
- You cannot render using the Mental Ray or Maya Vector renderers.
- Rendering is limited to a single CPU.
- Images are limited to 1024 × 768.
- The file format is specific to the PLE version (.mp). You cannot save your scene as (.ma) or (.mb) files. Particle disk caching is not supported.
- Text dump from the Blind Data Editor window is not supported
- Exporting skin weight maps and character maps is not supported.
- The script editor output section is limited to 75 lines of output.
- The script editor > Save Selected menu item has been removed.

Once you begin working with very dense scenes, you will always wish you had more memory and a faster processor. This is not an area to skim on. Max out your RAM as soon as possible and get the fastest processor you can.

A good starting system would be:

- 2 GHz Pentium 4.
- Macintosh G4.
- 1024 MB RAM.
- 120 GB 7200 rpm hard drive dedicated to your art.

Common Hotkeys

Menus:

F2	Loads Animation menu.
F3	Loads Modeling menu.
F4	Loads Dynamics menu.
F5	Loads Rendering menu.

Tools:

Insert	Pivot point edit mode.
q	Select tool.
w	Move tool.
e	Rotate tool.
r	Scale tool.
t	Show manipulators.
J	Snap rotate.
j	Snap move.
Alt+Up arrow	Move up one pixel.
Alt+Down arrow	Move down one pixel.
Alt+Left arrow	Move left one pixel.
Alt+Right arrow	Move right one pixel.
=	Decrease manipulator size.
-	Increase manipulator size.

Hotbox:

Spacebar (hold)	Show hotbox.
Spacebar (release)	Hide hotbox.

File:

Ctrl+s (or Command+s on the Macintosh)	Saves current scene.

Edit:

z or Ctrl+z (or Command+z on the Macintosh)	Undo.
Z	Redo.
[	Undo viewport change.

]	Redo viewport change.
Ctrl+d (or Command+d on the Macintosh)	Duplicates selection.
Ctrl+g (or Command+g on the Macintosh)	Group selection.
p	Parents first selection to second.
P	Unparent.

Viewports:

a	Frame all in current view.
f	Frame selection in current view.
4	Wireframe mode.
5	Shaded mode.
6	Textured and shaded.
7	Textured and lit.

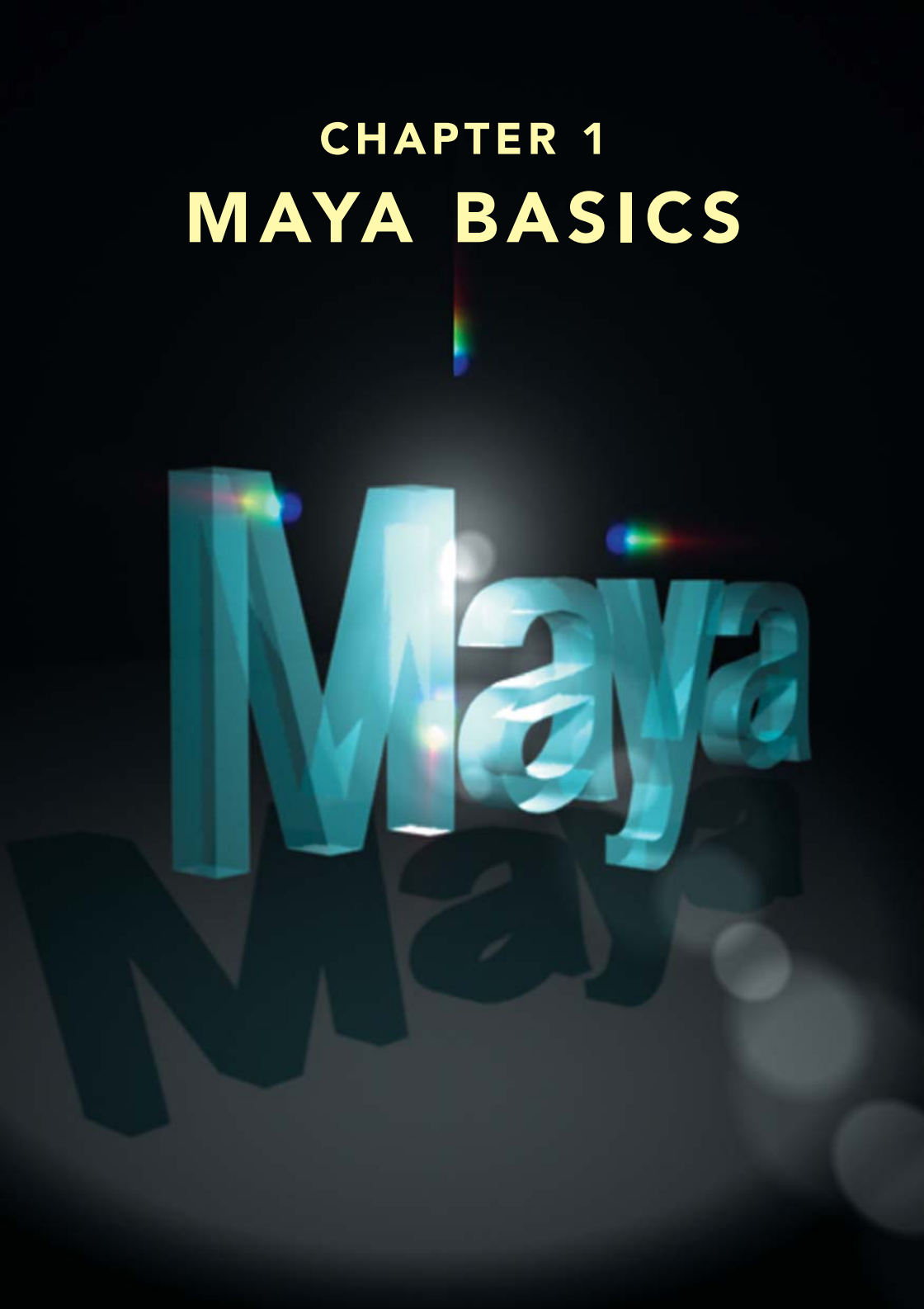
Display:

Ctrl+h (or Command+h on the Macintosh)	Hide selected.
Alt+h	Hide unselected.
Ctrl+H (or Command+H on the Macintosh)	Show last hidden.

Status line:

c	Snap to curve.
x	Snap to grid.
v	Snap to point
F8	Toggle selection masks.
F9	Vertex mask.
F10	Edge mask.
F11	Face mask.
F12	UV mask.

CHAPTER 1
MAYA BASICS



Maya 5 was designed from the ground up for complete customizability. Hotkeys, hotboxes, and shelves are just some of the functions and options that can be customized on a per user basis. Be aware that Maya is case sensitive. This really comes into play when working with hotkeys – for instance, 'p' has a different function than 'P'. The former parents one node to another, the latter will unparent the nodes. Alias has done a good job making Maya similar across all platforms. This book is written using the PC keyboard. If you are using a Macintosh and a tool calls for using either the Ctrl or Insert key then you should use the Command or Home key respectively.

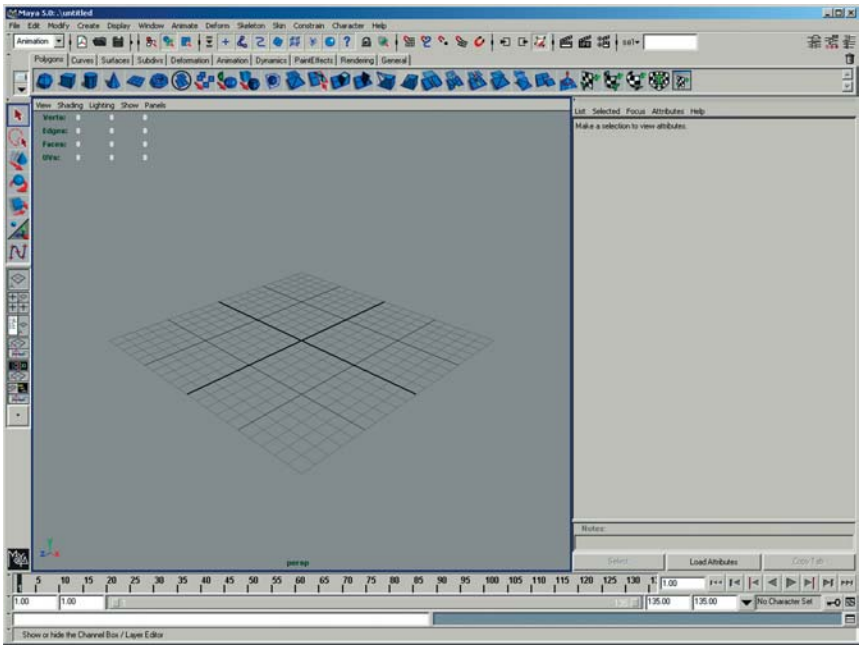


Figure 1.1 Maya's default startup window.

To navigate properly in Maya you need a three-button mouse. Holding down the Alt key press the left mouse button to tumble, the middle mouse button (MMB) to track, or right mouse button (RMB) to dolly.

Tumble rotates the view around the camera's center of interest. Track moves the camera horizontally and vertically in the current view. Dolly moves the camera

view in and out. The track and dolly tools will work in most windows. If you open a window and can't see all of the options, try to dolly out some.

Moving your mouse over a viewport window and quickly tapping the Spacebar will either maximize/minimize the current window. This allows you to move quickly and easily between viewport windows.

Figure 1.2 The camera move tools.

Tip: By pressing Alt + Shift while tumbling or tracking, the movement will be constrained to a single axis. Alt + Ctrl + RMB allows you to draw a marquee and instantly dolly into or away from the selected area.

The Hotbox

Pressing and holding the Spacebar will bring up the Hotbox window. The Hotbox contains each of the drop-down menu items available in Maya. The Hotbox can be customized so that only the menus you use frequently will show up when you access the tool.

1. To customize the Hotbox, press and hold the Spacebar.
2. Click on the Hotbox Controls menu on the right.
3. Using your left mouse button drag to the option you want to enable or disable and release.

The Marking Menu

A Marking Menu is another tool that can greatly increase your workflow. Holding down the RMB while working will bring up the Marking Menu of the

options available at that time. To select an option from a Marking Menu, press and hold the RMB, highlight the desired tool, and finally release the mouse button. To select an option from a Marking Menu that is accessed through the Hotbox, click it with the left mouse button and release. It may seem a bit awkward at first, but soon you will be able to zip through the different options.

1. To assign a marking menu to a hotbox area and mouse button, go to Window > Settings / Preferences > Marking Menus to bring up the main marking menu window.
2. Select Create New Marking Menu. This will display a marking menu popup window. Enter EasyMaya as the name in this new window.
3. Using the MMB, drag the icon of the polygonal sphere from the Polygons shelf onto the uppermost left square in your new marking menu.
4. Click Save and close the marking menu popup window.
5. You will now be in the main marking menu window again. Make sure Use Marking Menu In is set to Hotbox.
6. Set the Hotbox Region to West. The Hotbox is organized like the points on a compass: North is up, South is down, East is right, and West is to the left.
7. Set the Mouse Button to Left and Middle.
8. Click Apply Settings and close.

Go to a viewport in Maya and press the Spacebar. Now if you move your mouse to the left of the Hotbox and press the left mouse button, your new marking menu will appear. Click and drag up to the Polygonal Sphere option and release. A new sphere will appear in your scene.

The Title Bar

The title bar displays which version of Maya you are using as well as the name of the current scene. If the scene does not have a name it will be listed as \untitled. The title bar also displays the path for the current scene you are working on.

The Status Line

The Status Line contains shortcut icons to many of the more commonly used Maya tools.

Figure 1.3 The status line.

Construction History allows you to undo operations. Each operation you perform on an object is added to its history. When you are happy with the current state of an object, you can delete its history by going to Edit > Delete by Type > History. The selection masks allow you to set node types to non-selectable. This can be very useful if you have a dense scene and need to drag select only specific object types. The snap tools allow you to snap the current object to the specified snap type: grid, curve, or point. The Render Current Frame and IPR (Interactive Photorealistic Rendering) buttons on the Status Line will quickly become two of the most commonly used tools. These shortcuts will render the current frame based on the values set in the Render Globals into a new window.

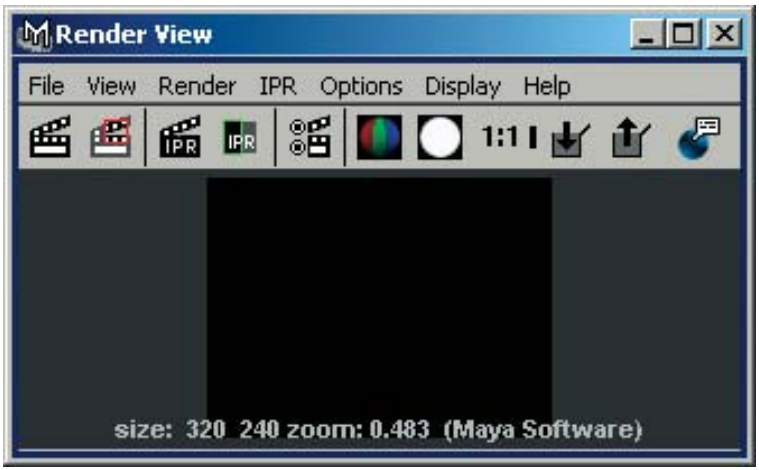


Figure 1.4 Render current frame window.

The IPR has the added benefit of constantly updating as you work. For instance, if you change a texture while the IPR is open, it will automatically re-render the change.

The shelf tabs allow you to create customized toolsets. The icons in the shelves are shortcuts to various tools. To add a button to your shelf, press Ctrl + Shift and click on the desired tool in the drop-down menus. A shortcut will appear in your current shelf. If you change the shelves, remember to click the arrow on the left-hand side of the shelf bar and select Save All Shelves.

The Menus

The Menu bar displays the drop-down menus available for the current menu set you are working in. In addition to the unique tools available while working within a specific menu set, there are six drop-down lists common to each menu set (File, Edit, Modify, Create, Display and Window).

File – Contains options to load/save scenes and set your project information.

Edit – Contains Undo/Redo functions and object duplication and manipulation.

Modify – Deals with node transform information and conversion.

Create – Contains creation controls for primitives, lights and cameras.

Display – Is where you can set your Maya HUD (Heads Up Display) options.

Window – Is the menu to access various work areas in Maya.

Each drop-down menu is organized into different sub-groups that have different themes associated with them. This lets you know right away what type of function you can expect from a particular tool. Many tools have adjustable options designated by ❐. If you need to change the options for a particular tool, navigate to and click on the ❐ next to it. If you are happy with the tool settings, simply click on the name of the tool and it will apply the most recently used settings. Many menus can also be made to float on top of your work area. Floating windows are designated with a double line known as the tear-off line. To tear off a menu, simply select the double line.

Working with Projects

The first thing you want to do when you begin work on a new project is create a project directory. This directory will house all files to be used for your current

project. When you begin work on a different project, you can create a new project directory.

> **Hint:** If you are using a Windows-based system, avoid creating projects in the My Documents folder. Maya won't be able to find your textures and references if you copy your work to a different computer.

When you open or save a scene or import or export a file, it points to the Scenes folder that is set in your current project. If you need to change to a different project use File > Project > Set and point to the new project.

Let's create a project to hold all of the scenes you'll be creating from the tutorials within this book.

1. Go to File > Project > New to bring up a blank Project window.
2. Click on the Use Defaults button. Unless there are specific needs for the project you are working on, I suggest that upon creation you select the Use Defaults option. This will place all of the project folders in their proper paths.
3. Type Easy Maya in the Name box.
4. For the Location, browse to your C:\ drive.
5. Click Accept.

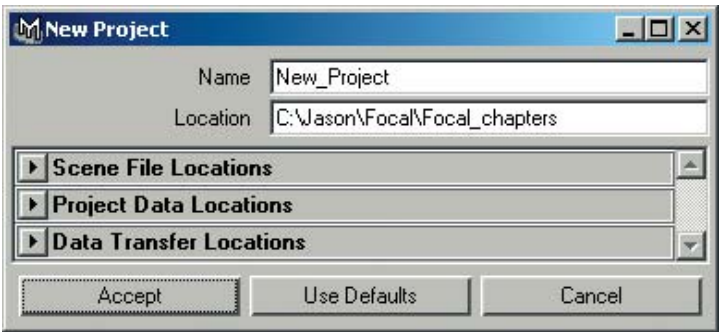


Figure 1.5 The Project window.

You now have a project folder for all of the tutorials you'll be working through. If you go to your C:\ drive you will see a folder named Easy Maya. The Easy Maya project will now open each time you start Maya 5.

The File Menu

There are a few items to take special note of in the File menu. Optimize Scene Size allows you to automatically remove unused data from your scene to reduce the size of the Maya file. Be wary, though, because Optimize Scene Size is not undoable. Import allows you to import data from another file. You can import an entire Maya scene or one of the many other available file types. Export and Export Selection allow you to export your scene in a different format. You can also export animation curves into a separate file.

The Edit Menu

The Edit menu contains undo and redo functions and commands. It is split into six areas: undo/redo, keys, delete nodes, selection, duplication, grouping, and parenting.

Undo and redo perform as they would in any other program. You can undo as many times as you have set in your Maya preferences. To set the number of undo levels select Window > Settings/Preferences > Preferences and go to the Undo category. A large Queue Size will slow Maya's performance, so I wouldn't set it to infinite. I like to set mine to Finite 200.

The Keys sub-group allows you to perform various edit functions on animation keys. Many of the options in the Keys sub-group work the same as their geometry-based equivalent. You can delete a key or copy a key from one place in the timeline, go to a different frame and paste the key

Figure 1.6 The Edit menu.

into the new time. Scale Keys allows you to change the duration for a range of keys. You can use the Scale Keys options to also change the start and end times of your animation. Bake Simulation is used to convert the selected simulation into keyframes. Once the simulation is baked into keyframes you can edit the curves as you would any other animation. This is very useful if you want to use dynamics in a game because most engines will only recognize keyframe animation so you will have to convert the simulation before it can be used.

Quick Select Sets are a handy way to easily pick objects and/or components (vertices, edges, and faces, etc.) that you select regularly. Follow the steps below to create a Quick Select Set.

1. Select the objects or components you wish to have in your Quick Selection Set.
2. Choose Create > Sets > Quick Select Set.
3. Type a name for your Quick Select Set. This name will be saved as part of your scene file.

When you need to pick this Quick Select Set, go to Edit > Quick Select Sets and choose the name of the desired set.

The Paint Selection tool lets you pick an object's components by painting them. This makes component selection very intuitive.

1. Create a new scene by going to File > New Scene.
2. Create a Polygon Plane. Create > Polygon Primitives > Plane > ❐. Set the Width and Height to 20 and the width and height subdivisions to 40.
3. Click Create.
4. With the plane still selected, right mouse click on the plane to bring up the Marking Menu and select Vertex.
5. Choose Edit > Paint Selection Tool > ❐.

6 When the options come up for the Paint Selection Tool, set the Radius (U) to .5 and leave everything else at the default.

7 Paint your initials on the object to select the components.

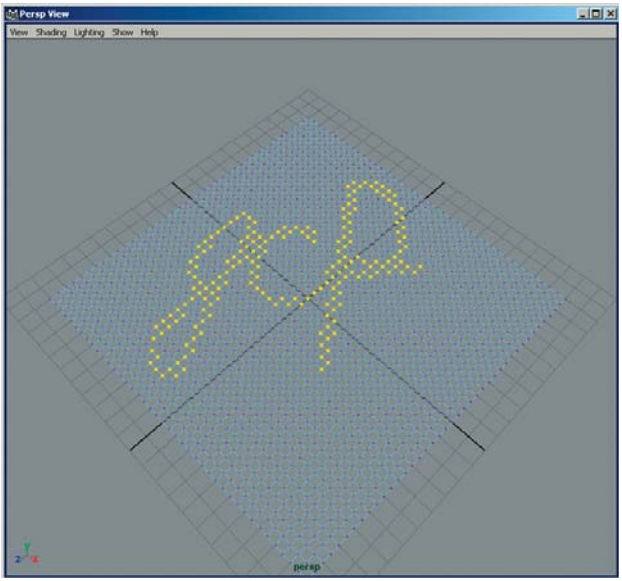


Figure 1.7 Painted initials.

The Paint Selection tool makes picking a complex layout of components very easy. Once you are happy with the paint selection you have made, you can add it to a Quick Select Set.

Tip: Many functions in Maya can be used with a drawing tablet. If you have a tablet available, it can make working with the Maya paint tools much easier.

The Modify Menu

The Modify menu is used for object manipulation and conversion. It is split into six parts: transforms, node evaluation, miscellaneous, attribute, conversion, and paint.

The transformation sub-menu contains the functions needed to move, rotate, and scale your objects.

Figure 1.8 The transform tools.

Figure 1.9 Tools in the Tool Box.

In addition to access through the drop-down menu and hotkeys, the move, rotate, and scale tools have permanent buttons in the Tool Box.

By picking one of the transform tools, a manipulator will appear for the selection.

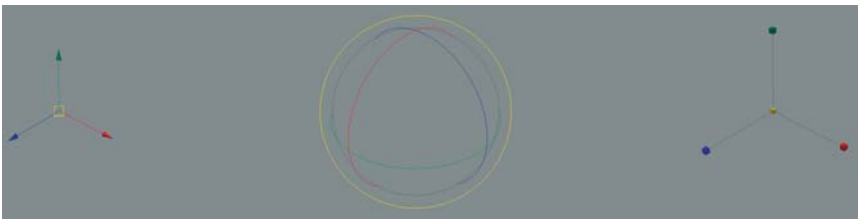


Figure 1.10 The move, rotate, and scale transform manipulators.

The manipulator handles are color-coded to correspond to the X, Y, and Z axes. Red represents X, green is for the Y axis, and blue corresponds to Z. When using a manipulator, the handle of the selected axis will become yellow indicating that it is currently active. When you click on a tool in the Tool Box, it uses the current settings for that particular tool. To bring up the options for a particular tool, you can either double click on an icon in the Tool Box to bring up the Attribute Editor or press and hold the keyboard hotkey while pressing the left mouse button to display a Marking Menu of the available options.

To use the Move tool, select and drag an arrow on the manipulator to move along a specific axis. To move freely, click the yellow square at the center of the manipulator and drag across the view plane. There are several coordinates systems you can use to move your selections in Maya. The default coordinate system is World. When World is selected, the object is set to move along the world axes. Selecting Object will move your selection in object space. Local will align the object to match the parent object's rotation. The Normal option allows you to move control vertices on a NURBS surface in the U and V directions.

To use the Rotate tool, select and drag a ring on the manipulator to rotate around a specific axis. To rotate freely, select and drag the imaginary sphere centered in the rotate manipulator. Click and drag the outermost ring to rotate your object around the view axis. To rotate an object on its local coordinates, select the Local radial button. If you select the Global swatch, objects will rotate around the world space. The Gimbal option will only allow one channel to be rotated at a time.

To scale an object, select and drag a box on the manipulator to scale along a specific axis. To uniformly scale your object, click the yellow cube at the center of the manipulator and drag across the view plane.

Freezing the transformations sets the current transform information on the selected objects as the new zero. To freeze transformations on the selected

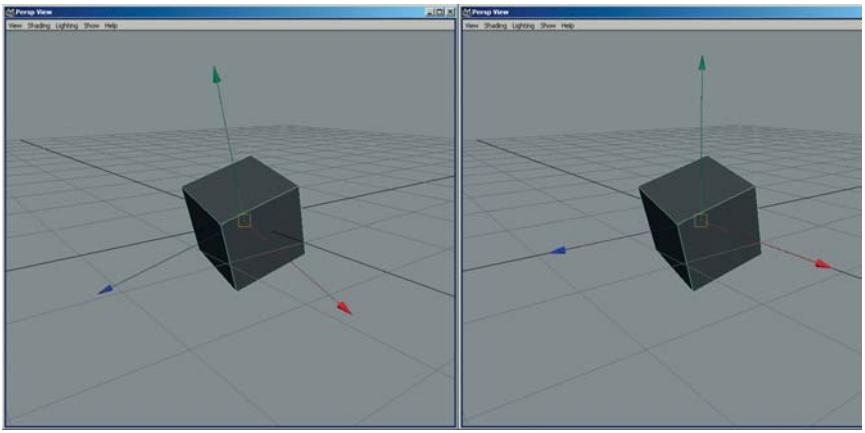


Figure 1.11 Before and after Freeze Transformations.

objects, go to Modify > Freeze Transformations. Whenever you move, rotate or scale an object, Maya calculates the new information starting from zero.

To reset the selected objects back to their zero state, select Modify > Reset Transformations.

Make Live is a tool that forces curves to snap onto the selected surface. Go to Modify > Make Live to make a surface live. When an object is live it will draw as a green wireframe in the viewport. Select Modify > Make Not Live to turn this function off.

Try making a sphere live.

1. Click on Create > NURBS Primitives > Sphere.
2. Select the plane and go to Modify > Make Live.
3. Select Create > Pencil Curve Tool and draw over the sphere.

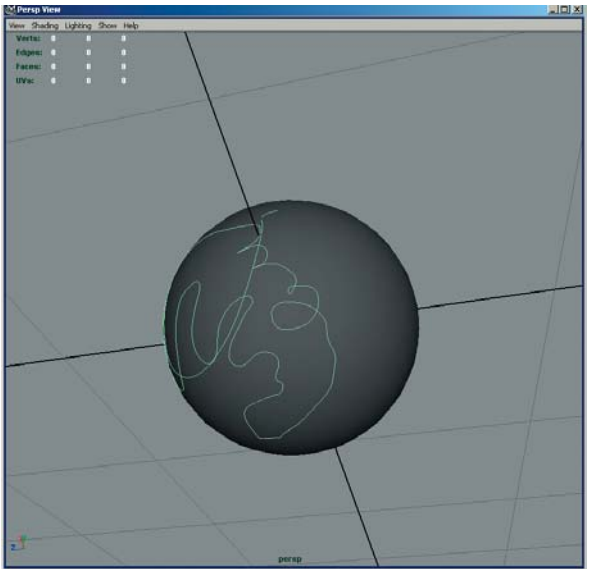


Figure 1.12 Live sphere.

Notice how the curve draws directly onto the Live sphere. Making an object Live allows you to easily trim surfaces or paint directly onto an object using Paint Effects.

To center the pivot of an object go to Modify > Center Pivot. To freely move an object's pivot point, press the Insert key to go into pivot point edit mode. Now the pivot point is unlocked and can be moved to the desired spot without affecting the object itself. When done, press the Insert key a second time to return to normal mode.

The Convert sub-menu allows you to convert from one modeling format to another. For example, if you created a character using NURBS and later decided it needed to be polygonal, you would go to Modify > Convert > NURBS to Polygons. Being able to convert an object can be really handy for game production. You can use SubD or NURBS models for your hi-res cutscenes and later convert these to polygons for the in-game work. In the options window for the tools, you can even set the maximum amount of polygons that can be used during the conversion, thus ensuring you won't go over your limits of your game engine.

The Create Menu

The Create menu is where you create your geometry, curves, lights, and cameras. This is also where you create locators and sets. A locator is more

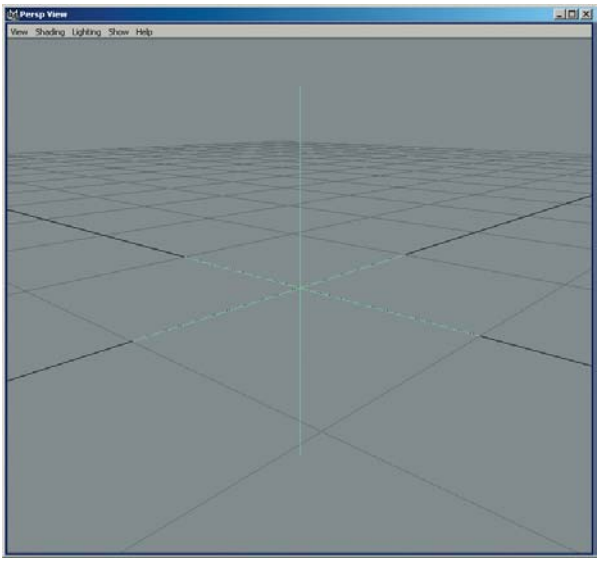


Figure 1.13 Locator.

commonly known as a dummy object. It is a non-renderable object that other nodes can be parented to. To create a locator go to Create > Locator.

A set consists of a group of objects or components. A set at first glance may look like a group but, unlike groups, sets do not change the scene hierarchy.

The Display Menu

The Display menu contains all of the user interface settings for Maya 5. To turn the grid on or off in all viewports select Display > Grid. If you need to change your grid options go to Display > Grid > ❐. You can set the length and width of the grid as well as the number of subdivision lines.

The Display > Heads Up Display options allow you to show object and scene information in your viewports.

Figure 1.14 Heads Up Display options.

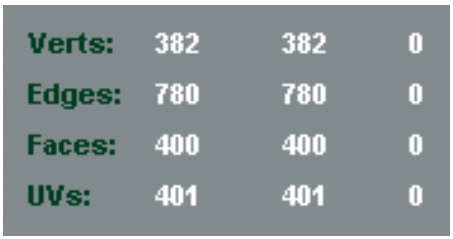


Figure 1.15 The Heads Up Display.

I always work with Poly Count, Camera Names, and View Axis checked, and will turn other options on as needed. But those three let me know if a character fits within the polygon limits and whether or not it is oriented correctly.

Hide is very important. You can hide selected objects or all objects of a specific type. Hidden objects will not render. Hiding objects can make your scenes much easier to work with. Once you are ready for the final render, use the Show commands to make any hidden objects visible.

The Window Menu

The Window menu is where you access the many different editors available in Maya. We'll be going over the various editors in more detail in their respective chapters. Settings / Preferences is where you go to set your Maya options. It's very important that before you begin working on your scene that you have all of your preferences set correctly. Unless your project requires specific settings, I would leave the majority of the preferences at their defaults. You should make sure your axis and time settings are correct though. Go to Window > Settings / Preferences > Preferences.

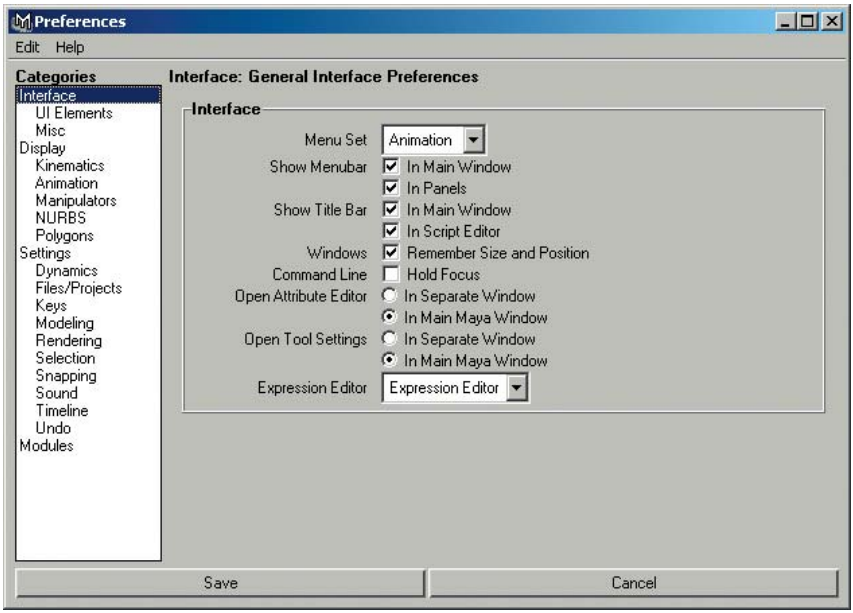
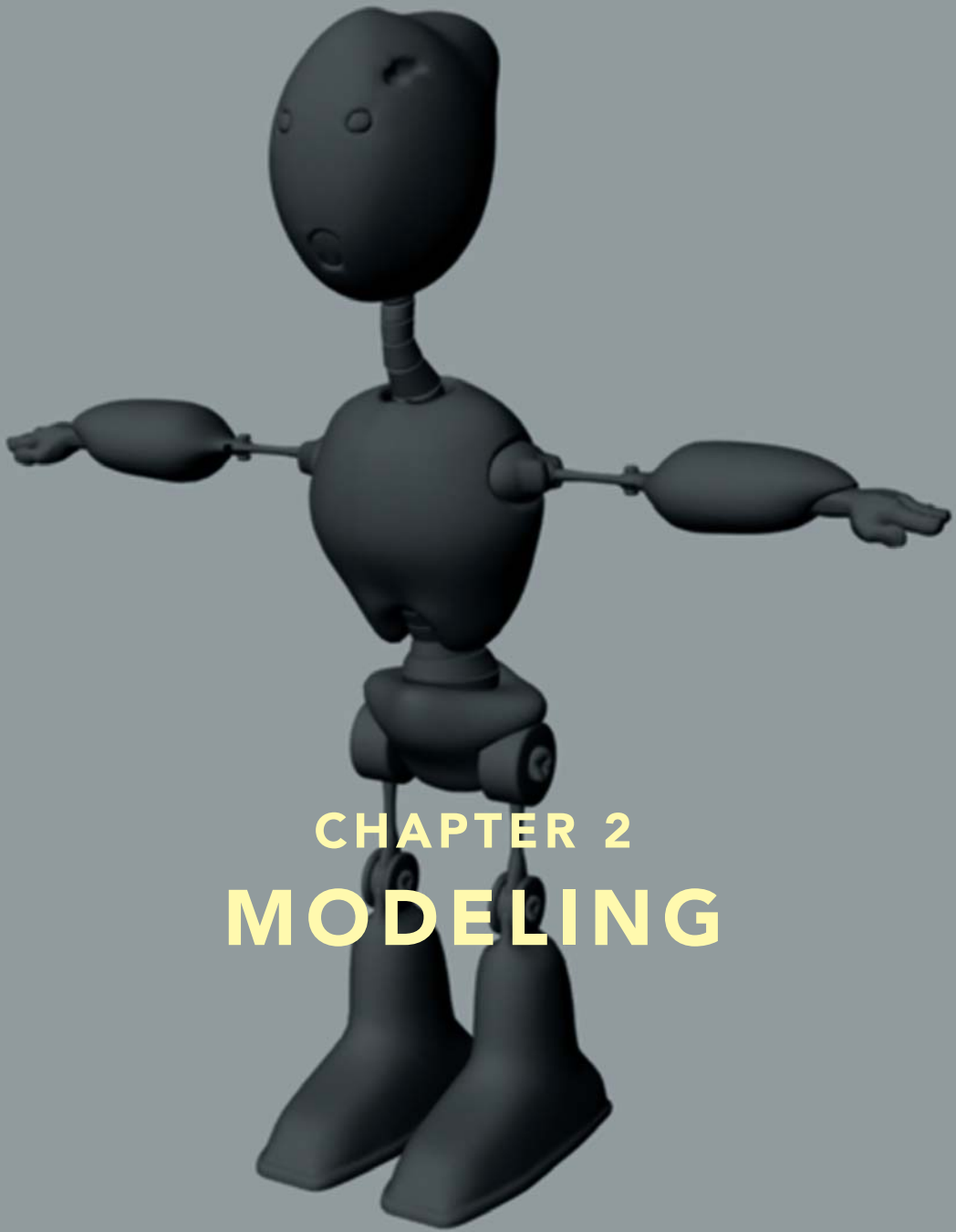


Figure 1.16 The Preferences window.

Click on Settings and set the World Coordinate System to Up Axis Y, and make sure the Working Units and Time are correctly set for your project. Leave the other Settings options at their defaults. Having the axis Y up will save you countless hours of frustration. Almost every software program or game engine is Y up, so if you have to work with other animators or third-party tools you'll be making things much easier for yourself by setting your axis correctly to begin with.



CHAPTER 2
MODELING

Modeling Concepts

Modeling is the actual building of objects in 3D space. The object can be as simple as a flat plane or as complex as a wilderness ecosystem. Maya 5 has three different modeling modes available: Polygonal, NURBS, and Subdivision surfaces (or subD surfaces). Each method has its benefits and disadvantages.

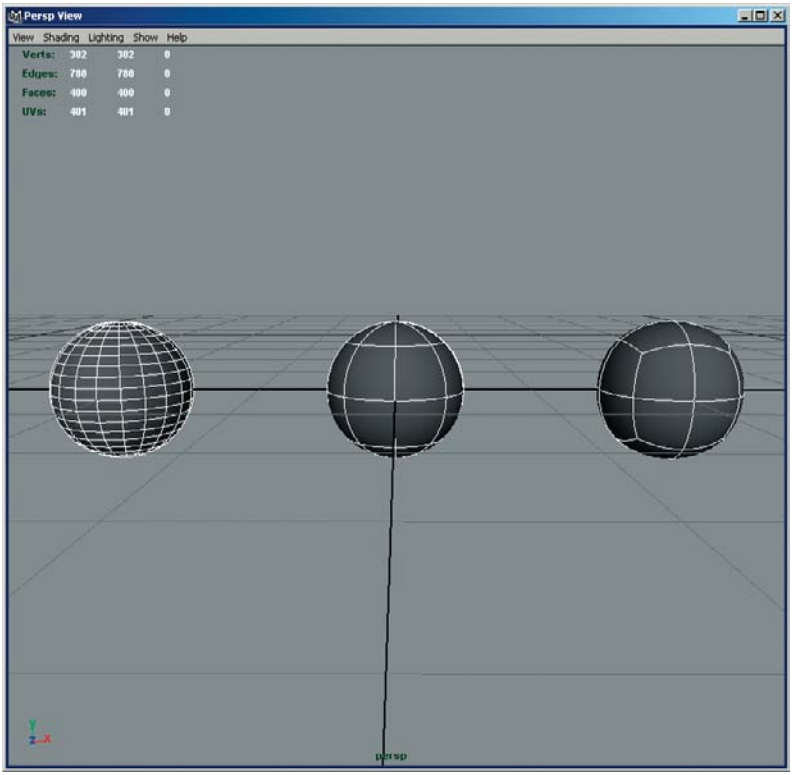


Figure 2.1 Object types. From left the spheres are Polygonal, NURBS, and Subdivision.

Polygonal modeling has been around longer than the other types and is generally easier to learn and more straightforward to work with. If you want to work in video games, polygons are what you will be using. To get smooth, detailed models with polygons, however, takes a large amount of data, thus causing the meshes to be much denser and harder to work with on the higher

end. NURBS, on the other hand, work very well for creating smooth, organic objects. On the downside, they have a steeper learning curve and are difficult to use when creating objects with sharp edges. Subdivision surfaces are the newest modeling method. In essence subD surfaces are a combination of polygons and NURBS surfaces. They offer many of the advantages of polygons and NURBS surfaces. For pre-rendered work, subD surfaces are becoming much more popular. The disadvantages of subD surfaces are the initial high learning curve and incompatibility with game engines.

Before you begin modeling, you'll want to have concept sketches and a minimum of a front and side orthogonal view of the model you plan on building. The concept sketches are for visual reference during model construction. The orthogonal views, though, will be used directly in Maya to help you create your model. First, you will need to scan your orthographic drawings. Next, you will need to bring the scanned images into Maya for use as a template to build your model.

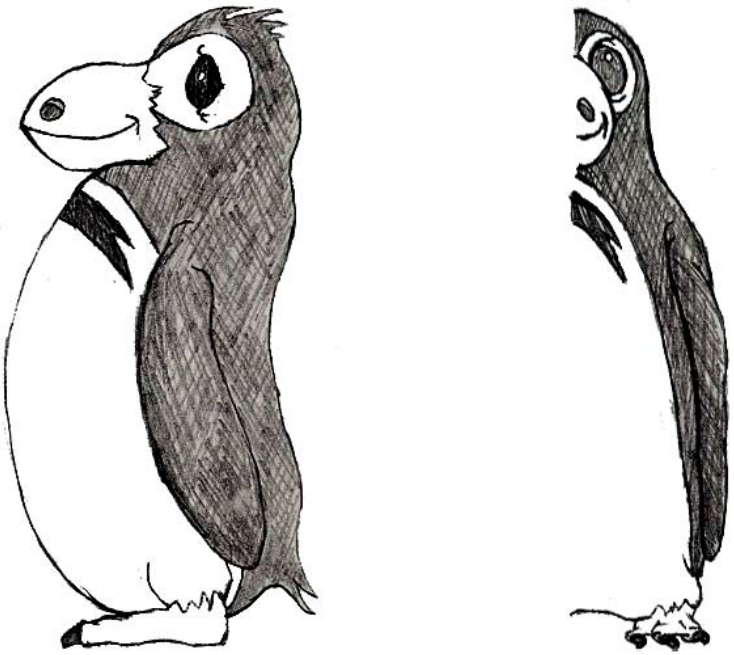


Figure 2.2 Front and side sketches of a model ready for construction.

Tip: When creating a character for animation you should only model half of the object in a neutral pose. Later you can mirror the object and join the two halves together. This will save you hours of work.

1. Create a new scene by clicking on File > New Scene.
2. In the Front viewport select View > Image Plane > Import Image.
3. At the prompt, load the front view sketch of your character.
4. In the Side viewport select View > Image Plane > Import Image.
5. At the prompt, load the side view sketch of your character.

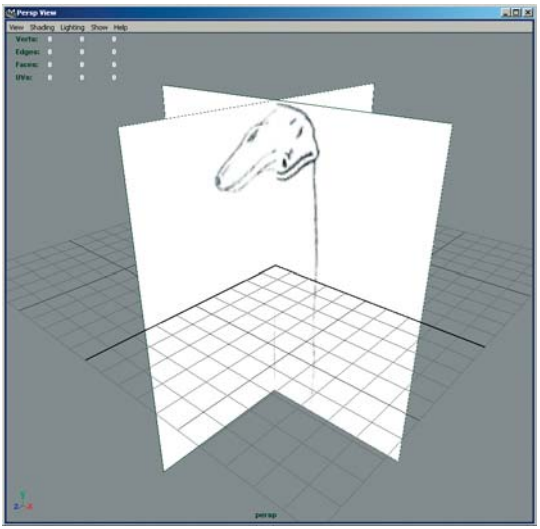


Figure 2.3 Template geometry.

6. Go to Display > UI Elements > Channel Box/Layer Editor to bring up the Channel Box or click the Channel Box button on the Status Line.
7. Press the Show the Layer Editor button in the Channel Box.
8. Select Layers > Create Layer in the Layer Editor.

9. Select the newly created layer.
10. Drag select the two planes in the Perspective view.
11. In the Layer Editor, select Layers > Add Selected Objects to Current Layer.
12. Click the middle box of your layer until it displays an R. If you need to open the layer for work at a later time, simply click the middle box of the layer until it is empty.

Now you can go back to your scene and begin modeling. If you need to hide the template objects for any reason, click the first box of your layer until it is empty. This will turn off the layer and hide any objects within it.

Tip: Keep in mind that layers are useful for more than just template geometry. Layers help you organize complex scenes in the same manner as many of the image manipulation programs available. I like to organize my scenes by having all of the characters in one layer, the terrain in another, particles in a third, and so on.

Polygonal Modeling

Polygons are probably the most commonly used modeling format. Low-res polygonal models are used extensively for video games, while hi-res models are widely used in print and films. Polygons are an extremely easy modeling form to work with, hence their widespread use.

An important note on polygons: unlike NURBS and subD surfaces, polygons are made up of straight edges. No matter how much you smooth or tessellate an object, if you get close enough, the straight edges will be visible.

Polygonal objects can be open or closed shapes. They can also contain multiple shells (more commonly known as meshes). A shell is a separate, self-contained mesh that is part of, but not physically connected to, a larger unit.

Tip: The number of meshes contained in your scene usually isn't a problem except in games. Most game engines not only have limitations on the number of polygons that can be used, but also on the number of meshes as well. By combining separate meshes together you can get around this.

Primitives are the building blocks of modeling. They are a fast and easy way to get basic shapes into your scene and often a properly lit and textured primitive will work fine in your scene. Primitives are available for polygons, NURBS, and subD. In this section we will be focusing on polygonal primitives, but keep in mind that all primitives function in the same way.

1. Select Modeling from the Status Line pull down or press the F3 shortcut to enter the Modeling menu.
2. Go to Create > Polygon Primitives > Cube. A default cube will appear in your scene.

Remember, Maya is completely customizable. This is only one method that can be used to create the cube. You can also go to the Polygons shelf and select the polygon icon to create a cube, or you can press the Spacebar while in the working area to bring up the Hotbox controls and create your primitive from there. You can even create a keyboard shortcut or MEL script to create your object.

There is an option box ❐ next to each primitive listing. You can go in and change the creation options for each primitive if desired. Open the option boxes and experiment with creating primitives using varied settings. If you create a primitive and later decide you would like to adjust it, you can do so by selecting the object and going to the Attribute Editor (Window > Attribute Editor or use the hotkey Ctrl + a) to make the changes.

1. Go to Create > Polygon Primitives > Sphere to place a sphere in your scene. Use the move tools to position it so that there is an overlap with the cube you created a moment ago.
2. Select the sphere, press the Shift key and select the cube. To select multiple nodes in Maya 5, you hold down the Shift key and click on everything you want included in the selection. To deselect nodes, use the Ctrl key.
3. Go to Polygons > Booleans > Difference.

You should now have something similar to Figure 2.4 below.

Mirror Geometry creates a mirrored duplicate of the selected geometry along a specified axis. There are options included that allow you to merge vertices

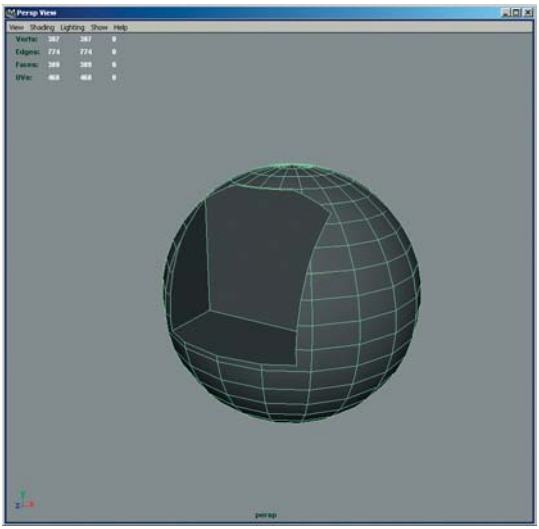


Figure 2.4 Boolean objects.

during the mirroring process or to connect border edges with new faces. Mirroring geometry is a great workflow habit to get into – you will be saving yourself half the work.

Smooth Proxy works on the principle of using a low-res mesh to build your hi-res geometry, but it differs from Smooth in that you do all of your work on a simple proxy object while a copy of the smoothed final object updates automatically.

1. Start a new scene.
2. Go to Create > Polygons Primitives > Cube and create a default cube.
3. Select the cube and go to Polygons > Smooth Proxy. Your cube will now be semi-transparent and there will be a smoothed copy in its center.
4. RMB click on the original cube to bring up the marking menu and select Vertex.
5. Select a vertice and move it. The smooth copy will move as well.

With Smooth Proxy anything you do to the original object will update automatically on the smooth copy as well.

