SkillsUSA
2010 Contest Projects

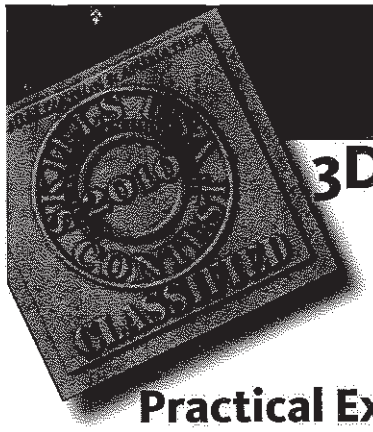
3-D Visualization and Animation

Click the “Print this Section” button above to automatically print the specifications for this contest. Make sure your printer is turned on before pressing the button.

3D Visualization and Animation Contest

The world of 3D is rapidly expanding, and career opportunities exist in a wide range of fields – including architecture, games, product and industrial design, civil engineering, and film and television animation. This contest allows students to step into a real world 3D production environment where creative output must be accomplished within specific timeframes, resources and design constraints. This is a two-person team event and includes a preliminary written exam. Contestants must produce high quality images and an animated short subject using 3D computerized images. Students are evaluated on their technical knowledge, production skills and creative abilities – including visual development and storyboarding. They will also have the opportunity to interface with and get feedback from high-profile judges with successful careers in 3D animation and visualization.

Autodesk®



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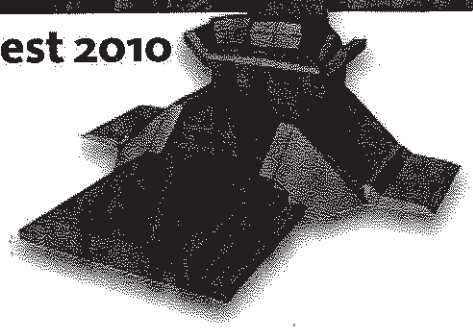


Practical Exercise: Storytelling

Background Information: Storytelling

All of you see movies, play video games, and watch television. Oftentimes, photographs and paint¬ings include no characters, yet you still understand what is happening and are moved by these images.

- In a movie, the camera may lead you through a space – focusing on objects that tell you who has been there, unveiling a portion of the story with no character in the scene, and revealing clues that may play a role later on in the movie.

- In games, you often have to discover what is happening by traveling through the environment as visual clues unveil the story.

- In an architectural visualization, the designer tells a story to the cli¬ent about what the space will look and feel like, conveying a mood.

If I walk into the room you live in, I would see things that tell me about you. That is the goal of today's challenge: tell us a story about a space. We need to be able to look at the rendered im-ages and animation and know exactly what is happening, just happened, or is about to happen.

The Task: Create an Environment that Tells a Story

These are the story concepts you may choose from:

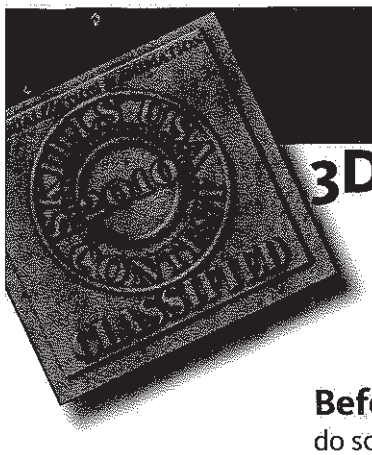
- The living room of a superhero in the year 2050 (futuristic)
- The laboratory of a mad scientist who is inventing a way to time travel (sci-fi)
- The secret hide out of an international spy (present)

(See the following pages for more in-depth story information on the three concepts)

What we want you to do is tell us a story using a room. This may sound constraining, but use your imagination. Rooms can be made from many things. They can be round or square; ceilings can be high or low; there may be steps that lead down or up. Light may play a role. Maybe you have windows, skylights or huge doors. All of these features depend on who lives there and the story you are telling.

By looking at your final images and animation, we should be able to answer these questions:

- Who lives or works here?
- What do they do?
- What is the general time period: past, present, future, fantasy?
- What type of a person is he/she?
- What just happened in this space? Are things knocked over, broken, or neat? What is the light like? Is it clean or dirty?



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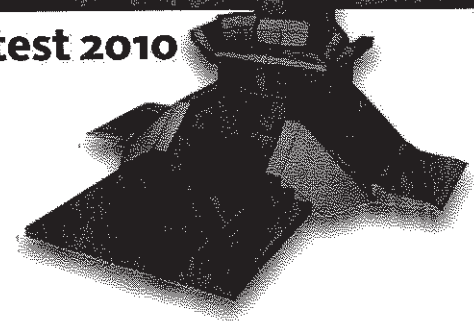

Before you begin to model in 3D, you will need to do some research and sketches so that you can tell your story the way you want the audience to see it. These are some steps that may be helpful before you start modeling.

- Make a list of all the objects you plan to place in the room.
- Lay out a floor plan of where everything will go, where the entry is, etc.
- Sketch some of the more complex objects and think about how they are made.
- Consider color and lighting that fits the mood you want to set.
- Think about your final short animated walk through, and sketch a storyboard of how the camera will move around the room and what you want the viewer to see.

Parameters for the Project: IMPORTANT!

- The room size is **15 x 20 feet (300 square feet)**
- Maximum top to bottom height of **20 feet.**
- The room can be any shape, but you must stay within this square footage. You may make it small¬er, but no larger. It may step down or up slightly, but may not be a two-story space.
- You may include any number of openings. While the outside may be visible through windows and doors, all the action must take place within the space. Be clever with how you use the "outside" space if you choose to incorporate it.
- You may use sound effects if you think that will enhance the storytelling.

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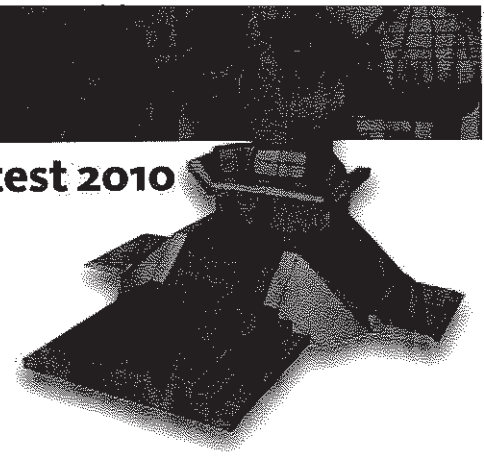

The Requirements

REQUIRED:

- At least one opening in the room
- General lighting and mood lighting
- A minimum of **three (3)** things must animate
- A minimum of **one (1)** use of "effects"
- The scene must include interesting use of textures

You may NOT use or include:

- A portrait or photograph of the person who lives here
- Characters of any type, human or animal
- Music

Work will be checked off on this Timeline:

1. Concept statement, Work Breakdown and Storyboard due at **10:00am**
2. Compositional Block in and first lighting pass due at **1:00pm**
3. Modeling and texturing complete **3:00pm**
4. Animation and Lighting Complete **4:00pm**
5. Rendering Complete **5:00pm**

Final Work to Turned in for Project:
ALL FILES DUE ON the USB drives (provided) AT 5:00PM CST

- Title and Concept Statement (3 sentences, the TV Guide version.) Use template
- Team Work Breakdown (Who will do what?) Use template provided.
- Storyboard/ Use template provided
- Floor Plan/ Use template provided
- Work in Progress renders (640x480 jpg) in a folder titled **"WIP"**
  - 3 Composition Block-ins with lighting, no textures jpg (see example)
  - 2 Wireframe renders jpg (see example)
- 10 still renders including close up and distance showing the room and details (640 x480 jpg) in a folder titled **"Shots"**
- Eye level Fly through/Walk through of the space telling the story (showing us the details)
  - 30 to 60-second rendered animation; 640x480 AVI file or Quick Time
  - Include Title page withTeam number
  - Include Credit Page withTeam number