Other commonly used tools from the Polygon menu are the Create Polygon Tool and Append to Polygon Tool. The tools allow you to make customized polygon shapes by placing the vertices where desired. The only restriction is that any new polygonal faces you create must be at least a triangle. Combine allows you to select separate meshes and make them into one piece. Reduce will trim down the number of polygons in your object while keeping your UVs intact.

The Edit Polygons menu contains the tools for fine-tuning polygons. This is where you'll find the tools that let you work on not just the polygons, but also the vertices, edges, and faces that comprise them.

1. Create a polygonal cube with one division each for height, width, and depth.
2. RMB click on the cube and go into edge mode.
3. Select the top four edges of the cube.

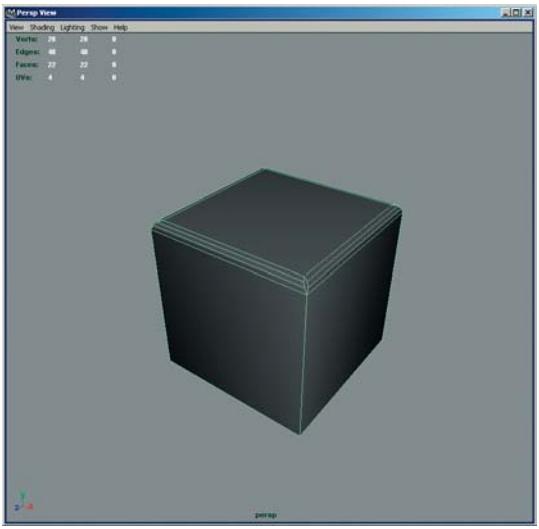


Figure 2.5 Beveled edges.

4. Go to Edit Polygons > Bevel > ❐.
5. Set the Offset to .05.
6. Set the Segments to 3.
7. Check the Auto Fit box.
8. Click Bevel.

Bevel rounds the selected edges. This is a highly useful tool; there are very few objects that have completely hard corners. Applying a bevel is a simple step that can lend quite a bit of realism to an object.

1. Undo the bevel and select the top four vertices on the object.
2. This time go to Edit Polygons > Chamfer Vertex. The chamfer function replaces each selected vertex with a face. Chamfered vertices are another small touch that can add a great deal of realism to your object.

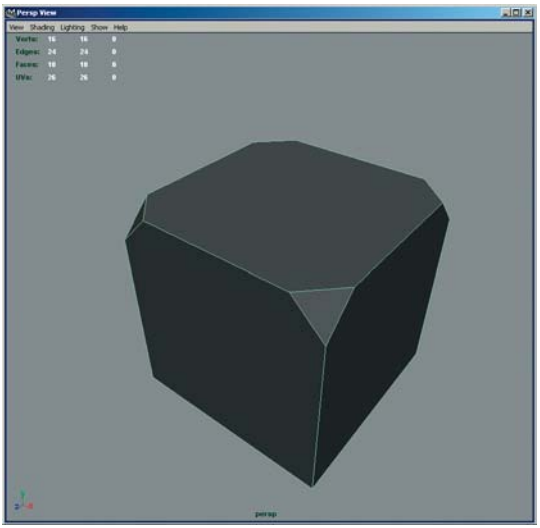


Figure 2.6 Chamfered vertices.

Select all of the vertices that made up the chamfer. Go to Edit Polygons > Extrude Vertex. You will now have spikes protruding from the cube. Extrude the

vertices a few more times and you can come up with some very intricate shapes quite easily.

Undo the extrusions and chamfer and select Edit Polygons > Cut Faces Tool. Drag the manipulator over the cube and when you release the mouse button the tool will slice the cube. You can set up the options for this tool to either delete or offset the cut portions.

Extract separates the selected faces from the polygonal object. Separate will separate any shells you have in your object.

The Colors and Normals tools are invaluable for games development. With these tools you can properly align vertex normals or color your vertices directly in the model without affecting your texture budget. You can even reverse the direction of polygon faces to point the normals in the opposite direction.

1 Start a new scene in Maya and create a sphere with a radius of 5 and 100 subdivisions along the Axis and Height.

2 Go to Edit Polygons > Sculpt Polygon Tool > ❐.

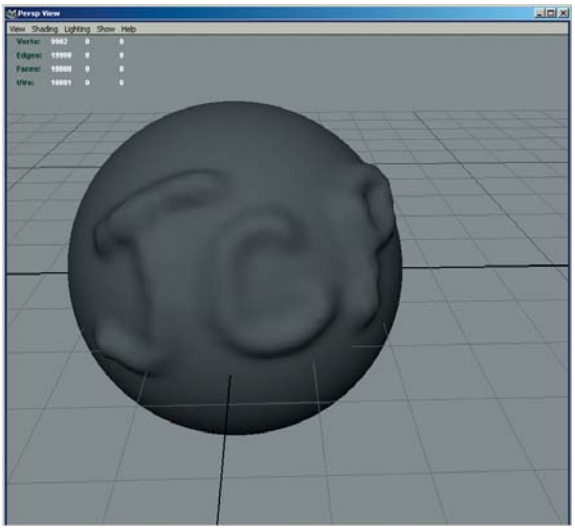


Figure 2.7 Sculpted polygons.

3. Set the Radius{U} to .500 and the Radius{L} to .100. The U is the maximum size the brush can become, while the L is the smallest size.
4. Click the first Shape button.
5. Change the Opacity to .100 and set the Operation to pull.
6. Paint your name on the sphere.

Tutorial: Creating a Snake

Let's begin building a polygonal character. I'm going to be using a snake character I created for one of my animations. He's not really an evil character *per se*, he's just hungry all the time. This snake is on a never-ending hunt for food and he is ready to eat anything that moves.

1. Set up a template for your scene and import the orthogonal views of your object onto the image planes.
2. Create two more layers. Name one layer hideMe and the other geometry. Turn the visibility off for the hideMe layer. The hideMe layer

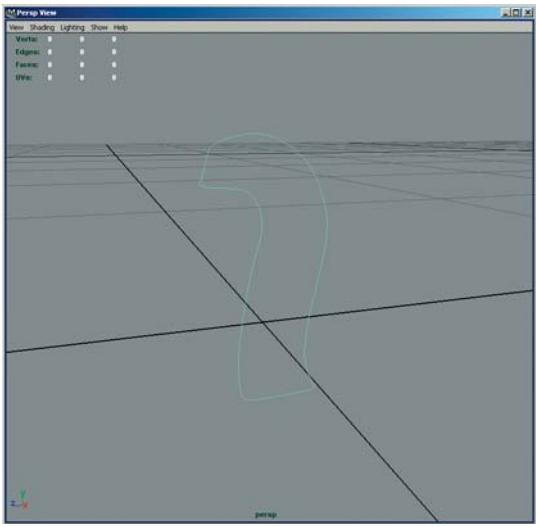


Figure 2.8 EP curve outline.

will contain things that will aid in building the object, but that we don't want in your final scene. The geometry layer will be for your character.

3 Go to the Side viewport and create an EP curve outline of your character that matches the template.

4 If needed, RMB click on the EP curve and use the Control Vertices and Edit Point options to fine-tune the curve.

Tip: If you need more edit points to work with, RMB click on the curve and select Curve Point. Click the spot on the curve that you would like to place your new edit point and go to Edit Curves > Insert Knot.

5 Once you are happy with the curve, go to Surfaces > Planar > ❐. Set the Degree to Cubic. For the Curve Range click Complete. Choose Polygons as the Output Geometry with the Type set to Quads, and the Count set to 100. Click the Planar Trim button. Using a lower polygon count here is very important. If you set the count too high, your model will be too difficult to work with later.

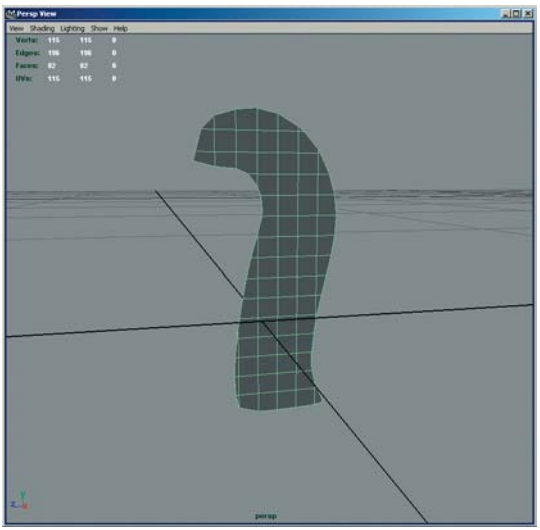


Figure 2.9 The flat outline.

6 Place the EP curve in the hideMe layer. Because hideMe is already a hidden layer, anything you add to it will also become hidden.

7 Select your mesh and rename it to snakeLow. Maya scenes can become very hectic very quickly; by renaming things now, you'll have a much easier time keeping track of things.

8 Delete the history for snakeLow.

9 Now we need to match the edges of the mesh to the template. RMB click the mesh and go into Vertex component mode. Using the Move tool, adjust the vertices so they match the outline. You'll notice some areas that you can't match because of the low polygon count. To correct these use the Split Polygon Tool.

10 Go to Edit Polygon > Split Polygon Tool. Click the tool where you want to begin the split and again where you want it to end. Press Enter on your keyboard to finalize the split.

11 Continue using the Split Polygon Tool along with moving vertices until the mesh edges roughly match the outline. Keep in mind that you want to keep the polygon counts low at this stage so don't try to match things up exactly. That will all be done later.

12 The snake has a couple of ridges that run down its side. Use the Split Polygon Tool to add these ridges to the snakeLow mesh.

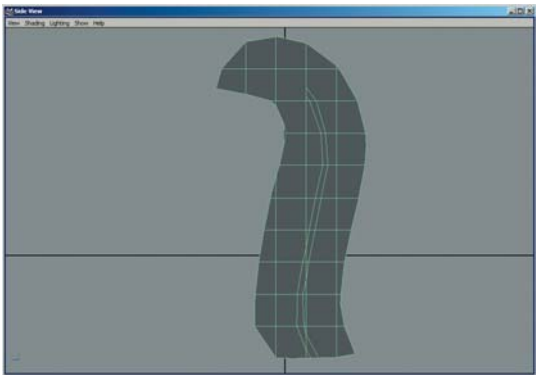


Figure 2.10 The added ridges.

13 Using a planar trim and splitting polygons can sometimes lead to extra vertices. We need to clean these up before we continue. Go into vertex component mode for the mesh and select every vertex.

14 Select Edit Polygons > Merge Vertices > ❐. The Merge Vertices tool works by combining any vertices within the distance you set. The trick here is to merge overlapping vertices with just the right amount, otherwise you will wind up with a mangled snake. If you set it too high, undo and lower the amount before trying again.

15 You should go over the model to see if there are any areas that could benefit from a higher power of merged vertices. Cleaning up any loose vertices now can save you a great deal of frustration later.

16 We are now ready to add some depth to the character. Before you begin, make sure Polygons > Tool Options > Keep Faces Together is checked. This option forces the selected faces to extrude as one. If you turn this off, each face would extrude as its own entity.

17 Go into face component mode and select all of the faces of the snake.

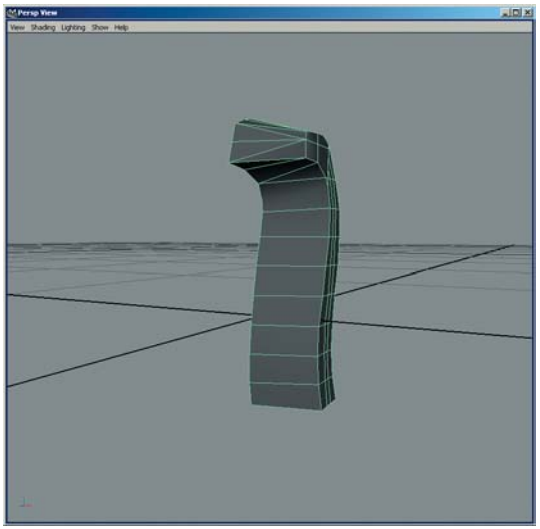


Figure 2.11 Extruded snake.

18 Go to Edit Polygons > Extrude Face. There are move, rotate, scale handles on the Extrude tool. Drag the X move handle until the extrusion roughly matches the template in the front viewport.

19 Now you need to adjust the vertices so they match the front view of your template. Take extra care not to move the vertices that lie on the zero coordinates. We are building half of the snake now and will mirror later; if you move the inside vertices, you won't be able to mirror the object correctly.

20 Select the faces that make up the ridge and extrude them to match the template.

21 Delete the faces on the bottom of the snake.

22 Select the faces at the front of the neck and extrude them forward to make the basic form of the head.

23 Now that we have the basic form for the snake, let's create the other half. We won't actually do any work on the second mesh; it's just for visual reference. Having both halves visible will help you shape the model.

24 Select the mesh and go to Edit > Duplicate > ❐.

25 Set the X scale to –1. Using a negative scale during a duplicate operation mirrors the object.

26 For Geometry Type, use Instance. An instances object will update automatically any time you change the original object.

27 Set Group Under to Parent. Make sure Smart Transform and Assign Unique Names to Child Nodes are both off.

28 Press Duplicate.

29 Continue to mold the snake to match the main shape of the template. Remember to work only on the original mesh; any changes you make will automatically pass down to the other models. Use the Split Polygon Tool to create more detail in a particular area if it is needed.

30 Once the main shape is done, use the Split Polygon Tool to create the outline for the eyebrow and eye.

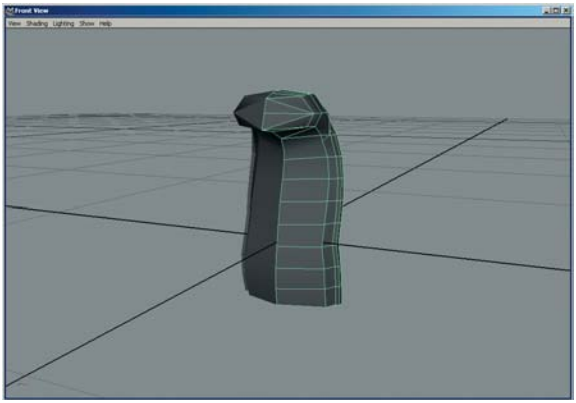


Figure 2.12 Second half.

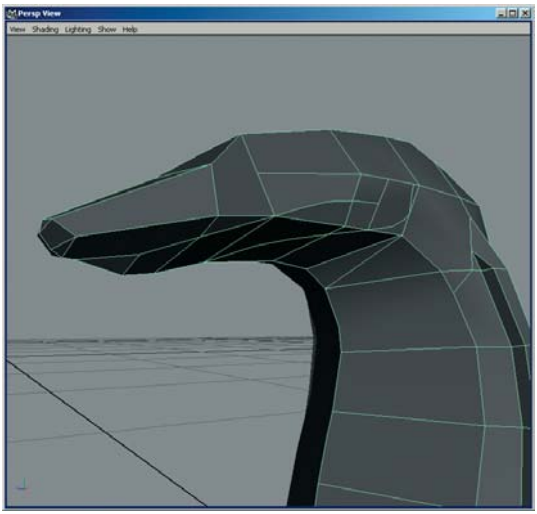


Figure 2.13 Eyes created using the Split Polygon Tool.

31 Push and pull the vertices until you have properly shaped the brow and eye.

32 Select the new polygons that make up the faces of the eye. Go to Edit Polygons > Extrude > ❐. Set the X translate to –.004 and the X, Y, and Z scales to .75. Click Apply.

33 Delete the faces that you extruded. We want to create the actual eyeball later. The reason for extruding the faces before deleting them is that this adds a bit of depth to the eye socket.

34 Next use the Split Polygon Tool to create an outline for the nose.

35 When the nostril outline is ready, extrude the faces that are to be the actual cavity back.

36 Again use the Split Polygon Tool to draw an outline of the mouth. Notice the creation of the top and bottom of the mouth. This is a very important step. By creating the full outline of the mouth, it will make constructing the inner mouth much easier.

37 For creation of the inner mouth you should hide all but the main mesh. This will allow you to get inside the snake's mouth. Select the three other meshes and go to Display > Hide > Hide Selection. Don't worry this in no way affects your models. We just need to hide them until we are finished creating the mouth.

38 Now back to the main mesh. Select the inner row of faces of the mouth outline and delete them. Select the two edges that form the front end of the top jaw.

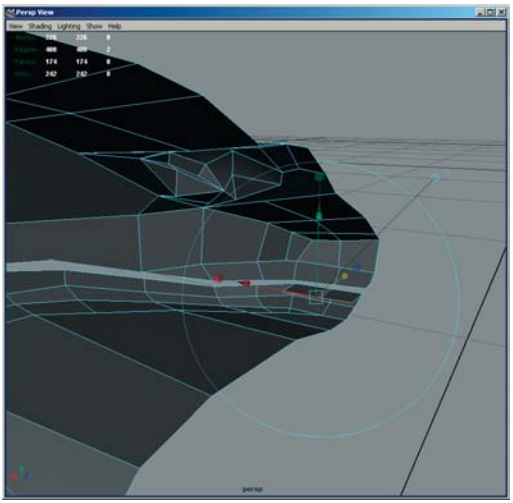


Figure 2.14 Creating the inner mouth.

39 Go to Edit Polygons > Extrude Edge. Click the Local/World switch on the extrude manipulator so you will be extruding in world space. Extrude the edges back until they line up with the first vertex of the top jaw.

40 With the edges still selected, go to Edit Polygons > Extrude Edge again. This will create the next segment of the inner mouth. Extrude this back until it lines up with the next vertex of the top jaw. Do this for each vertex of the top jaw. Remember to go into world space each time you extrude here. Once these are finished, create some extra segments to extend down into the throat.

41 Now you need to line up the vertices of the segment you created. Select the vertex nearest the first jaw vertex, go into Snap to Points mode, and snap the points together. Continue until each segment is snapped to the proper jaw vertex. The segments you created for the throat won't need to be snapped to anything. Once finished, turn off Snap to Points.

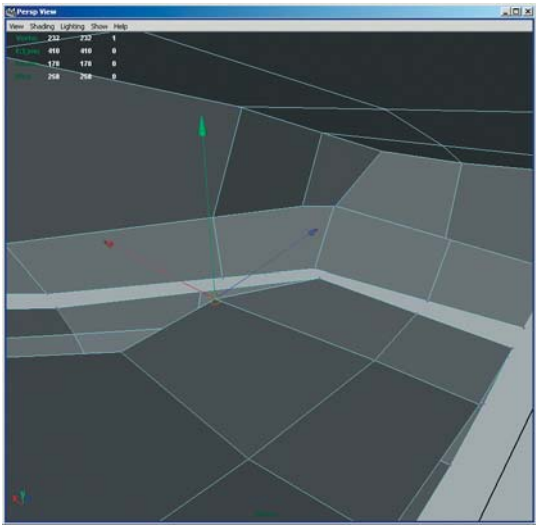


Figure 2.15 Snapping the vertices.

42 There will now be two vertices at each top jaw position. Use Merge Vertices to fix this.

43 Follow the steps above to create the bottom half of the inner mouth.

44 Go to Display > Show > Show Last Hidden to display all of the snake meshes.

45 Now you need to complete the bottom half of the snake. Select the bottom edges and extrude them down. Make sure you are in world space during the extrusion. Also, extrude down in chunks so that your object has enough faces to deform properly during animation.

46 After each extrusion, adjust the edges in the side view to match your desired curvature.

47 Once you are happy with the length, go to the front view and begin matching the vertices to the snake's front view.

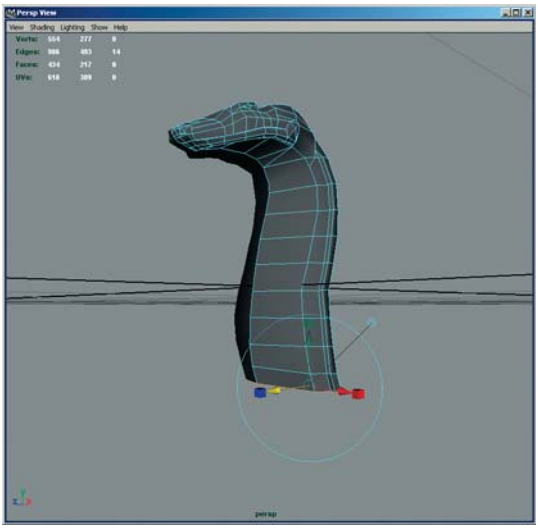


Figure 2.16 Creating the bottom half.

48 You are now ready to merge the pieces into one. Select both halves of the lower polygon snake and click on Polygons > Combine.

49 This will create a new mesh node. Delete the history on this node and rename it snake.

50 Go into the front viewport, select the center column of vertices and run a low-strength Merge Vertices operation. This will clean up any overlapping vertices.

51 All that is left now is to create eyeballs and a tongue. These are each made from a simple primitive by pushing and pulling vertices into the desired shapes. Once complete, duplicate the eye and put one in each socket and position the tongue inside the throat.

52 Your model is now done.

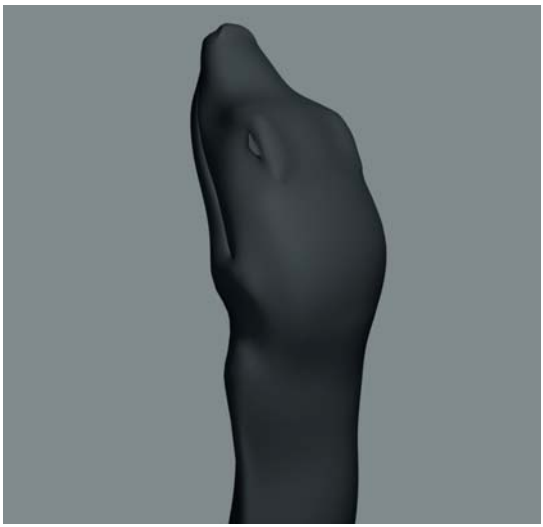


Figure 2.17 The final snake.

The final combining of the halves was done on the low polygon version because this affords you the most options. If you need to keep a low polygon version, it is ready to go as is. But if you can go with a higher resolution, simply run a smoothing operation on the model; we already know this works. You can even run multiple smoothing operations on it and go ultra-high res. I didn't extend the template down for the snake because the tail section was very similar to the main body of the snake. Also, I modeled the head in the arched position to get more of a menacing look to the snake. Before this could be used for animation, the head would need to be turned up for proper rigging.

NURBS Modeling

NURBS (short for Non-Uniform Rational B-Spline) is great for modeling organic shapes. A NURBS object comprises curves and surfaces.

The curves you create act as a framework for you to stretch a surface over. Curves have many uses in Maya. Not only are they used for creating geometry, but curves can also be used for creating text, setting animation paths, and for controlling character animation rigs.

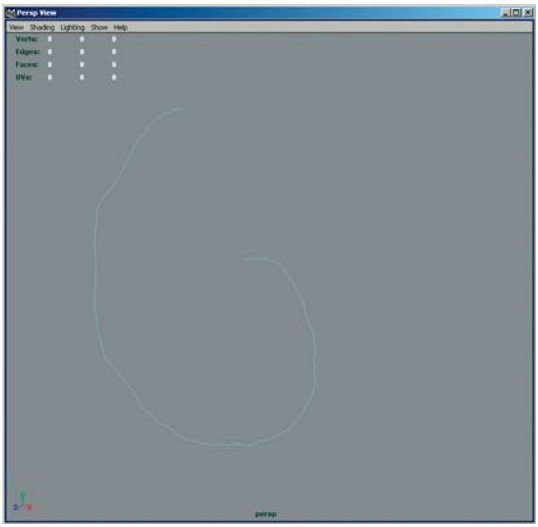


Figure 2.18 The different curves.

If curves act as the skeleton, surfaces would be the skin laid on top of these curves. Usually you will manually create NURBS surfaces using tools like Loft, Revolve, and Extrude, but there are also primitives available in Create > NURBS Primitives to aid in your modeling. Working with surfaces is similar to working with curves. Just keep in mind that a curve has one direction to work with, whereas a surface has two directions (U and V). The U and V directions are used to form the N (or surface normal) direction.

Go to the Create window. In the curves sub-group you will see the CV (control vertices) Curve, EP (edit points) Curve, and Pencil Curve tools. The CV Curve

tool creates curves by placing a control vertex at each mouse click. The EP Curve tool places an edit point with each mouse click. To create a free flowing curve, use the Pencil Curve tool. After placing the points of your curve you need to press the Enter key to finalize it.

To edit a curve RMB click on it to go into component mode. Use the Control Vertex and Edit Point options to manipulate the shape of the curve. Selecting Curve Point allows you to fine-tune the curve by adding an edit point at the specified spot using the Edit Curves > Insert Knot tool.

1. In the top viewport, create an EP curve.
2. In the front viewport create a NURBS circle oriented on the Z axis.
3. Select the circle then the EP curve.
4. Go to Surfaces > Extrude. When you extrude, you first select your shape followed by the path. You should have a tube similar to the one below. Tube is the default extrusion method.

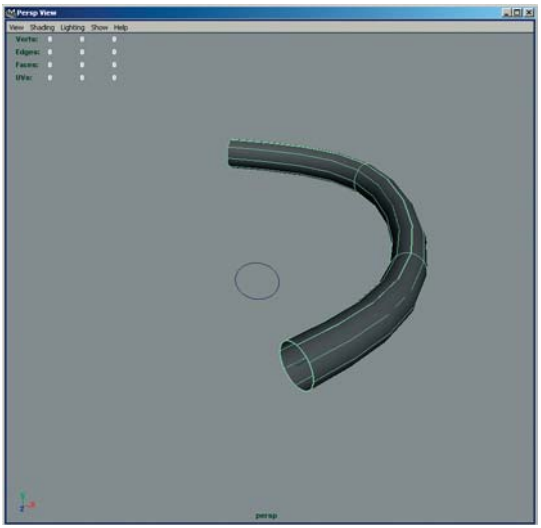


Figure 2.19 Extruded circle.

Undo the extrude operation, select the EP curve first and the circle second. If you run the Extrude tool now, it will use the circle as the path and create an

entirely different shape. Of course, if Construction History is still on, you can continue to manipulate the curves to alter the surface.

Tutorial: Binoculars

1. Start a new scene in Maya 5.
2. In the top viewport create an EP curve similar to the one shown in Figure 2.20.
3. With the curve selected, go to Surface > Revolve > ❐.
4. Set the Axis Preset to Z and the Pivot to object.
5. For Surface Degree select Cubic and use 0.00 for Start Sweep Angle and 360 for the End Sweep Angle. This will create a solid shape. If you started and ended at different angles, you would get a different surface.
6. Choose 8 for Segments. Set the Curve Range to Complete and NURBS as the Output Geometry. Click Create.

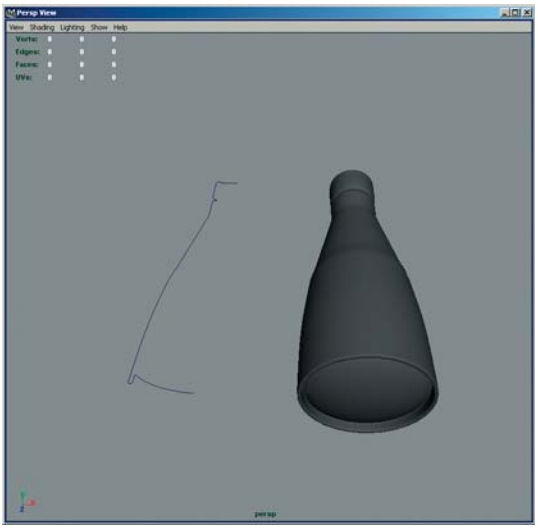


Figure 2.20 EP curve before and after revolve operation.

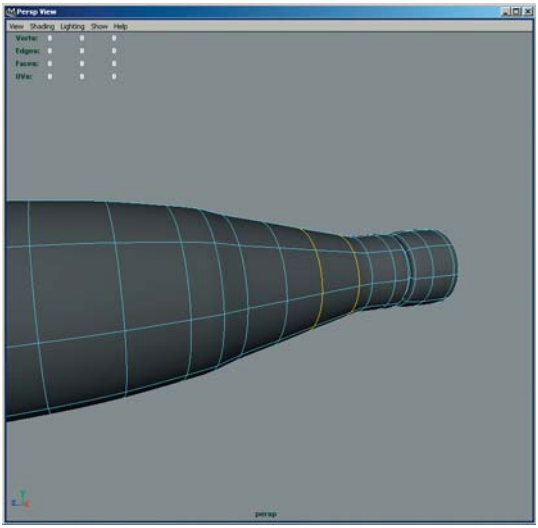


Figure 2.21 Isoparms needed to build the crosspiece.

7 Now you need to build the crosspiece. Select two adjacent isoparms partway along the barrel of the revolved binocular barrel.

8 Go to Edit Curves > Duplicate Curves. This will make separate curves for the isoparms that you selected.

9 Name the larger curve Crosspiece01 and the smaller curve Crosspiece02.

Hint: Maya allows you to rename nodes when they are initially created. Or you could also rename the node in question by clicking on the name and changing it in the Channel Box or Attribute Editor.

10 With the two new curves selected, go to Edit Curves > Open/Close Curves.

11 We will only be using parts of the new curves so delete the unneeded edit points on the two curves. If your curves lose their shape in this process, try deleting only one edit point at a time.

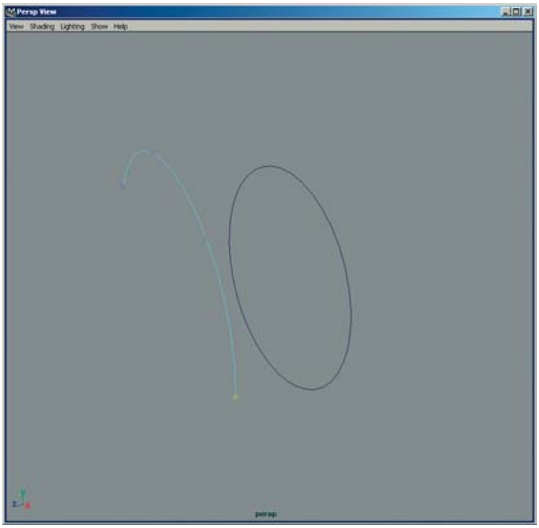


Figure 2.22 Readying the new curves.

12 Turn on Snap to Points mode.

13 Select the EP curve tool, then RMB click on the first curve and enter Edit Point component mode. Click near the top edit point of the curve and the EP tool will snap the first edit point to that point.

14 RMB click on the second curve and enter Edit Point component mode.

15 Click near the top edit point of this second curve and the next EP curve point will snap to that point.

16 Press enter to create the EP curve. This is the top guide that will help us in construction of our crosspiece.

17 Follow steps 13 to 16 to create the bottom guide.

18 Turn off Snap to Points.

19 In the front viewport, create the inner outline for the crosspiece.

20 Duplicate the outline and adjust the CVs and EPs to form the outer edge of the outline (see Figure 2.23).

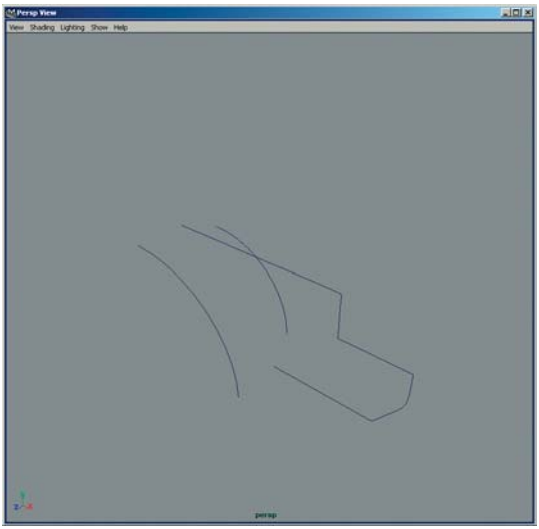


Figure 2.23 Inner and outer outlines.

21 Duplicate the inner edge twice and the outer edge three times. Place them according to Figure 2.23.

22 Rename the outline sequentially starting with Outline01 for the curve aligned with Crosspiece01, to Outline07 for the curve aligned to Crosspiece02.

23 If you look at the crosspiece outlines, they won't match up with the guidelines you created. To do this, select the top guideline and RMB click to Curve Point component mode, select the spot where you want to create an EP and run Edit Curves > Insert Knot.

24 Turn Snap to Points on.

25 RMB click on an outline curve and enter Edit Point component mode. Select the end EP.

26 RMB click on the guideline and enter Edit Point mode. Now when you move the edit point, it will snap to the guideline curve.

27 Repeat steps 26 for the tops of the other outline curves.

28 Once the top is done, follow steps 25 to 27 to complete the bottom.

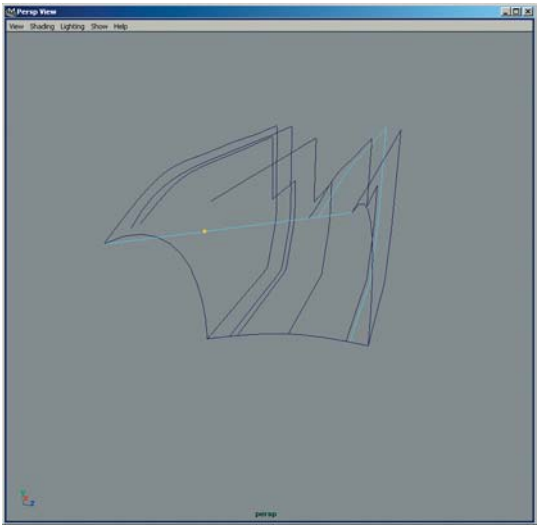


Figure 2.24 Adding edit points.

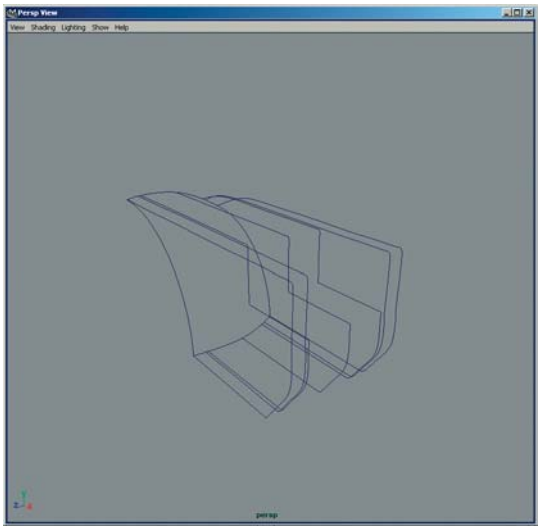


Figure 2.25 The completed outlines.

We are now ready to loft the surfaces for the crosspiece. For this particular object we are going to loft the surfaces in chunks. This makes it easier to create slightly rounded edges, which will add to the realism.

29 Select Outline01 first, followed by Outline02.

30 Go to Surfaces > Loft > ❐.

31 Set the Parameterization to Uniform with Auto Reverse.

32 For Surface Degree use Cubic with a Section Span of 1.

33 The Curve Range should be set to Complete and choose NURBS for the Output Geometry.

34 Click Create.

35 Next select Outline02 and Outline03 and run Surface > Loft.

36 Repeat step 35 for Outline03 and 04, Outline04 and 05, Outline05 and 06, and lastly Outline06 and 07.

37 Select Outline01 followed by Crosspiece01 and go to Surface > Loft.

38 Select Outline07 followed by Crosspiece02 and go to Surface > Loft.

39 Select the first loft and second loft surfaces.

40 Go to Edit NURBS > Attach Surfaces > ❐.

41 Set the Attach Method to Blend and the Blend Bias to .25. Check Insert Knot options.

42 Leave Insert Parameter at .100.

43 Click Attach.

44 Select this new surface and the second loft surface. Go to Edit NURBS > Attach Surface.

45 Repeat step 44 for each loft surface making sure to only attach one surface per operation. Attach the two surfaces created with the Crosspiece curves last.

46 Select the Crosspiece and go to Edit > Duplicate > ❐. Set the X scale to –1 and click Duplicate.

47 Line the second crosspiece up with the first one.

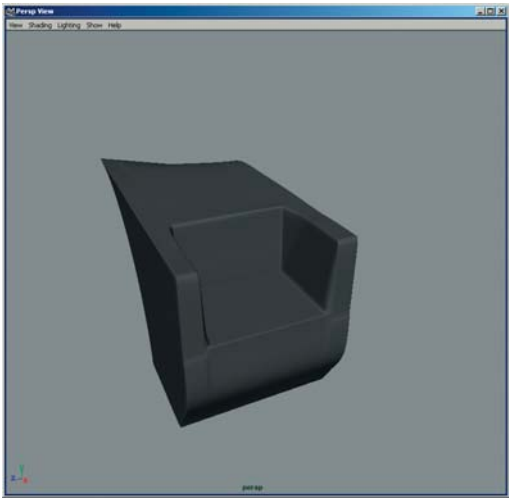


Figure 2.26 The completed crosspiece.

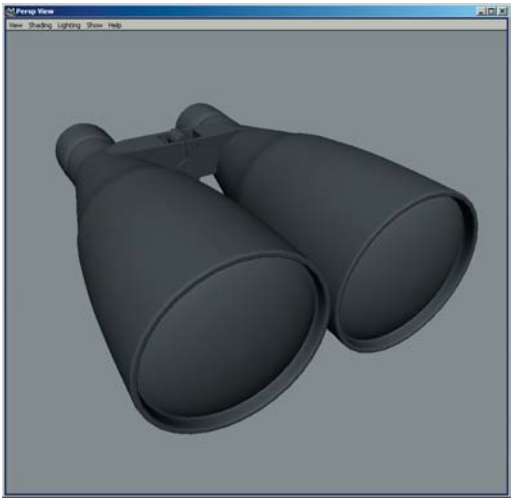


Figure 2.27 The completed binoculars.

48 Duplicate the first lens and line it up with the second crosspiece.

49 Go to Create > NURBS Primitives > Cylinder > ❐. Change the Axis to Z and choose Both for Caps. Click Create.

50 Place the cylinder in the hole between the two crosspieces and scale it to fit. This will be the focusing knob.

51 Duplicate this cylinder and move it below the focusing knob. It should intersect the bottom of each crosspiece. Scale it to fit. This will be the part that holds the two halves of the binoculars together.

Subdivision Surfaces

Subdivision surfaces (or subD surfaces) are best described as a cross between polygons and NURBS surfaces. They work by starting with a coarse base mesh for your model, which is then made finer and finer as you subdivide any desired areas.

One advantage of subdivision surfaces is they can be modeled using a single surface. This means that the potential of having seams in your models is not present as they are with NURBS surfaces. Another big advantage is that a coarse subD surface can be rigged for animation and the information will automatically transfer to the finer levels.

1 Go to Create > Subdiv Primitives > Cube. This will place a subD cube in your scene.

2 RMB click on the cube and select Vertex from the marking menu. You will see a 0 displayed next to each vertex. This indicates that the vertices are set to base level. The display levels range from zero to thirteen.

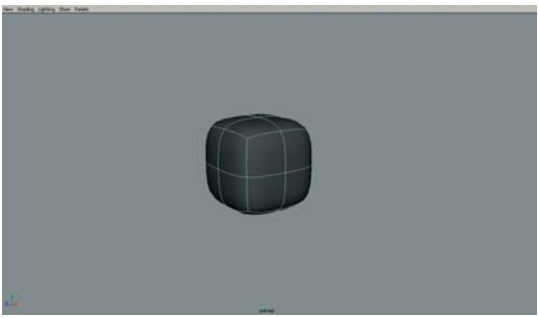


Figure 2.28 A subdivision cube.

3. Select a row of vertices marked by 0.
4. Go to Subdiv Surfaces > Refine Selected Components. This will refine the selected vertices to level 1.

You can continue to refine the selected vertices. Repeat step four until you have the desired smoothness for your vertices. You can also perform refine operations using faces and edges.

1. Start a new scene in Maya.
2. Create three subD cubes using Create > Subdiv Primitives > Cube and place them side by side.
3. Select the upper front row of vertices on the first cube.
4. Run Subdiv Surfaces > Refine Selected Components twice.
5. Double click on the Move Tool icon in the Tool Box to bring up the attribute editor for the tool. For Move Settings select Normal.
6. Select the N handle and move the vertices a tad in the positive Z.
7. Repeat steps 3 to 6 for the second cube, selecting the upper front two edges.
8. Repeat steps 3 to 6 on the faces of the third cube.

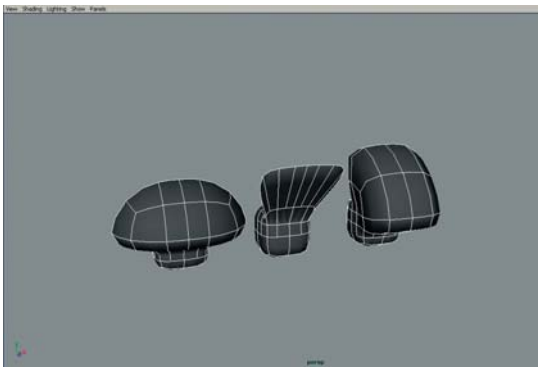


Figure 2.29 Three different manipulated subdivided cubes.

By refining different components, you get drastically different results. Keep in mind that you can choose different component types for different levels. Also, you will get different results if you move the components before refining them.

1. Start a new scene in Maya.
2. Go to Create > Subdiv Primitives > Cylinder to place a subD cylinder in your scene.
3. RMB click on the cylinder and go into vertex component mode.
4. Select the top center vertex of the cylinder.
5. Go to Subdiv Surfaces > Full Crease Edge/Vertex. This will create a crease on our selection. Subdivision surfaces excel at creating creases and edges, something that NURBS surfaces have trouble with.
6. Double click on the Move Tool icon in the Tool Box to bring up the attribute editor for the tool. For Move Settings select Normal.
7. Move the vertex up on the Y axis. Notice how, because you selected the full crease tool, the vertex forms a well-defined point on top of the cylinder.
8. With the vertex still selected go to Subdiv Surfaces > Partial Crease Edge/Vertex. A partial crease creates a softer edge compared to a full crease.
9. Use the Move Normal Tool to move the vertex selection on the positive Y axis until you have a bulb in your scene.

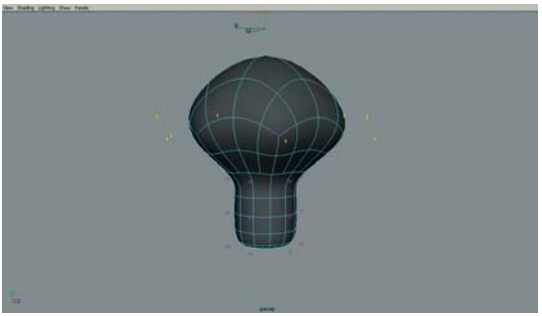


Figure 2.30 Subdivision bulb.

10 Double click on the Move Tool icon in the tool box to open the attribute editor.

11 Change the Move Settings to Object. You can switch between the move settings without losing your selection.

12 Move the vertices down, as in Figure 2.31.

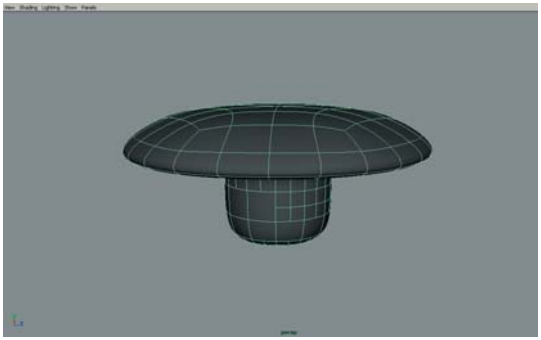


Figure 2.31 Flattened bulb.

13 Select the vertices that form the top of the object and run Subdiv Surfaces > Refine Selected Components twice to smooth them to level 3.

14 Save your scene as subDMushroom.

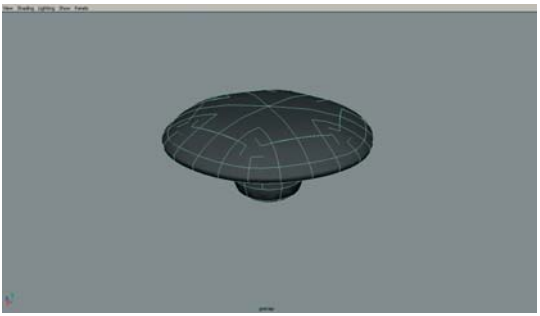


Figure 2.32 Final mushroom.

There is another way to work with subdivision surfaces – Polygon Proxy Mode. When you switch to Polygon Proxy Mode, a polygonal cage surrounds the base level of your subdivision surface.

1. Open the mushroom you created in the previous tutorial.
2. Select the object.
3. Go to Subdiv Surfaces > Polygon Proxy Mode. You will see a low resolution cage appear in your model.
4. Press 4 to switch to wireframe mode. As you can see, the polygonal cage matches the work you did on the base level of the object.
5. In order to get a polygonal cage to surround your object once you have refined it, you need to collapse the hierarchy of the levels.
6. Go to Subdiv Surfaces > Standard Mode to return to the standard subD editing mode.
7. Go to Subdiv Surfaces > Collapse Hierarchy > ❐. Type 3 for the Number of Levels and press Collapse. The number of levels options refers to how many levels of refinement you want to collapse. You can collapse up to the number you currently have set for your object.
8. Go to Subdiv Surfaces > Polygon Proxy Mode. The polygonal cage will now surround the entire mushroom object.

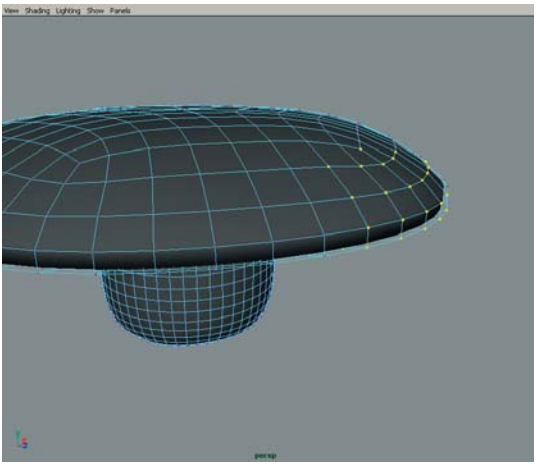


Figure 2.33 Polygon proxy mushroom. Notice the proxy cage vertices are selected.

In Polygon Proxy Mode you can use any of the polygonal editing tools on the new proxy mesh. Experiment with extruding some faces and pulling vertices of the new polygon cage. The subD surface will deform as well. When you are happy with your edits, go to Subdiv Surfaces > Standard Mode to return to the normal subdivision work mode. When you switch back to standard mode, the polygonal cage will automatically be deleted.

A very common workflow with subdivision surfaces is to start with a low polygon object that you form into the basic shape you desire. Once you have the basic form ready the object is converted to subD surfaces using Modify > Convert > Polygons to Subdiv.