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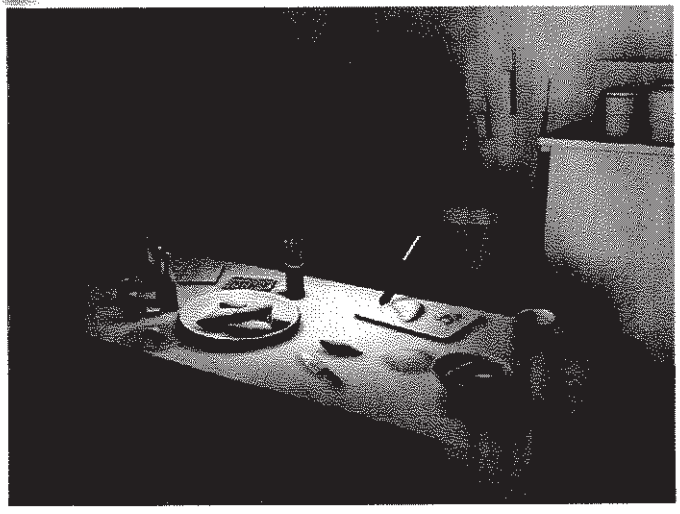
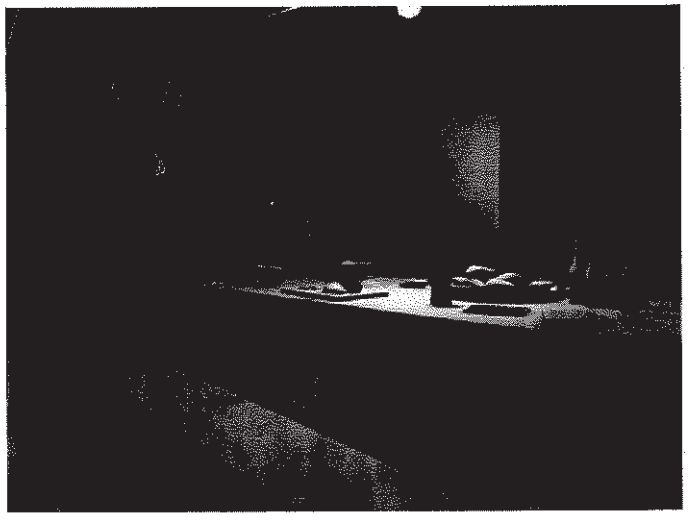
Block in examples



Composition Block in shots with lighting



Wireframe

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Character Profiles

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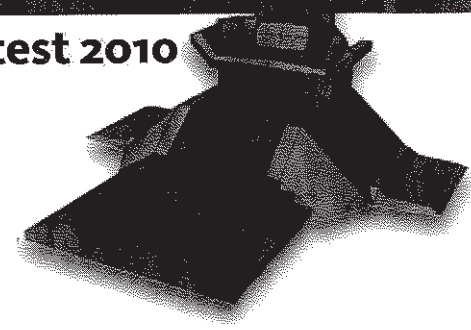

Title and Concept

Team Number: _____

Project Title: _____

Superhero ☐

Mad Scientist ☐

Spy ☐

Concept Statement:

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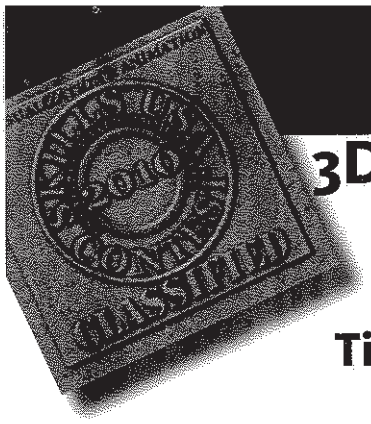

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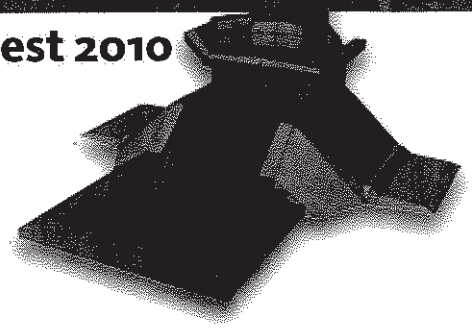

Title and Concept

Team Number: _____

Project Title: _____

Superhero ☐

Mad Scientist ☐

Spy ☐

Concept Statement:

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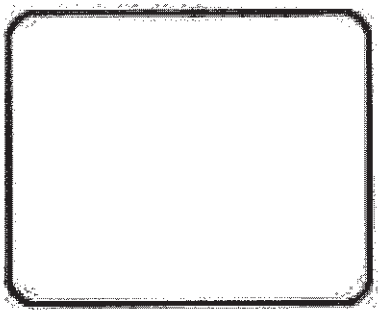
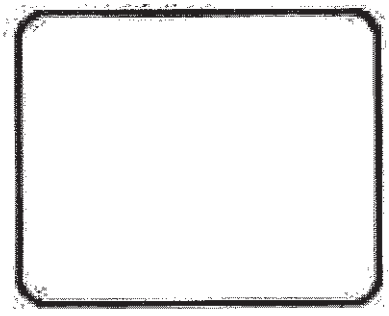
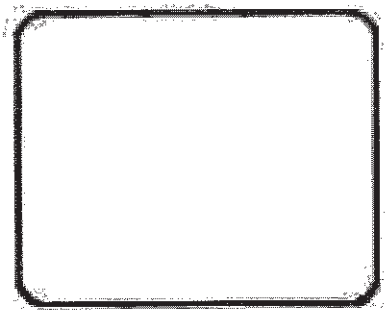
Team Number: _____