Tutorial: Creating a Hand with Subdivision Surfaces

1. Start a new scene in Maya.
2. Create image planes in the front and side viewport to template your hand drawings.

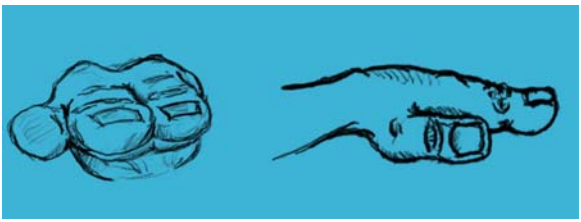


Figure 2.34 Hand drawings to be modeled using subD surfaces.

3. Go to Create > Polygon Primitives > Cube > ❒. Set 4 for the subdivisions along the X, Y, and Z axes. Click Create.
4. Position the cube of the palm of your template.
5. Scale the cube to the approximate dimensions of the palm of your template. We will be extruding the fingers later.
6. RMB click on the cube and enter Vertex Component mode. Start moving vertices to get the basic shape of the palm (see Figure 2.35).

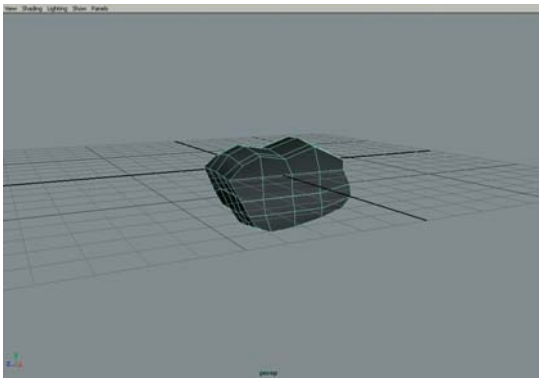


Figure 2.35 Beginning polygon model.

7. Now that you have the basic shape of the palm, it's time to convert it into subD surfaces. Go to Modify > Convert > Polygons to Subdiv. Your model will now be smoother. But it still lacks fingers and good palm definition.

8. Select the model and go to Subdiv Surfaces > Polygon Proxy Mode. A cage of the original polygonal mesh will surround the subD surface.

9. Select the faces that are in line with the index finger of the sideview template drawing.

10. Using the polygon toolsets, extrude the faces out to just before the first knuckle.

11. Adjust the faces so they match the area of the template.

12. Extrude again to the middle of the knuckle and adjust the faces to match this area.

13. Extrude a third time to just after the knuckle and adjust the faces to match the template. The reason for extruding in chunks around the knuckles is because the extra detail in these areas allow for deformation of the model.

14. Continue extruding in chunks until you have the basic shape of the index finger.

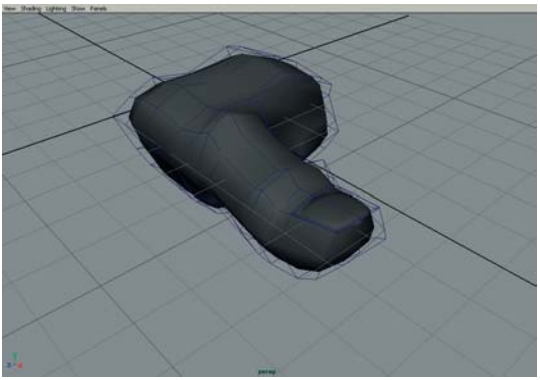


Figure 2.36 SubD surface index finger.

15 Take some time to fine-tune the shape of the index finger. Remember, during this stage, all of the polygon tools are at your disposal. If you need to merge vertices or split faces to match the template, now is the time to do so.

16 Select the faces that correspond to the fingernail of the index finger.

17 Extrude them down a very slight amount.

18 Scale the faces uniformly down a small amount.

19 Extrude the faces back to their original position.

20 Split the polygon cage on the sides of the finger to add dimples around the fingernail.

21 Pull the vertices in around the fingernail so they overlap the nail.

22 Use the Split Polygon Tool to create extra faces between the two fingers.

23 Repeat steps 9 to 22 to shape the other finger.

24 Select the faces that lie over the thumb in the template.

25 Extrude them out.

26 Rotate the selection so that edges nearest the wrist are back near their starting point. This is an important part of cleaning up the thumb.

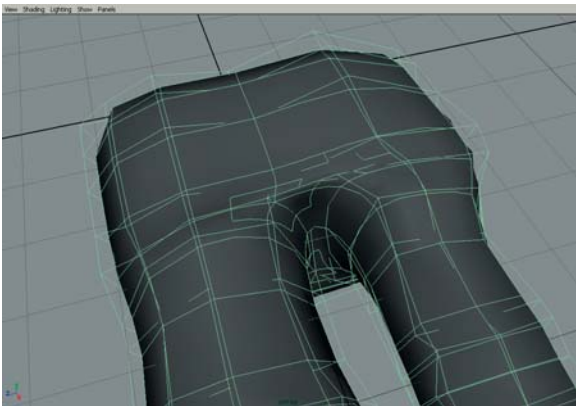


Figure 2.37 Creating extra space between the fingers.

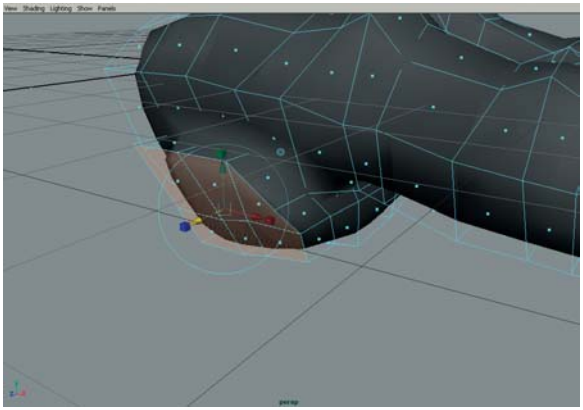


Figure 2.38 Creating the thumb.

27 Merge the vertices that have been rotated back to their starting point with the vertices that are currently in those coordinates. This step is vital for creating the bulge of the thumb where it shoots out from the wrist.

28 Continue manipulating vertices to get the shape for the base of the thumb.

29 Select and extrude the thumb faces using the same methods as used for the fingers.

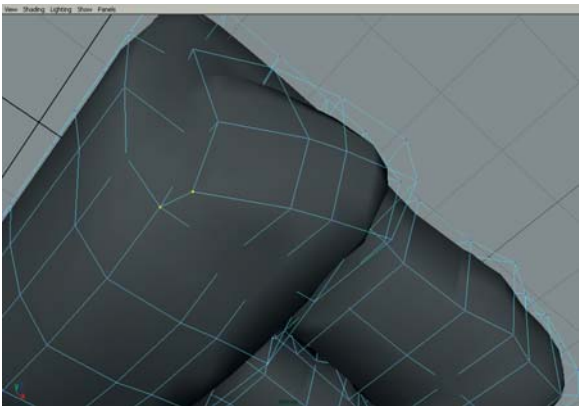


Figure 2.39 Merging the vertices at the base of the thumb.

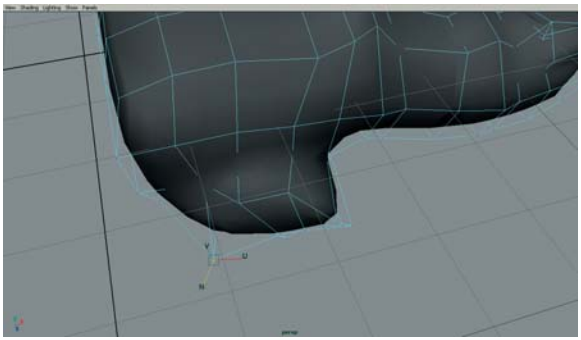


Figure 2.40 The base of the thumb.

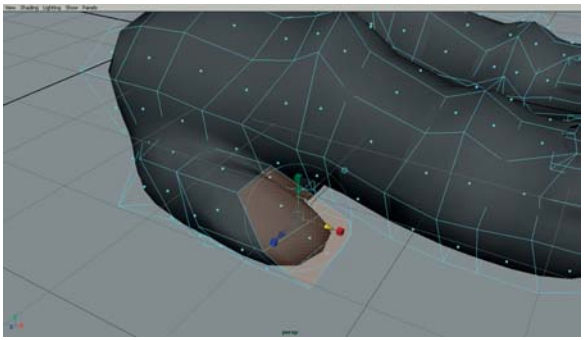


Figure 2.41 Extruding the thumb.

30 Create the nail for the thumb. Remember to use the Split Polygon Tool to create extra faces so you can overlap them over the thumbnail.

31 Select the faces at the base of the hand and extrude them back to make the wrist.

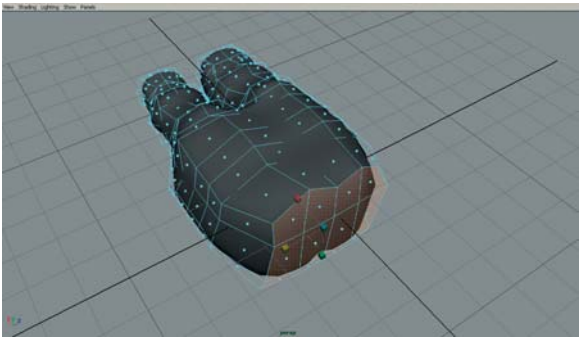


Figure 2.42 Making the wrist.

32 Once the wrist is extruded, delete the faces of the base. They will not be needed.

33 Go to Subdiv Surfaces > Standard Mode. We are now ready to finish the hand. We can get more finely tuned details in standard subD mode.

34 Select the rows of edges starting at the wrist and extending to the first set of knuckles (see Figure 2.43).

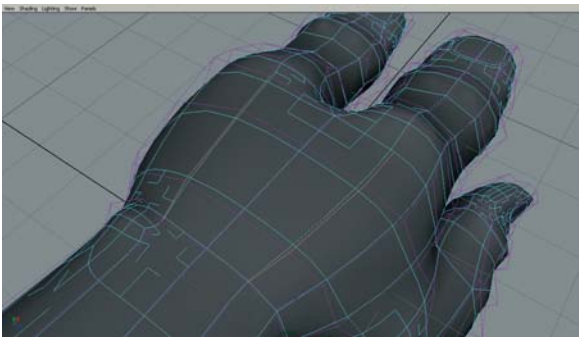


Figure 2.43 Edges on the top of hand.

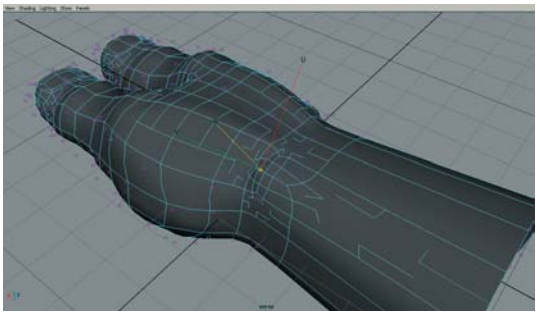


Figure 2.44 Forming the bones and muscles of the wrist.

35 Go to Subdiv Surfaces > Partial Crease Edge/Vertex. Pull the crease up a bit to form ridges on the back of the hand.

36 Use the Partial Crease Edge tool to create the bones and muscles of the wrist.

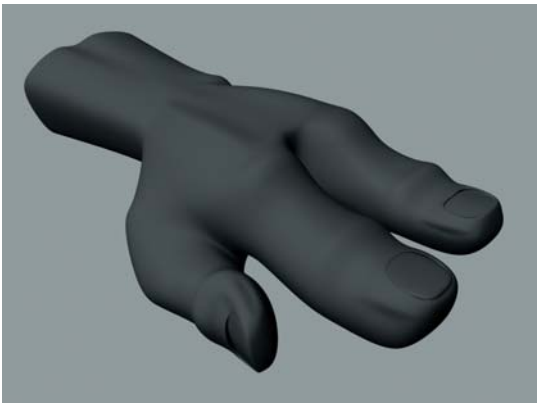


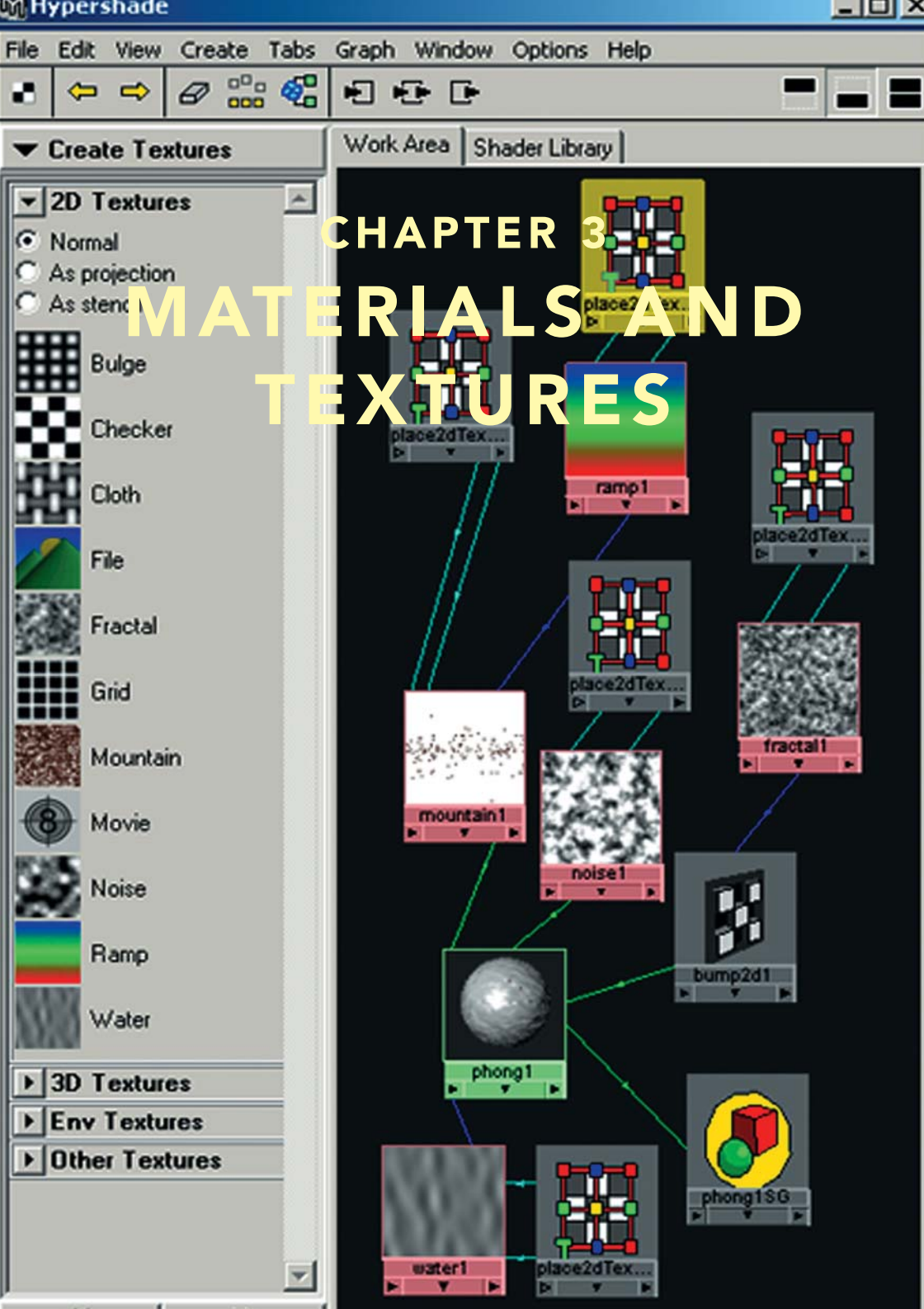
Figure 2.45 The completed hand.

37 RMB click on the hand and select Vertex Component mode from the marking menu.

38 Select the vertices for each fingertip.

39 Go to Subdiv Surface > Refine Selected Components. The fingertips will now be smoothed to level 1. Keep in mind that with subdivision surfaces you only need to smooth out areas that need the extra detail.

The images I have used are unique hands for an android I created named Feedle. Feedle only has a thumb and two fingers on each hand. Of course if you are modeling a traditional hand, simply repeat the steps for each finger.


Hypershade
File Edit View Create Tabs Graph Window Options Help
Create Textures
2D Textures
Normal
As projection
As stenc
Bulge
Checker
Cloth
File
Fractal
Grid
Mountain
Movie
Noise
Ramp
Water
3D Textures
Env Textures
Other Textures
Work Area
Shader Library
CHAPTER 3
MATERIALS AND TEXTURES
place2dTex...
ramp1
mountain1
noise1
fractal1
bump2d1
phong1
phong1SG
water1

After you create the geometry, you will need to let Maya know the surface properties of the object. In Maya this is known as a Shading Network. Each Shading Network you build holds such information as transparency, color, incandescence, and textures. All of the material work is done in a work area known as the Hypershade.

The Hypershade

Start a new scene in Maya 5.0, and open the Hypershade by going to Window > Rendering Editors > Hypershade. You could also select the Perspective/Hypershade button on the Tool Box to create a stacked window of the two views.

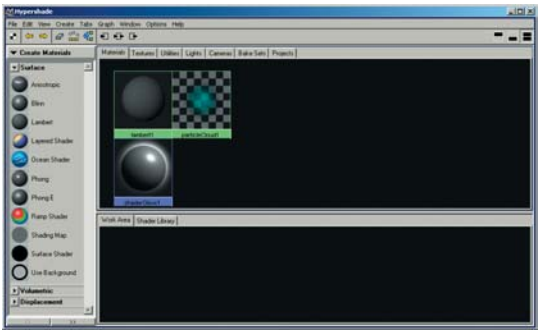


Figure 3.1 The Hypershade window.

The Hypershade is separated into three main areas. To the left is the node creation area. This is where you initially create your shading networks. You can also RMB click in the Hypershade and create these nodes through the marking menu. The two other key areas of the Hypershade are the top and bottom work spaces. The top space contains the main node information. You can switch between node types using the tabs along the top of this area. The bottom space is the working area where you actually construct the shading networks. You navigate through the Hypershade using the same mouse and keyboard command used in moving through Maya's main menus.

You will notice that there are always three material nodes present. These are non-deletable nodes that Maya uses as default shaders for new objects.

Material Types

You have many different material types to choose from when you begin constructing your shading network. It's very important to choose the correct material type as they each render differently.

Anistropic – For surfaces with small grooves, like brushed metal or a CD. As your view of an object with an Anistropic material changes, the highlight will change depending on the direction of the grooves.

Blinn – For surfaces that have soft specular highlights. Blinn materials are a good choice for soft metal surfaces.

Lambert – For matte surfaces. Use for object that will have no specular highlights.

Layered Shader – Use if you want more than one material on an object. Using a Layered Shader you can mix the added materials to create unique surfaces.

Phong – For use on very glossy surfaces. Phong materials have a hard specular highlight.

Phong E – Similar to Phong, but with a slightly softer specular highlight. Phong E also renders faster than a regular Phong.

Ramp Shader – Uses gradients to control color changes of the material associated with changes of lights and angle.

Shading Map – For creating non-photorealistic surfaces.

Surface Shader – Allows you to connect keyable attributes to the material. With a Surface Shader you could have an object's color change automatically as it moves through the scene.

Use Background – For use with blending real-life images with computer-generated objects. Objects using the Use Background material will not appear in your scene, but they are still affected by nodes in your scene. Thus shadows can still fall on them and they can still accept reflections. If you had a photograph of a fence and you wanted it to appear that your character walked behind it, you would create a stand-in object to match the outline of the fence

and apply a Use Background material to it. If a shadow fell across the stand-in object, it would appear to actually affect the fence in the photograph.

Texturing Objects Using NURBS

There are two ways to texture your object, procedurally and with image maps. Procedural textures are generated within Maya using mathematical formulae. Image maps are user-created files that you import into Maya and place on an object.

1. Open the binoculars you created earlier.
2. Hide the left barrel and crosspiece. For identical objects it's a good idea to texture the original piece before you duplicate it. When you duplicate an object, the Shading Network is transferred onto the new geometry.

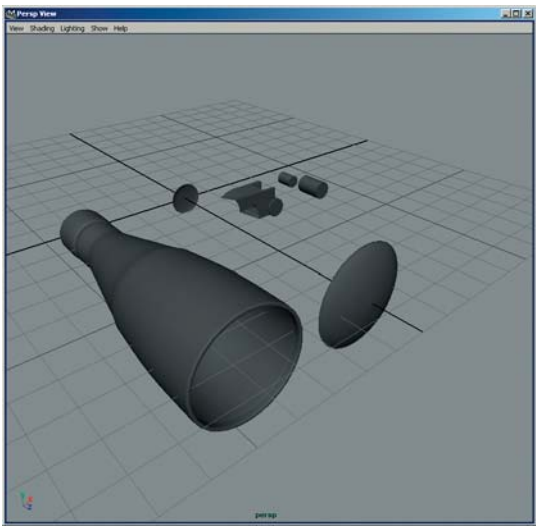


Figure 3.2 Preparing the binoculars for texturing.

3. RMB click on the barrel and select the isoparms that make up the main lens of the binoculars.

4. Go to Edit NURBS > Detach Surfaces. This will detach the lens into multiple surfaces.

5. Select the two separate surfaces of the lens and go to Edit NURBS > Attach Surfaces > ❐. Set the Attach Method to Connect and the Multiple Knots to Keep. Press Attach. By attaching the surface in this way, you get the lens to not distort during the attachment.

6. Continue attaching until the lens is all one surface.

7. Check the CVs at the center of the lens and if necessary snap them together using the Snap to Point tool.

8. Repeat steps 3 to 7 for the smaller eyepiece lens.

9. Open the Hypershade by going to Window > Rendering Editor > Hypershade.

10. Click once on the Phong icon and once on the Phong E icon in the Create work area of the Hypershade. If the Create area does not have the Materials loaded, click on the bar at the top and select Create Materials from the menu. Also, remember you can RMB click in the work areas and use the marking menu to create your material.

11. Double click on the Phong E material swatch in the work area to open the Attribute Editor.

Tip: If you lose track of the icons in the work area press the a key on your keyboard to frame all. Remember that you can navigate through here using the regular Maya controls.

12. Click on the checkered box next to the Color setting. This will bring up the Create Render Node. This window has the same nodes you can access through the Create window of the Hypershade but if you assign them through here, they are linked automatically to the Shader Network for you.

13. In the Create Render Node select the Textures tab and click on Checker. The reason for applying the checker material is that it helps locate

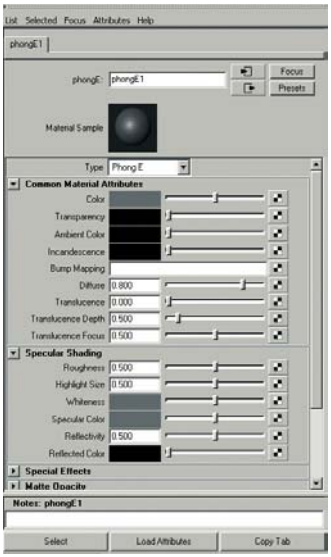


Figure 3.3 The Attribute Editor for the Phong E material.

Figure 3.4 The Create Render Node.

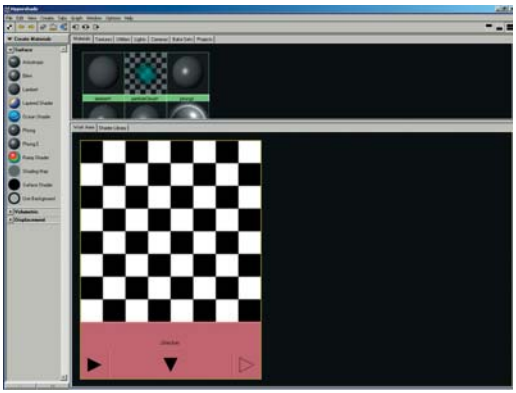


Figure 3.5 The Checker texture.

problem areas on your mesh. With a checker textures assigned, you can quickly see which areas of your object need work to prevent texture stretching and crunching.

14 Select the barrel of the binoculars.

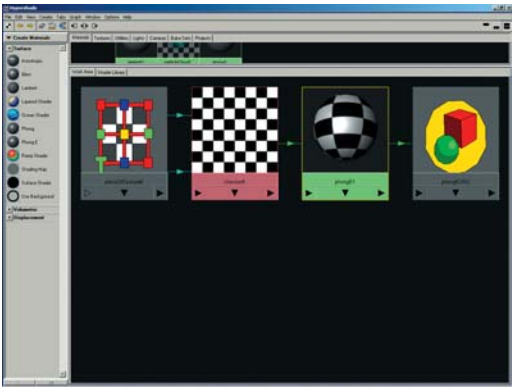


Figure 3.6 The Phong E Material checker ready to assign.

15 Go back to the Hypershade. The Phong E material will now appear as a checkered sphere.

16 With your object still selected, RMB click on the checkered Phong E material and click on Assign Material to Selection in the marking menu.

17 Press 6 on your keyboard to enter hardware texturing mode.

18 You will see a checkered barrel similar to Figure 3.7.

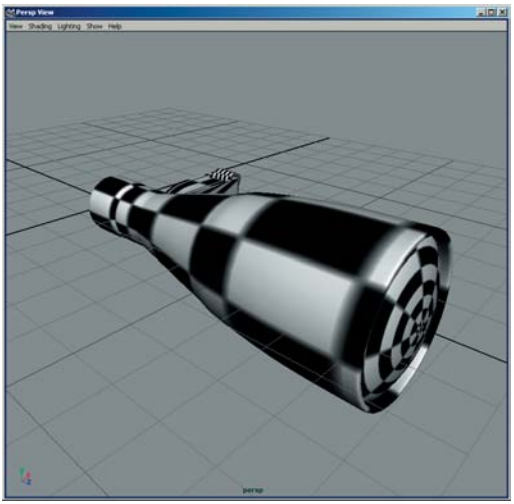


Figure 3.7 The checkered barrel.

19 Select all of the surfaces for the crosspiece and assign the checkered Phong E to them.

20 Select the two lenses and repeat steps 11 through 19 using the Phong material. This will give the lenses a shinier appearance.

21 Inspect the checker textures for any stretching. The crosspiece needs a bit of work.

22 Select the crosspiece surface and go to Window > Attribute Editor (or use the Ctrl + a keyboard shortcut).

23 In the Attribute Editor select the Shape node for the crosspiece.

24 Click on the arrow next to Texture Map to expand the options.

25 Click the Fix Texture Warp swatch. Leave the Grid divisions at 4.

26 This Fix Texture Warp works on a per surface basis. It does not affect the material you created in any way.

27 To see the changes this makes to your crosspiece you will need to render the scene. Center the crosspiece in your Perspective View and click on Render the Current Frame in the Status Line.

28 The checker texture is no longer stretched way out of proportion on the object.

29 Open the Hypershade and double click on Phong E material. We need now to replace the checker texture with the one we will be using for rendering.

30 Select Graph > Input and Output Connections in the Hypershade window.

31 Select the checker texture and the place2dTexture swatches and delete them. The Phong E material is still mapped to surfaces all we have to do is add our final texture.

32 Double click on the Phong E swatch to open the Attribute Editor.

33 Click on the color bar next to Color to bring up the Color Chooser.

34 Set each of the RGB values to 37. If the Color Chooser is in HSV (Hue, Saturation, and Value) mode click on the HSV/RGB pulldown in the Sliders section. If the numerical value pulldown is set to 0–1, you may want to change it to 0–255. Most people are more familiar with the 0–255 color picking system.

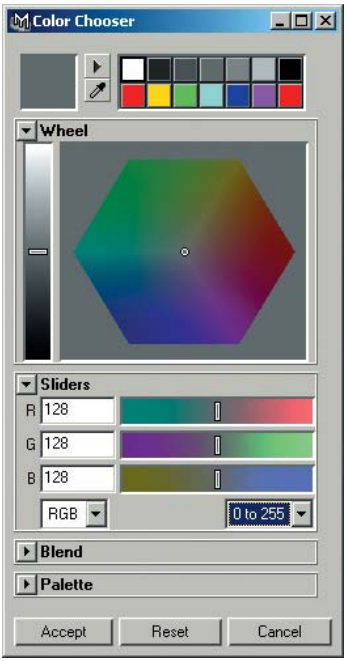


Figure 3.8 The Color Chooser.

35 Click on the checker box next to Bump Mapping.

36 Set the Bump Depth to .125.

37 Click on the checker box next to Bump Value.

38 The Create Render Node window will come up. Select Leather from the 3D Textures list.

39 Enter these attributes:

- Cell color of R 89, G 89, and B 89.
- Crease color of R 51, G 51, and B51.
- Cell Size to .500.
- Density to .488.
- Spottyness to .100.
- Randomness to .500
- Threshold to .909
- Creases checked.

40 Go back to the Hypershade and select the Phong material that is mapped to the lenses and open it in the Hypershade.

41 Enter the following attributes:

- Color of R 128, G 128, and B 128.
- Transparency of R 198, G 198, and B 198.
- Expand the Raytrace Options section and turn on Refractions.
- Refractive index of 1.1.
- Refractions Limit of 2.
- Surface Thickness of 1.0.
- Shadow Attenuation of .5.

42 Now that you have textured this half of the binoculars, duplicate and position the lenses, crosspiece, and barrel as you did in the modeling tutorial.

43 Press the Render the Current Frame button to see your final work. Keep in mind that though we set up the lenses to use a refracted raytraced material, it will not show up until the final render.

Figure 3.9 The finished binoculars.

Texturing Polygonal and SubD Models

Texturing polygons and subdivision surfaces uses a completely different workflow from NURBS. NURBS embed the UV information automatically when

you create a surface. With polygons and subD surfaces, you actually have to let Maya know where the UV coordinates lay. This is done using the Texture commands found in Edit Polygons > Textures and Subdiv Surfaces > Textures. Mapping polygons and subD surfaces are essentially the same so we will be focusing on polygons. The only differences between mapping the two model types is that subD surfaces have fewer mapping types to work with compared to polygons and when mapping subD surfaces, you need to remember to select the Display Level which contains the faces you want to map.

1. Create three subdivision spheres in a new scene and place them side by side.
2. Name the first sphere1 and leave it as is; name the second and third sphere2 and sphere3 respectively, select the top face of each and refine to level 3.
3. Open the Hypershade by going to Window > Rendering Editor > Hypershade.
4. Create a Phong material.
5. Double click on the Phong material swatch in the work area to open the Attribute Editor.
6. Click on the checkered box next to the Color setting to bring up the Create Render Node.
7. In the Create Render Node select the Textures tab and click on Checker.
8. Select all of the faces of the base level of sphere1.
9. Go to Subdiv Surfaces > Textures > Automatic Mapping to create a UV set for the base layer.
10. Go to the Hypershade and, with base level faces still selected, RMB click on the checkered Phong material and click on Assign Material to Selection in the marking menu.
11. Pick sphere2 and select all of the faces of the base level.
12. Go to Subdiv Surfaces > Textures > Automatic Mapping to create a UV set for the base layer.

13 Go to the Hypershade and, with base level faces still selected, RMB click on the checkered Phong material and click on Assign Material to Selection in the marking menu.

14 Now pick sphere3 and all of the faces for the level 3 refinement.

15 Go to Subdiv Surfaces > Textures > Automatic Mapping to create a UV set for the base layer.

16 Go to the Hypershade and, with base level faces still selected, RMB click on the checkered Phong material and click on Assign Material to Selection in the marking menu.

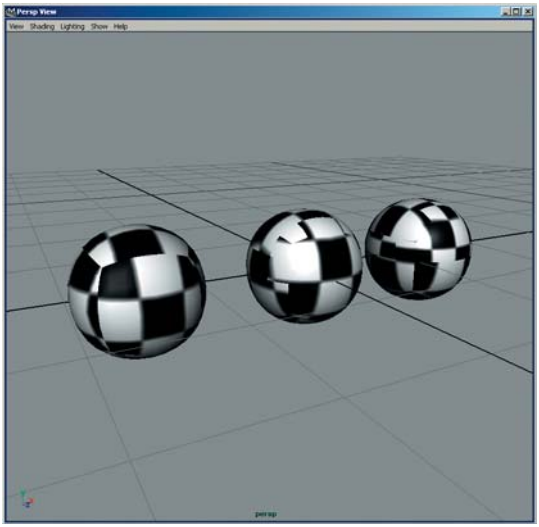


Figure 3.10 UV mapped subdivision spheres.

Notice how the checker texture is mapped differently on each sphere. That is because with subD UV mapping you can map the desired layer and the coordinates automatically apply to any refinement levels upstream. This can give you a very different result to that you would get if you mapped each level separately.

The UV Texture Editor

The UV Texture Editor is where you adjust the UVs for polygonal and subD models. This is an integral part of texturing polygons and subdivision surfaces.

1 To open go to Window > UV Texture Editor.

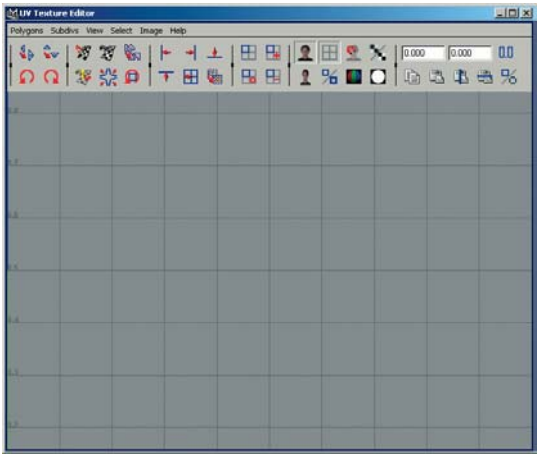


Figure 3.11 UV Texture Editor.

2 Select the subD model you created, sphere1.

3 Open the UV Texture Editor. You will see your sphere coordinates spread out over the checkerboard texture. Use the standard Maya command to navigate in the Texture Editor window.

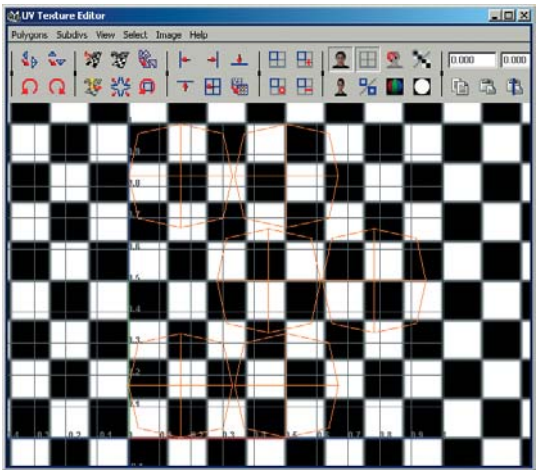


Figure 3.12 An object in the UV Texture Editor.

4. RMB click over one of the sphere outlines and select UV from the marking menu.
5. Drag select all around an outline to select all of the UVs of that area. You will notice that when you select something in the UV Texture Editor, the selection also occurs in the main Maya viewports. The reverse is also true.
6. Scale the UVs up. While working in the UV Texture Editor keep an eye on the object in the Maya viewports. As you scale the outline, the selected area of sphere updates with more checkers. Try moving and rotating the UVs to see the effects they have.

After mapping a polygonal or subdivision model the UV Texture Editor is where you do all of the UV manipulation. While working in the editor, you can use the drop-down options to snap UVs together, cut UVs, or even flip them. Take some time to practice with both polygonal and subD objects to get a feel for how each works.

1. Open the polySnake tutorial. For this tutorial you will need to create image maps to project onto the model similar to those in Figure 3.13.

Figure 3.13 Image maps.

Hint: If you have not already done so, rotate the snake's head so that it is pointed up. This will make texturing much easier.

2 Select the faces for the underside of the snake.

3 Go to Create > Sets > Quick Select Set to add the faces to a quick selection set named Belly.

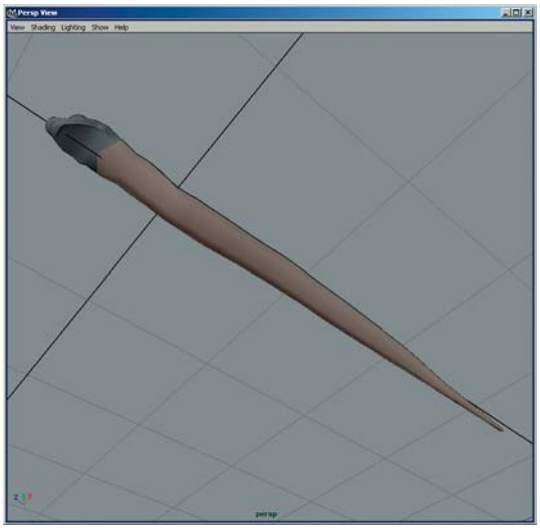


Figure 3.14 The faces of the snake's belly.

4 With the faces of the belly selected go to Edit Polygons > Texture Planar Mapping > ❐. Apply the following settings:

5 Smart Fit checked.

6 Fit to Bounding Box checked.

7 Mapping Direction set to Z axis.

8 Click Project. A mapping gizmo will appear similar to the one in Figure 3.15.

9 The selected faces of the belly now have UV coordinates. All we need to do now is supply the image. Open the Hypershade and create a new Lambert material.

10 Double click the Lambert material to open the Attribute Editor.

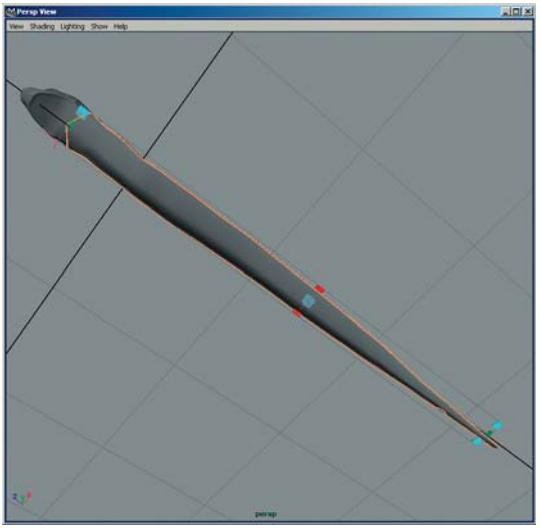


Figure 3.15 Mapping gizmo.

11. Click on the checkerboard next to Color to bring up the Create Render Node window.
12. Select File from the Textures tab.
13. This will create, and connect to the Lambert material, a node for your image file.
14. Double click on the Lambert material again and you will see that the checkerboard next to Color has changed to a different icon. This is the Input Connections icon, which indicates there are now more nodes in that path.
15. Click on the Input Connections icon next to color.
16. The texture file node will come up. Click on the folder icon next to Image Name and select the belly texture. The load image icon defaults to the source images directory of the current project, but it can be directed to any folder.

Tip: Unless you are specifically using alpha transparency in the texture file, make sure your image is 24 bit before you load it into Maya.

17 Quick select the belly faces.

18 RMB click on the Lambert material and select Assign Material to Selection. The texture will now be assigned snake's belly, but it is horribly stretched. To correct this we need to adjust the number of V repetitions.

19 Double click on the place2DTexture tab for the belly texture in the Hypershade to open the Attribute Editor. You can also reach the place2DTexture node by selecting the input and output connection buttons at the top of the Attribute Editor if you have the main material selected.

20 Change the Repeat V node to 14.

21 Repeat steps 19 to 20 for the back of the snake. When you create the Lambert for this material, point it to the texture you created for the snake's back.

22 Select the sides of the ridges and create a Quick Selection Set for them.

23 Go to Edit Polygons > Texture > Planar Mapping > ❐ and change the Mapping Direction to project along the X Axis in.

24 Apply the Lambert used for the back of the snake to the ridges.

25 Select the sides of the head and add them to a Quick Selection Set.

26 Assign a Planar Projection to the selection oriented along the X axis.

27 Go to the Hypershade and select the Lambert material used for the back of the snake. If we applied this material to the current faces, the image would tile too much.

28 In the Hypershade window, select Edit > Duplicate > Shading Network.

29 Select the new network and adjust the V tiling in the place2dTexture node. Currently the Repeat U is set to 1 and the V is 14.

30 Change the V to 1.5.

Figure 3.16 The outer mouth texture.

31 Select the faces that make up the upper portion of the outer mouth and create a Quick Selection Set for them. Because the mouth needs to blend to the interior mouth, you will need to create a texture that blends from the scales into the fleshy interior of the mouth (see Figure 3.16).

32 Apply a Planar Projection to the selection along the X axis.

33 Create a new Lambert and load the outer mouth texture. If needed, rotate the UVs using the UV Texture Editor.

34 Repeat steps 31 to 33 for the faces along the lower edge of the outer mouth.

35 Map the inside of the mouth with a pinkish texture that blends with the edge of Figure 3.16.

36 Use the back texture to finish mapping the faces around the eyes and snout.

37 Adjust any UVs needing work using the UV Texture Editor.

Figure 3.17 The textured snake.

38 Open the Hypershade, double click on the Lambert material for the belly and click on the checker box next to Bump Mapping.

39 Set the Bump Depth to .250.

40 Click on the checker box next to Bump Value.

41 The Create Render Node window will come up. Select file from the Textures tab and point to the grayscale image you want to use for your bump map. I made a copy of the snake's belly texture and converted that to grayscale, but you can use any grayscale image.

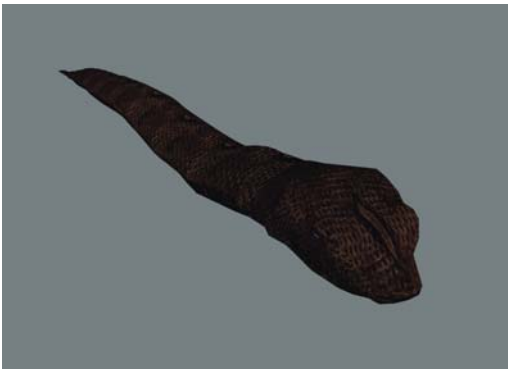


Figure 3.18 The final snake.

42 Repeat steps 38 to 41 for each material using the corresponding grayscale image. Take care to match RepeatUV values of the bump map's place2dTexture node with that of the image map node.

CHAPTER 4
LIGHTING

Lighting is often an afterthought when creating a 3D scene. Don't fall into this trap. A well-lit scene is often the difference between a mediocre image and a truly outstanding one.

Light in the real world is emitted from a source as photons that are either absorbed or bounce from object to object. As the photons bounce, light and color are absorbed depending on the makeup of any surfaces that they strike.

In Maya, light doesn't bounce. Because of this, all surfaces in Maya need to be lit directly by the lights in your scene.

Types of Light

All of the lights are accessed through Create > Lights >. There are five main types of lights: ambient, directional, point, spot, and area. There is also a sixth light, the volume light, which is not used as often.

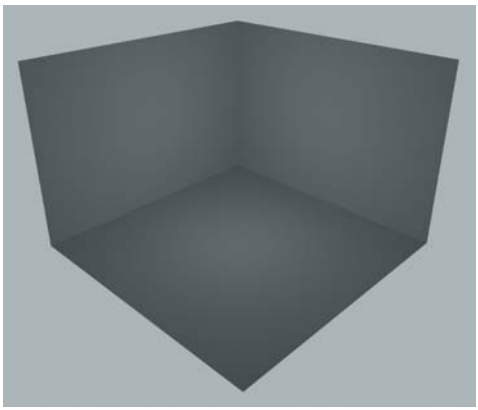


Figure 4.1 An ambient light emits light uniformly in each direction from the source.

Each light is displayed in Maya with a different icon. These are just for placement purposes and will not render in your scene.

Once you create a light, use the Attribute Editor to change its parameters. Each light has a Light Attribute section in the Attribute Editor. The Light Attribute section is where you control a light's color and intensity. This is also where you control a light's decay rate and cone properties.

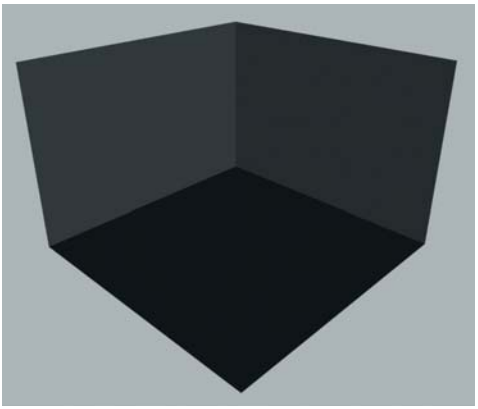


Figure 4.2 A directional light emits parallel light rays from the source. Sunlight striking the earth is a common example of directional light.

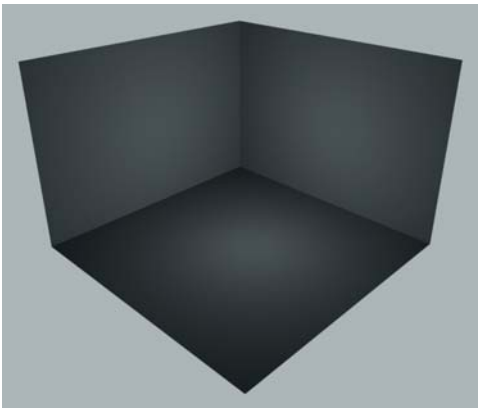


Figure 4.3 A point light has rays that travel in all directions emanating from a single point.

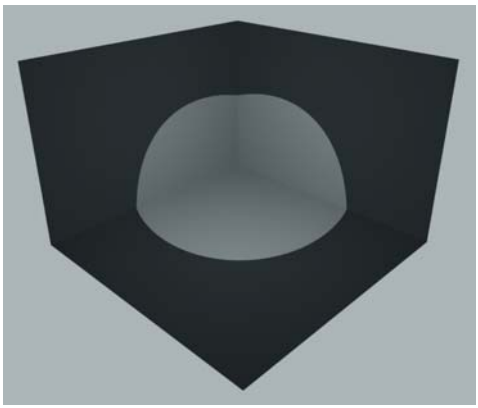


Figure 4.4 A spot light originates from a single point, but is limited by a cone.

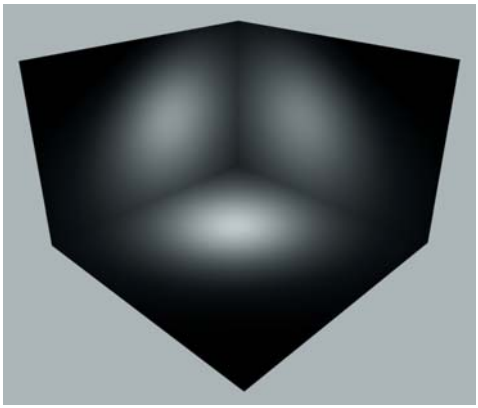


Figure 4.5 An area light emits light from a 2D area.

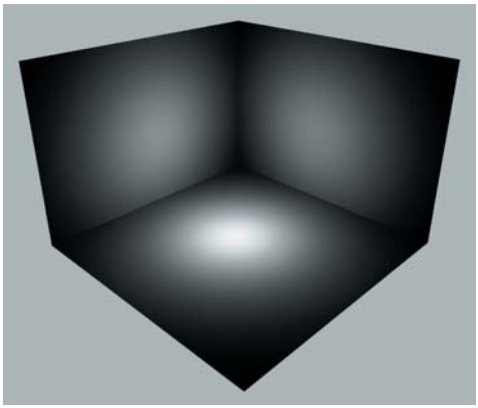


Figure 4.6 The volume light.

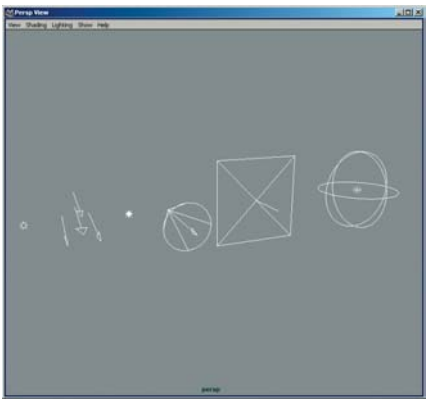


Figure 4.7 The different light icons. From left, they are ambient, directional, point, spot, area, and volume.

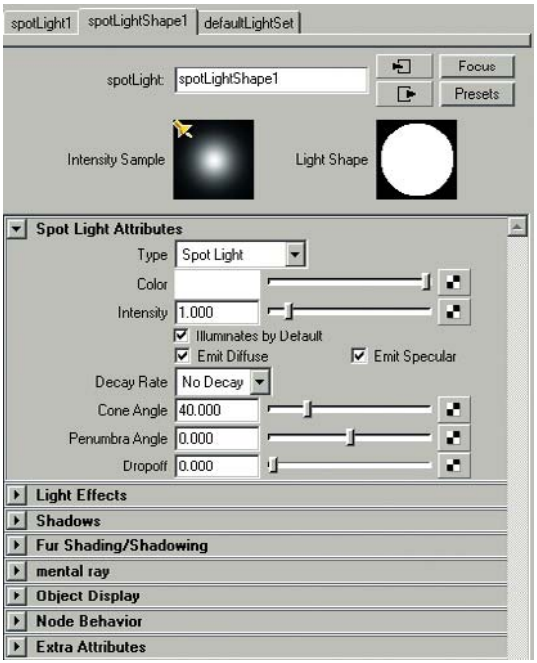


Figure 4.8 Light Attribute section for a spotlight.

The other section that all lights share is Shadows. Maya does not render shadows by default; you need to set up this option on a per light basis. Additionally, some lights will have a Mental Ray and/or a Light Effects section. The Mental Ray section is for setting up lights to be used with the Mental Ray renderer. The Light Effects section is to add optical effects such as lens flares or fog to a light.

Tutorial: Creating a Three-Point Lighting System

The three-point lighting system is a good foundation to build upon to light your scene. This method of lighting is commonly used in real world photography and motion picture shoots. It's quite a simple rig, but can do wonders to liven up your scenes. You start with a Key light that provides the main illumination of your object or scene. Next you place a Fill light to soften the shadows in your scene. Finally you add a Backlight to separate the object from the background.

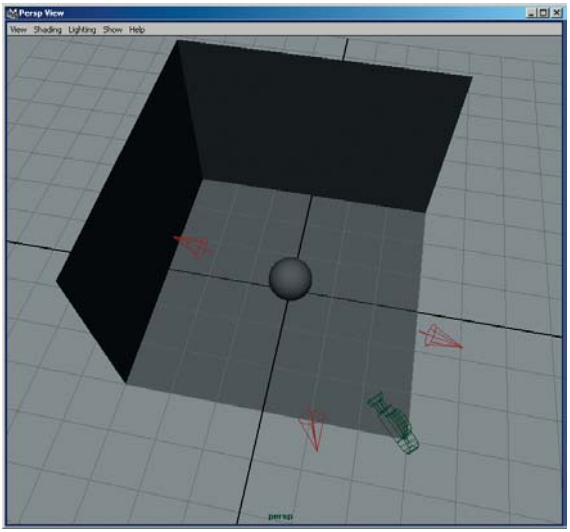


Figure 4.9 Three-point lighting rig.

In the basic three-point lighting system the Key light is the main source of illumination. The Fill light is approximately forty-five degrees from the Key light on the opposite side of the camera. The Fill light has less intensity than the Key. The Backlight is behind the object pointing toward the camera. It is almost opposite the Fill light and generally raised a bit. The Backlight intensity varies by what is needed to highlight the edges of the object.

1. Create three polygonal planes and arrange them into a floor and two walls (see Figure 4.11).
2. Place a NURBS sphere in the center of the room.
3. Go to Create > Camera. Position the camera so it is looking at the sphere. To check the camera point of view, go to Panels > Perspective > Camera1 in the drop-down menus of your current viewport.
4. Go to Create > Lights > Spot Light. Name this light Key and position it according to Figure 4.12.
5. Create a Fill light and a Backlight. Name them Fill and Backlight respectively and position them according to Figure 4.13.

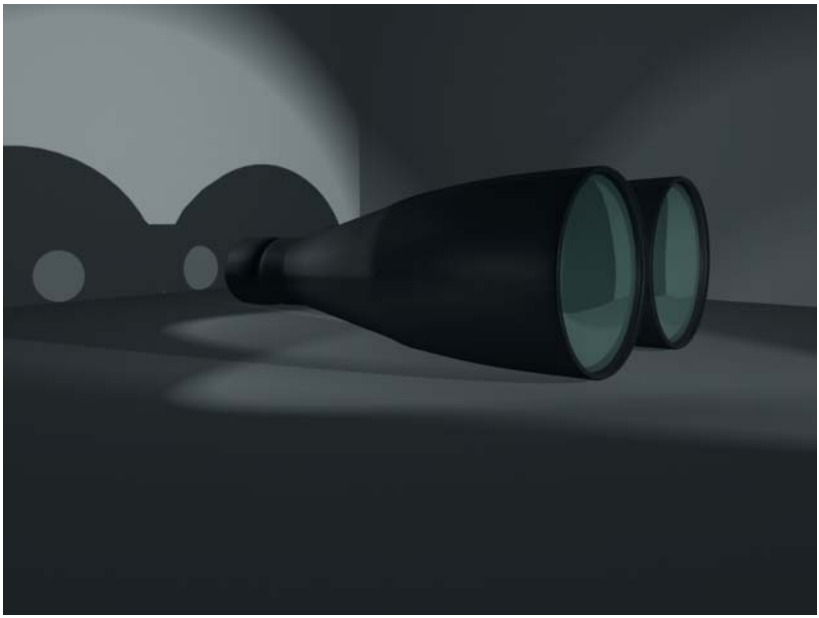


Figure 4.10 Object lit using a three-point lighting rig.

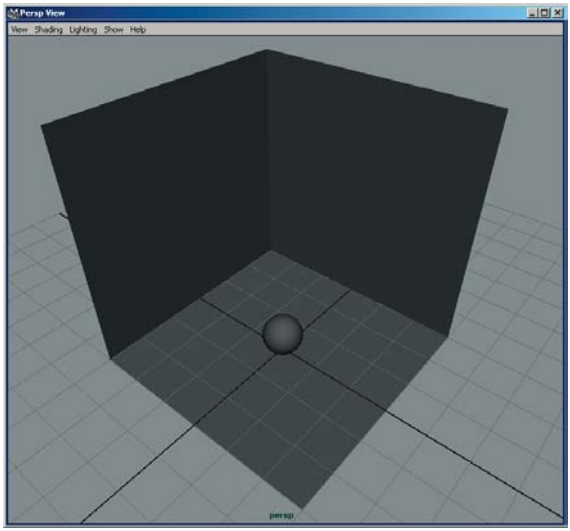


Figure 4.11 Walls and floor for three-point lighting.

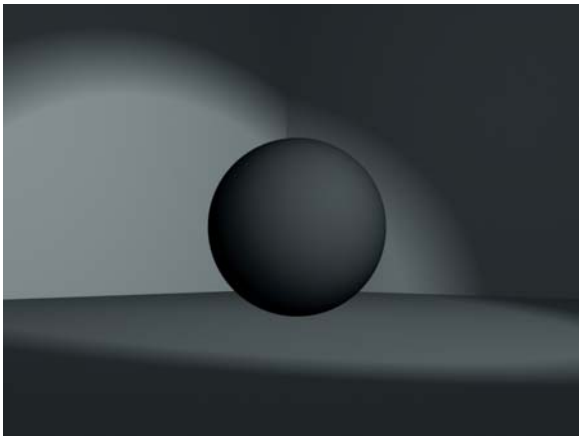


Figure 4.12 Key light only.

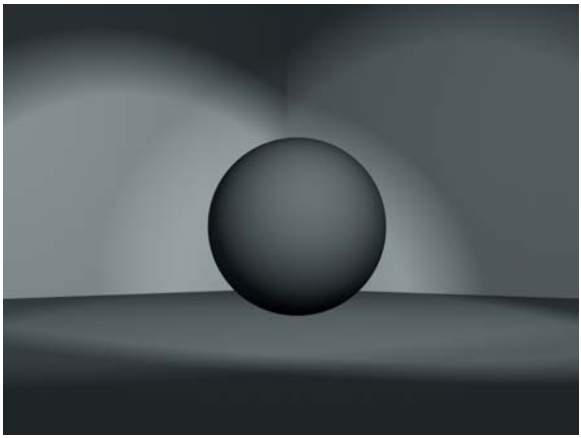


Figure 4.13 Key and Fill lights.

6. Select the Key light and press Ctrl + a to open the Attribute Editor.
7. In the Spot Light Attributes section, change the Penumbra Angle to 5.372. Lights rarely have a hard edge. This will give the light cone a soft edge.
8. Repeat step 7 for the Fill and Back lights.
9. Go to Panels > Perspective > Camera1 to look through your camera.
10. Press the Render the Current Frame button on the Status Line.

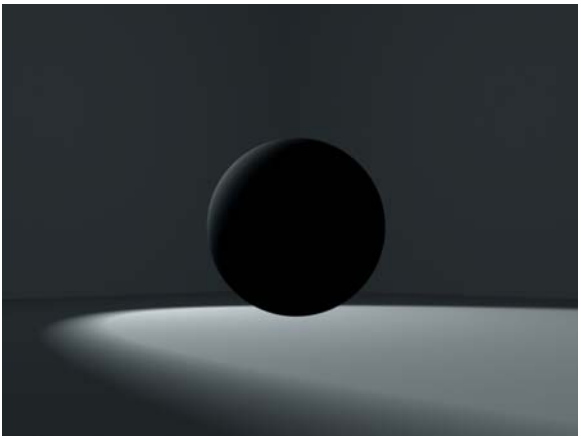


Figure 4.14 Backlight only.

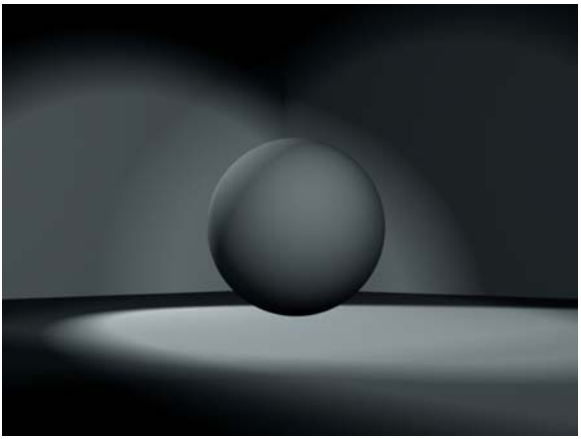


Figure 4.15 The final lit sphere.

Notice how the addition of the Backlight adds depth to the object. The three-point system will, more often than not, be a good starting point to begin lighting your scene. This scene lacks a very important element though – shadows. Shadows will help ground your object into the scene.

Shadows

There are two types of shadows available in Maya: Depth Map and Raytraced. Depth Map (or Dmap) shadows take much less time to render compared to

raytraced shadows and will often give you very good results. Raytraced shadows may be more time-consuming to render but you get the added benefit of being able to use transparent and colored shadows.

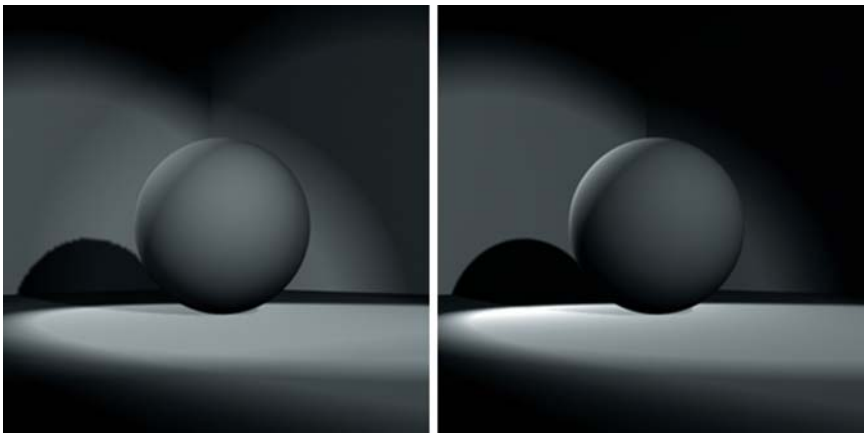


Figure 4.16 Depth Map on left versus Raytrace shadow on right.

The rendering time for this very simple scene using a high anti-aliasing quality at a resolution of 1000 × 1000 on a 1.8 GHz P4 was 32 seconds using Dmap shadows. Compare that to the 54 seconds it took using raytraced shadows. Of course the Dmap shadow is quite blocky, but this is where one of the huge benefits of depth map shadows comes into play – you can adjust the resolution of the shadow map without significantly raising the rendering time. The rendering time for Figure 4.17 is only 33 seconds with the newly adjusted depth map. That's not much more than the original rendering, but still a huge saving over the raytraced shadow.

Depth map shadows work by creating a grayscale image that displays the distance from a light to the nearest shadow-casting object it encounters.

1. Open the three-point lighting tutorial you finished earlier.
2. Select the Fill and Back lights.
3. Go to Display > Hide > Hide Selection.
4. Select the Key light and press Ctrl + a to open the Attribute Editor.
5. Expand the Shadows section.

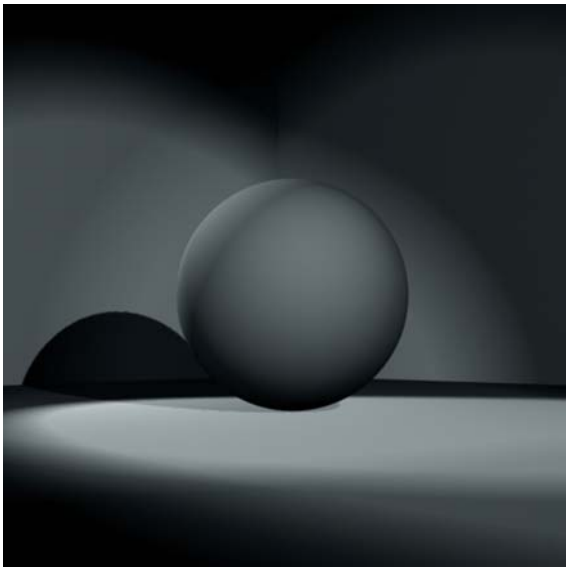


Figure 4.17 Adjusted Dmap resolution.

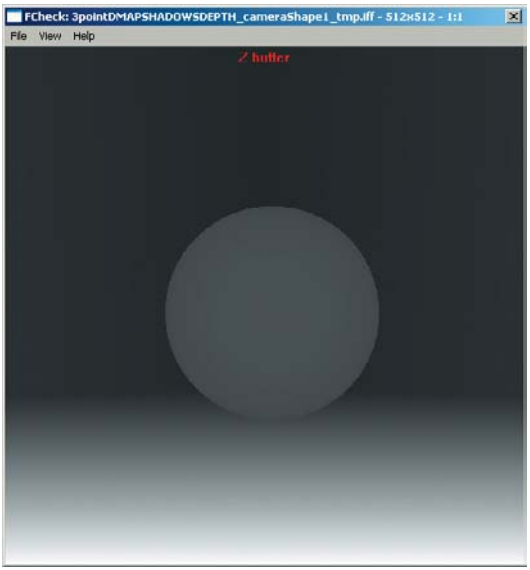


Figure 4.18 Depth mask.

6 Check the Use Depth Map Shadows box.

7 Change the Dmap Resolution to 1024.

8 Change the Dmap Filter size to 2. The Dmap Filter controls the softness of the edges of the shadow. Be aware that higher values can increase rendering time.

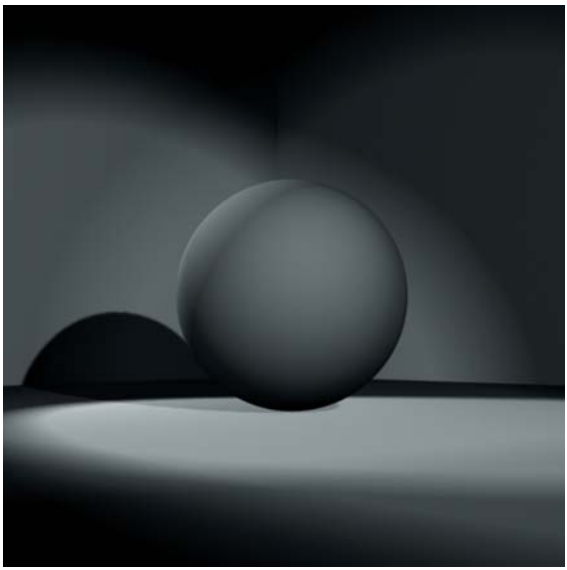


Figure 4.19 Increased Dmap Filter.

Render the scene. Notice how the edges become softer. Also note that the shadow behind the sphere is completely opaque.

1 Select the Key light again.

2 In the Shadows section of the Attribute Editor click on the color swatch and change color values to R 255, G 0, and B 0.

Render the scene again and you will see that the shadow cast by the sphere is now red. Playing with the shadow colors of Dmap shadows can give some interesting results.

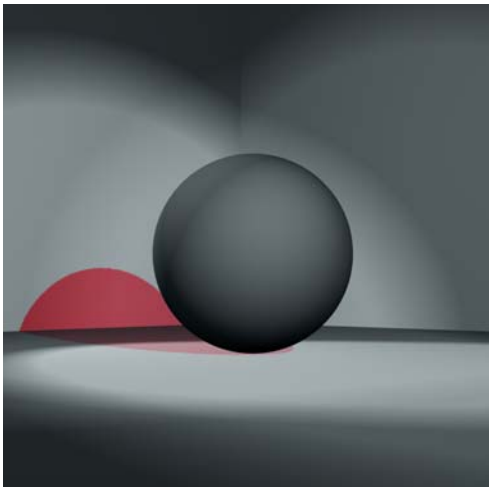


Figure 4.20 Red Shadow.

1. Undo the red color for the shadow and turn off Dmap Shadows.
2. Go to the Raytrace Attribute section and check the Ray Trace Shadows button.
3. Go to Window > Rendering Editors > Render Globals.
4. Click the Maya Software tab.
5. Expand the Raytracing Quality tab and check the Raytracing box.
6. Render the scene. Notice how sharp the edge of the shadow is. This is an inherent part of raytracing.
7. Change the Light Radius to .050.
8. Change Shadow Rays to 12.

Render the scene. The shadows will be much softer now.

1. Open the Hypershade and create a Phong material.
2. Click the Transparency color swatch and change the RGB values to R 41, G 140, and B 255. Click Accept.
3. Assign the Phong material to your sphere.

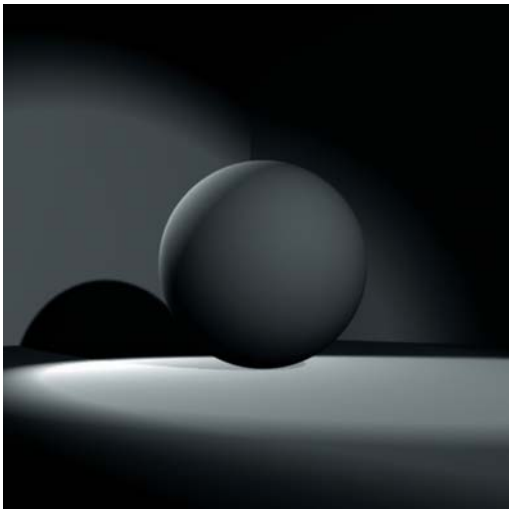


Figure 4.21 Softer raytraced shadows.

Render the scene and you will notice that the shadow has a blue tint. If you set a color (or texture map) to the transparency channel of an object, the shadows will take on that color.

Figure 4.22 Colored raytraced shadows.

Tutorial: Indoor Lighting

For this tutorial, you will need to create a polygonal room approximately five meters by five meters with a height of two and a half meters. Add some windows and a table, lamp and vase (see Figure 4.23) to one corner. Place a camera in the opposite corner to look toward the lamp.

> **Hint:** The yellow glow of the light bulb is a Lambert material with the Incandescence channel cranked to the maximum and a yellow tint to it.

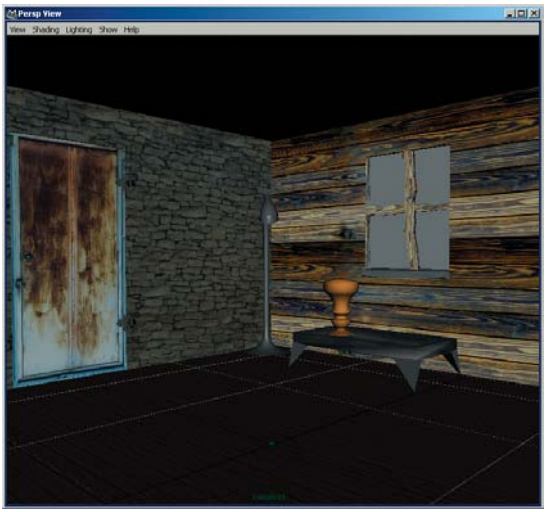


Figure 4.23 The indoor scene using default lighting.

1. Go to Create > Spot Light to add a spot light to your scene.
2. Scale and position it so that it sits inside the lightbulb.
3. Adjust the light's Cone Angle so it matches the hood of the lamp. If you render you scene now, you won't see any light because the bulb blocks it.
4. Open the Attribute Editor for the spotlight and check Use Decay Regions in the Decay Regions section. Decay regions allow you to

specify when light starts and stops. Spotlights are the only type of light that has decay regions.

5 Go to Display > Show > Light Manipulators to display the decay regions for the light.

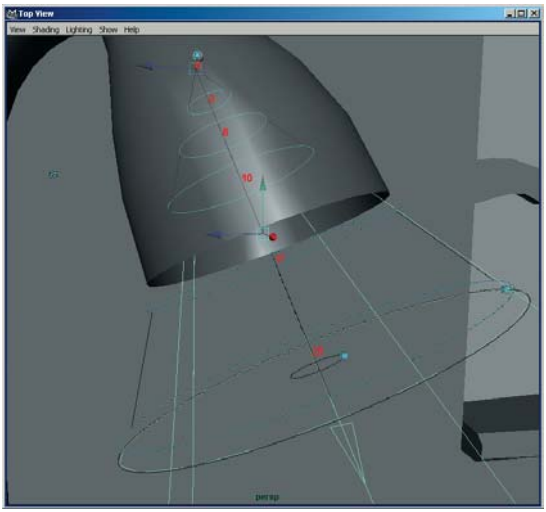


Figure 4.24 Decay regions.

6 Adjust the bottom decay region so that it extends through the floor.

7 Adjust the other decay regions so they line up with the edge of the bulb.

8 Render the scene and you can now see the light emitted from the spotlight.

9 Select the color swatch and change the RGB values to R 255, G 255, and B 195.

10 Change the Penumbra to 10 to soften the edges.

11 Change the Dropoff to 12.644 so the center of the light is brighter than the edges.

12 Turn on Use Raytraced Shadows in the Raytrace Shadows Attributes section.

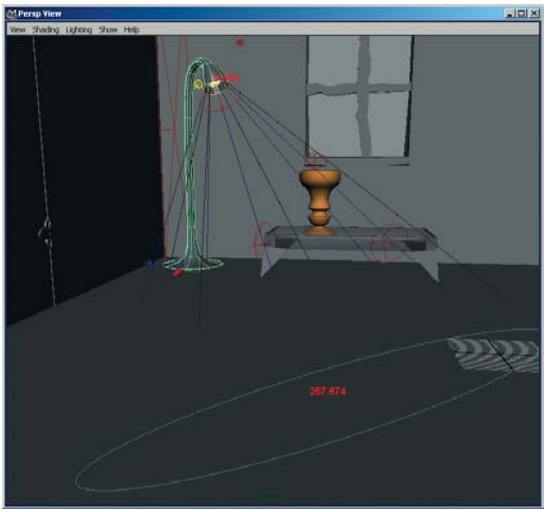


Figure 4.25 Decay regions set for the bulb.

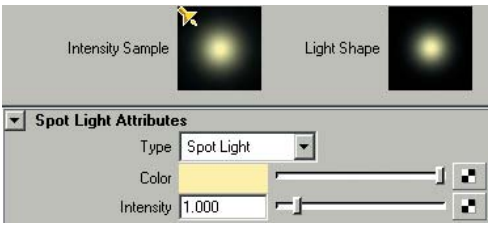


Figure 4.26 Yellow color.

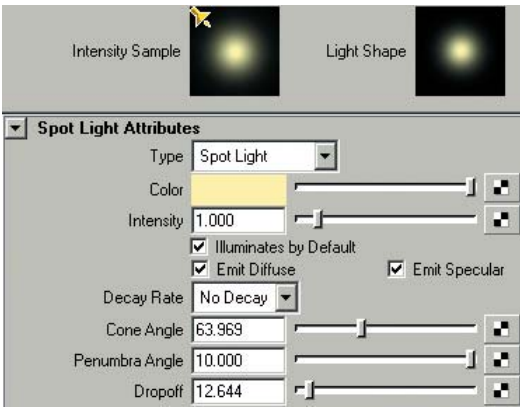


Figure 4.27 Adjusting the Penumbra and Dropoff.

13 Set Light Radius to 1.250.

14 Change Shadow Rays to 12.

15 If you render the scene now, the light doesn't appear. Because you placed the light inside the bulb, Maya is having problems calculating the raytraced shadow effects.

16 Select the light-bulb geometry and click on the shape node in the Attribute Editor.

17 Expand the Render Stats section.

18 Deselect Casts Shadows.

19 Open the Light Effects section of the Attribute Editor. Light Effects add nodes to your light that makes it react more like a real world light. You can add fog and optical F/X-like lens flares. Not all Light Effects are available for every light.

20 Click on the checker box next to Light Fog.

21 Change the Density in the Light Fog node to .750.

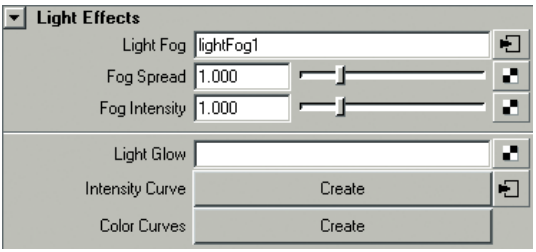


Figure 4.28 Visible Light Fog.

22 Add a point light to the scene and position it above the lamp.

23 Set the Color to R 255, G 255, B 206.

24 Change the Intensity to 24.

25 Set the Decay Rate to Linear.

26 Add a spotlight to the scene and position it behind and above the camera. The purpose of this spotlight is to add a low level light through the scene. Depending on the room you are lighting, you could use a different type of light, but for our purposes, a spotlight works well.

27 Set the Intensity to .650.

28 Set the Cone Angle to 120.

29 Change the Penumbra to 6.198.

30 Set the Dropoff to 4.126.

31 Create an area light and place it behind the lamp. Rotate it to face the wall.

32 Scale the area light to fit the corner (see Figure 4.29).

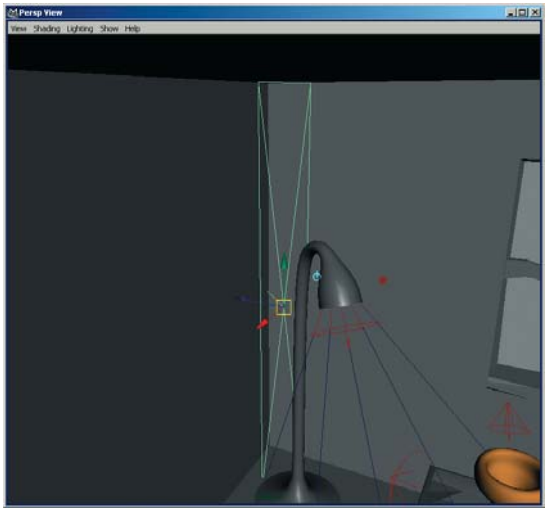


Figure 4.29 Corner area light.

33 Set the Intensity to –.004. Any time you apply a negative intensity value to a light, Maya will remove light from the scene.

The room is nearly complete. The only thing left now is to add some depth to the objects. The spotlight for the lamp is the main point of illumination for the

scene and can be considered the Key light. The second spotlight is used as the Fill light. That leaves us with Backlights to add in order to bring out the depth of the objects.

34 Add a spotlight and position it behind the vase (see Figure 4.30).

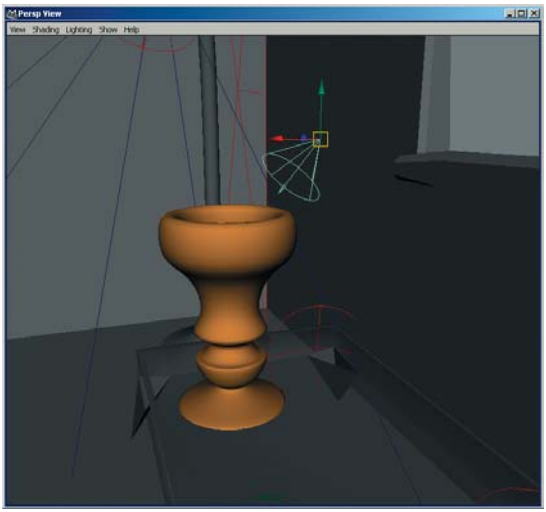


Figure 4.30 Vase backlight.

35 The vase has a nice backlight now, but the extra light washes out other parts of the scene. The problem is that whenever a light is added in Maya, by default it affects the entire scene. We can fix this by using the Light Linker.

36 Go to Window > Relationship Editors > Light Linking > Light-Centric. The Relationship Editor will open in a new window. On the left you will see all of the lights in your scene listed in the Light Source window. On the right are the scene nodes affected by the lights in the Illuminated Objects window.

37 Click on the vase backlight in the Light Source window. The nodes in the Illuminated Objects window will turn gray to indicate that the current light affects them.

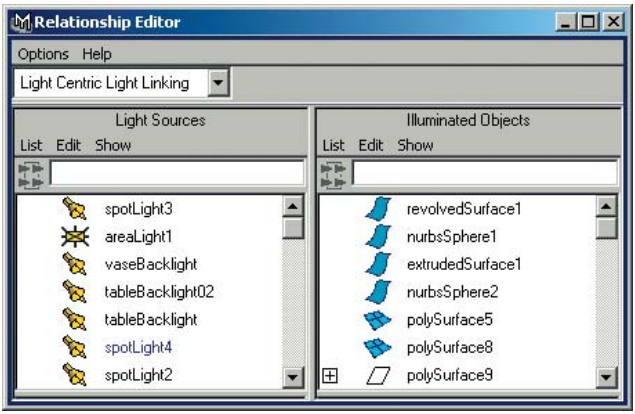


Figure 4.31 The Relationship Editor.

Figure 4.32 The final render of the interior scene.

38 Select Show > Objects > Geometry in the Illuminated Objects menu list. By setting the window to list only geometry, you'll be able to navigate the window more easily.

39 Deselect everything but the vase.

40 Repeat steps 36 to 39 to create two backlights for the table, one for each end.

Tutorial: Outdoor Lighting

1 For this tutorial you will need an outdoor environment similar to the one in Figure 4.33. The lighting scheme for an outdoor environment will be completely different depending on the time of day, season, or atmospheric conditions.

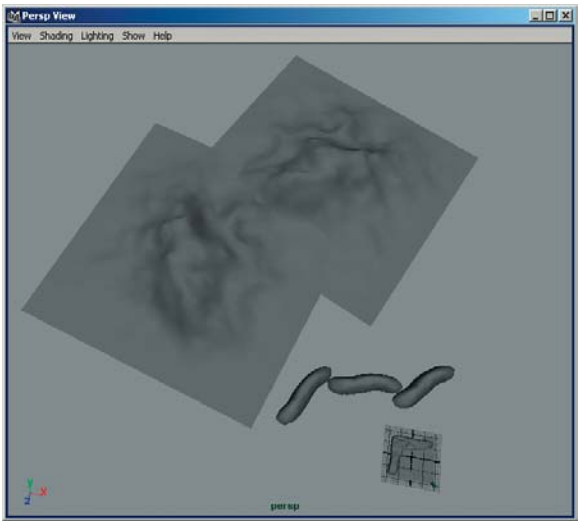


Figure 4.33 Outdoor environment ready for lighting.

2 Open your outdoor scene in Maya. In Figure 4.34 you can see the terrain meshes are considerably spread apart. But the same terrain using default lighting viewed through the scene camera lacks depth. Remember how the basic three-point lighting rig adds depth and form to a scene? We'll be using that as our starting point.

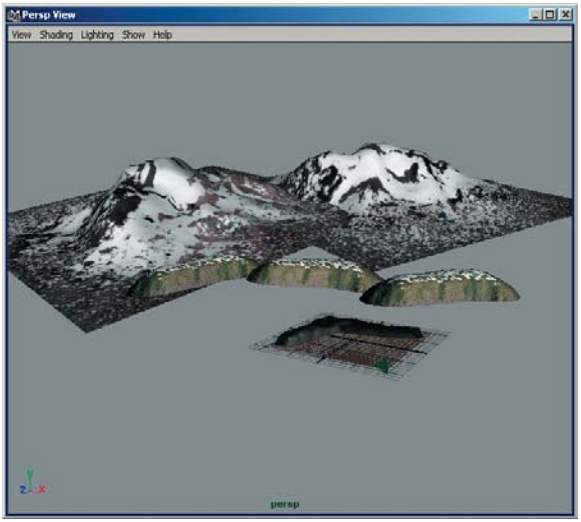


Figure 4.34 Perspective view of a default lit environment.

3. Go to Create > Lights > Directional Light. The sun can be thought of as the Key light.
4. Adjust the Intensity to 1.175.
5. Position the Key at roughly where the sun would be during mid-morning (see Figure 4.35).

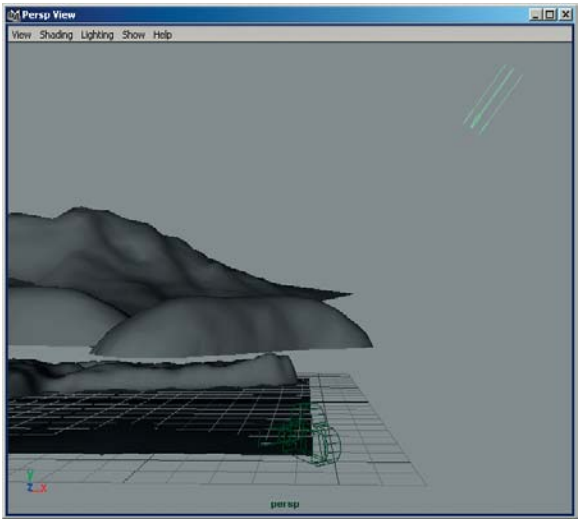


Figure 4.35 Placing the Key light.

6. Go to Create > Lights > Point Light to add a fill light to your scene.
7. Set the Color to R 162, G 190, B 214.
8. Adjust the Intensity to .125.
9. Position this light on the opposite side of the camera from the Key light (see Figure 4.36).
10. Now comes the trick to lighting outside environments: for each chunk of terrain, you should add a different backlight and use the Light Linker so the backlight will only affect specified terrain.
11. Create a Directional light to act as the main backlight. Position this behind and slightly above the first cliff.

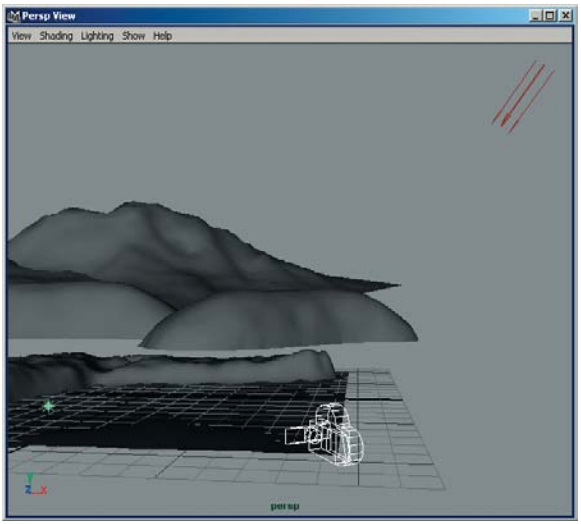


Figure 4.36 Adding the fill light.

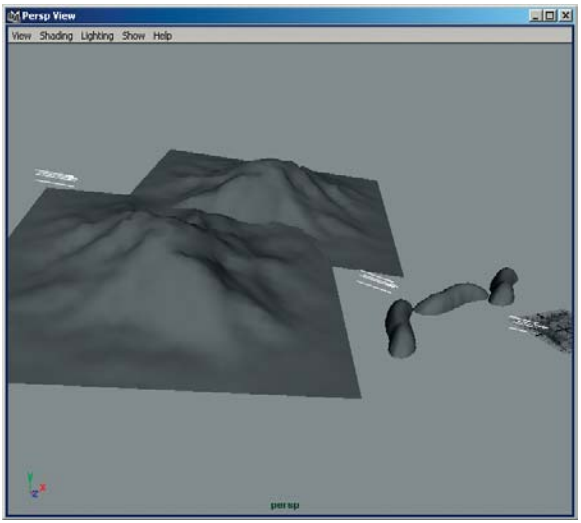


Figure 4.37 Placing the backlights.

12 Set the Intensity to .5.

13 Create a second Directional and place this behind the terrain in the middle of the scene.

14 Set the Color to R 183, G 250, and B 255.

15 Change the Intensity to .600.

16 Create a third Directional light and place it behind the rear mountains.

17 Set the Color to R 37, G 217, and B 255.

18 Go to Window > Relationship Editors > Light Linking > Light-Centric. Set the first backlight to affect only the foreground terrain, have the second backlight affect only the middle terrain, and change the third backlight to affect only the rear terrain.

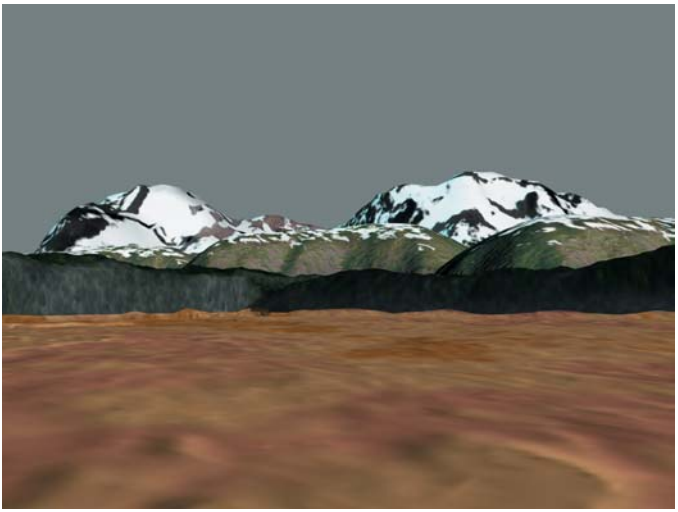
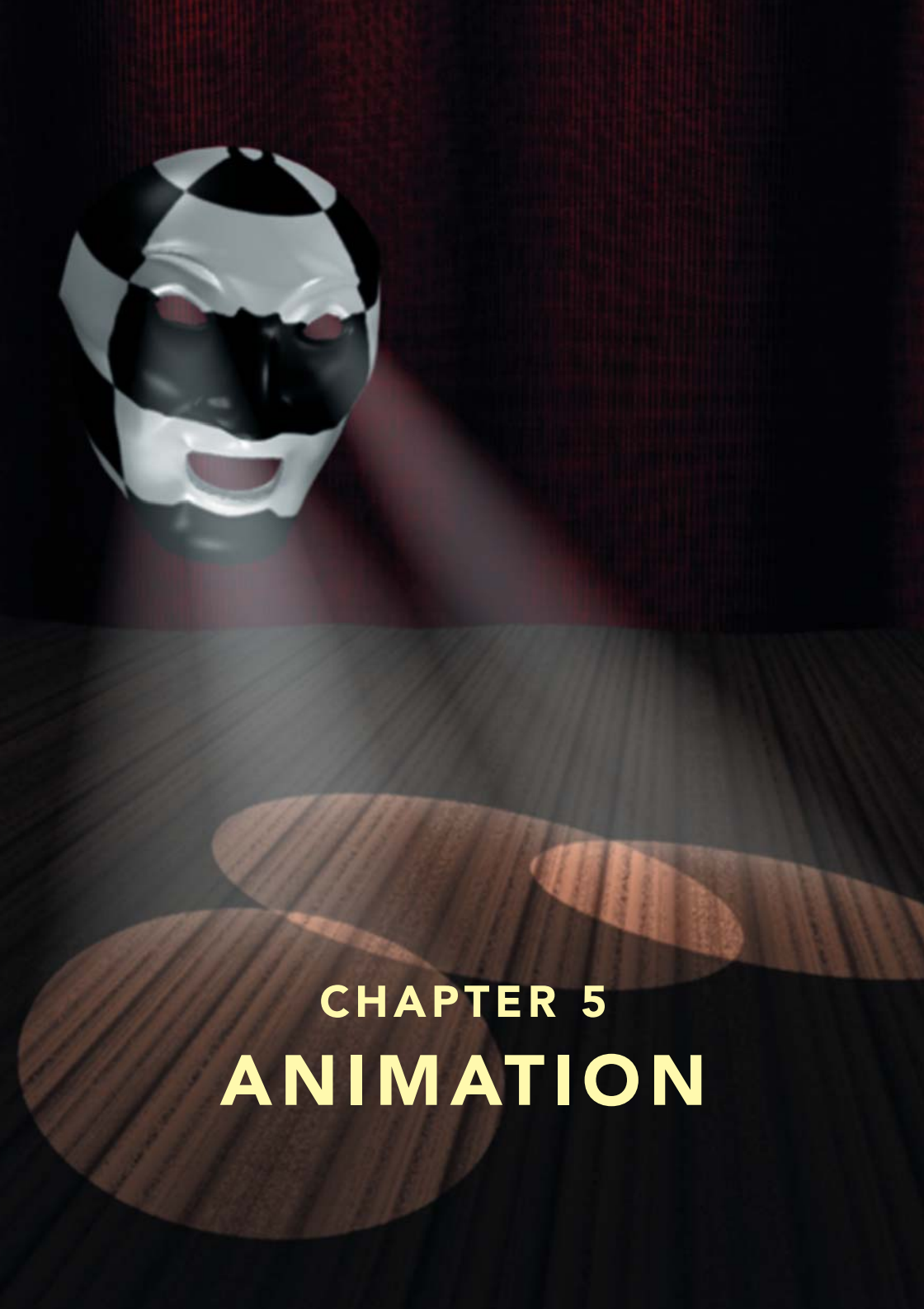


Figure 4.38 The final scene.



CHAPTER 5
ANIMATION

Maya excels at animation. In fact almost everything in Maya can be animated. The main type of animation used in Maya is keyframes. A keyframe is an individual frame showing the extreme of an action. Once the keyframes are set, Maya interpolates the in-between frames automatically. Other types of animation include path based, dynamic, and blend shapes.

Many of the guidelines used for traditional animation are also useful for 3D animation. While the focus of this book is not on the principles of animation, it is nonetheless important to point out that functions such as anticipation, squash and stretch, timing, follow through, ease in and ease out, secondary action, and arcs are all vital to creating a solid animation.

Animation Terms

Anticipation – The preparation to an action. A slight turn of the head to the left before the full turn to the right is one example of anticipation. Another example would be a boxer cocking a fist back before throwing the punch.

Squash and stretch – The mass and deformability of an object. Kick a football and it will squash upon contact and stretch while moving away.

Timing – Defines the weight and size of objects. A bowling ball takes longer to reach full speed and slow down than a tennis ball does.

Follow through – Relates to the stopping of one action while setting it up for another. A waving flag is the perfect example of follow through. As the base of the flag stops moving in one direction and begins moving the other way, the end of the flag trails behind.

Ease in and ease out – Also known as slow in and slow out. This refers to adding extra frames moving into and out of an animation so the object does not abruptly reach its goal.

Secondary action – Refers to an object reacting to a different action. If a dog with droopy ears suddenly stops, the ears will continue moving forward resulting in a secondary action.

Arcs – This refers to movement along natural arcs.

To access the animation tools, Press F2 or select Animation from the Menu Set on the Status Line.

Figure 5.1 The Animation menu.

Keyframe Animation

The Animate drop-down menu is where you'll find the basic animation keyframing information. In the first section you will find key options. The clip section is for use with the Trax Editor which we shall work with later in this chapter.

The bottom of the work area contains the Timeline and Range sliders.

Figure 5.2 The Animate drop-down menu.

1. Start a new scene in Maya.
2. Go to Windows > Settings > Preferences and click on Settings.
3. Change the Time to NTSC (30 fps).
4. Click on the Timeline category.
5. Set the Playback start time to 1.
6. Set the Playback end time to 30.
7. Change the Animation start time to 1.

Figure 5.3 Timeline.

Figure 5.4 Range slider.

8. Change the Animation end time to 30.
9. Click Save.
10. Create a NURBS plane with a width and length of 20.
11. Create a default NURBS sphere.
12. Move the sphere up one unit so it is sitting on the plane.
13. Freeze transformations on the sphere.
14. Drag the black bar in the Timeline to frame one.
15. Press the Key Transform shortcut W or go to Animate > Set Transform Keys > Translate. A line will appear in the Timeline at frame one indicating there is a keyframe on that frame. The line will be blue if that frame is currently active and red if it is inactive.
16. Drag the black bar to frame 16 of the Timeline.
17. Open the Channel Editor for the sphere and change the Y Translate to 4.
18. Press the Key Transform shortcut W or go to Animate > Set Transform Keys > Translate. Any channel that has a keyframe will indicate thus by being shaded a sort of pale orange in the Channel Editor.
19. Drag the black bar to frame 30 of the Timeline.
20. Go to the Channel Editor and change the Y Translate to .635.

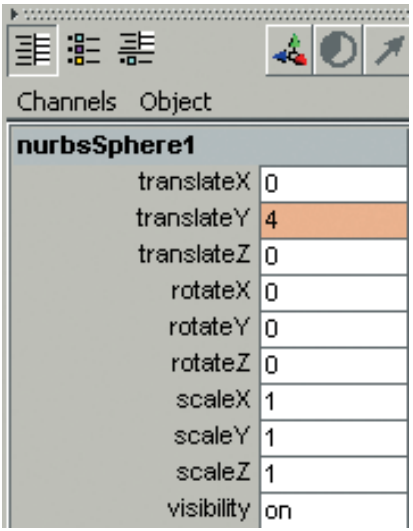


Figure 5.5 Channel Editor keyframes.