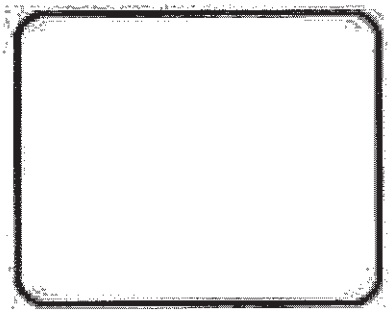
Storyboard

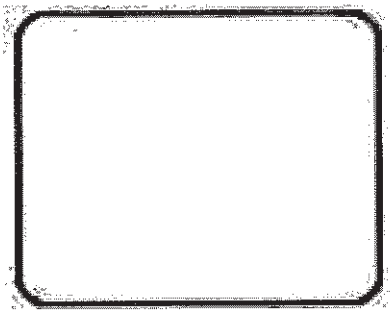
Project Title: _____

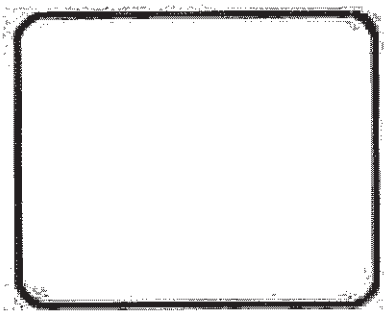


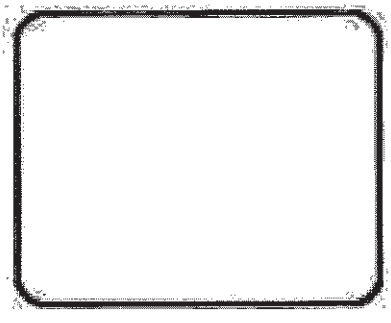


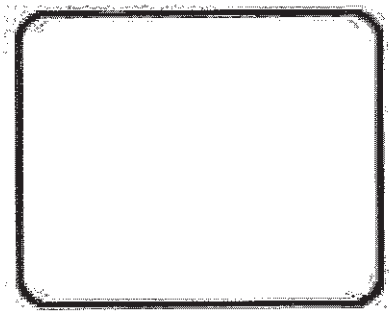


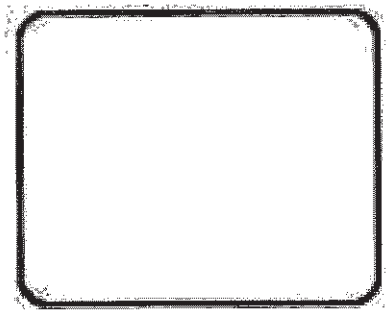








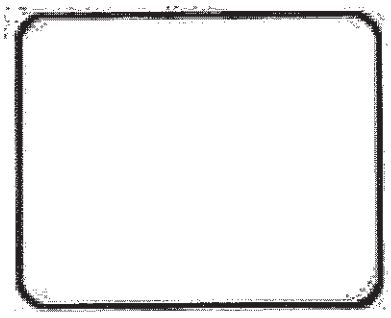




Team Number: _____

Storyboard

Project Title: _____



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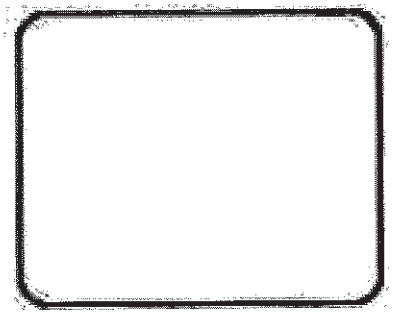

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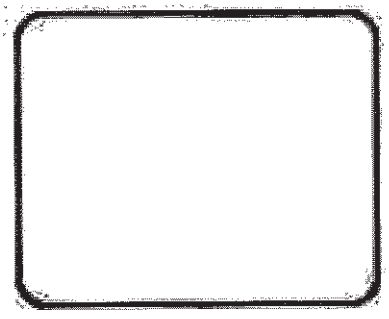