21. Press the Key Transform shortcut W or go to Animate > Set Transform Keys > Translate.

Tip: Click and drag the black bar in the Timeline. The animation will update as you move the bar. This is known as scrubbing and can be very helpful in setting up your animations.

Press the Play button on the Timeline. The playback buttons act just as a VCR. The ball bounces in place. Not very exciting, I know, but this is a good introduction to keyframing, which plays a huge role in Maya animation. Experiment with setting keyframes for the other channels.

1. Go to frame 1 and input the following in the Channel Box.
2. Rotate X 28.91.
3. Rotate Y 4.296.
4. Rotate Z –24.273.
5. Go to frame 16.

Hint: In the Playback controls are buttons that allow you to either step forward to the next key or step back to the previous one. These can be very helpful when working with many keyframes.

6. Change Rotate X to –76.699.
7. Change Rotate Y 75.331.
8. Change Rotate Z 81.706.
9. Go to frame 30.
10. Change Rotate X to –133.367.
11. Change Rotate Y 139.75.
12. Change Rotate Z 108.06.
13. The sphere now rotates as it bounces.
14. Save this scene as bouncingBall.

Create a playblast for your bouncing ball animation by going to Window > Playblast. Playblasts allow you to quickly view your animations running at full frames per second. Smaller animations are usually not a problem, but for files that have a larger number of characters, playback within Maya might actually be off. Creating a playblast may be the only way to view the animation at full speed without actually having to render it out.

When you reference a file, Maya simply points from within the current file to the reference in question. When you really start diving into large numbers of animations, and especially if you have many separate animations controlled by a single character rig, it's a good idea to use the Reference Editor. That way, if you need to change any part of the model, rather than changing each animation you just have to change the master file and the changes will occur automatically within any files that use it as a reference.

1. Create a new scene in Maya.
2. Go to File > Reference Editor.

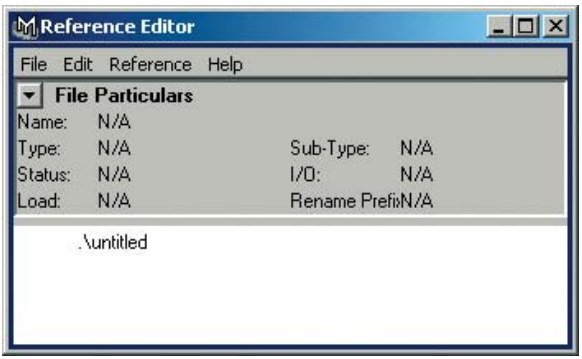


Figure 5.6 The Reference Editor.

3. Click on File > Create Reference in the Reference Editor window.
4. Point the load reference prompt to the bouncingBall file.
5. Save this file as ballDeformer.

The objects will now appear in your scene. Press play and the animation will play as normal. Referenced objects have the letter r placed over the icon in the Outliner.

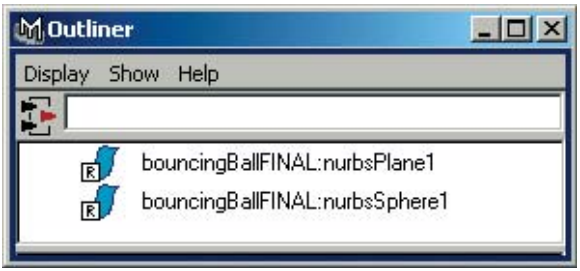


Figure 5.7 Referenced objects in the outliner.

1. Load ballDeformer.
2. Select the sphere and open the Channel Editor.
3. Shift click on Rotate X, Rotate Y, and Rotate Z in the Channel Editor. The channels will become highlighted in black to indicate they are selected.
4. RMB click on one of the channels and select Break Connections. This will remove the keyframe information for those channels. However, because this is a referenced file, it will only break the channels in this file; the original bouncing ball file will remain unchanged.
5. Change Rotate X, Rotate Y, and Rotate Z to 0. The ball no longer rotates as it bounces.
6. Go to frame 8 and select Deform > Create Lattice > ❐. Enter the following.
7. Divisions to S 2, T 5, and U 2. S, T, and U are lattice-specific axes and are the equivalent of X, Y, and Z.
8. Check Use Local Mode.
9. Local Divisions, S 2, T 2, and U 2.

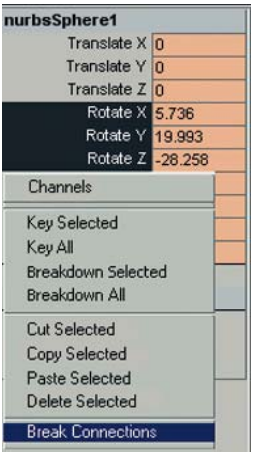


Figure 5.8 Break connections.

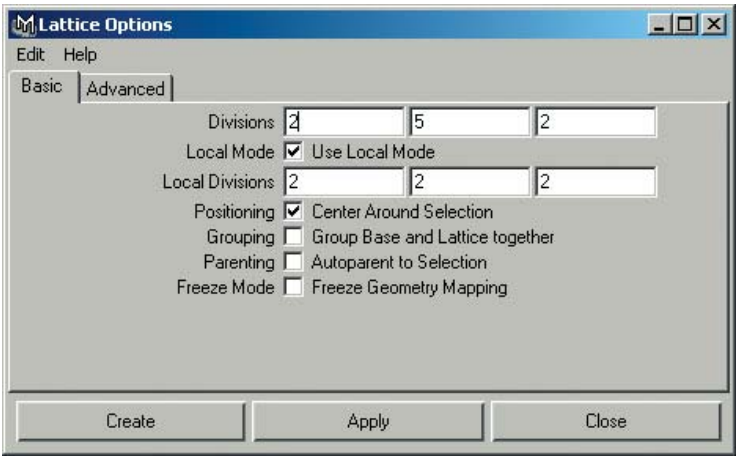


Figure 5.9 Lattice options.

10 For Positioning, check Center Around Selection.

11 Click Create. The lattice will appear around the sphere.

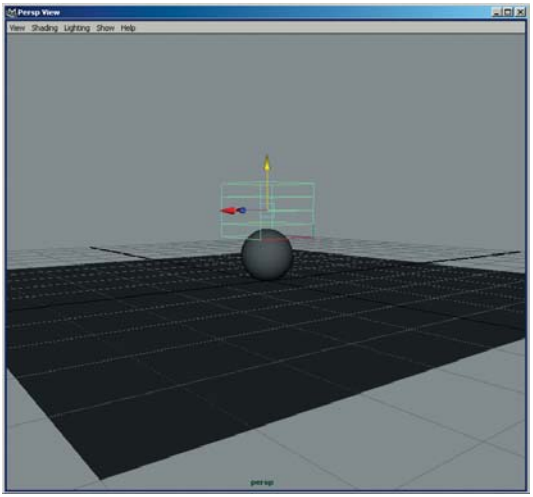


Figure 5.10 The lattice deformer.

12 RMB click on the lattice to bring up the marking menu and select Lattice Point.

13 Select the middle row of lattice points and scale them down to a narrow opening.

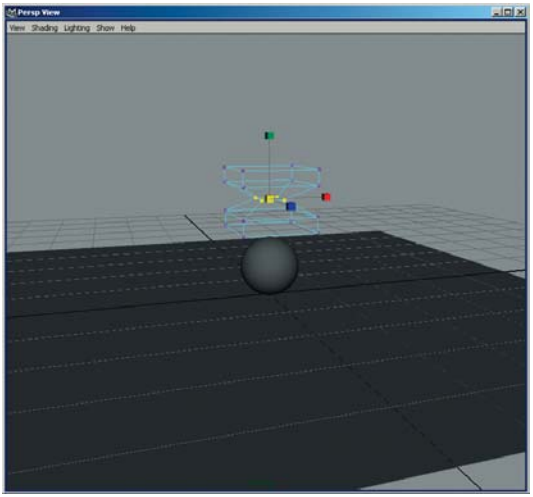


Figure 5.11 Scaled lattice points.

14 Play the animation. As the sphere passes through the scaled portion of lattice points, it deforms to try to fit through the smaller opening.

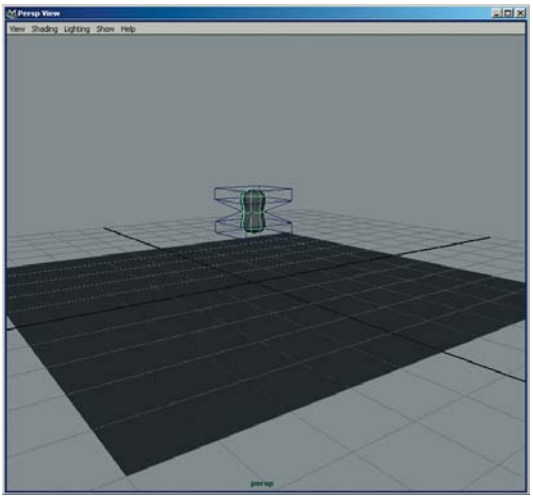


Figure 5.12 Sphere scaled to fit lattice points.

15 Select the lattice and delete it. The sphere should switch back to its original shape.

Deformers

A lattice is just one type of deformer. Maya also allows you to work with deformers such as squash, bend, and twist.

1 Go to frame 1.

2 Select the sphere and go to Deform > Create Nonlinear > Squash > ❐. Enter the following.

3 Low Bound –1.

4 High Bound 1.

5 Start Smoothness 0.

6 End Smoothness 0.

7 Max Expand Position .5.

8 Expand 1.

9 Factor 0.

10 Press Create.

11 Open the Outliner and select the squashHandle node then Ctrl click the sphere.

12 Go to Edit > Parent or press the shortcut p. The squash handle now moves with the sphere as it bounces. A parent object is used to control the attributes of child objects. For example, if you rotate or translate the parent object, any child objects attached to it will rotate and translate as well.

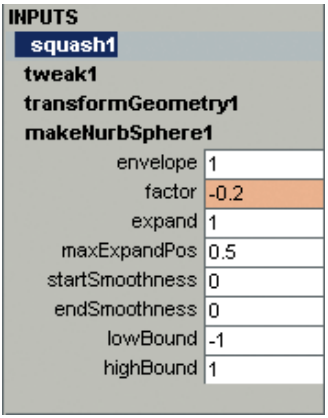


Figure 5.13 Channel editor inputs.

13 Select the sphere and open the Channel Editor.

14 In the Inputs section of the Channel Editor, select the squash node.

15 Go to frame 1.

16 In the Channel Editor, change the squash factor to –.2.

17 Select the factor channel and RMB click to bring up the marking menu.

18 Select Key Selected.

> **Tip:** You can click on a channel to highlight it in the Channel Editor, then using your MMB you can click and drag in a viewport to change the value interactively.

19 At frame 8 key the Factor at .3.

20 At frame 13 key the Factor at –.25.

21 At frame 16 key the Factor at 0.

22 At frame 19 key the Factor at .26.

23 At frame 24 key the Factor at .4.

24 At frame 28 key the Factor at 0.

25 At frame 30 key the Factor at –.1.

26 Play the animation, and the sphere will squash and stretch as it bounces.

You can add as many deformers as you like. Also, deformers are also helpful in modeling. If you need to bend a model, apply a nonlinear bend. Once you like the shape, simply delete the history and your model is permanently bent.

Tutorial: A Falling Lamp

Now that you've seen the basics of keyframe animation, let's try something more advanced. Open the scene you created for the interior lighting tutorial.

1. Go to Windows > Settings > Preferences and click on Settings.
2. Change the Time to NTSC (30 fps).
3. Click on the Timeline category.
4. Set the Playback start time to 1.
5. Set the Playback end time to 150.
6. Change the Animation start time to 1.
7. Change the Animation end time to 150.
8. Click Save.
9. Select the lamp and rotate it on the Z axis toward the floor. The first thing you will see is that the pivot point is in the center of the object, which causes the lamp to rotate incorrectly. Also notice the lights don't rotate at all.

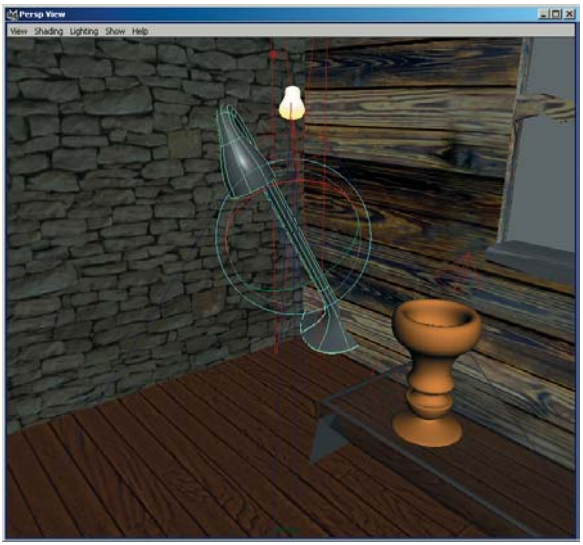


Figure 5.14 Pivot point on lamp.

10. The scene needs to be prepped for animation. The lights are fairly straightforward to set up.

11 Select the spotlight then Shift select the light bulb surface.

12 Go to Edit > Parent > ❐.

13 Set the Parent Method to Move Objects.

14 Check Preserve Position.

15 Press Parent.

16 Select the light bulb surface then shift select the lamp.

17 Go to Edit > Parent or use the keyboard shortcut p.

18 Select the point light above the lamp then Shift select the lamp surface.

19 Go to Edit > Parent or use the keyboard shortcut p.

20 Select the lamp and try rotating it again. The lights will now properly follow the lamp as it rotates.

21 Setting up the lamp rotating is a bit more involved. You could press the Insert key to edit the lamp's pivot point and place it in the proper position, but in this case there is a better method.

22 Select the lamp and add it to a group by going to Edit > Group or by using the Ctrl+g shortcut.

23 Name this group lampMain.

24 Press Insert and move the pivot point of the group to the edge of the lamp.

25 Press Insert a second time to exit the pivot point edit mode.

26 Select the group and rotate it. The lamp, bulb, and lights should properly rotate now (see Figure 5.16).

27 This rotation will only work on the side where the pivot is located. If you try rotating in the other direction, the lamp will clip the floor. We can correct this by creating another group.

28 Go to Window > Outliner.

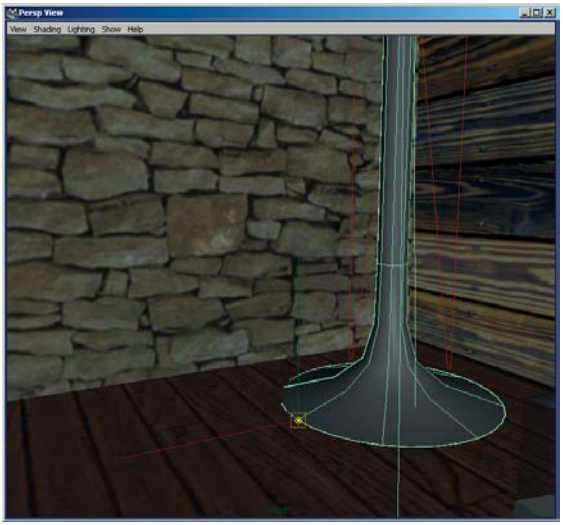


Figure 5.15 Moving the pivot point of the group.

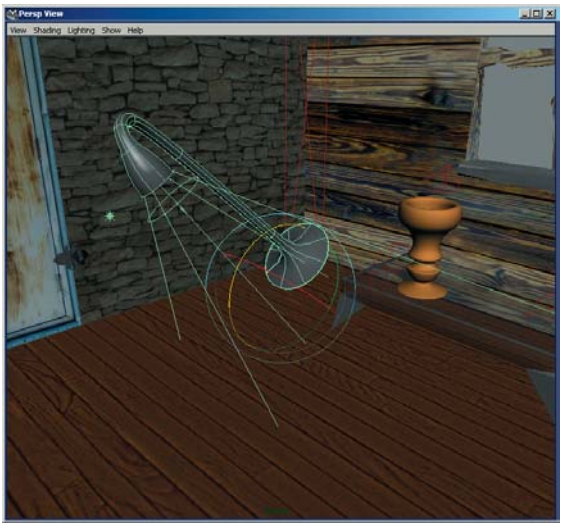


Figure 5.16 Rotating the lamp.

29 Click the plus next to the first group to expand it.

30 Select the lamp surface.

31 Go to Edit > Group ❐.

32 Change Group Under to Parent.

33 Leave Group Pivot at Origin.

34 Press Group. This will add the lamp to a new group2 that is parented under the first group.

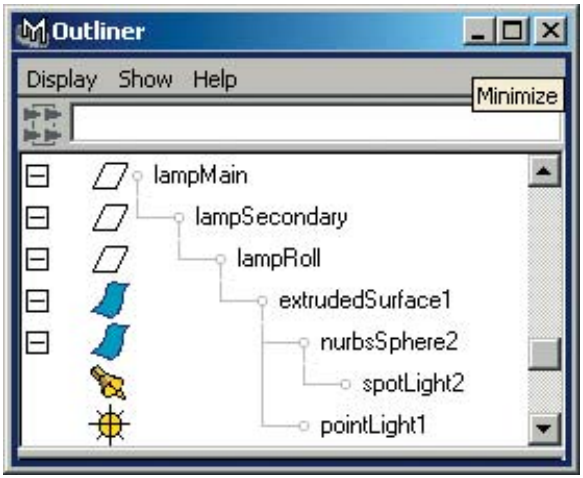


Figure 5.17 The groups in the outliner.

35 Name the second group lampSecondary.

36 Select the lampSecondary group.

37 Press Insert and move the pivot point to the edge of the lamp on the opposite side of the first group.

38 Open the Channel Editor by going to Display > UI Elements > Channel Box/Layer Editor or by pressing the Channel Box button on the Status Line.

39 Go to frame 1 of the animation.

40 Select the lampMain group.

41 Enter –2.333 for the Rotate Z.

42 Create a rotation key by going to Animate > Set Transform Keys > Rotate > or by pressing the keyboard shortcut E.

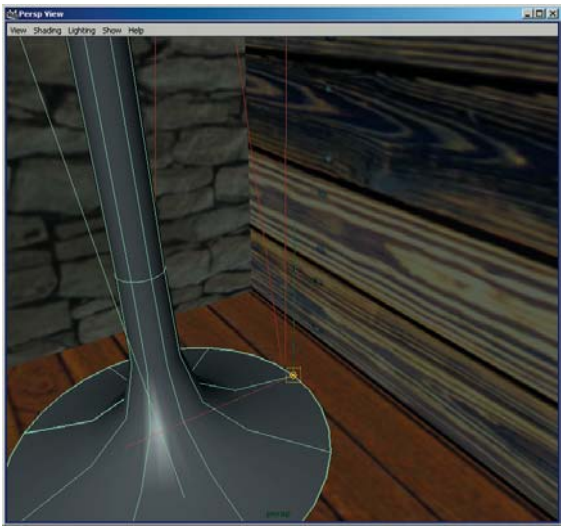


Figure 5.18 The second group.

43 Set six more rotation keys for lampMain with the following values.

- Frame 5 with X 0, Y 0, and Z 0.
- Frame 25 with X 0, Y 0, and Z 0.
- Frame 36 with X 0, Y 0, and Z –26.049.
- Frame 50 with X 0, Y 0, and Z 97.5.
- Frame 53 with X –3.6, Y 0, and Z –87.67.
- Frame 56 with X –9, Y 0, and Z –97.5.

44 Select lampSecondary and enter the following rotational keyframe values.

- Frame 5 with X 0, Y 0, and Z 0.
- Frame 9 with X 0, Y 0, and Z 8.37.
- Frame 13 with X 0, Y 0, and Z 9.686.
- Frame 25 with X 0, Y 0, and Z 0.

45 Select the lamp surface.

46 Go to Edit > Group. This will add a third group parented to second group.

47 Name this group lampRoll.

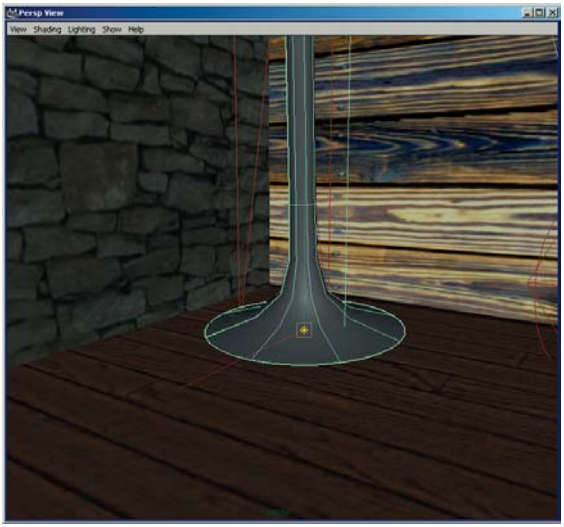


Figure 5.19 Adding the third group.

48 Move the pivot point for lampRoll to the center of the base of the lamp surface. This will allow you to add some roll to the lamp as it falls without making it clip through the floor.

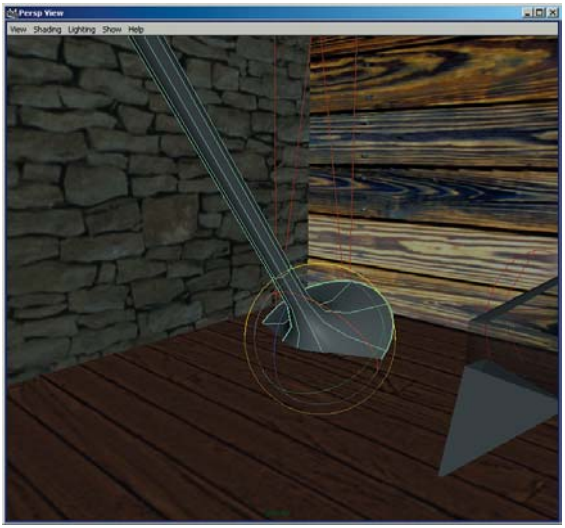


Figure 5.20 The pivot point for the third group.

49 Enter these rotational keyframe values for lampRoll.

- Frame 5 with X 0, Y 0, and Z 0.
- Frame 13 with X 0, Y 14.684, and Z 0.
- Frame 25 with X 0, Y 24.42, and Z 0.
- Frame 36 with X 0, Y 44.193, and Z 0.
- Frame 50 with X 0, Y 45.633, and Z 0.
- Frame 56 with X 0, Y 45.633, and Z 0.
- Frame 62 with X 0, Y 48.153, and Z 0.
- Frame 56 with X 0, Y 45.633, and Z 0.

50 Select the main lamp spotlight and go back to frame 1 of the animation.

51 Click on Visibility in the Channel Editor. It will become highlighted in black.

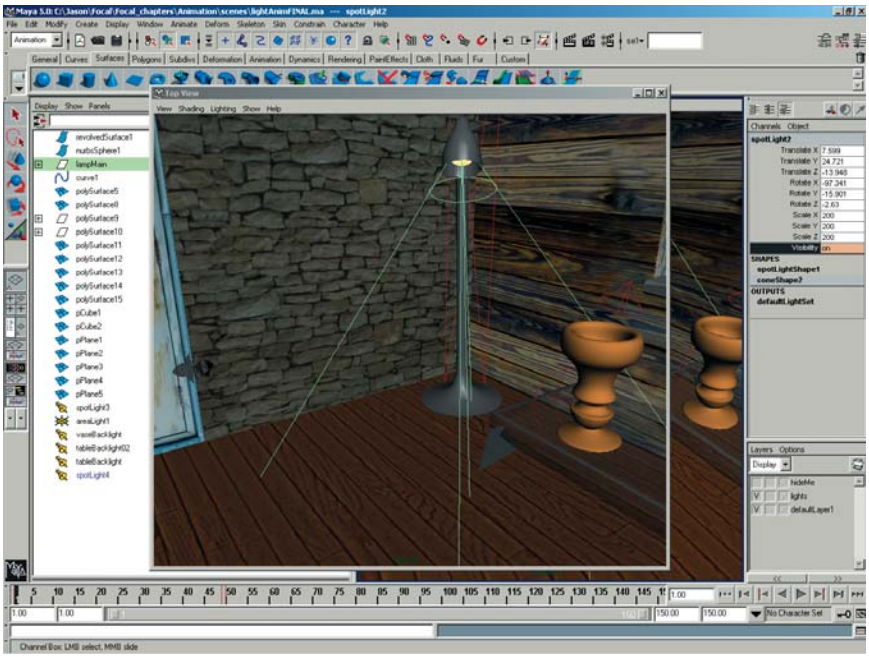


Figure 5.21 Changing the visibility.

52 RMB click on it to bring up the marking menu and choose Key Selected.

53 Go to frame 49. Visibility should still be highlighted in the Channel Editor.

54 RMB click on Visibility to bring up the marking menu and choose Key Selected.

55 Go to frame 50.

56 Type 'off' in the Visibility slot.

57 Click on Visibility in the Channel Editor again to highlight it.

58 RMB click on Visibility to bring up the marking menu and choose Key Selected.

59 Repeat steps 50 to 58 for the point light parented to the lamp.

60 Open the Outliner and select the outside spotlight.

61 Go to frame 1 of the animation.

62 Type 'off' in the Visibility slot of the Channel Editor.

63 Click on Visibility in the Channel Editor and RMB click to bring up the marking menu.

64 Choose Key Selected.

65 Go to frame 55 and again key the visibility off.

66 Go to frame 56.

67 Type 'on' in the Visibility slot of the Channel Editor.

68 Choose Key Selected from the marking menu for Visibility.

69 Go to frame 1.

70 Open the Hypershade.

71 Double click on the light bulb texture to bring it up in the Attribute Editor.

72 RMB click on Incandescence to bring up the marking menu and choose Set Key.

73 Go to frame 49.

74 RMB click on Incandescence to bring up the marking menu and choose Set Key.

75 Go to frame 50.

76 Drag the Incandescence slider all the way to the left to turn off this channel.

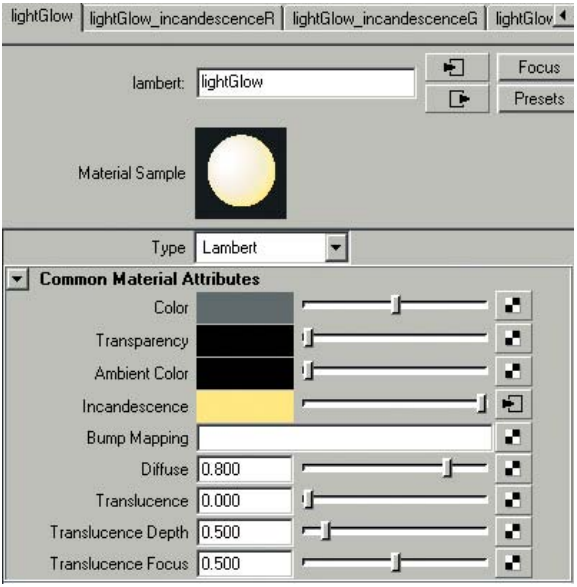


Figure 5.22 Changing the incandescence.

77 RMB click on Incandescence to bring up the marking menu and choose Set Key.

78 Save this file as fallingLamp.

Forward Kinematics

Forward kinematics (or FK) animation is when you rotate each joint or pivot individually. A character waving is a good example of FK.

1. To build an FK arm rig you would parent the hand to the forearm, the forearm to the bicep, the bicep to the shoulder, and finally the shoulder to the torso (see Figure 5.23).

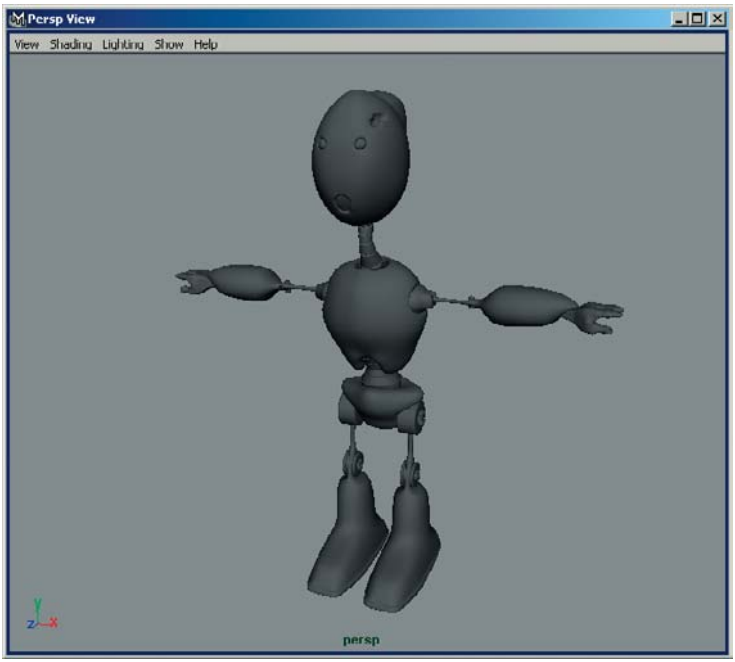


Figure 5.23 Character to add FK arm.

2. Create a new scene in Maya.
3. Create a new character. It doesn't have to be super-detailed for this example. Just make sure that it has separate meshes for the hand, forearm, upper arm, shoulder and torso. FK animation can also be performed on a skeleton rig, but for this tutorial, we will use an even simpler setup.
4. Select the hand and Shift select the forearm.

5 Go to Edit > Parent or use the shortcut p.

6 Select the forearm and Shift select the upper arm.

7 Go to Edit > Parent or use the shortcut p.

8 Select the upper arm and Shift select the shoulder.

9 Go to Edit > Parent or use the shortcut p.

10 Select the shoulder and Shift select the torso.

11 Go to Edit > Parent or use the shortcut p.

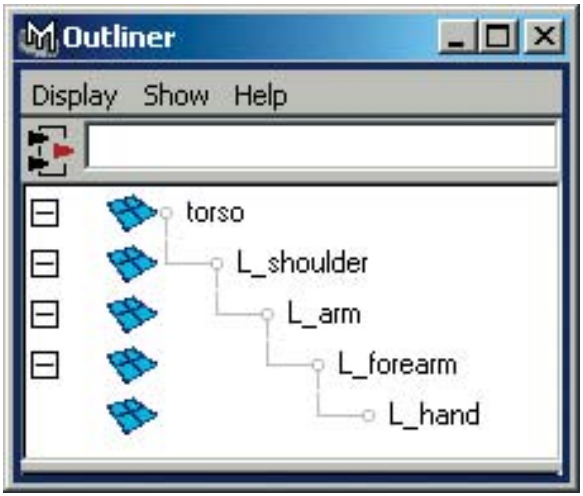


Figure 5.24
FK parenting.

12 Next you would need to move the pivot point for each piece so that it will rotate in the proper place.

13 Select the hand and press Insert to edit the pivot point.

14 Move the pivot point to the wrist.

15 Select the forearm and press Insert to edit the pivot point.

16 Move the pivot point to the elbow.

17 Select the upper arm and press Insert to edit the pivot point.

18. Move the pivot point to the shoulder.
19. Select the shoulder and press Insert to edit the pivot point.
20. Move the pivot point into the center of the shoulder.
21. Go to frame 1.
22. Rotate the arm into the starting position and keyframe its rotational values. With FK you rotate the parent piece first then move down the line. In this case you would start with the shoulder (the torso is acting only as an anchor).
23. Continue rotating each piece and keyframing it at different positions in the timeline until you have your finished wave.

FK is a great way to move the arms and upper torso around. Working with forward kinematics lends itself to creating natural arcs of movement, which happens to be one of the foundations for working in animation.

Inverse Kinematics

Inverse kinematics (IK for short) is, of course, the opposite of FK. With IK you select the end node in the rig and move it to the desired position. Everything else follows. Legs are a great example of what can be set up with IK. Setting up a leg with IK allows you to move just the foot and the rest of the leg will follow. Creating an IK chain requires a skeleton rig to be set up for your character. Commonly known as character rigging, this is a highly advanced area of Maya.

1. Start a new scene.
2. Create a simple low polygons leg similar to the one in Figure 5.25.
3. Select Skeleton > Joint Tool.
4. In the side viewport click the joint tool near the hip to place a joint.
5. Move a tad and create the joint for the top of the leg. As joints are connected they will be joined by triangular shapes known as bones.
6. Move down to the knee and click to add another joint. Make sure you make this a bit bent, the same as a real knee.

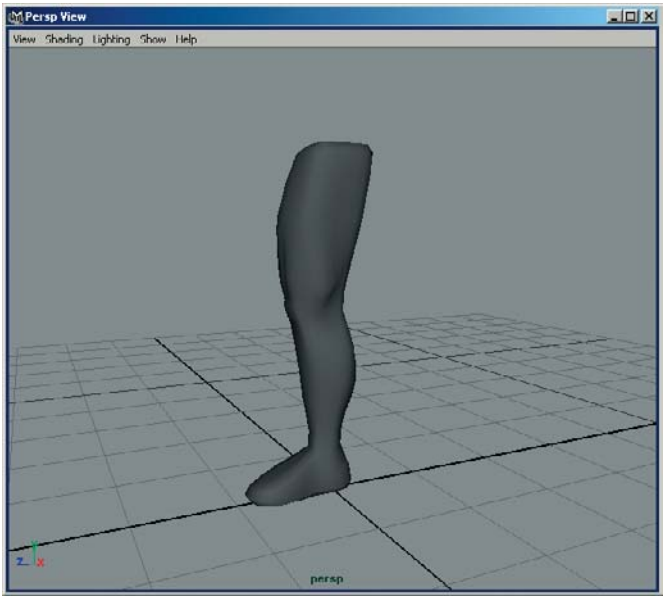


Figure 5.25 Leg for use with IK.

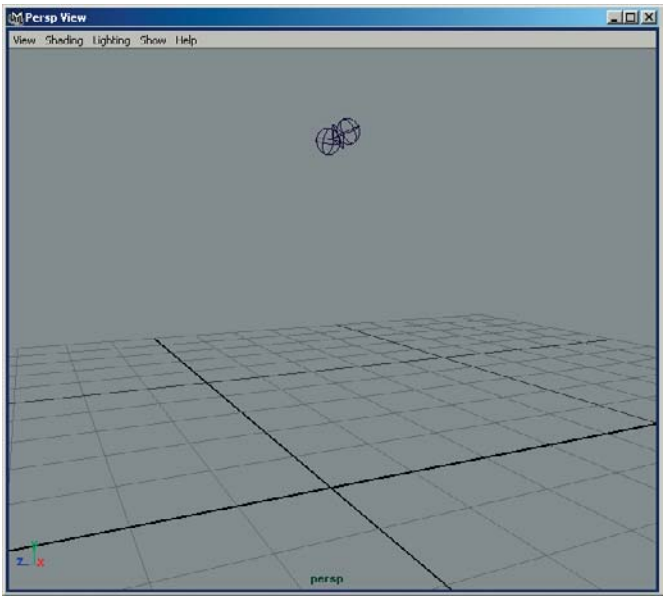


Figure 5.26 Joint and bone.

7 Move down again to the ankle and create a joint.

8 Place a couple more joints in the foot to finish it off.

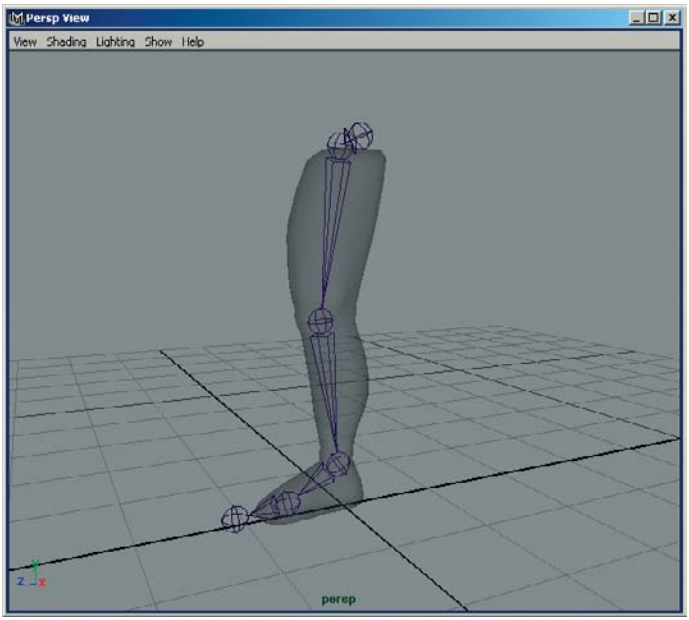


Figure 5.27 Placement of the bones.

9 Go to Skeleton > IK Handle Tool.

10 Click on the ankle joint.

11 Click on the joint just below the hip.

12 This will create an IK solver and place a handle for you to move it.

13 Select the hip bone and Shift select the mesh.

14 Go to Skin > Bind Skin > Rigid Bind.

15 Select the ankle IK solver at the ankle.

16 Move it around and the rest of the leg follows.

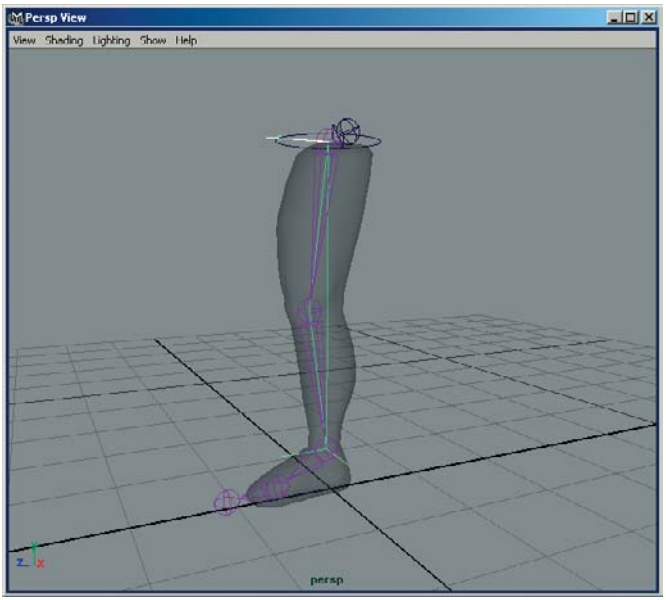


Figure 5.28 Adding the IK solver.

Set Driven Animation

Set driven animations are a unique way to have one attribute change (or drive) another attribute. Using driven keys, you could have an object fall when a character nears it or have a bird's wings flap when it flies in a specific direction. Driven keys work by linking one attribute to another.

1. Create a new scene in Maya.
2. Create a pair of wings with the pivot points at the base. Name the left one wing01 and the right wing02.
3. Group the wings using Edit > Group or the Ctrl + g shortcut.
4. Name the group wingDriver.
5. Press Insert to edit the pivot point of the group.
6. Snap the group to match the pivot point of the wings.
7. Press Insert to exit the edit mode.

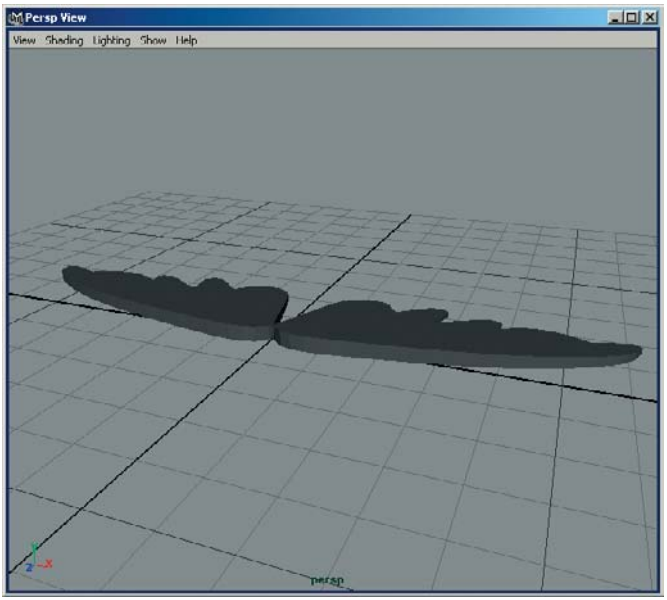


Figure 5.29 Wing.

8. Open the Channel Editor.
9. Go to Animate > Set Driven Key > Set > ❐.
10. Select the wingDriver node and click the Load Driver button. The Driver window is for the object that will control the driven keys. When you load an object, it will be listed on the left side of the window. The right side lists the attributes it will work with.
11. Select the two wings and click Load Driven. The Driven window is where you place the object to be affected.
12. Move the group node –40 units on the Z axis.
13. Select the group node in the Driver window and click on translate Z in the attribute section of the Driver window.
14. In the Channel Editor, change the translate Z to –40.
15. Select wing01 in the Driven window.

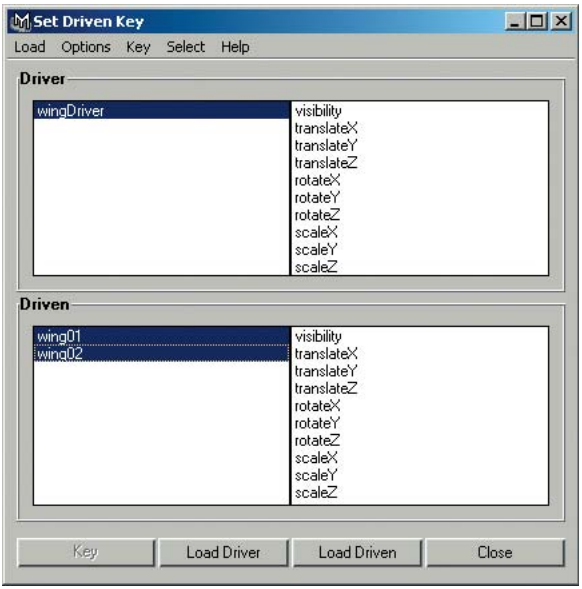


Figure 5.30 The Set Driven Key window.

16 Click on rotate Z in the attribute section of the Driven window.

17 In the Channel Editor, change the rotate Z to 40.

18 Click the Key button in the Set Driven Key window.

19 Select wing02 in the Driven window.

20 Click on rotate Z in the attribute section of the Driven window.

21 In the Channel Editor, change the rotate Z to –40.

22 Click the Key button in the Set Driven Key window.

23 Select the group node in the Driver window.

24 In the Channel Editor, change the translate Z to –35.

25 Select wing01 in the Driven window.

26 Click on rotate Z in the attribute section of the Driven window.

27 In the Channel Editor, change the rotate Z to –10.

28. Click the Key button in the Set Driven Key window.
29. Select wing02 in the Driven window.
30. Click on rotate Z in the attribute section of the Driven window.
31. In the Channel Editor, change the rotate Z to 10.
32. Click the Key button in the Set Driven Key window.
33. Repeat steps 21 to 32 five times, each time changing the Driver Z translation by 5 and alternating between 40 and –10 Z rotation.
34. Save this scene as Wings.

Select the wingDriver group and move it around the perspective window. Whenever it reaches the range you designated, the wings will begin flapping. Driven keys are based on the attributes you set and not the timeline. This means that the wings will flap anytime they move within the range you set up.

Blend Animations (Morphing)

Blend shapes (also known as morphing) changes one object into another. Blend animations are commonly used for lip-syncing. Using the Blend Shape editor, you can morph between as many targets as desired.

1. Create a new scene.
2. Set the animation length to 90 frames.
3. Build a face similar to the one in Figure 5.31 and name it 'face'. This will be the base object.
4. Duplicate the face four times. Name them faceBase, faceM, faceA, and faceY.
5. Hide the original face model.
6. Shape faceBase to a neutral resting position. The original geometry is in an unnatural open-faced position, which is a great starting point for shaping the other nodes but not so good to use as the base position in our blend animation.

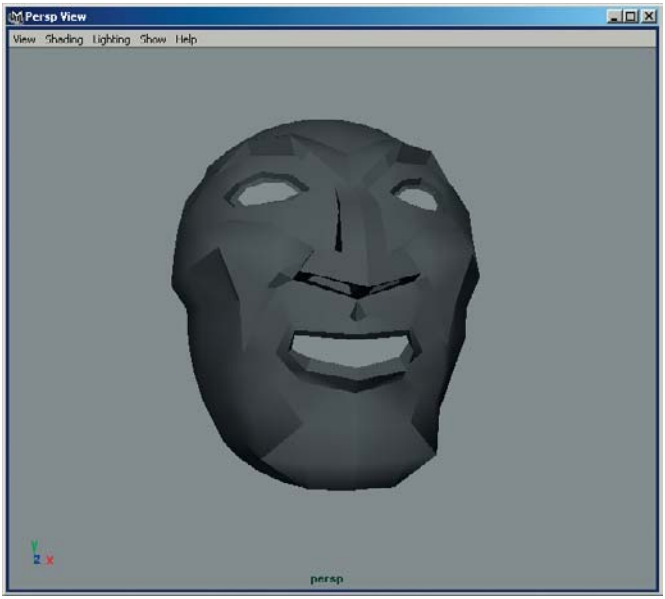


Figure 5.31 Face to be used for blending.

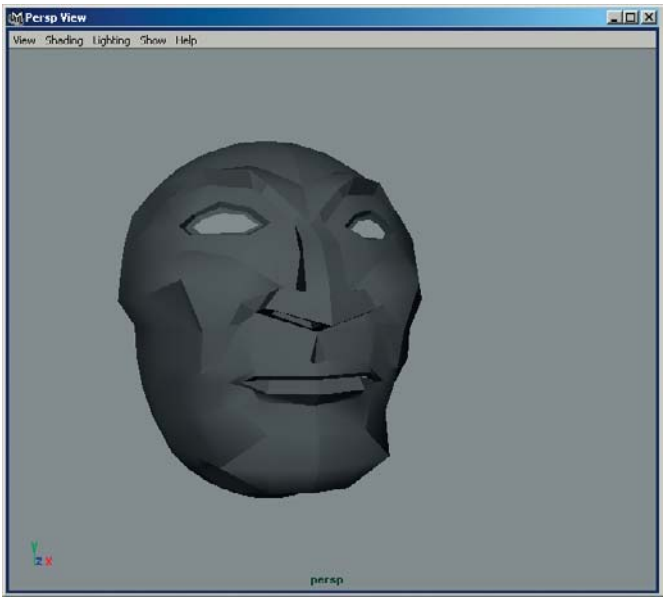


Figure 5.32 Creating the base position.

7 Shape faceM to form the letter M (see Figure 5.33). Move the vertices into place, but do not merge or delete any. The default blending mode is to blend between objects with identical vertex counts. There are other blending modes available but I find that the default works best.

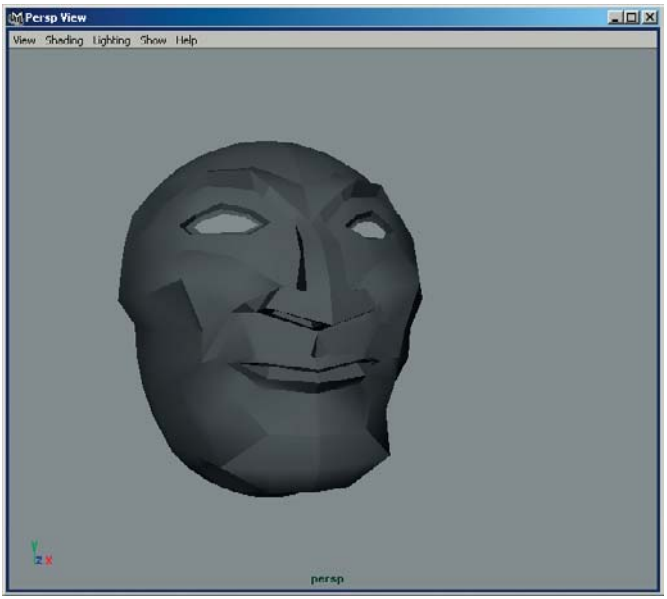


Figure 5.33 FaceM forming the letter M.

8 Shape faceA into the letter A.

9 Shape faceY into the letter Y.

10 In this order select faceM, faceA, faceY, and finally faceBase. The base object is always the final selection.

11 Go to Deform > Create Blend Shape ❐.

12 Name the BlendShape node faceBlend.

13 Set the Envelope to 1.

14 Set the Origin to Local.

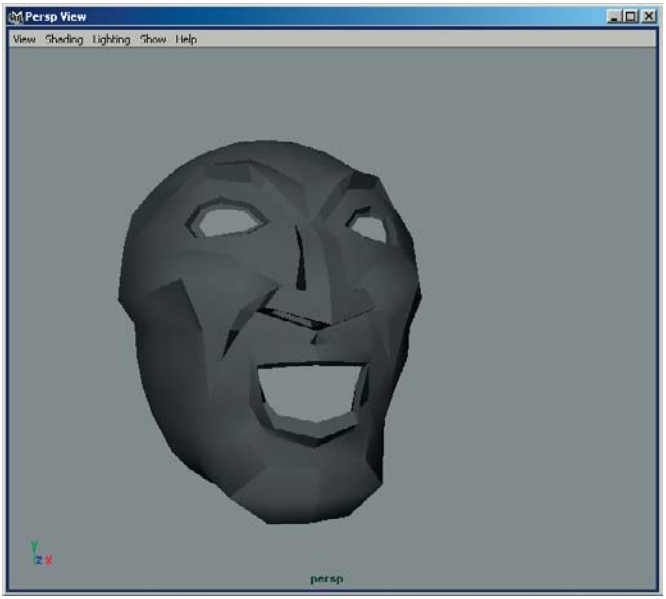


Figure 5.34 FaceA forming the letter A.

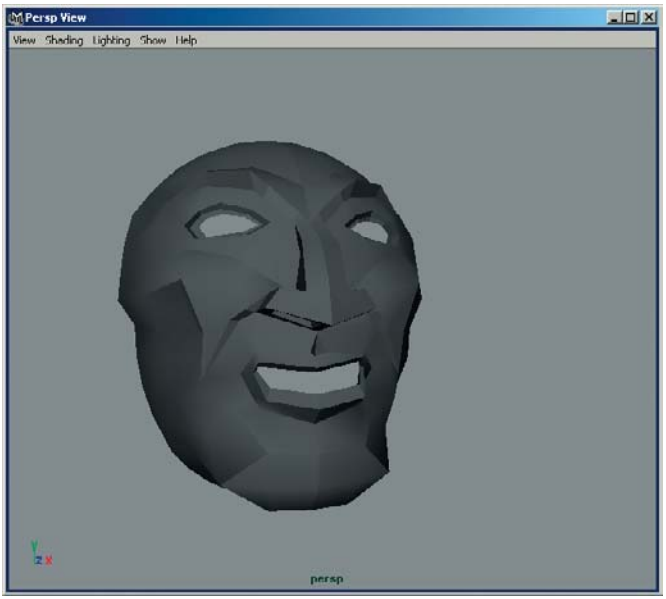


Figure 5.35 FaceY forming the letter Y.

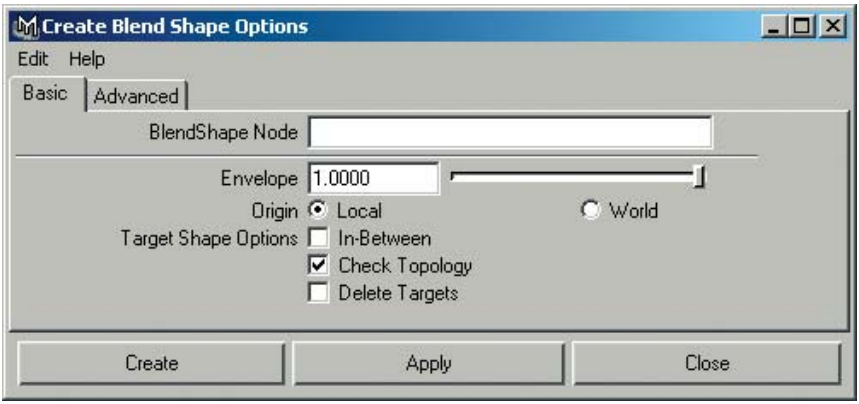


Figure 5.36 The Create Blend Shape window.

15 For Target Shape Options, select Check Topology.

16 Click Create.

17 Hide faceM, faceA, and faceY.

18 Go to Window > Animation Editors > Blend Shape.

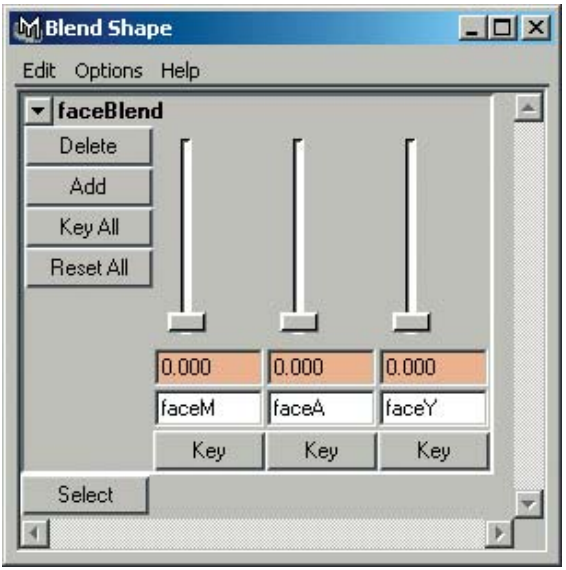


Figure 5.37 The Blend editor.

Each shape node gets its own slider that ranges from off (0) to on (1), or anywhere in between. You can also elect to keyframe the blend nodes individually or all at once.

19 Go to frame 1 and set faceM to 0, faceA to 0, and faceY to 0.

20 Press Key All.

21 Go to frame 10 and set faceM to 1, faceA to 0, and faceY to 0.

22 Press Key All.

23 Go to frame 20 and set faceM to 0, faceA to 1, and faceY to 0.

24 Press Key All.

25 Go to frame 30 and set faceM to 0, faceA to 0, and faceY to 1.

26 Press Key All.

27 Go to frame 40 and set faceM to 0, faceA to 1, and faceY to 0.

28 Press Key All.

29 Go to frame 55 and set faceM to 0, faceA to 0, and faceY to 0.

30 Press Key All.

31 Save your scene as faceBlend.

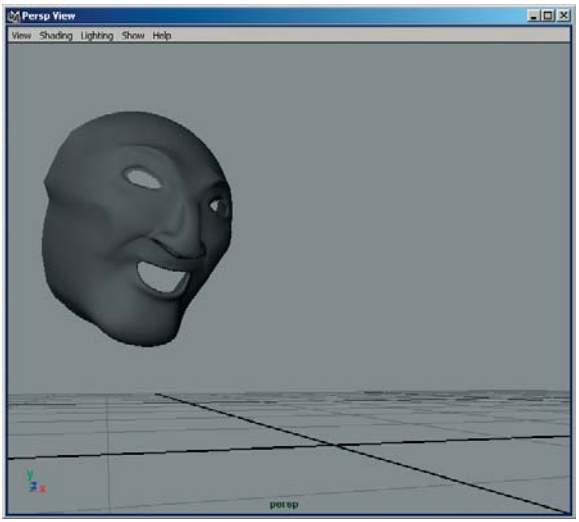


Figure 5.38 After the blend.

When you playback the animation, the shapes seamlessly blend into a talking character. Also, once the blend is set up, you are free to tweak the faceBase node. You can move it to a different spot or even run a smooth operation on it without breaking the blend animation (see Figure 5.38).

Sound

Sound is often overlooked when creating an animation. But Maya allows you to quickly add sound to your work environment to help make timing and lip-syncing easier for you.

1. To add sound to your scene go to File > Import.
2. Change the type of file it is looking for to Audio.
3. Direct the importer to the audio file and click Import.
4. Right click on the Timeline bar to bring up the marking menu.
5. Select Sound to list all of the current sound files loaded in Maya. You can only have one sound in your Timeline at any one time. If you need to load a different one, go through the marking menu again to pick the new sound.

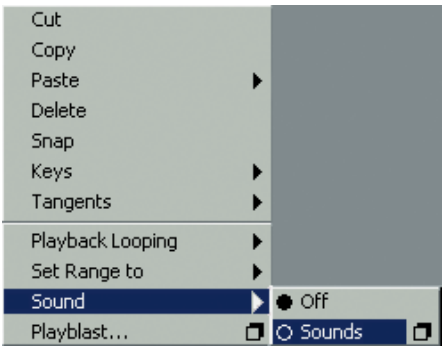


Figure 5.39 Timeline marking menu.

6. Select the one you want.
7. The Timeline will display an audio line.

Figure 5.40 Timeline audio.

8. Scrub the black bar back and forth in the Timeline to hear your animation.

Motion Paths

Motion paths use a curve to define the motion of an object. A motion path gives very nice flowing animations. Motion paths are ideal for such things as an airplane flying overhead, a whale swimming through the sea, or even a camera moving through your scene.

1. Start a new scene in Maya.
2. Set the animation length to 90.
3. In the top viewport create an S-shaped CV curve.
4. Create a polygonal cube on the Y axis with a width and height of one and a depth of four.

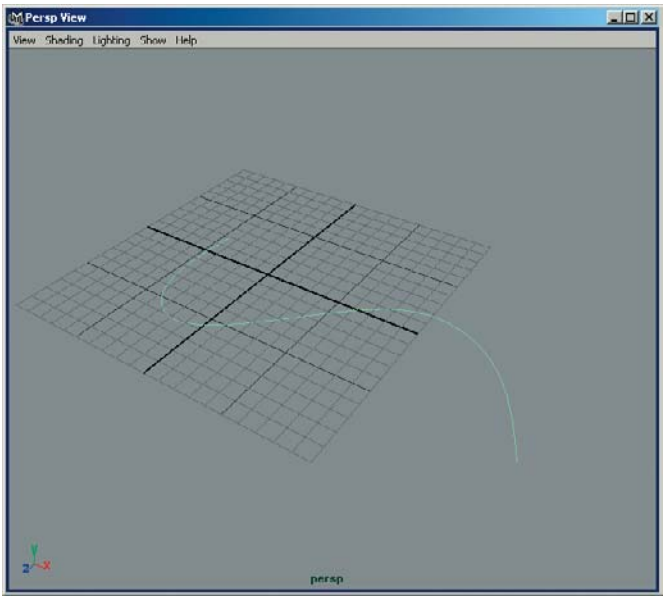


Figure 5.41 Readying a motion path.

5. Select the cube then Shift select the curve.
6. Go to Animate > Motion Paths > ❐.

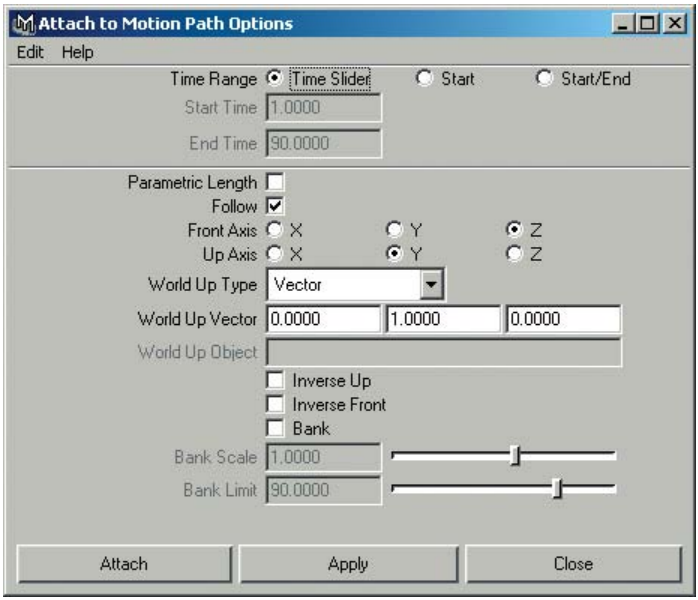


Figure 5.42 Motion path options.

7. For Time Range select Time Slider.
8. Deselect Parametric Length.
9. Deselect Parametric Follow.
10. Click Attach.

The cube will snap the starting point of the curve. Numbers will also appear on the curve designating the start and end points of the motion path.

1. Play the animation. As you can see, the cube moves along the path, but it continues to face along its own axis.
2. Select the cube and open the Attribute Editor.
3. Click on the MotionPath tab.
4. Click the Follow checkbox.
5. Leave the World Up Type on Vector.

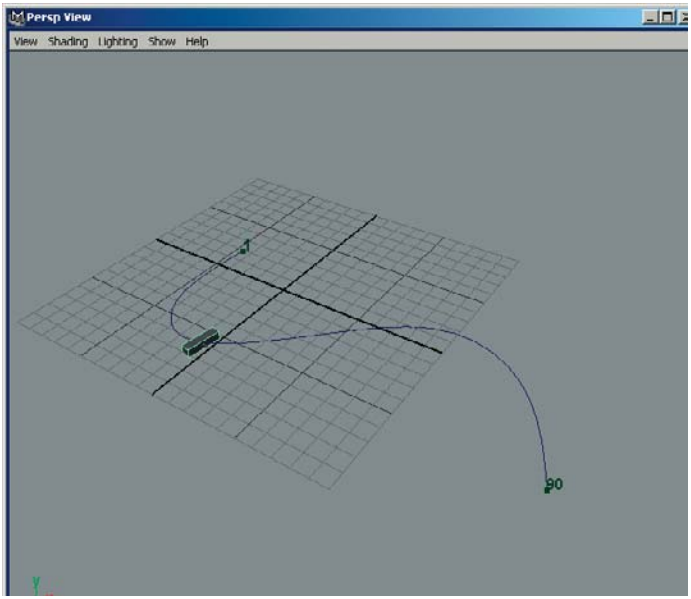


Figure 5.43 Moving along the path.

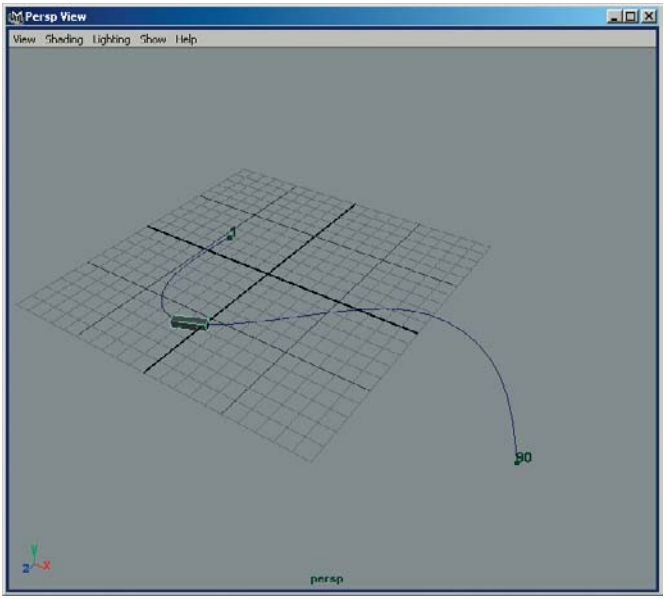


Figure 5.44 Object set to follow.

6. Change the Front Axis to Z.
7. Change the Front Axis to Y.
8. Press play. The cube is now oriented correctly on the path, but it moves too evenly throughout the scene.
9. Click the Bank checkbox.
10. Change the Bank Scale to 5. Now when you play the animation, the cube will bank going into and exiting each curve.

Motion paths are also a good way to have an object move along the terrain. Having a car drive along a road is quite easy to set up using a motion path.

1. Start a new scene in Maya.
2. Set the animation length to 90.
3. In the top viewport create a NURBS plane with a width and length of 40 and U and V patches of 10.
4. Deform the CVs to create hills.
5. Select the plane and go to Modify > Make Live.
6. Use the Pencil Curve Tool to draw a curve on the surface of the plane.
7. Select the plane and go to Modify > Make Live to return the plane to normal.
8. Create a polygonal cube on the Y axis with a width and height of one and a depth of four.
9. Select the cube and Shift select the curve.
10. Go to Animate > Motion Paths > ❐.
11. Set the Time Range to Time Slider.
12. Select Follow.

13 Choose Z for the Front Axis.

14 Choose Y for the Up Axis.

15 Select Scene Up for World Up Type.

16 Deselect Inverse Up and Inverse Front.

17 Check Bank.

18 Set the Bank Scale to 1.

19 Press Attach.

Play the animation and the cube will follow the curve that exactly matches the surface of the plane.

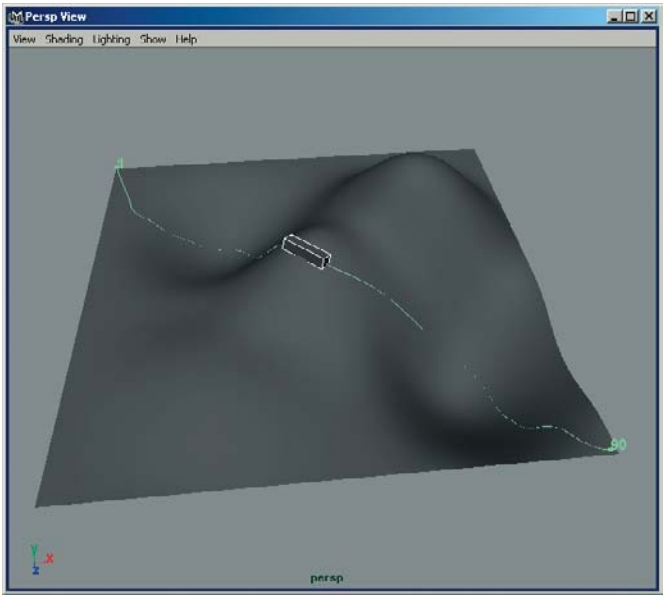


Figure 5.45 Attaching to a terrain.

1 Open the wings animation you made using set driven keys.

2 Create a looping curve similar to the one in Figure 5.46.

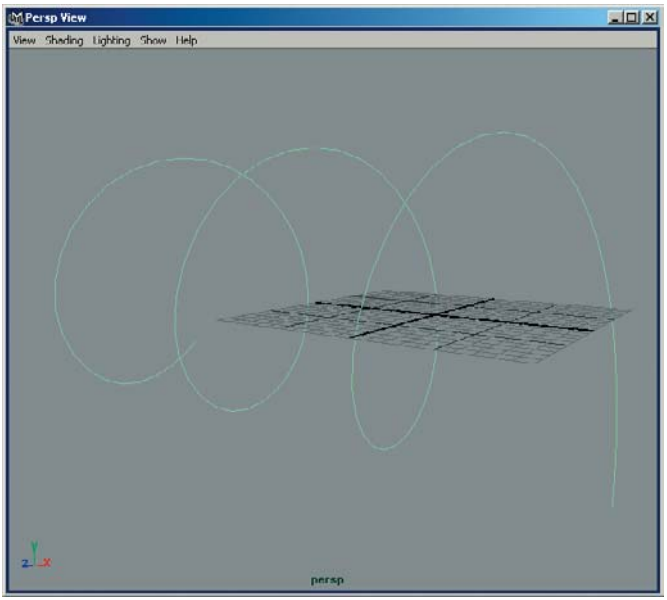


Figure 5.46 Looping curve.

3. Create the curve so that part of it lies within the boundaries you created for the set driven keys.
4. Select the wingDriver group node and shift select the curve.
5. Go to Animate > Motion Paths > Attach to Motion Path > ❐.
6. Check Follow.
7. Set World Up Type to Normal.
8. Check Bank.
9. Set the Bank Scale to 1.
10. Click Attach.

Play the animation. The wings travel smoothly around the loop but when they encounter the Set Driven Key range, the wings flap.

Hint: The Front, Up, and Side Twist option are available when you manually create a motion path using Animate > Motion Paths > Set Motion Path Key. But you can still use them with a normal motion path. To do so, open the motion path in the Channel Editor, RMB click on the twist you want to use and select Break Connections from the marking menu. You can now enter twist values. Once done, you should RMB click on the twist and choose Lock Selected.

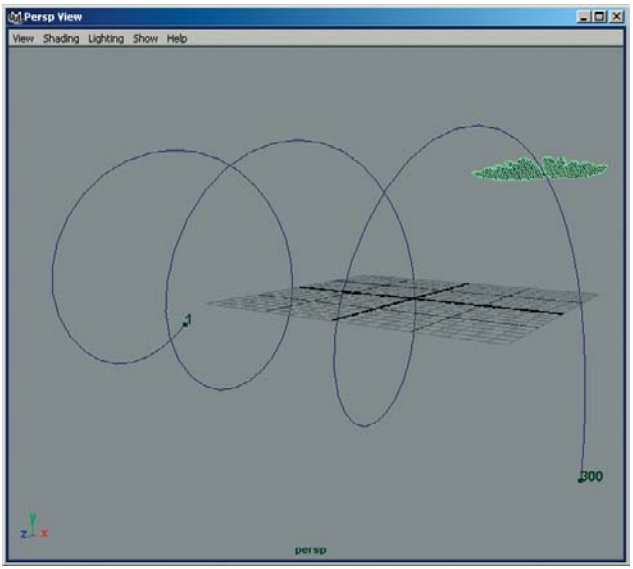


Figure 5.47 Flapping wings on path.

Another use for motion paths is to use them as flow paths. A flow path causes an object to deform realistically along the path.

1. Create a new scene in Maya.
2. Create a reference to the snake you modeled previously.
3. Set the animation to 600 frames.
4. Create a squiggly curve in the top viewport.
5. Select the snake and Shift select the curve.
6. Go to Animate > Motion Paths >Attach to Motion Path > ❒.

7 Set the Time Range to Time Slider.

8 Check Follow.

9 Set the Front Axis to Z.

10 Set the Up Axis to Y.

11 Change the World Up Type to Scene Up.

12 Click Attach.

Play the animation. The snake follows the curve but, as you can see, its body remains rigid. To fix this we need to create a flow attachment.

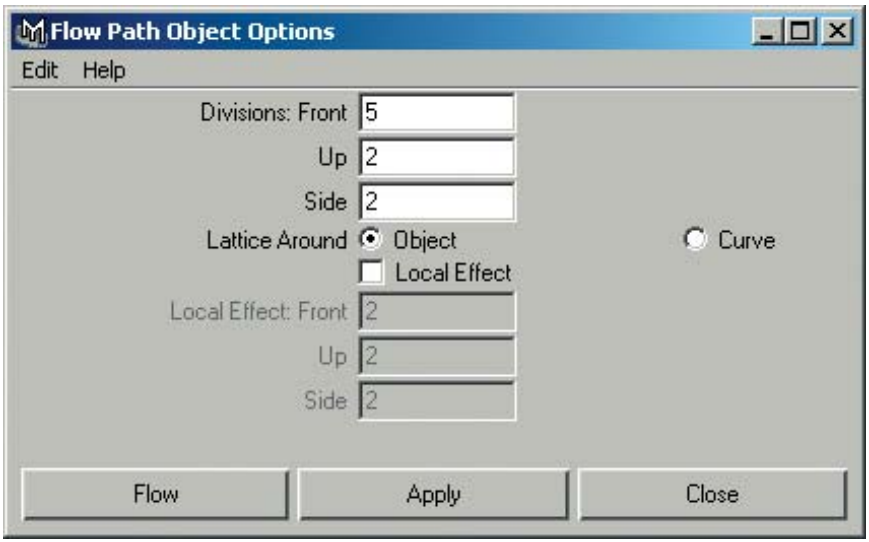


Figure 5.48 Flow path options.

13 Select the snake.

14 Go to Animate > Motion Paths > Flow Path Object > ❐. Input the following.

15 Front Divisions of 300.

16 Up Divisions of 2.

17 Side Divisions of 2.

18 Lattice Around set to Curve.

19 Check Local Effect.

20 Front Local Effect set to 15.

21 Up Local Effect set to 2.

22 Side Local Effect set to 2.

23 Click Flow. A lattice will appear along the length of your path.

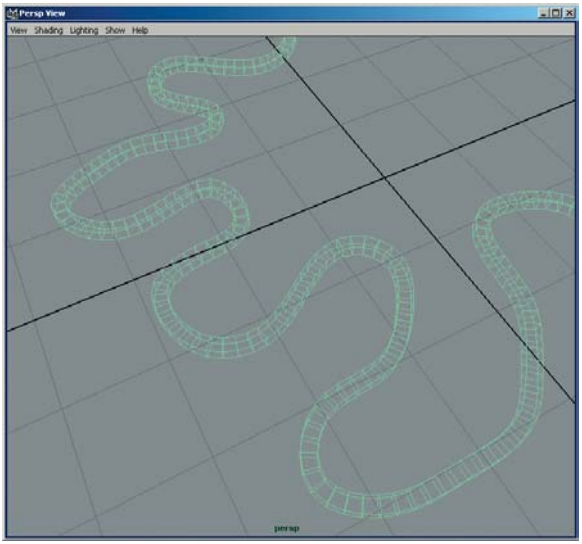


Figure 5.49 Flow lattice.

Play the animation and the snake will bend as it moves along the path. But keep an eye out for problem places. In Figure 5.50, the geometry passes outside the flow lattice, causing it to stretch.

24 To fix this go to Window > Outliner.

25 Select the ffdBase node and uniformly scale it out until the stretching disappears.

26 Save this file as snakeMotion.

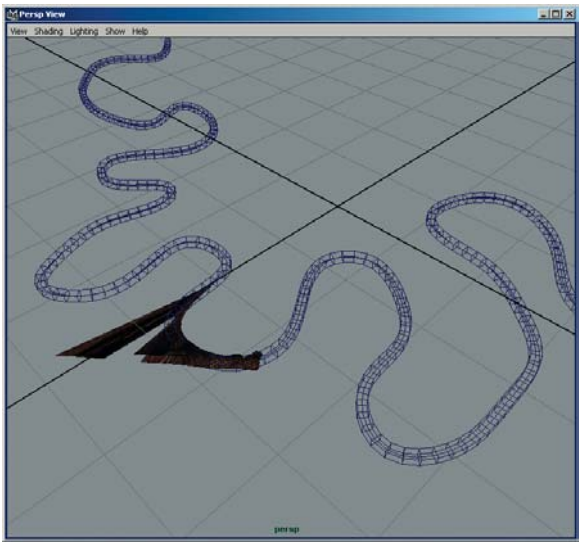


Figure 5.50 Problems along the flow path.

The Dope Sheet

Go to Window > Animation Editors > Dope Sheet. The Dope Sheet is based on the traditional animation tool of the same name. The Dope Sheet is used to help synchronize sounds and to edit keys.

1. Open your scene, bouncingBall.
2. Go to Window > Animation Editor > Dope Sheet.
3. If it is not checked, click on View > Scene Summary in the Dope Sheet drop-down menu. The black marks in the view area indicate keyframes.
4. Select the sphere in your scene. It will now show up in the Dope Sheet.
5. Click on the plus marks next to the sphere to expand the information for it.
6. Select Translate Y in the Dope Sheet outliner. All of the keyframes associated with Y translation become highlighted.
7. Click the Move Keys button on the Dope Sheet status line.

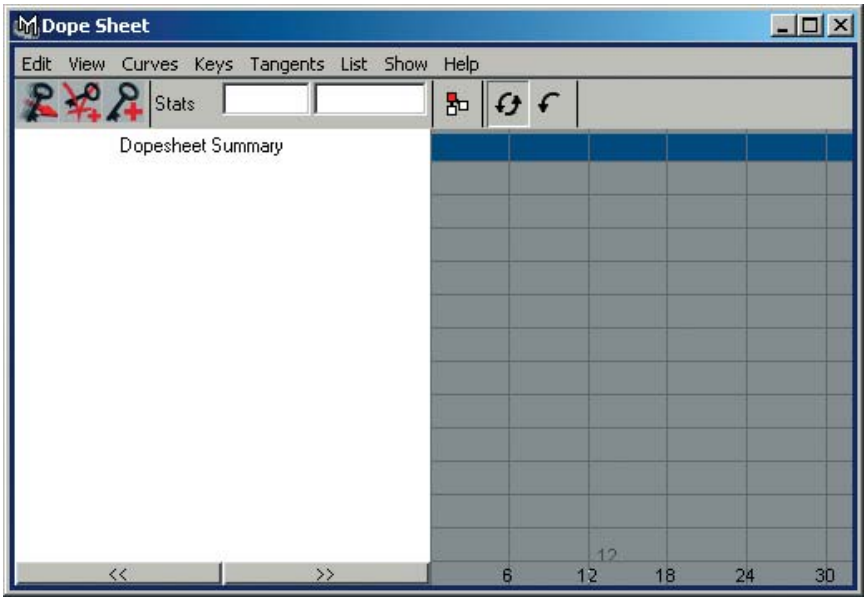


Figure 5.51 The Dope Sheet.

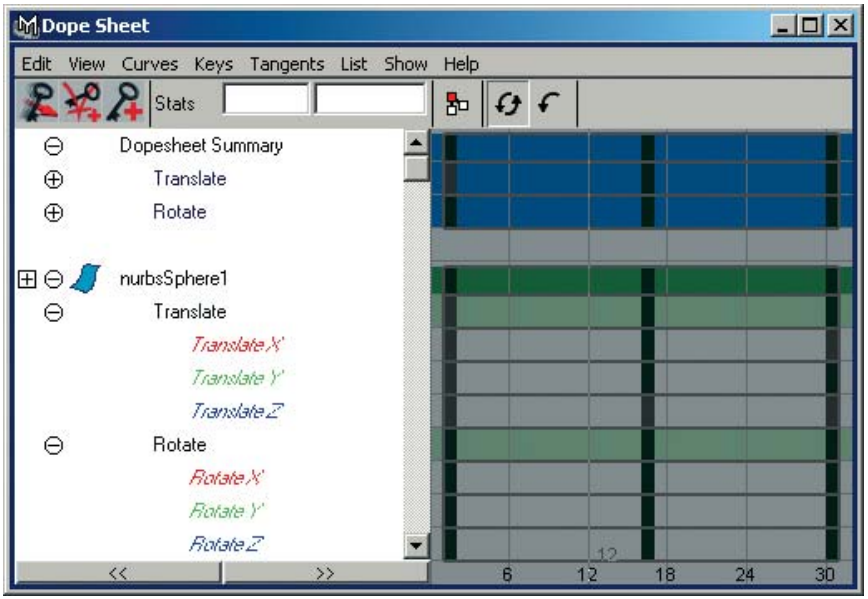


Figure 5.52 The Dope Sheet status line.

8. MMB select and drag the middle Translate Y keyframe five frames to the left in the view area. The ball will bounce earlier now.
9. Select the middle Translate Y keyframe in the view area.
10. Delete the middle Translate Y keyframe.
11. Playback the animation and the sphere no longer bounces.
12. Undo the deletion.
13. Select Scene Summary to pick every keyframe in the scene.
14. Go to Edit > Scale > ❐ in the Dope Sheet menu.
15. Change Method to Start/End.
16. Change New Start Time to 10.
17. Change New End Time to 20.
18. Click Scale Keys. The entire animation now plays between frames 10 and 20. You could also scale the frames out and make the animation longer.

The Graph Editor

Go to Windows > Animation Editors > Graph Editor. The Graph Editor allows you to edit animation curves. Fine-tuning a curve can go a long way toward giving your animation that extra bit of polish.

1. Open your scene, bouncingBall.
2. Go to Window > Animation Editors > Graph Editor.
3. Select the sphere and it will appear in the Graph Editor. In the View Area you will see red, green, and blue colored lines. These correspond X (red), Y (green), and Z (blue).
4. Click on the plus next to the sphere in the Graph Outliner.
5. Select Translate Y. Selecting a single attribute will remove the other attributes from the view.

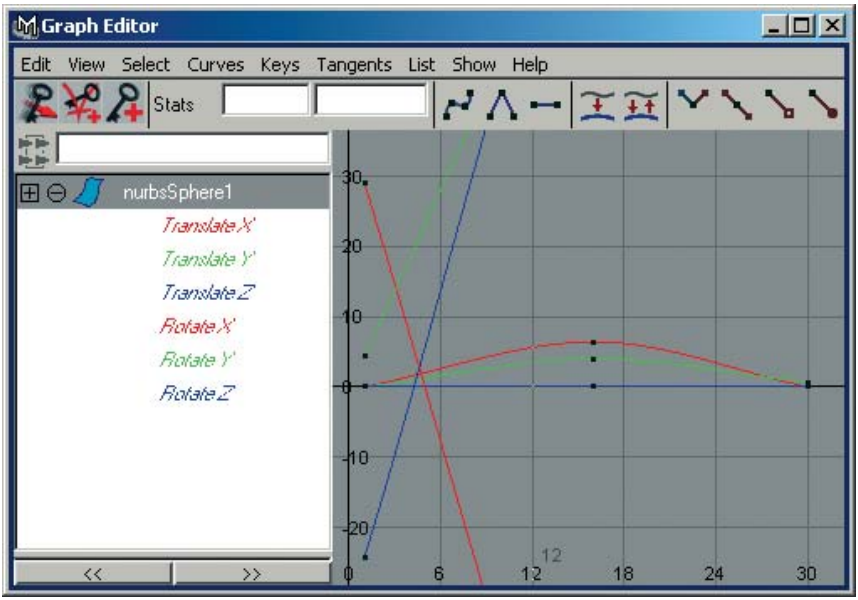


Figure 5.53 The Graph Editor.

6. Go to frame 16.
7. Click the Move Nearest Picked Key Tool from the Graph Editor Status Line.
8. Select the middle keyframe in the view area and move it up. The sphere will now bounce higher.
9. With the keyframe still selected, click on the Linear Tangents button on the Status Line. The transitions into and out of this frame are now very snappy.
10. Click on a keyframe. Tangents will appear for that frame.
11. Select a tangent with the MMB to edit it.
12. Click on a keyframe.
13. Click on the Break Tangents button. You can now edit each half of a tangent separately.

The Trax Editor

Go to Windows > Animation Editors > Trax Editor. The Trax Editor is a non-linear animation tool which you can use to create animation clips that blend into one another. You can even move the clips to change the playback times.

1. Open your scene, bouncingBall.
2. Use the Dope Sheet, delete all of the animation data on the sphere.
3. Open the Channel Editor.
4. Change the rotation values of the sphere back to 0 for the X, Y, and Z channels.
5. Go to frame 1.
6. Key Translate X at –2.
7. Go to frame 16.
8. Key Translate X at 2.
9. Go to Window > Animation Editors > Trax Editor.

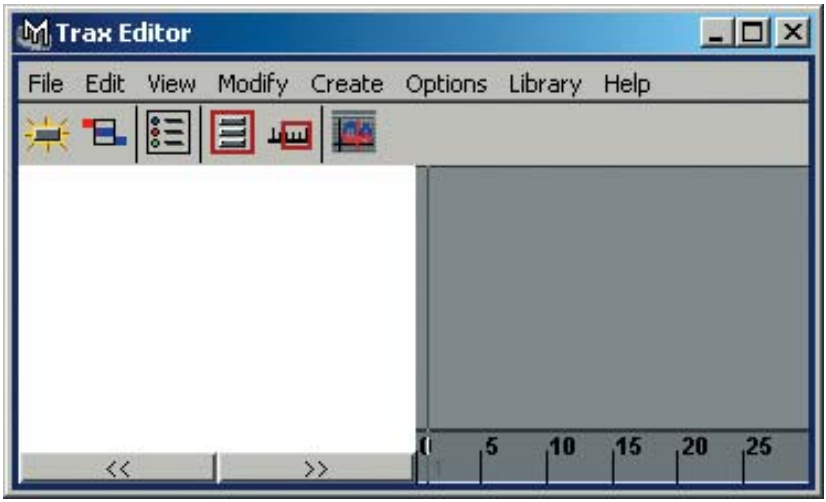


Figure 5.54 The Trax Editor.

10 Select the sphere.

11 Click Create > Character Set > ❐ from the Trax Editor drop-down menus.

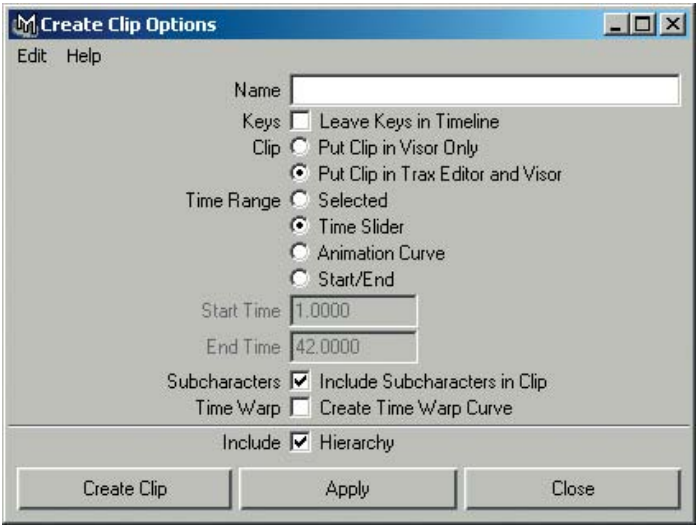


Figure 5.55 Clip window.

12 Name the set ballMove.

13 For Character Set Attributes, select All Keyable.

14 Click Create Character Set.

15 Select the sphere again.

16 Go to Create > Clip > ❐ from the Trax Editor drop-down menus.

17 Name the clip ballMove.

18 Select Put Clip in Trax Editor and Visor.

19 Choose Animation Curve for the Time Range.

20 Click Create Clip. The Trax window now has a bar representing the animation you just created. The keyframes will disappear from the Timeline.

21 Save this scene as ballForward.

22 Open the original bouncingBall scene.

23 Select the sphere.

24 Click Create > Character Set > ❐ from the Trax Editor drop-down menus.

25 Name the set ballBounce.

26 For Character Set Attributes, select All Keyable.

27 Click Create Character Set.

28 Select the sphere again.

29 Go to Create > Clip > ❐ from the Trax Editor drop-down menus.

30 Name the clip ballBounce.

31 Select Put Clip in Trax Editor and Visor.

32 Choose Animation Curve for the Time Range.

33 Click Create Clip.

34 Go to File > Create Reference and choose ballForward as the reference file.

35 Open the Trax Editor.

36 Click the clip ballMove from the file you just referenced. It will turn yellow, indicating it is selected.

37 Go to Edit > Copy in the Trax Editor drop-down menus.

38 Click anywhere in a gray area to deselect the clip.

39 Click on the ballBounce Character Set.

40 Go to Edit > Paste in the Trax Editor drop-down menus. This will copy the clip from the referenced file directly into your scene. This is a vital step for working with multiple trax clips. Maya will have interpolation problems if you try to bring in clips from other sources using any other method.

41 Go to File > Reference Editor.

42 Expand the arrow and select the reference on the bottom portion of the window.

43 Select Edit > Remove Reference from the Reference Editor drop-down menus.

44 Press play. The sphere will bounce and move forward at the same time. These are two distinctly different animations that are playing at the same time.

45 Open the Trax Editor again. Each of the clips is a self-contained track of animation that can be moved at your discretion.

46 Change your animation length to 45 frames. You can do this by simply typing 45 in the End Time box on the Range Slider.

47 Drag the ballBounce clip to frame 16.

48 Play the animation. This time it moves forward before bouncing.

49 Drag the ballBounce clip back to frame 1 in the Trax Editor.

50 Click on File > Visor in the Trax Editor drop-down menu.

51 Click on the Character Clips tab of the Visor. You will see a source clip for each of the clips.

52 Open the Channel Editor.

53 Click on ballBounce source clip in the Visor.

54 Click on ballBounce1 in the Outputs section of the Channel Editor. This is a very important step. Make sure you are selecting the correct output.

55 Change the Cycle to 2.

56 Select the ballMove source clip from the Visor. Be aware that because you copied this clip from a referenced file the name will actually begin with the name of the original reference.

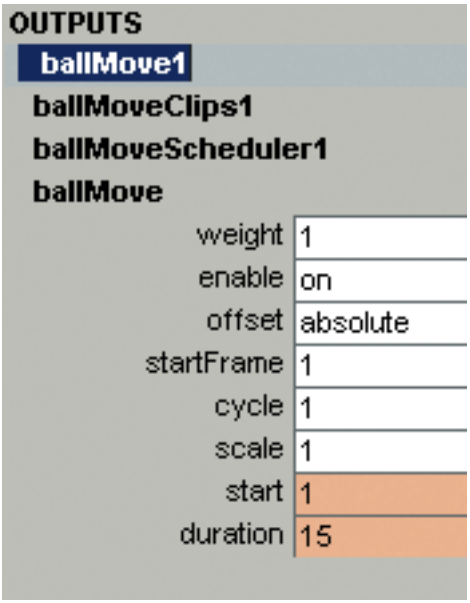


Figure 5.56 Output options.

57 Click the ballMove1 output in the Channel Editor.

58 Change the Cycle to 4.

59 Change the Offset to Relative. Click on where it says absolute and a drop-down menu will appear.

60 Go to the Trax Editor and drag the ballMove clip so it ends at the same frame as the ballBounce clip.

61 Change the End Time animation to 59.

62 Press play. The ball now bounces forward. The relative setting forces a cycled clip to start each cycle from the end of the previous one.

63 Save this scene as bounceTrax.

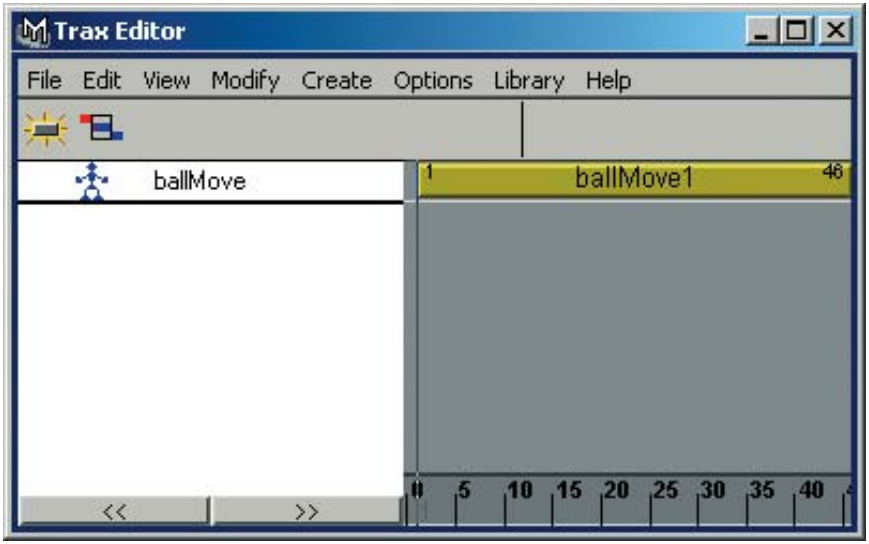
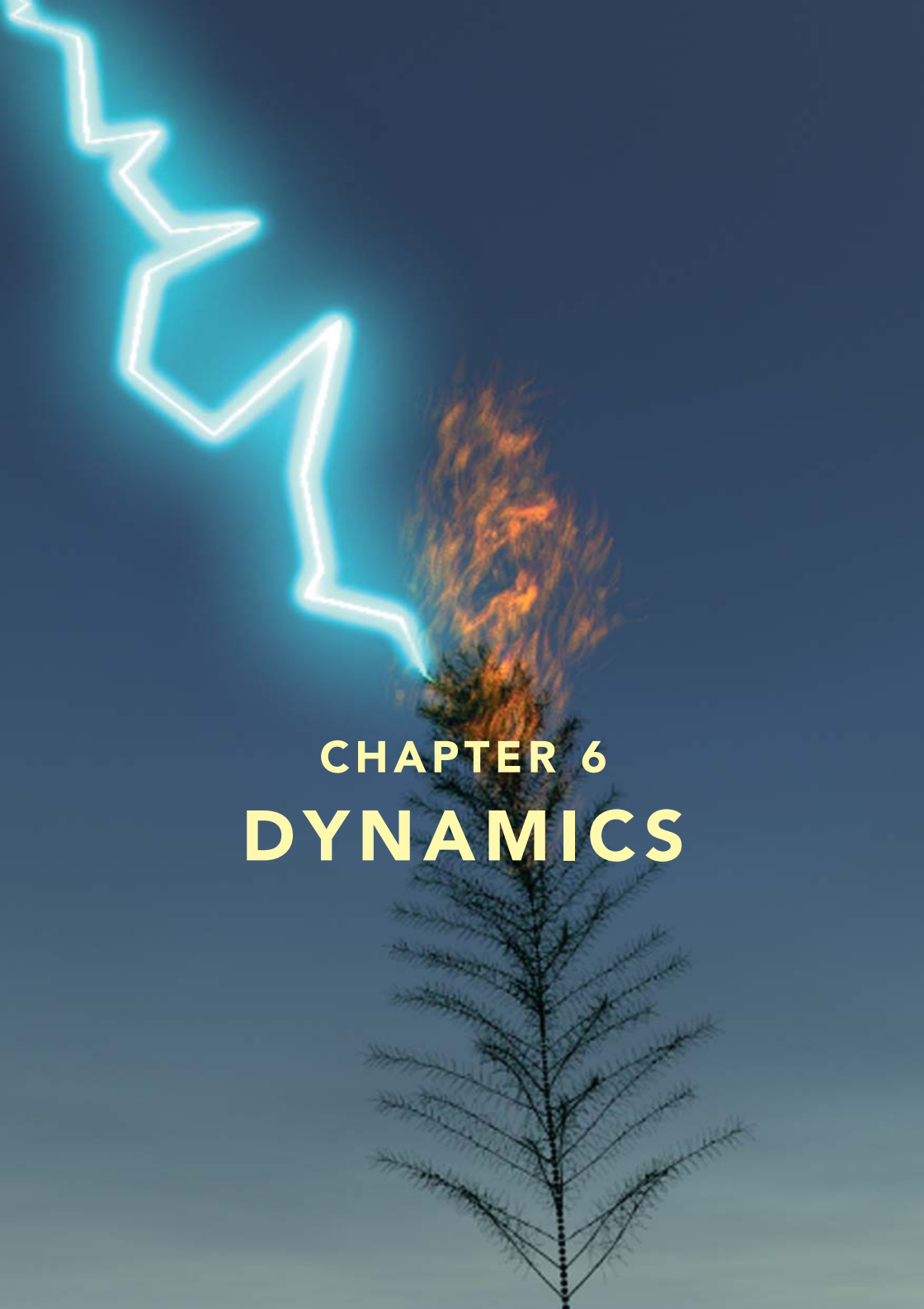


Figure 5.57 Cycled clip.

You can layer as many clips as you need. The Trax Editor also allows you to create blends between two animations, poses, and change animation times without affecting the curves (called time warps).



CHAPTER 6
DYNAMICS

In Maya dynamics are the simulations based on physics. Rain, sparks, and tumbling objects are all examples of dynamics. In Maya dynamics are split into two distinct areas, particles and soft/rigid body.

Particle Effects

Particle effects are useful in creating fire, smoke, laser blasts, nebulae and other voluminous matter. Body dynamics are for creating realistic impact and reaction simulations. In addition, there is an Effects drop-down menu that has preset F/X types available which utilize a mix of particles and body dynamics to help you quickly create more common phenomena. To access the dynamics toolset, press the F4 key or select the Dynamics drop-down from the Status Line.

Figure 6.1 The Dynamics menu set.

Select the Particles drop-down menu. An important thing to remember when working with Maya particles is that most types need to be rendered using Hardware Rendering. You will need to render the hardware particles in a separate pass from the rest of your scene and add them to your animation using a compositing program during post-production.

Hardware particles can be multi-point, multi-streak, numeric, points, spheres, sprites, or streaks that you can animate with a variety of techniques including keyframes, expressions, and fields.

Software particles can be a Blobby Surface, Cloud, or Tube. Software particles can be animated just like hardware particles, but they have the added benefit of being able to be rendered directly in your scene.

Particle Tool lets you manually place individual particles as desired throughout your scene.

Create Emitter places an emitter and particle in the scene.

Figure 6.2 The Particles drop-down menu.

Emit from Object turns the selected object into a particle emitter.

Use Selected Emitter binds the selected particles to the selected emitter.

Per-Point Emission Rates allows you to vary emission rate for individual particles within omni or directional emitters.

Make Collide causes the selected particles to collide with selected geometry.

Particle Collision Events is used when you want particles to perform a special function when they collide with geometry.

Goal specifies how much the particles are attracted to the object they are trailing.

Instancer (Replacement) is used to replace the selected particles with a specific piece of geometry.

Sprite Wizard takes you through the creation of particle sprites step by step.

Connect to Time is used to connect duplicated particle networks back to the timeline.

Tutorial: Dragging Particles

1. Open bounceTrax.
2. Go to Window > Animation Editors > Trax Editor.
3. RMB click on the bounce clip and uncheck Enable Clip. The clip name will gray out and the bounce animation will no longer play.
4. Press F5 or select Dynamics from the status line to open the dynamics tools.
5. Go to Particle > Particle Tool > ❐. Input the following settings.
6. For the Particle Name use Dust.
7. Set Conserve to 1.
8. Check Create Particle Grid.
9. Particle Spacing of 1.
10. For Placement select With Cursor.
11. Click near the left forward corner of the plane to place the first particle point.
12. Click near the right forward corner of the plane to place the second particle point. Do not press Enter yet.
13. Press the Insert key to go into edit mode for the particles.
14. Drag the second particle point to the rear right corner of the plane.
15. Go to the front or side viewport and drag the second particle point up one unit.
16. Press Enter. You will now have a 3D particle grid in your scene.
17. Select the particle grid.
18. Go to Fields > Air > ❐. Enter the following settings.

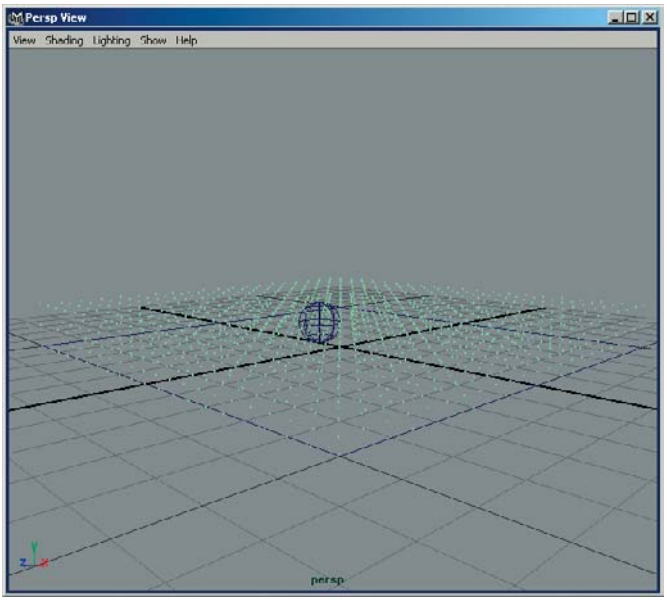


Figure 6.3 3D particle grid.

19 Select Wake.

20 Change the Magnitude to 3.

21 Check Enable Spread.

22 Change the Spread to 1.

23 Check Use Max Distance.

24 Set the Max Distance value to 8.

25 Click Create.

26 Move the airField behind that sphere as in Figure 6.4.

27 Parent the airField to the sphere.

28 Press play. The particles will move as the field passes through them.

The particles currently have a default texture assigned to them. Generally you will want the particles to vary over their lifespan.

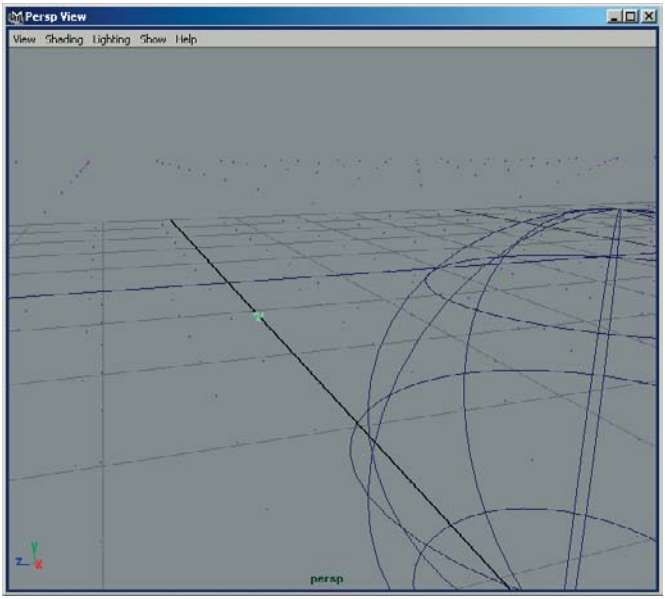


Figure 6.4 Positioning the airField.

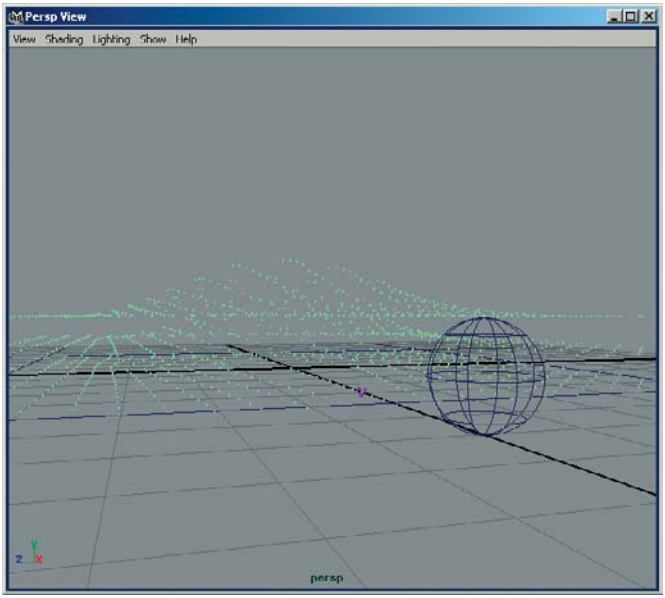


Figure 6.5 Animated particles

29 Select the particle grid and go to the Attribute Editor.

30 Expand the Add Dynamic Attributes section.

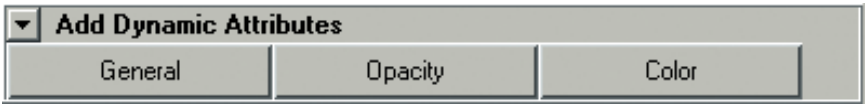


Figure 6.6 Add Dynamic Attributes.

31 Click on the Color button in the Add Dynamic Attribute section.

32 In the Particle Color window, choose Add Per Particle Attribute.

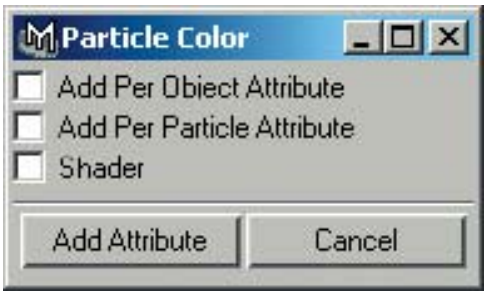


Figure 6.7 Particle Color window.

33 Click Add Attribute.

34 In the Attribute Editor, expand the Per Particle (Array) Attributes section. As you add particle attributes, the new attributes will appear here.

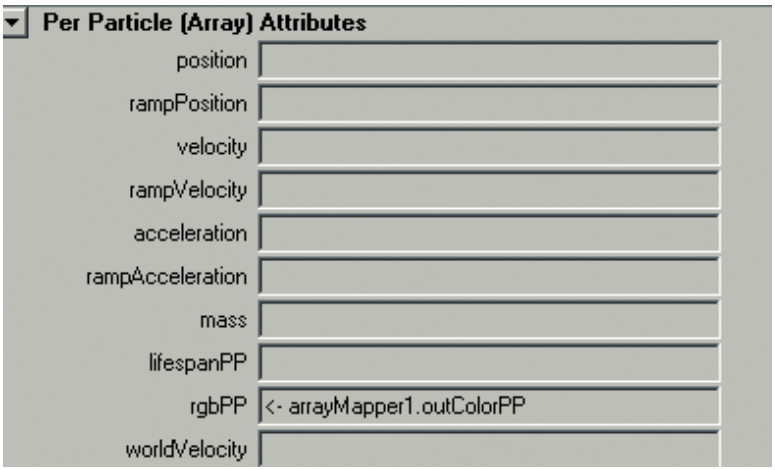


Figure 6.8 Per Particle Attributes.

35 RMB click on rgbPP, drag to Create Ramp and release. An Array mapper node will appear in the rgbPP box.

36 RMB click the arrayMapper node and select Edit Ramp.

37 The ramp will open in the Attribute editor.

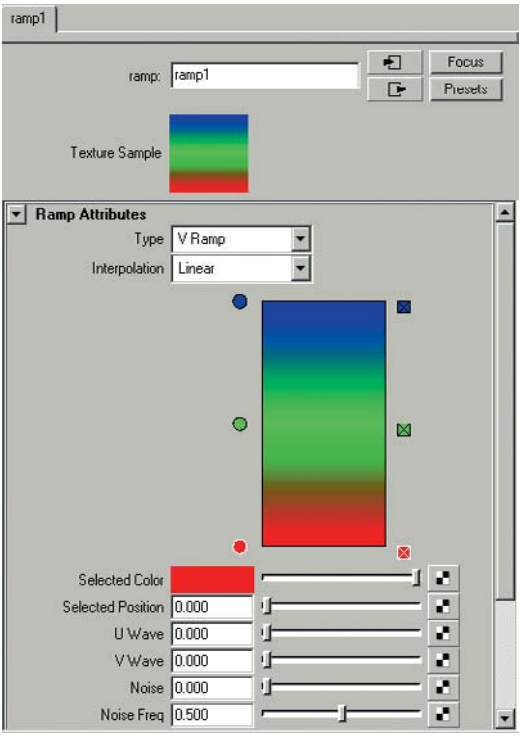


Figure 6.9 Particle color ramp.

38 Select the green circle to activate the color channel.

39 Click on the Selected Color swatch to bring up the Color Chooser window.

40 Change the color to a bright yellow.

41 Repeat steps 38 to 40 for the blue channel, but pick a purple color this time.

42 Play the animation.

43 Go to the particle shape node in the Attribute Editor.

44 Expand the Lifespan Attributes section.

45 Change Lifespan to 2. The particles now live for 2 seconds rather than the default 1.

46 Save this scene as sphereWake.

Using the particle attributes allows you to customize everything from size, to randomness, to velocity. You can also use Expressions to drive the attributes to get even more realistic results.

CHAPTER 7
RENDERING

Rendering is the output of a Maya scene as a 2D image. This image could be a high-resolution still for use in a magazine ad, or it could be an animated sequence ready to playback on a TV. Finding the right render settings is dependent on the final medium used for viewing the images. In general, print requires the highest resolution images, followed by film, games, and lastly TV.

Rendering times can be significant, so keep that in mind when you begin working on your scene. A high-resolution, fully anti-aliased image could potentially take a couple of hours to render just one frame. Imagine if you tried to render out an animation with similar settings: 24 seconds of animation would take 48 hours.

Rendering a Scene

Press F5 or select Rendering from the Status Line. Go to Window > Rendering Editors > Render Globals.

Figure 7.1 The Rendering set.

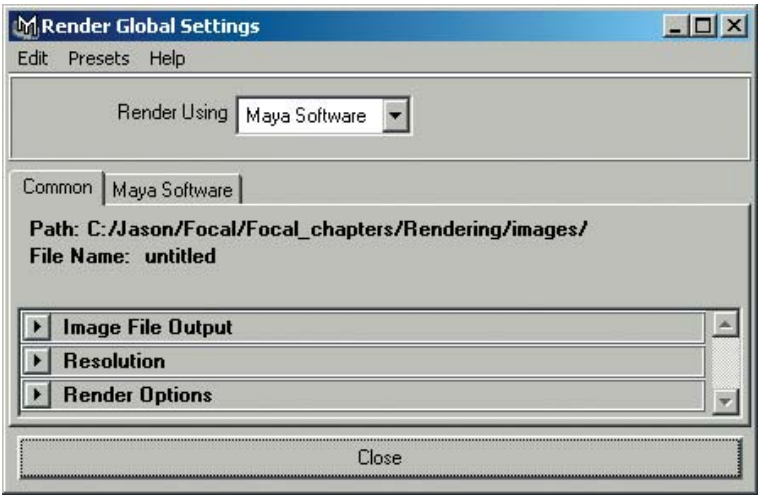


Figure 7.2 The default render globals.

Maya 5 comes standard with four rendering engines: Maya Software, Maya Hardware, Mental Ray, and Maya Vector. Please note that Maya 5 Personal Learning Edition does not include the Mental Ray or Vector renderers. The default rendering engine is Maya Software. To use a different renderer select it from the Render Using option at the top of the globals window.

The Common tab is used by all four of the renderers. This is where you set the project's resolution and image output format. When you use the Render Current Frame or IPR shortcuts, it uses the resolution you set here.

Hint: It's a really good idea to set your resolution at the beginning of the project so you don't accidentally compose your scene to the wrong aspect ratio. If you want to change the render globals to output a lower resolution to speed up your work always keep the same aspect ratio. For example, if your original scene is 640 × 480 and you need to render a low-res test, output it at 320 × 240.

Settings

When you are ready to render your scene open the Render Globals and make sure you have the correct settings in the Image Output Settings.

Any render you make will default to the Images folder of your current project. For every new render, you will need to set the following.

File Name Prefix is the name that you would like to call your render. Type in a name, otherwise it will default to the name of your current scene.

Frame/Animation Ext is set to single frame by default. If you are rendering an animation, select one of the other options. I always use name#.ext when rendering an animation as it make it much easier to load the sequence into post-production editing programs later.

Image Format needs to be set to your desired output format. The benefits for using Targa files for both single frame and as sequential frame animations cannot be stressed enough. Render out as a Targa sequence and recompile the frames in a video-editing program if available. Otherwise use AVI for your animations.

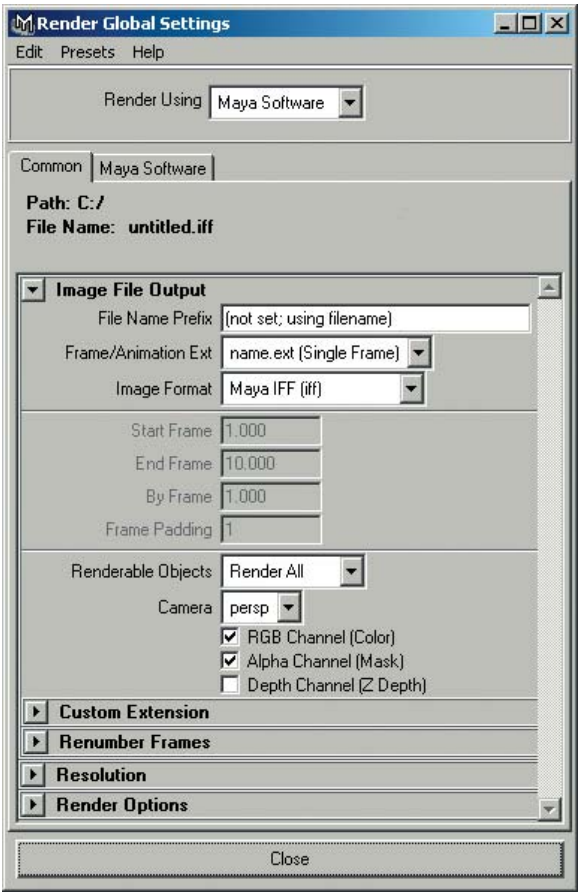


Figure 7.3 Image output settings.

Start and End Frames should be set to match the length of your animation. It defaults to end at frame 10.

By Frame should be set to 1.

Renderable Objects should be set to 1.

Camera needs to be the camera that you used to compose your scene.

RGB Channel (Color) needs to be checked.

Alpha Channel (Mask) should be checked if it is needed.

Rendering Using Maya Software

1. Open your animation file, fallingLamp.
2. Go to Window > Rendering Editors > Render Globals. Input the following.
3. Render Using Maya Software.
4. Frame/Animation Ext set to name#.ext.
5. Image Format set to AVI. Normally I would render a Targa sequence, but not everyone has access to a video post-editing program to recompile the frames so we'll use AVI for now.
6. Start Frame of 1.
7. End Frame of 150.
8. By Frame 1.0.
9. Renderable Object set to Render All.
10. Camera set to camera1.
11. Go to the Resolution section and set the Width and Height to 512 × 512.
12. Click on the Maya Software tab.
13. Expand the Anti-aliasing Quality tab.
14. Change Quality to Production.
15. Expand the Raytracing Quality tab.
16. Check the Raytracing box.
17. Set Reflections to 5.
18. Set Refractions to 5.
19. Set Shadows to 10.
20. Click on the Motion Blur section.
21. Check the Motion Blur box.

22 Set Motion Blur Type to 2D.

23 Close the Render Globals window.

24 Go to Render > Batch Render > ❐ to bring up the Batch Render window.

Figure 7.4 Batch Render window.

25 Check Use All Available Processors.

26 Click Batch Render.

27 The Command Feedback line will display the rendering progress for your animation. When it's complete, open the Images folder and play the AVI file to see the final result.

Rendering Using Maya Hardware

Maya Hardware rendering is the only way to render many of the available particles. Hardware rendering is very fast. It actually uses processing power from your video card during the render stage to help speed things up. The downside to Hardware rendering is that the quality is not as good as Software mode. However, the quality is fine for particles because they are points or streaks as opposed to a full character walking about.

1 Open sphereWake.

2 Render the current frame. The sphere and plane appear just fine, but the particles are nowhere to be seen.

3 Go to Window > Rendering Editors > Hardware Render Buffer. The Hardware Render Buffer is where you set up your scene to be rendered with the aid of your graphics card.

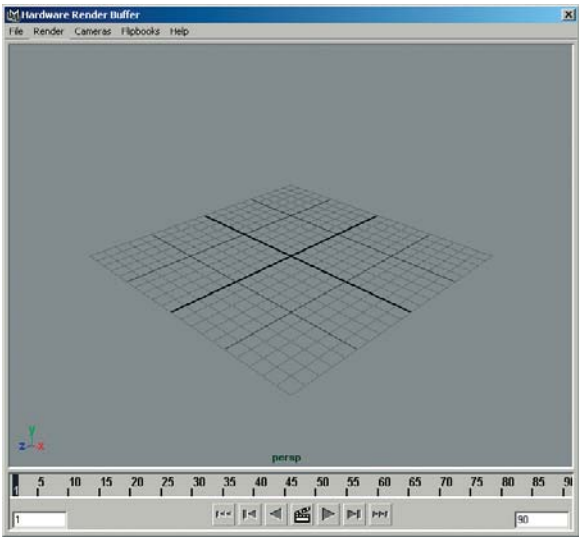


Figure 7.5 Hardware render buffer.

4. In the Cameras menu select the camera you want to render from.
5. Go to Render > Attributes on the Hardware Render menu. This will open the Hardware Render settings in the Attribute Editor.
6. Enter 'test' as the name.
7. Start Time of 1.
8. End Time of 59.
9. By Frame of 1.
10. Image Format set to Targa. Note that in the hardware buffer, you can only render out image sequences.
11. Set the Resolution to 640 × 480.
12. Alpha Source set to Hardware Alpha.
13. Check Write ZDepth.
14. Click on the Render Mode section.
15. For Lighting Mode select Default Light.

16 Check Texturing.

17 Check Line Smoothing.

18 Check Full Image Resolution.

19 Check Geometry Mask. This will turn off the geometry at render time.

20 Go to Window > Rendering Editors > Render Globals.

21 Click the Maya Hardware tab.

22 Set the Quality Presets to Production Quality.

23 Go to Render > Render Sequence on the Hardware Render menu. This will render out the specified sequence. It's very important that you don't do anything while the sequence is rendering. Maya is actually taking screenshots of the buffer so if you move your mouse over it your final sequence will have unwanted extras.

24 Once the sequence is done click on Flipbook > test to playback the sequence.

Rendering Using Mental Ray

Mental Ray is a renderer that has been around for quite some time but only recently became available for use with Maya. It has proved to be so popular that in Maya 5 it is fully integrated into the program. Mental Ray is a superior photo-realistic renderer that excels at rendering caustics and global illumination effects. Be forewarned: the quality when using Mental Ray can be exceptional but the rendering times can increase significantly.

1 Open your three-point lighting scene, threeLighting.

2 Adjust the camera angle to look down at the sphere.

3 Hide the fill and back lights. For this tutorial, we want to see what Mental Ray can do on its own.

4 Open Window > Rendering Editors > Render Globals.

5 For Render Using, select Mental Ray.

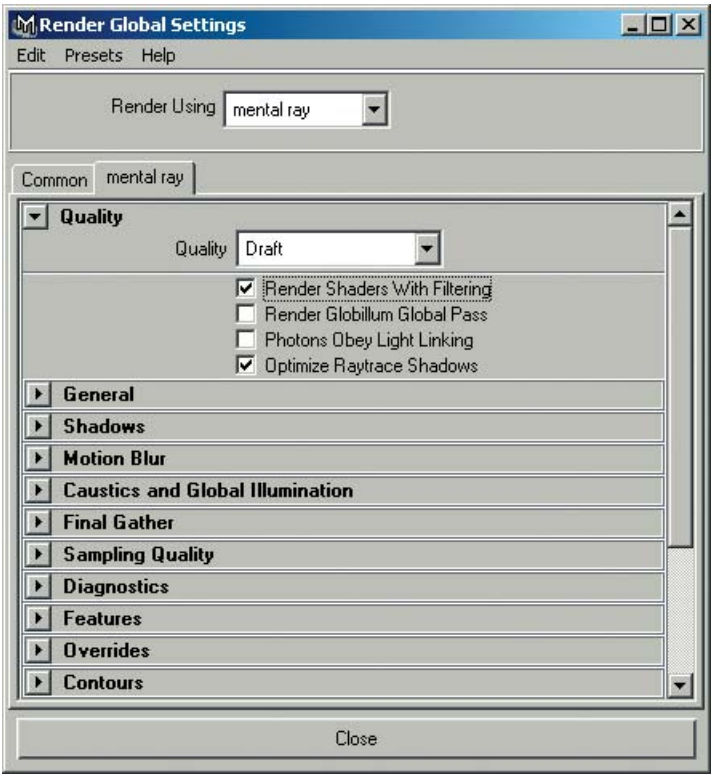


Figure 7.6 Mental Ray globals.

6 Click on the Mental Ray tab.

7 Open Window > Rendering Editors > Render Globals.

8 For Render Using, select Mental Ray.

9 Click on the Mental Ray tab.

10 Expand the Quality tab.

11 Choose Custom Quality.

12 Expand the General Tab.

13 Check the Ray Tracing box.

14 Set Max Reflection Rays to 10.

15 Set Max Refraction Rays to 10.

16 Set Max Ray Depth to 20.

17 Expand the Caustics and Global Illumination section.

18 Check the Global Illumination box.

19 Set Max Reflection Photons to 10.

20 Set Max Refraction Photons to 5.

21 Set Max Photo Depth to 5.

22 Check the Photon Map Rebuild button.

23 Expand the Final Gather button and check the Final Gather box. Close the Render Globals window.

24 Select the sphere and click on the Transform tab in the Attribute Editor.

25 Expand the Mental Ray section.

26 Uncheck the Derive From Maya box.

27 Change Caustic to Cast+Receive.

28 Change Globillum to Cast+Receive.

29 Select the box mesh and click on the Transform tab in the Attribute Editor.

30 Expand the Mental Ray section.

31 Uncheck the Derive From Maya box.

32 Change Shadow to Yes.

33 Change Caustic to Cast+Receive.

34 Change Globillum to Cast+Receive.

35 Open the Hypershade.

36 Create a Phong material and assign it to the sphere. Keep the default settings.

37 Create a Lambert Material and assign it to the box. Keep the default settings.

38 Select the Key light and expand the Mental Ray section in the Attribute Editor.

39 Expand the Caustic and Global Illumination section.

40 Check the Emit Photons box.

41 Change the Energy to 2500, 2500, 2500.

42 Set the Exponent to 2.

43 Set the Global Illum Photons to 10000.

44 Save the scene as mentalGlobal.

45 Render the scene. Notice how Mental Ray's global illumination gives added realism to the scene.

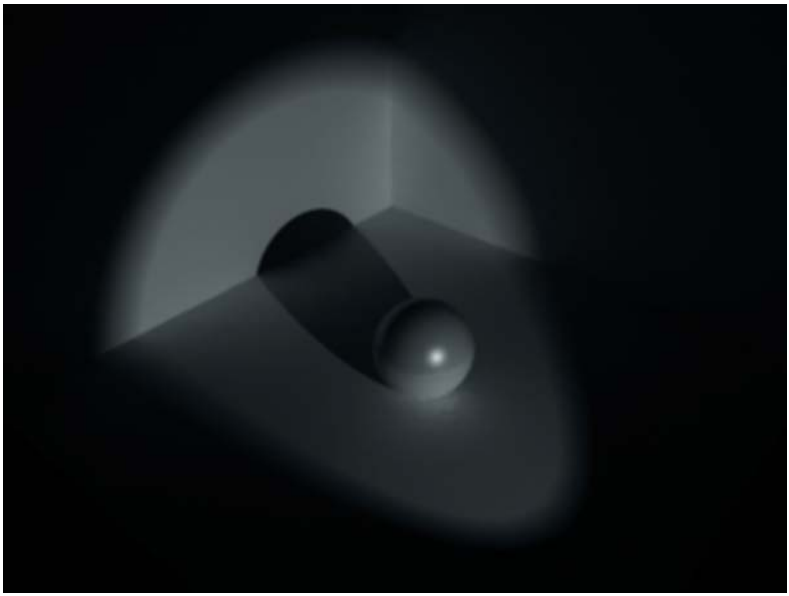


Figure 7.7 The rendered sphere.

Mental Ray also renders caustic effects. An example of caustics would be the rippling light shimmering on the bottom of a swimming pool.

1. Open the mentalGlobal scene.
2. Open Window > Rendering Editors > Render Globals.
3. For Render Using, select Mental Ray.
4. Click on the Mental Ray tab.
5. Expand the Quality tab.
6. Choose Custom Quality.
7. Expand the General Tab.
8. Check the Ray Tracing box.
9. Set Max Reflection Rays to 4.
10. Set Max Refraction Rays to 4.
11. Set Max Ray Depth to 4.
12. Expand the Caustics and Global Illumination section.
13. Check the Caustics box.
14. Change Caustic Filter Type to Cone.
15. Check the Global Illumination box.
16. Set Max Reflection Photons to 5.
17. Set Max Refraction Photons to 5.
18. Set Max Photo Depth to 7.
19. Check the Photon Map Rebuild button.
20. Expand the Final Gather button and check the Final Gather box.
21. Close the Render Global window.
22. Select the sphere and click on the Transform tab in the Attribute Editor.

23 Expand the Mental Ray section.

24 Uncheck the Derive From Maya box.

25 Change Caustic to Cast+Receive.

26 Change Globillum to Cast+Receive.

27 Select the box mesh and click on the Transform tab in the Attribute Editor.

28 Expand the Mental Ray section.

29 Uncheck the Derive From Maya box.

30 Change Shadow to Yes.

31 Change Caustic to Cast+Receive.

32 Change Globillum to Cast+Receive.

33 Open the Hypershade.

34 Create a Phong material and assign it to the sphere.

35 Expand the Common Material Attributes section.

36 Click the Transparency color box and change the values to R 26, G 160, and B 226.

37 Change the Diffuse value to .250.

38 Expand the Mental Ray section.

39 Expand the Photon Attribute section.

40 Uncheck the Derive From Maya box.

41 Press the Take Settings From Maya button. This will import the material information from the Common Attributes section.

42 Change the Refractive Index to 1.3.

43 Check the Refractions box.

44 Check the Absorbs box.

45 Create a Lambert material and assign it to the box.

46 Change the Diffuse value to .9.

47 Select the Key light and expand the Mental Ray section in the Attribute Editor.

48 Expand the Caustic and Global Illumination section.

49 Check the Emit Photons box.

50 Change the Energy to 5000, 5000, 5000.

51 Set the Exponent to 2.

52 Caustic Photons to 15000.

53 Set the Global Illum Photons to 6000.

54 Save the scene as mentalCaustics.

55 Render the scene to see the caustic effects.

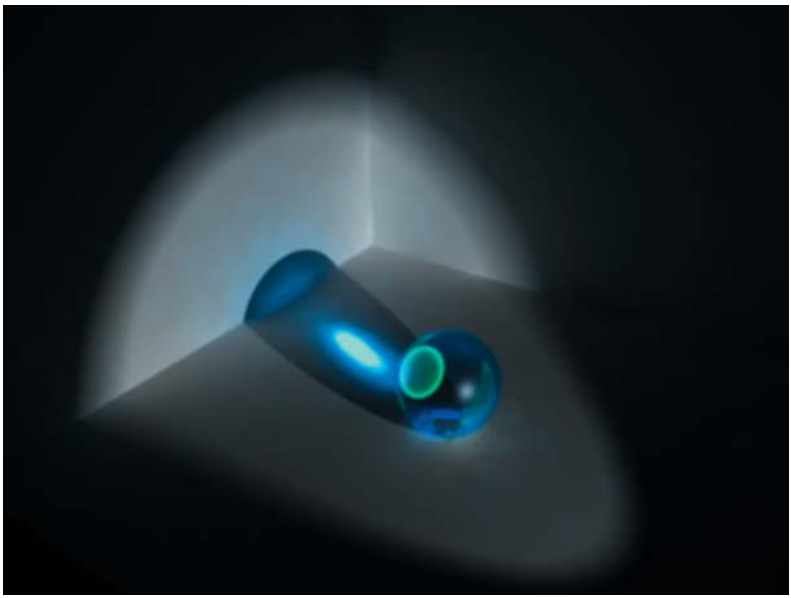


Figure 7.8 The sphere rendered using caustics.

Rendering Using Maya Vector

The Maya Vector rendering engine creates images with a cartoon-like quality. You control options like line edge width and internal shading to output line art or cartoon-like images. Maya Vector can also render directly into vector format for use on the web or within a vector-based art program.

Below are some things to be aware of when building a scene for use with Maya Vector rendering.

Bump maps will not render using Maya Vector so any shading nodes using bump maps will need to be rebuilt.

Figure 7.9 The fallingLamp animation rendered using Maya Vector.

Point lights are the only type of light supported.

Image planes and particles are not supported.

Cameras

Understanding cameras is crucial in getting good images from Maya. Thankfully Maya's cameras work on the same principles as real-world ones. You have three options when creating a camera.

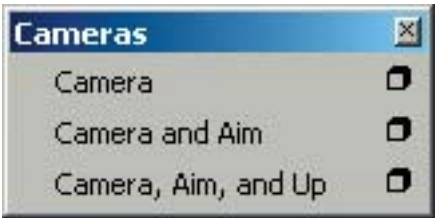


Figure 7.10 Camera creation.

Camera – Places just the camera in your scene.

Camera and Aim – Places a camera with the lens constrained to always look at a specific node.

Camera, Aim, and Up – Places an up constraint in addition to the aim.

1. Start a new scene in Maya.
2. Set the animation length 60 frames.
3. Go to Create > Camera > Camera and Aim.
4. Go to Create > NURBS Primitives > Sphere.
5. Go to frame 1.
6. Open the Channel Editor.
7. Change Translate X to –10.
8. Change Translate Z to –10.
9. Press the s key to keyframe all attributes for the sphere.
10. Go to frame 30.

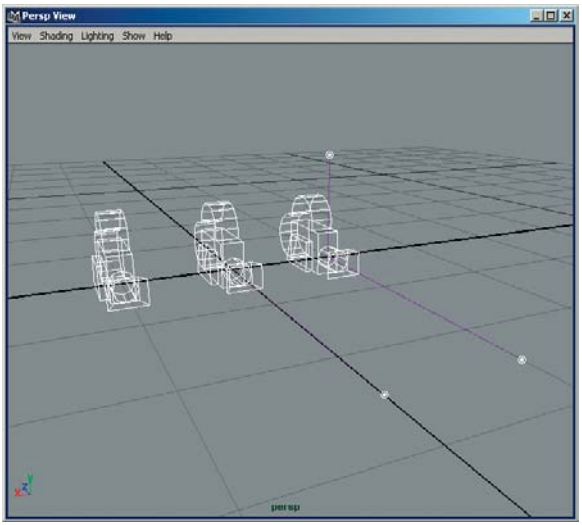


Figure 7.11 The three camera types.

11 Change Translate X to 0.

12 Change Translate Y to 10.

13 Press the s key to keyframe all attributes for the sphere.

14 Go to frame 60.

15 Change Translate X to 10.

16 Change Translate Y to 0.

17 Press the s key to keyframe all attributes for the sphere.

18 Go back to frame 1.

19 Select the aim constraint.

20 Snap move it to the sphere.

21 Shift select the sphere.

22 Parent the aim to sphere.

Play the animation. The aim constraint is now parented to the sphere and will move with the sphere during the animation. The camera is still attached to the aim constraint and will continue to follow it throughout the animation. This is a great way to create follow-shot animations. The constraints make it easier to track your camera's aim, but aside from that all cameras function the same.

1. Create a new scene.
2. Go to Create > Camera > Camera.
3. Go to Create > NURBS Primitives > Sphere.
4. In your viewport menus, select Panel > Perspective > camera1. This will change you to the camera view. This menu will list as many cameras as you have loaded in your scene.
5. While in camera view, use the Alt + mouse dolly, zoom, and tilt controls to center the sphere in the camera's view. This allows you to interactively move the camera in your scene. If you are unhappy with the moves use the [key to undo your last viewport move. The] key will redo the viewport move.
6. Open the Channel Editor.
7. Change Translate Y to 5.
8. Change Translate Z to –10.
9. Change Rotate X to –25.
10. Enter 0 for the other translation and rotation channels if needed.
11. With the camera selected, open the Attribute Editor to see the default camera values.
12. Adjusting the Focal Length changes the view without moving the objects.

It's important to remember that the Maya camera functions in the same way as a real-world camera. By simply changing your camera settings you can dramatically alter the appearance of your scene.

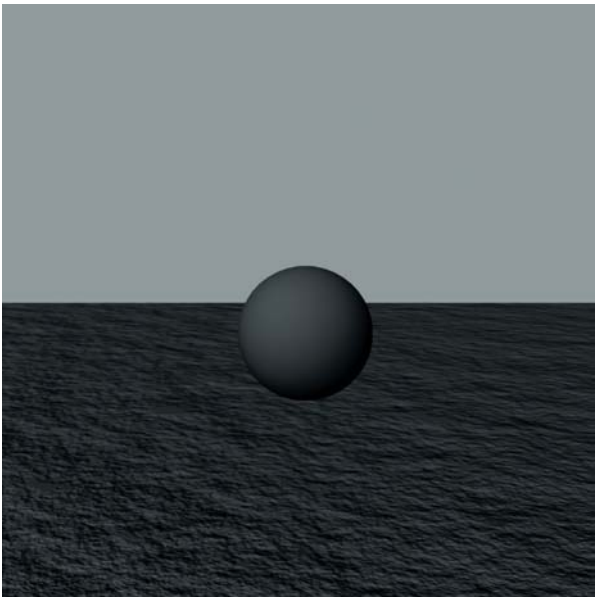


Figure 7.12 The default camera focal length of 35.

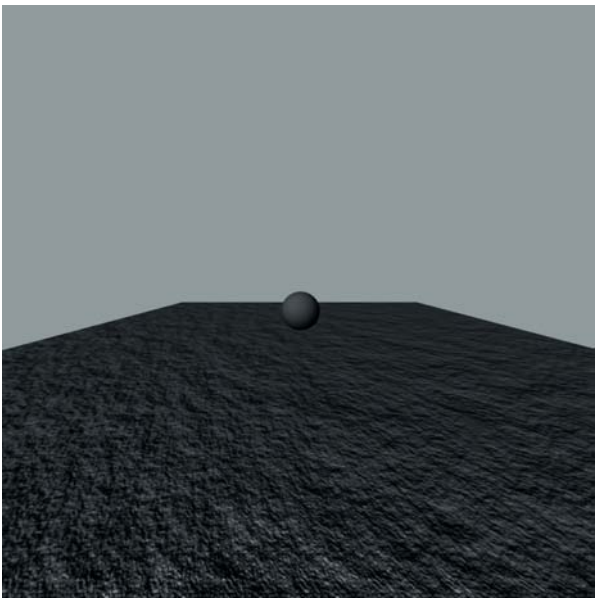


Figure 7.13 Focal length of 10.

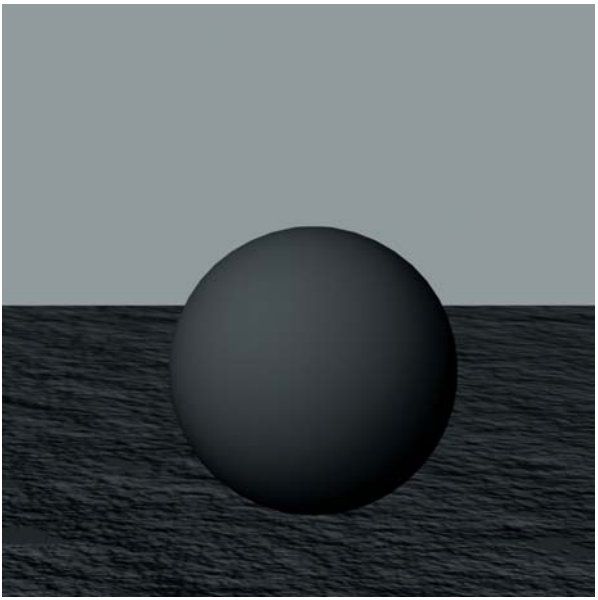


Figure 7.14 Focal length of 75.

Tip: The Display Options section displays white lines, which do not render, in the camera view allowing you to see what will and will not be included in the final rendering of your camera view. I generally check Display Resolution, Display Action, and Display Safe Title.

1. Open your outdoorLighting scene.
2. Select your camera and open the Attribute Editor.
3. Go to the Display Options section.
4. Turn on Display Resolution, Display Action, and Display Safe Title so you can make sure you are working within the proper frame areas.
5. Go to the Camera Attributes Section adjust the Clipping Planes if you cannot see any pieces of your geometry that should be there. When working with either a very small scene or with terrain chunks spaced extremely far apart, geometry might fall outside of the visible area known as a Clipping Plane.

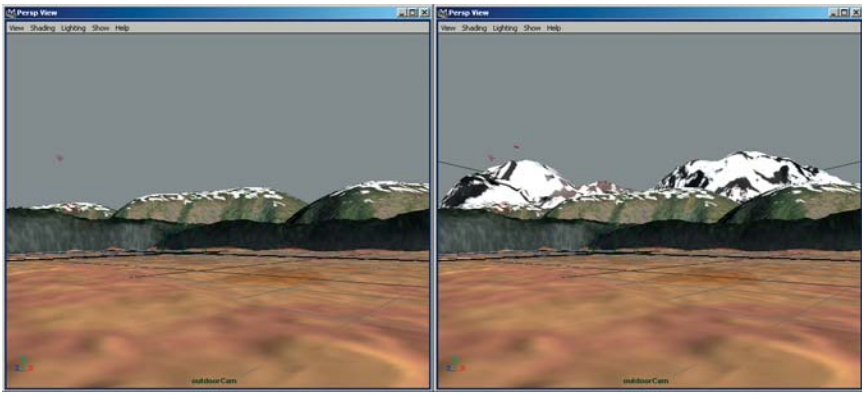


Figure 7.15 Terrain before and after adjusting the Clipping Plane.

Figure 7.16 Camera Environment tab.

6. Go to the Environment Section in the Attribute Editor.
7. Click on the Create button next to Image Plane.
8. Expand the Placement rollout section.
9. If needed, change the Depth for the Image Plane. The Depth indicates how far from the camera the Image Plane will be located. You can create multiple Image Planes and stack them to get unique background. Just remember to change the Depth of each Image Plane so they will render in the proper order.
10. Expand the Image Plane Attributes rollout section.
11. Change Type to Texture. This unlocks the Texture bar directly below.
12. Click on the checkered box next to Texture.
13. In the Create Render Node, expand the Environment Textures section.
14. Click on Env Sky. The Env Sky (or environment sky) procedurally creates atmospheric conditions.

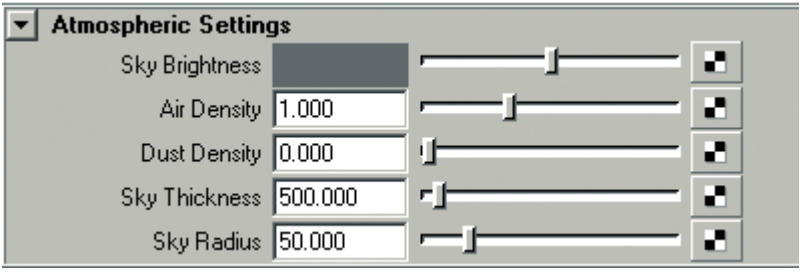


Figure 7.17 Env Sky attributes.

15 In the Sun Attributes section change the Elevation to 80. This will put the sun almost directly overhead.

16 In the Atmospheric Settings section change the Sky Thickness to 500.

17 In the Cloud Attributes section check Use Texture.

18 Click the checkered box next to Cloud Texture.

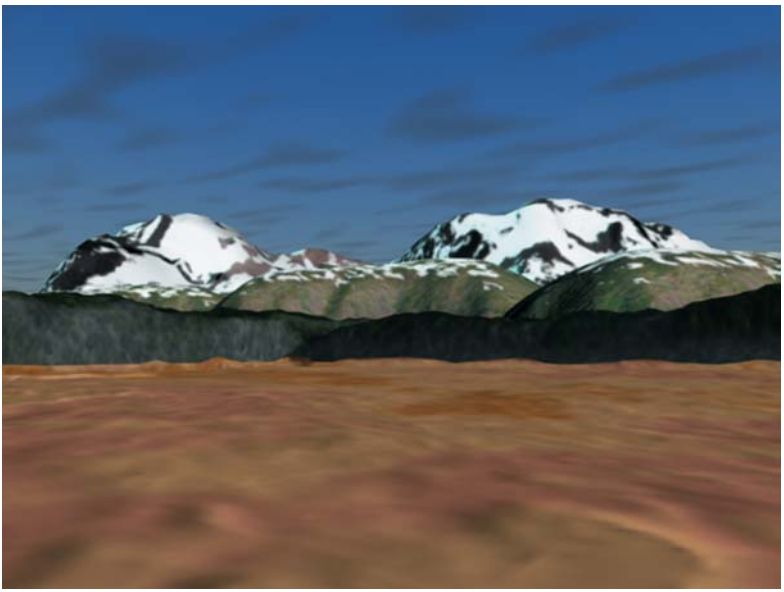


Figure 7.18 Added sky.

19 In the Create Render Node window select Fractal from the 2D textures section.

20 Expand the Fractal Attributes section.

21 Change Frequency Ratio to .917.

22 Expand the UV Coordinates section and click on the Inputs box.

23 Change the Coverage to 1.5 for U and 1.5 for V.

24 Change Repeat UV to 1.5 for U and 3 for V.

25 Go back to the Env Sky node in the Attribute Editor.

26 Click on the Cloud Attributes section.

27 Change the Altitude to .09.

28 Save your scene.

Other Rendering Options

Most of the options in the Rendering menu are accessible elsewhere. The Lighting/Shading drop-down menu tools can also be manipulated through the Hypershade and through Window > Relationship Editor.

1 Start a new scene in Maya.

2 Create a 40 × 40 NURBS plane.

3 Select Texturing > 3D Paint Tool > ❐.

4 Try painting your initials on the plane. A red X will appear and you will see the error message in the Command Feedback line that says // Warning: Some surfaces have no file texture assigned to the current attribute. // The error message appeared because we need to actually set up an image to paint with first.

5 Create a Lambert material in the Hypershade and assign it to the plane.

6 In the Attribute Editor for the 3D Paint Tool, expand the File Texture section.

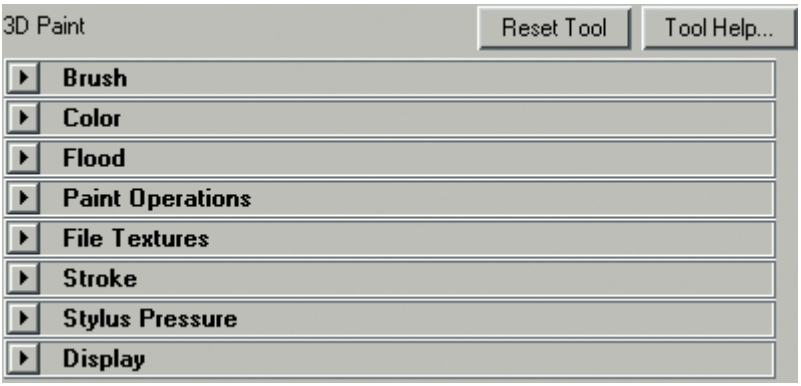


Figure 7.19 3D Paint tool.

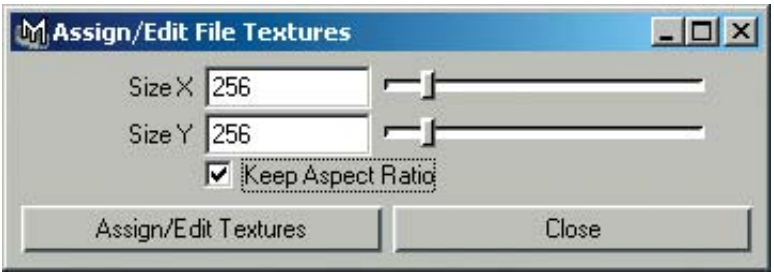


Figure 7.20 The Assign Textures prompt.

7. Set the Attribute to Paint to Color.
8. Set the Image Format to Targa (tga).
9. Click on Assign/Edit Textures. A window will pop up prompting you for the texture dimensions.
10. Set the X size to 256.
11. Set the Y size to 256.
12. Click Assign Texture.
13. Now paint your initials on the plane. Black letters appear; altogether not very exciting.
14. Expand the Brush section in the Attribute Editor.

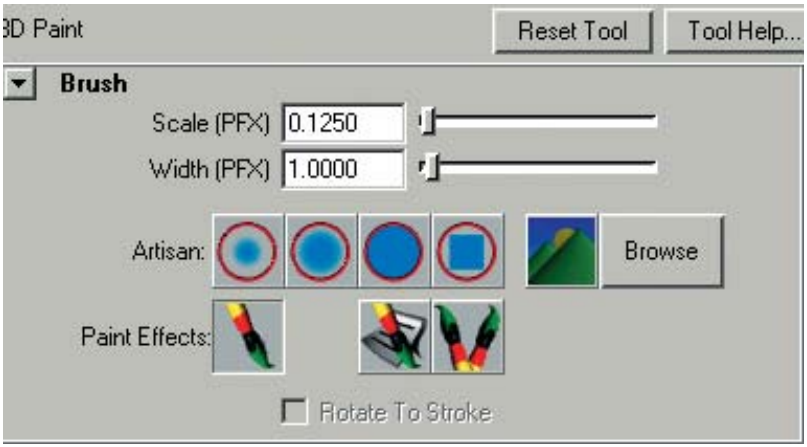


Figure 7.21 The Brush section.

15 Click on the Paint Effects Get Brush button. The Visor will appear.

16 Click on the Paint Effects tab.

17 Select the metal directory from the folder list on the left.

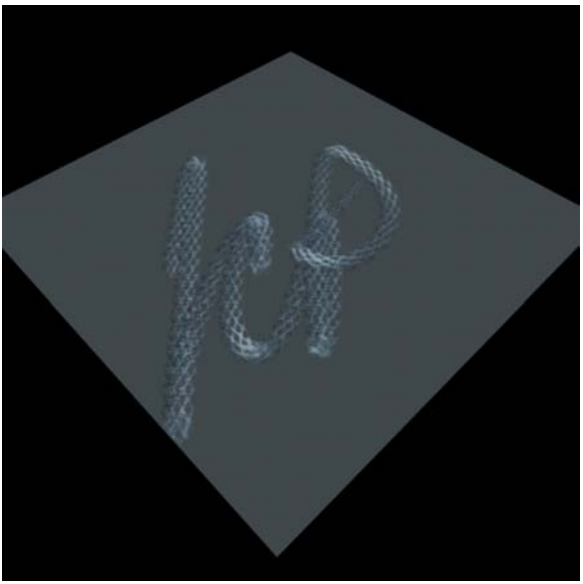


Figure 7.22 Metal initials.

18 Click on the metalweave icon on the right-hand side.

19 Paint your initials on the plane again. This time it will be a weaved metal texture.

20 Create a large sphere and place it behind the plane. If you render the scene now the sphere will be blocked from view by the plane.

21 Go to the Brush Settings in the Attribute Editor and resize the Brush Scale to 10.

22 Paint the weave metal over the entire plane.

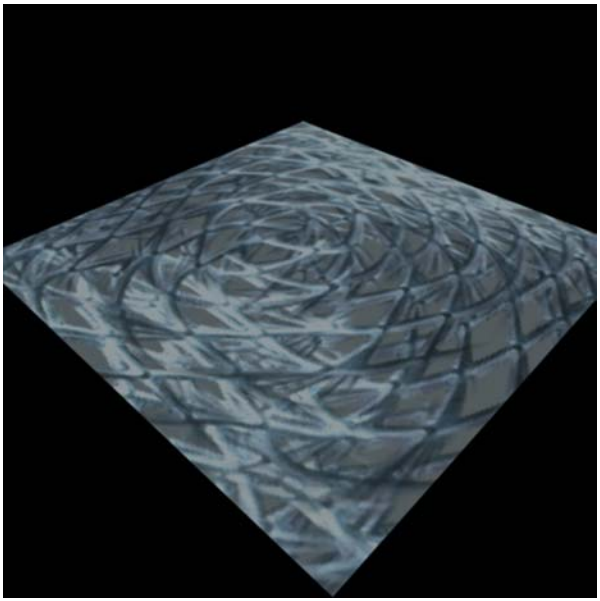


Figure 7.23 Metal plane.

23 Go to the File Textures section and change the Attribute to Paint to Transparency.

24 Click Assign/Edit Textures.

25 At the prompt, set the X and Y to 256 and click Assign.

26 Paint the entire plane a second time.

If you render the scene, the sphere will now be visible on the other side of the plane. The second painting pass you made solely affected the transparency channel. You can repeat as needed, painting a different channel each time.

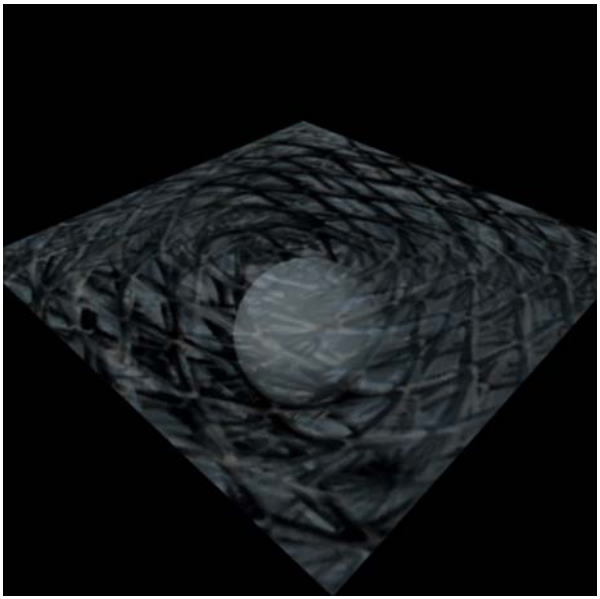
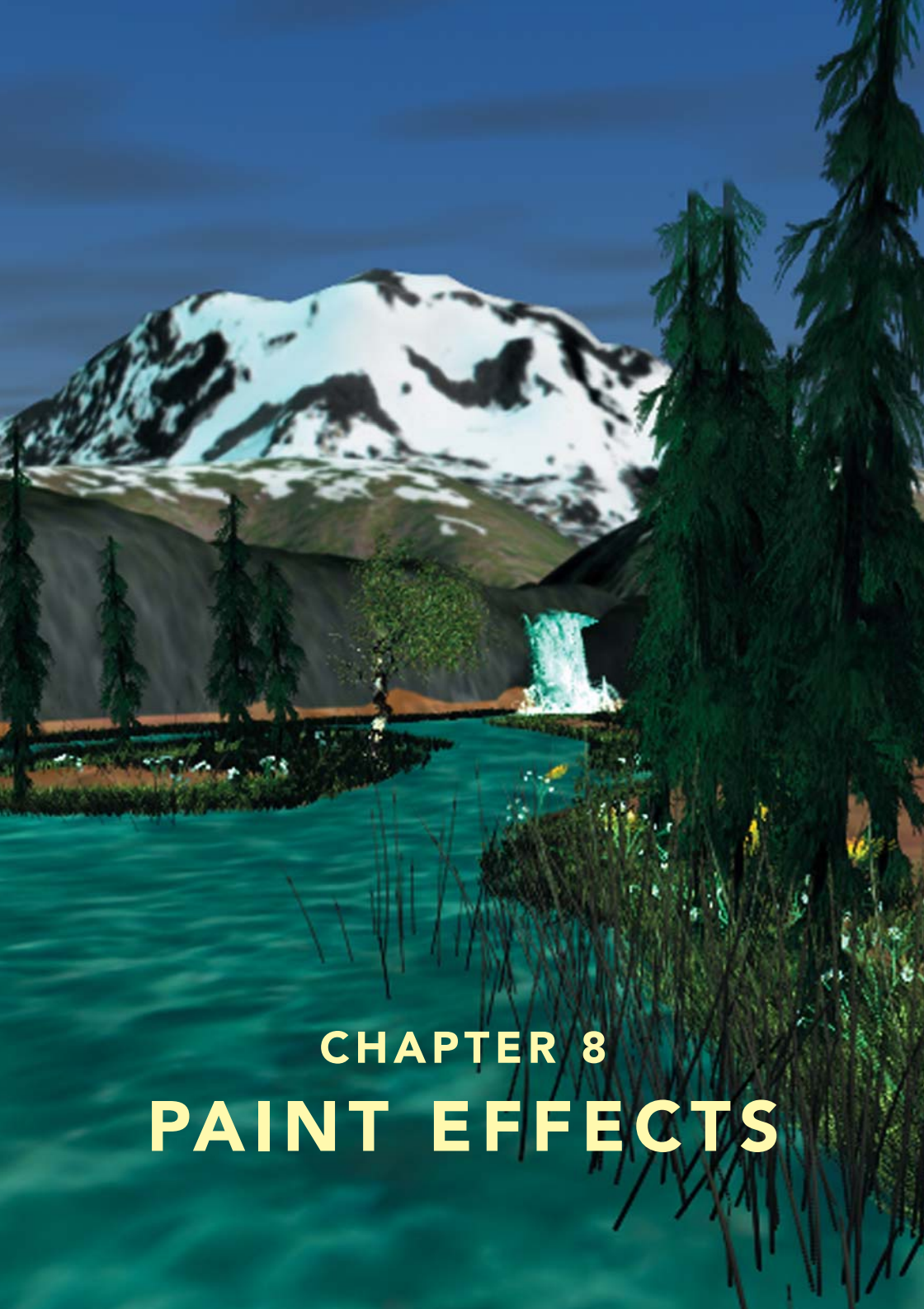


Figure 7.24 Transparent metal plane.



CHAPTER 8
PAINT EFFECTS

Maya Paint Effects is a module that allows you to paint custom effects directly in your scene. You can paint either in 2D, just like painting on a traditional canvas or you can paint directly within 3D space.

The Paint Effects Panel

Go to Window > Paint Effects to open the Paint Effects Panel. The Paint Effects Panel defaults to the perspective view, but you can switch to orthogonal views by selecting the Camera menu along the top toolbar. The Paint menu allows you to switch between working on a canvas and the current scene.

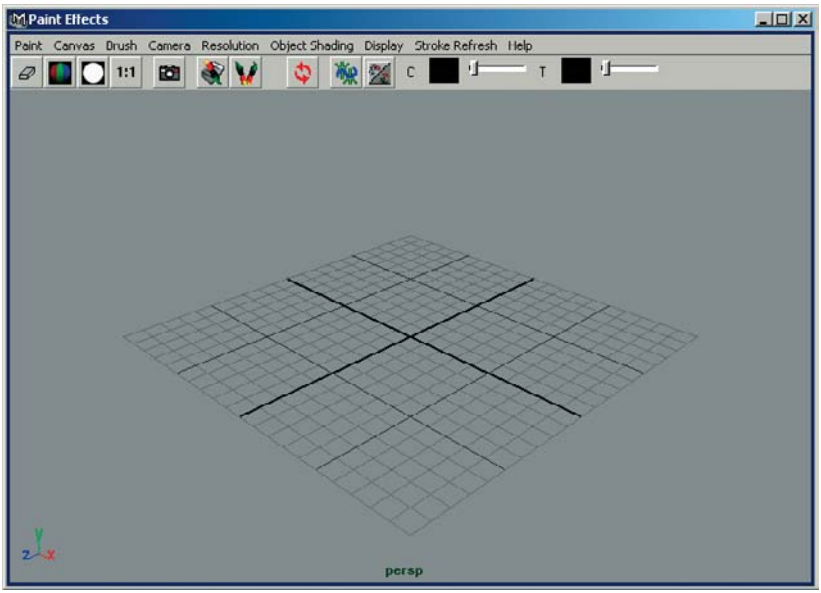


Figure 8.1 The Paint Effects Panel.

Working with Brushes

1. Start a new scene in Maya.
2. Go to Window > Paint Effects.

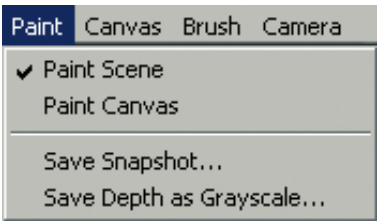


Figure 8.2 Paint menu.

3 Select Brush > Get Brush or click the Get Brush button on the toolbar. The Visor window will appear. The Visor lets you view thumbnails for things like textures, shading nodes, and character.

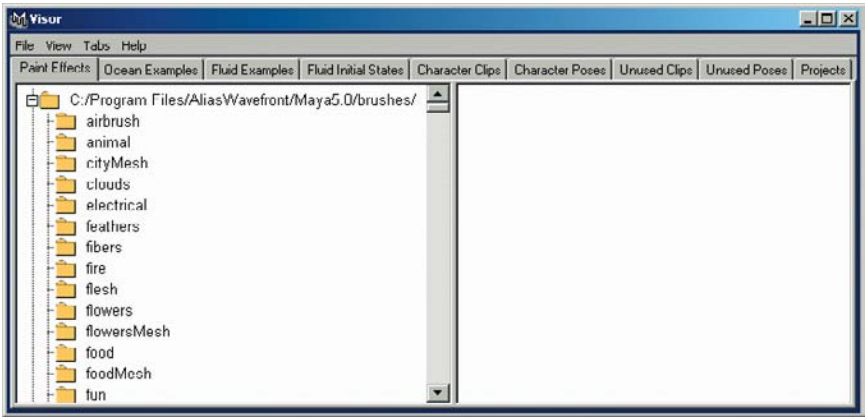


Figure 8.3 Visor.

4 Click the Paint Effects tab and select the grasses folder from the left-hand folder list. The available grass brushes will appear on the right.

5 Click the largeFlames icon.

6 Paint some squiggles in the Paint Effect panel. Some shaded lines will appear in the window as well as in your main Maya scene.

7 Render the current frame. Paint Effects often uses simple lines or points to represent Paint Effects in your scene; this helps to avoid Maya getting bogged down. Any time you render, the full effect will be visible.

8 Select Brush > Edit Template Brush or click the Edit Template Brush button on the toolbar. The Paint Effects Brush Settings window appears. This contains all of the information pertaining to the currently selected brush.

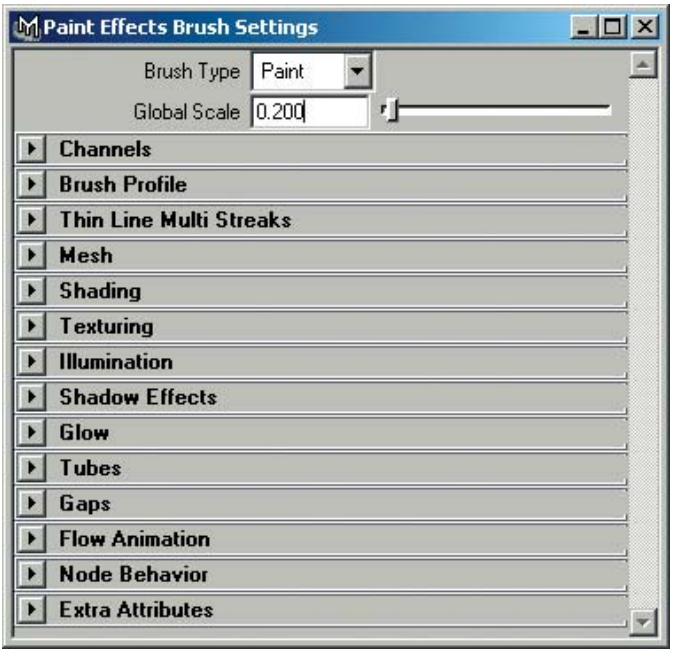


Figure 8.4 Brush Settings.

9. Change the Global Scale of the flame brush to 10.
10. Paint some more large flames in your scene. You can mix and match brush sizes.
11. Close the Paint Effects panel and click the Play animation button. The lines move slowly.
12. Render this current frame and you can see that, yes, the flames are animated.

Paint Effects can also be used to paint directly onto a NURBS surface. Maya only supports painting effects on NURBS surfaces, but you can get around this very easily.

1. Start a new scene and create a default NURBS sphere.
2. Go to the Rendering menu set.

3. Select the sphere and Go to Paint Effects > Make Paintable.
4. If it is not currently checked, select Paint Effects > Paint on Paintable Objects.
5. Go to Paint Effects > Get Brush. For this exercise, we will be working directly in the scene.
6. Click on the hair folder and select hairThickBlond.
7. In the perspective view, paint some lines on the sphere. Notice how the curve follows the sphere.

Figure 8.5 Hairy ball.

8. Select the sphere and open its Shape node tab in the Attribute Editor.
9. Expand the Render Stats section and uncheck Primary Visibility.
10. Render the scene again. The sphere is no longer visible.

Figure 8.6 Hair.

Using this method, you can easily create paint effects to match any object you would like by building an underlying NURBS template. If you need the paint effect to move with another object, simply group the paint nodes together and parent the group to the new object.

Mesh Brushes

New to Maya 5 are Mesh Brushes and the ability to convert a brush into polygons. Mesh brushes render with particles rather than the standard brush stamp. This makes for an even more realistic rendering. Converting a brush to polygons allows you to then edit in scene as you would any other geometry.

1. Create a new scene.
2. Go to Paint Effects > Get Brush. For this exercise, we will be working directly in the scene.

3. In the Visor, select the grasses folder and click the grassWindWide icon.
4. Go to Paint Effects > Template Brush Settings and change the Global Scale to 2.
5. Paint a simple grass curve.
6. Press Play and you can see that the grass Paint Effect is animated.
7. Select the strokeGrassWindWide node in the Outliner. Make sure you select the stroke and not the curve.
8. Go to Modify > Convert > Paint Effects to Polygons.
9. Select and hide strokeGrassWindWide.
10. Press Play and you can see that the new polygonal grass animates as well. It will continue to animate with the grass effect until the History is deleted.

The curve you draw as you create an image with Paint Effects is known as the stroke. Any object that sprouts from the stroke is a Tube.

1. Create a new scene in Maya.
2. Set the animation to 180 frames.

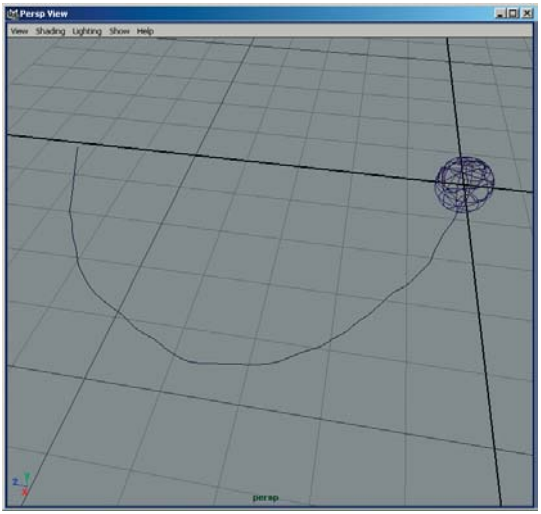


Figure 8.7 Setting the scene.

3. Create a NURBS sphere.
4. Go to Paint Effects > Get Brush. For this exercise, we will be working directly in the scene.
5. In the Visor, select the glows folder and click the laserGlow icon.
6. Starting from within the sphere, paint a simple arc.
7. Select the sphere and go to Paint Effects > Make Paintable.
8. Go to Paint Effects > Get Brush. In the Visor, select the fire folder and click the largeFlame icon.
9. Paint a single flame curve around the top of the sphere.
10. Go to frame 1.

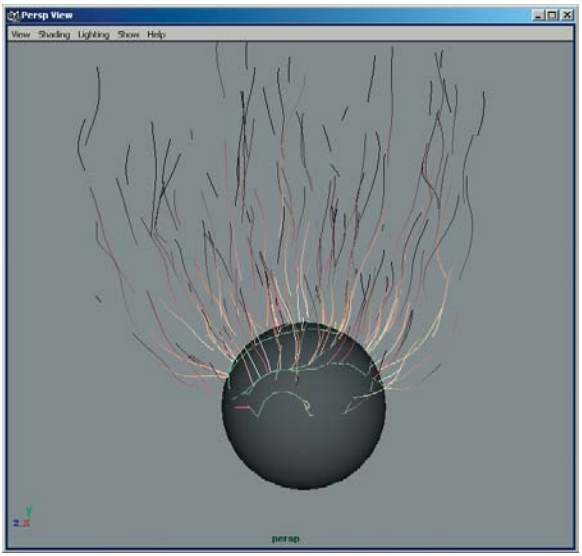


Figure 8.8 Adding the flame.

11. Select the laserGlow stroke and open it in the Attribute Editor.
12. Click the shapenode tab and expand the End Bounds section.
13. Set the Min Clip to 1, RMB click on it and select Set Key from the marking menu.

14 Go to frame 60.

15 Set the Min Clip to 0, RMB click on it and select Set Key from the marking menu.

16 Click the laserGlow tab in the Attribute Editor and expand the Tubes section.

17 Expand the Creation section.

18 Still at frame 60, set the Length Max to .244, RMB click on it and select Set Key from the marking menu.

19 Go to frame 61, set the Length Max to 0, RMB click on it and select Set Key from the marking menu.

20 Select the largeFlame stroke and open the Attribute Editor.

21 Go to frame 1.

22 Click the largeFlames tab in the Attribute Editor and expand the Tubes section.

23 Expand the Creation section.

24 Set the Length Min to 0, RMB click on it and select Set Key from the marking menu.

25 Set the Length Max to 0, RMB click on it and select Set Key from the marking menu.

26 Go to frame 61.

27 Set the Length Min to 0, RMB click on it and select Set Key from the marking menu.

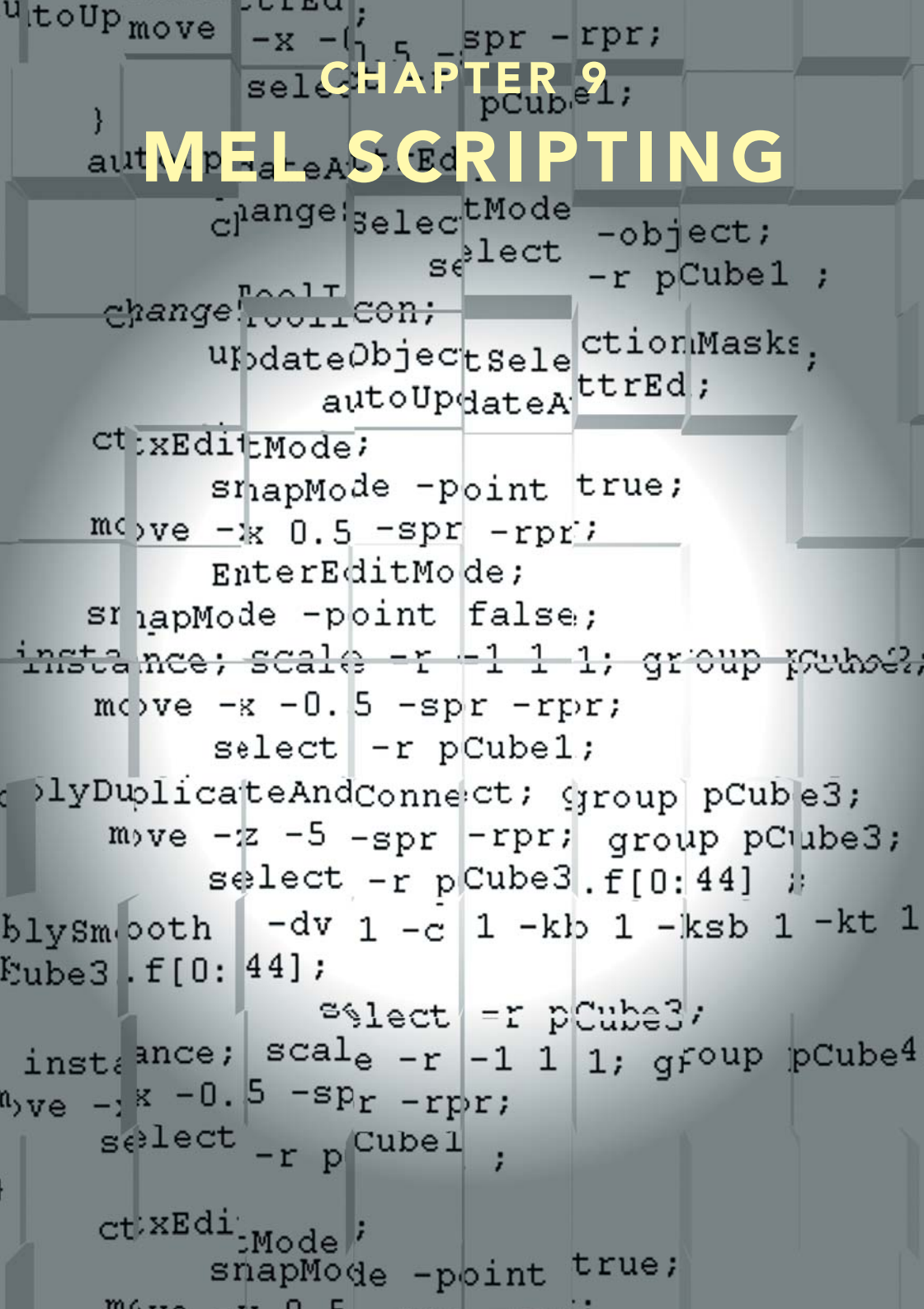
28 Set the Length Max to 0, RMB click on it and select Set Key from the marking menu.

29 Go to frame 120.

30 Set the Length Min to .020, RMB click on it and select Set Key from the marking menu.

31 Set the Length Max to .150, RMB click on it and select Set Key from the marking menu.

32 Play the animation. The fuse zips down the fuse and ignites the sphere. Using this workflow, you can create any number of Paint Effects animations.



CHAPTER 9
MEL SCRIPTING

Maya's user interface was built from the ground up using a proprietary scripting language called Maya Embedded Language (MEL for short). As you work in the Maya UI, MEL scripts are executing in the background. Alias provides access to the MEL language to allow artists to further enhance their work.

The scripting tools are split into two tools, the Command Line and the Script Editor. Everything is text based so you can copy, paste, and delete as needed.

The Command Line

The Command Line is for entering single-line MEL commands (see Figure 9.1). Simply type the command you wish to execute into the Command Line and press Enter.

Figure 9.1 The Command Line.

The Script Editor

The Script Editor is for executing advanced scripts (see Figure 9.2). Open the Script Editor by going to Window > General Editors > Script Editor or by selecting the shortcut icon on the right edge of the Command Line. The Script Editor is divided into a top history section and a bottom input section. The History section displays any commands you run and lists any error messages.

When working with the Script Editor it is important to remember that the main keyboard Enter key is used to go to the next line, whereas the numeric Enter key will execute the selected script. Also, if you highlight the script before you press the numeric key, it will remain in the window. If the text is not highlighted when you press Enter, it will be cleared from the Input window.

For example, suppose you have a large number of alternating NURBS and polygonal objects in a row in your scene. If you wanted to make a copy of just the polygonal cubes, and rotate the duplicates to make a column, MEL scripting would be the best way to achieve this.

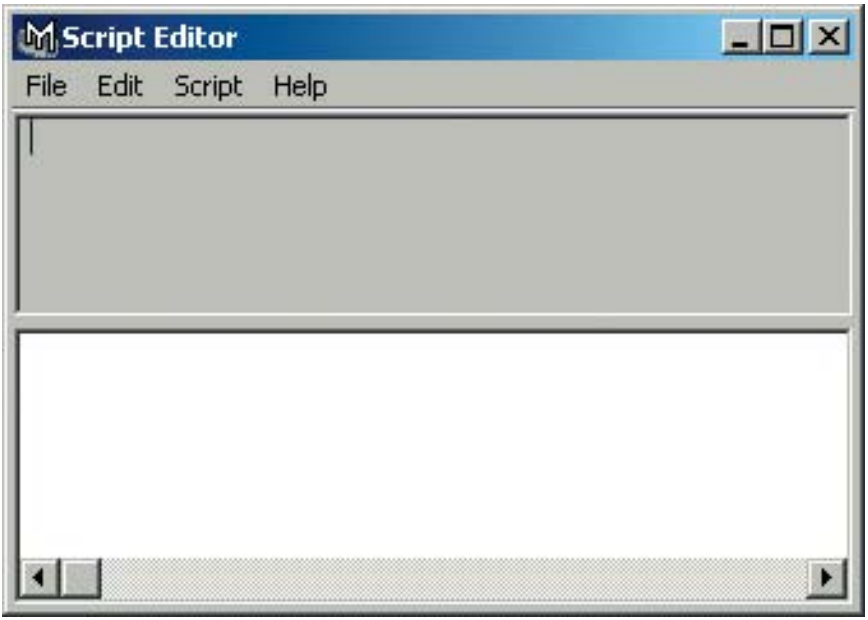


Figure 9.2 The Script Editor.

1. Open the Script Editor.
2. Type the following in the bottom Input Window.

```
select -r `listTransforms "-type mesh"`;
group; xform -os -piv 0 0 0;
select group1;
rotate -r 0 90 0;
```

3. Click and drag to highlight the text.
4. Press the Enter key on the numeric keypad.
5. The polygonal objects will rotate under a new group.

Working with shelves is a very easy way to access your tools. Highlight the script you created and using the MMB drag it up to a shelf. An icon will be created. You can simply press this button whenever you need to run the script.

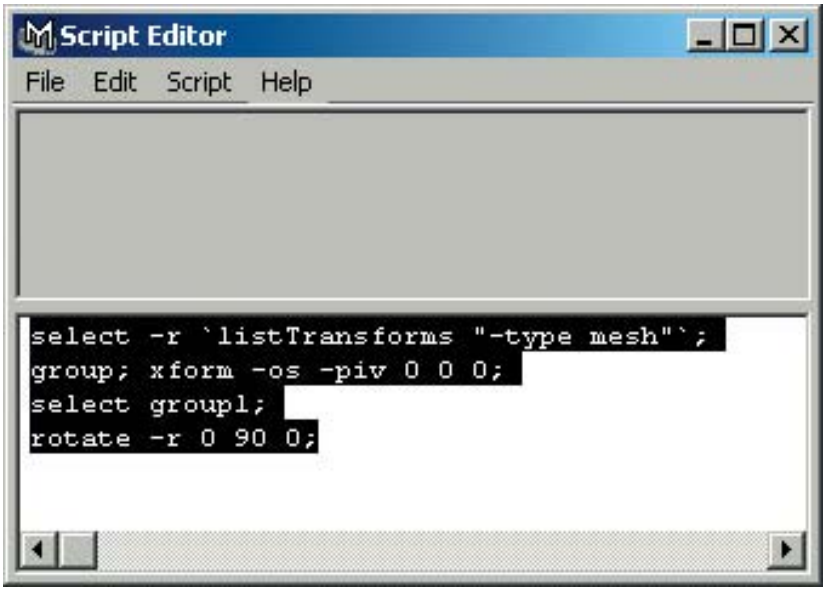


Figure 9.3 Selected text in the Script Editor.

Copy the following text into the Script Editor and execute it.

```
loadNewShelf “shelf_General.mel”;
loadNewShelf “shelf_Curves.mel”;
loadNewShelf “shelf_Surfaces.mel”;
loadNewShelf “shelf_Polygons.mel”;
loadNewShelf “shelf_Subdivs.mel”;
loadNewShelf “shelf_Deformation.mel”;
loadNewShelf “shelf_Animation.mel”;
loadNewShelf “shelf_Dynamics.mel”;
loadNewShelf “shelf_Rendering.mel”;
loadNewShelf “shelf_Fluids.mel”;
saveAllShelves $gShelfTopLevel;
```

This will ensure you have the more useful features for the shelves loaded and it will save your shelves so they will remain when you next run Maya.

A very useful feature of the Script Editor is the Echo All Commands. This is located in the Script menu of the editor window. When enabled, everything you

do in Maya is listed in the history window of the Script Editor. Using this command, you quickly see the commands for any function. In fact, simply copying the echoed history of commands into your own scripts is often enough to create unique MEL scripts. Scripts can be saved or created in any text editor.

Here is one useful script that will help you in creating low-polygon characters. The double slashes (//) will comment out that particular line so that Maya will ignore it during execution. This allows you to enter in specific comments anywhere during the length of the script. Also, notice that there is a lot of extra space in the body of the script. Maya does not require the extra space, but it does help organize it for easier reading in case there is a problem.

```
//Half Cube
//
//
//Author: Jason Patnode
//
//Description: Creates a cube for low polygon
//mirror modeling. Creates cube, deletes half of the
//faces and positions the cube to the proper point on
//the grid. Creates a smoothed copy of these as a
//modeling aid.

{
polyCube -w 1 -h 1 -d 1 -sx 3 -sy 3 -sz 3 -ax 0 1 0
-tx 1 -ch 1;
updateComponentSelectionMasks;
autoUpdateAttrEd;
updateObjectSelectionMasks;

    {
      select -r pCube1.f[51];
        autoUpdateAttrEd;
      select -tgl pCube1.f[52];
        autoUpdateAttrEd;
      select -tgl pCube1.f[53];
```

```
        autoUpdateAttrEd;
      select -tgl pCube1.f[50];
        autoUpdateAttrEd;
      select -tgl pCube1.f[49];
        autoUpdateAttrEd;
      select -tgl pCube1.f[48];
        autoUpdateAttrEd;
      select -tgl pCube1.f[45];
        autoUpdateAttrEd;
      select -tgl pCube1.f[46];
        autoUpdateAttrEd;
      select -tgl pCube1.f[47];
        autoUpdateAttrEd;
      delete;
    }
  autoUpdateAttrEd;
      changeSelectMode -object;
        select -r pCube1;
  changeToolIcon;
      updateObjectSelectionMasks;
        autoUpdateAttrEd;
  ctxEditMode;
      snapMode -point true;
  move -x 0.5 -spr -rpr;
      EnterEditMode;
  snapMode -point false;
      instance; scale -r -1 1 1; group pCube2;
  move -x -0.5 -spr -rpr;
      select -r pCube1;
polyDuplicateAndConnect; group pCube3;
move -z -5 -spr -rpr; group pCube3;
select -r pCube3.f[0:44];
polySmooth -dv 1 -c 1 -kb 1 -ksb 1 -kt 1 -ch 1
pCube3.f[0:44];
```

```
select -r pCube3;
instance; scale -r -1 1 1; group pCube4;
move -x -0.5 -spr -rpr;
select -r pCube1;
}
```

CHAPTER 10
ADVANCED TOPICS

Maya 5 is an incredibly complex package; a person could work for a long time with the program and still not have used all of the modules or uncovered some of the very exciting hidden gems. This section contains information on often-overlooked work areas.

Body Dynamics

Body dynamics simulate real-world physics on either a rigid or soft form. A rigid body will not deform upon collision with another body; a soft body will deform.

1. Create a new scene in Maya.
2. Set the animation to 300 frames.
3. Select Dynamics from the Status Line or press the F4 shortcut.
4. Create a polygonal plane of 20 × 20 units with X and Y subdivisions of 1.
5. Create a 1 × 1 × 1 cube with 1 subdivision on each axis.
6. Duplicate the cube three times and position them according to Figure 10.1.

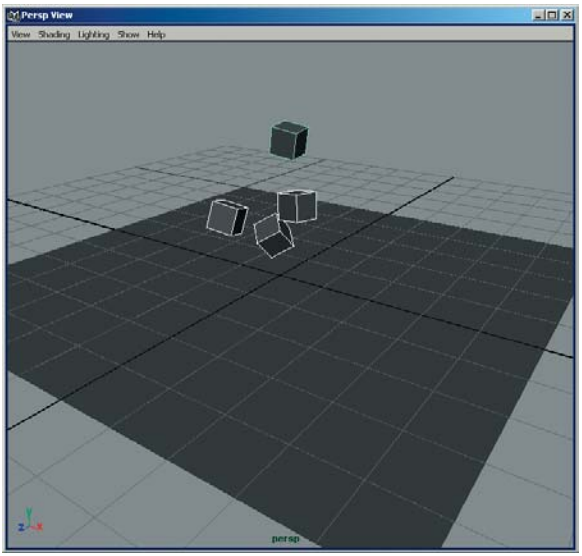


Figure 10.1 Positioning the cubes.

7. Select all of the cubes and go to go to Soft/Rigid Bodies > Create Active Rigid Body.
8. Select the plane and go to Soft/Rigid Bodies > Create Passive Rigid Body.
9. Select the cubes a second time and go to Fields > Gravity.
10. Press Play.

Body dynamics can be affected by the same fields that affect particle effects. Active rigid bodies cannot have keyframes on them but passive rigid bodies can. Using a combination of the two types you can create many different types of crash simulations.

1. Select the bottom-most cube and shift select the one directly above it.
2. Go to Soft/Rigid Bodies > Create Constraint > ❐ and choose Pin for constraint type.
3. Select the second cube and shift select the one directly above it.
4. Go to Soft/Rigid Bodies > Create Constraint > ❐ and choose Pin for constraint type.
5. Select the third cube and shift select the final cube.
6. Go to Soft/Rigid Bodies > Create Constraint > ❐ and choose Pin for constraint type.
7. Select the topmost cube and go to Soft/Rigid Bodies > Create Constraint > ❐.
8. Choose Nail for constraint type.
9. Play the animation again.

Constraints are one way to control active bodies. For example, you could create a wrecking ball with the constraints attached to the crane at one end and the ball at the other. When the simulation starts the ball will swing smashing any active bodies it encounters, but it will stay tethered to the crane.

Expressions

Expressions allow you to control keyable attributes over time. You can use math, conditions, or MEL commands to drive an expression.

1. Start a new scene.
2. Set the animation length to 60 frames.
3. Create a polygonal torus oriented on the Z axis.
4. Go to frame 1 and select the torus.
5. Open the Channel Editor and create a keyframe of 0 for Translate X.

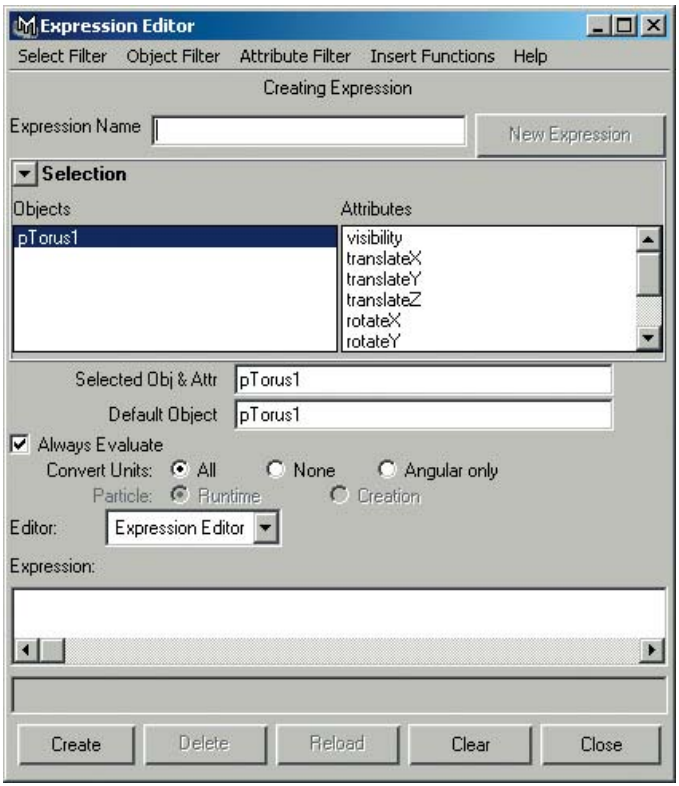


Figure 10.2 The Expression Editor.

6. Go to frame 60 and enter create a keyframe of 25 for Translate X.
7. Select the torus and go to Window > Animation Editors > Expression Editor.
8. Select the torus from the Objects list.
9. Click on rotateZ in the Attributes list.
10. The box next to Selected Obj & Attr lists pTorus1.rotateZ. This is the actual name for the selected attribute. This is what you will need to use in your expression.
11. In the Expression field type the following.

```
if (pTorus1.translateX > 0)
pTorus1.rotateZ = time*360 + 1;
```

12. Click Create.
13. Play the animation. The torus now rolls along during the animation like a tire rolling on the ground.
14. Change the animation length to 100 frames.
15. Key the TranslateX channel to 45.
16. Play the animation again. The expression automatically updates.

Light Arrays

A light array is a set of light specifically placed to create natural-looking lighting. The general theory is that many low-level lights create a softer, more diffuse and thus more realistic rendering than a few brighter ones. Generally, you want to match the color of the lights to the immediately surrounded area. Arrays can take many forms, of which this is just one example.

1. Create a new scene in Maya.
2. Place two different-sized spheres on a plane (see Figure 10.3).
3. Next build a polygonal sphere with six subdivisions along both the height and axis.

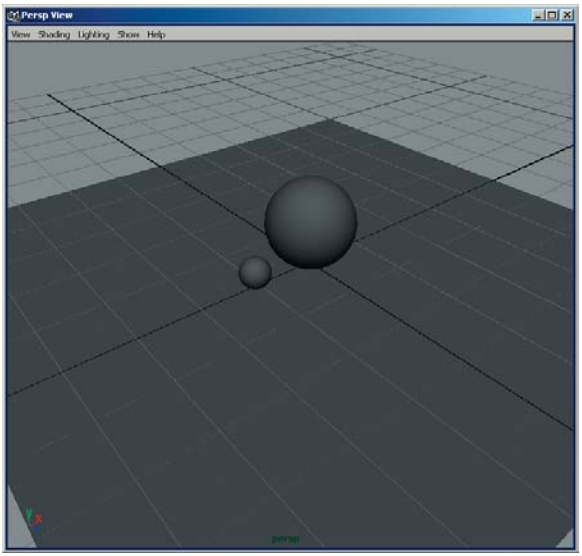


Figure 10.3 Setting the scene.

4. Delete the bottom half of the sphere.
5. Open the Attribute Editor and expand the Render Stats section.
6. Uncheck Primary Visibility. This will be your light array cage.
7. Create a point light.
8. Open the Attribute Editor.
9. Set the Intensity to .025.
10. Snap the point light to one of the vertices on the bottom edge of the sphere.
11. Duplicate this sphere five times, snapping each one to a different vertex along the bottom row.
12. Create another point light.
13. Open the Attribute Editor.
14. Set the Intensity to .125.

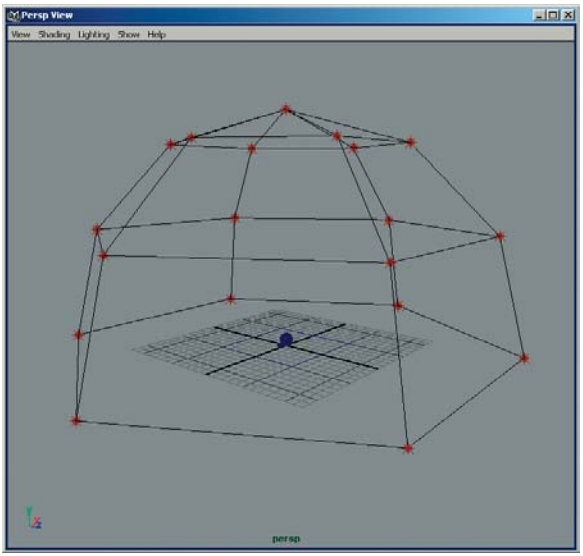


Figure 10.4 Light array with point lights.

15 Snap the point light to one of the vertices on the second row of vertices on the sphere.

16 Duplicate this sphere five times, snapping each one to a different vertex along the bottom row.

17 Create a third point light.

18 Open the Attribute Editor.

19 Set the Intensity to .250.

20 Expand the Shadow Maps section.

21 Set the Resolution to 1024.

22 Set the Dmap Filter size to 2.

23 Snap the point light to one of the vertices on the third row of vertices of the sphere.

24 Duplicate this sphere five times, snapping each one to a different vertex along the third row.

25 Create a fourth point light.

26 Open the Attribute Editor.

27 Set the Intensity to .5.

28 Expand the Shadow Maps section.

29 Set the Resolution to 1024.

30 Set the Dmap Filter size to 2.

31 Snap this light to the topmost point.

32 Render the scene.

A light array is a great way to build lighting for a skydome. It makes creating soft, natural-looking shadows very easy.

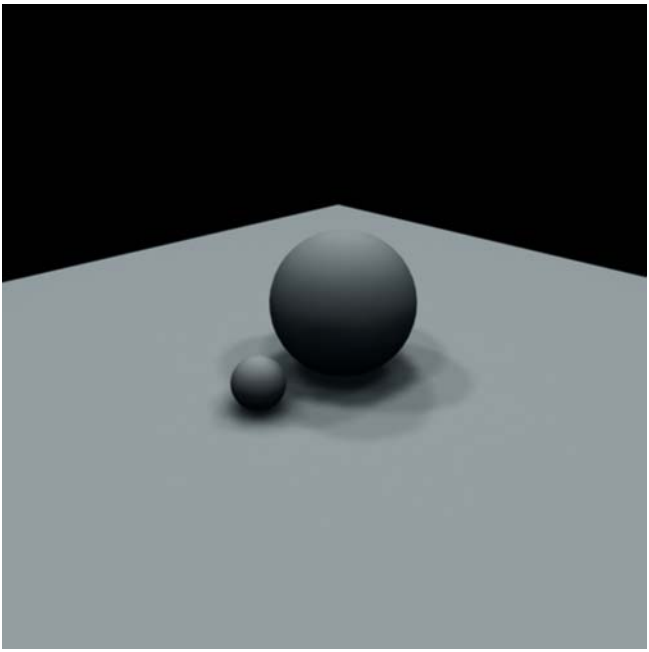


Figure 10.5 Image rendered with a light array.

Resources

http://www.alias.com/eng/index.shtml
The home page for Alias, the makers of Maya 5.0. Tons of great tutorials and forums available.

http://www.highend3d.com/maya/
Probably the most widely known Maya website aside from Alias's. This site contains tons of helpful information.

http://www.learning-maya.com/tutorials.php
Formerly known as boris3d, this is another feature-rich site. This is rich with tutorials.

http://www.ewertb.com/maya/mel/
Great MEL scripting examples.

http://avalon.viewpoint.com/
Public domain meshes and textures available for download. This is one of the oldest 3D library sites on the Internet.

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