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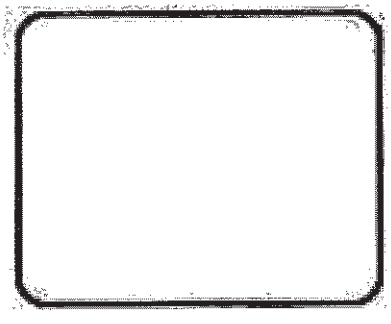

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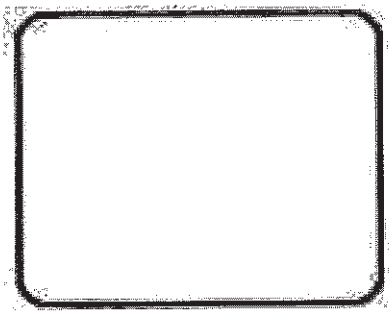

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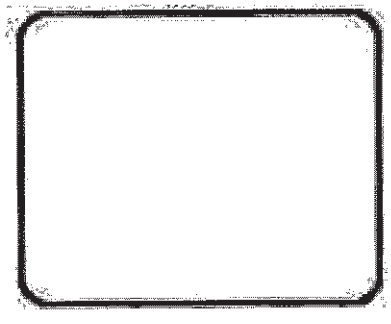

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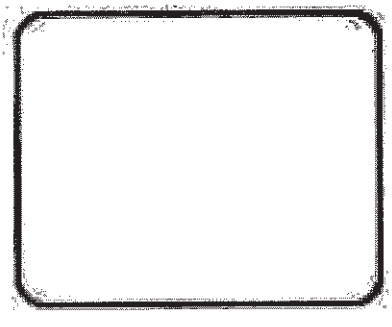

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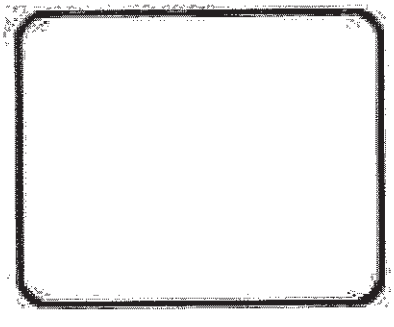

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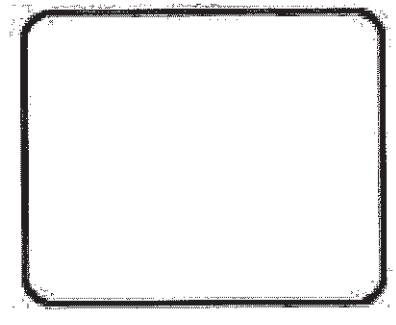

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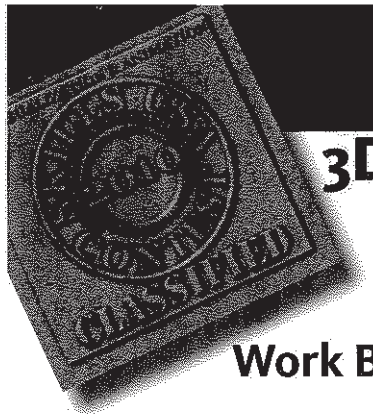

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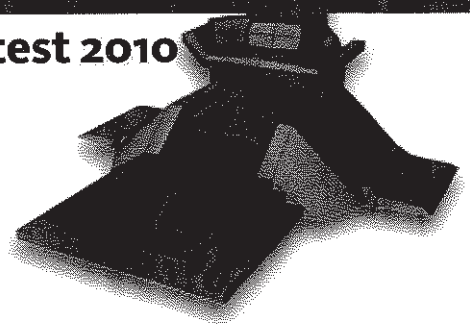
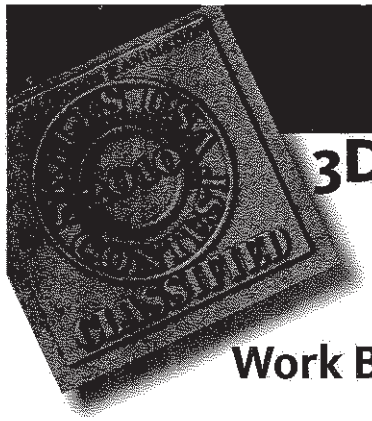


Work Breakdown by Team Members

Team Number: _____

Project Title: _____

	Team Member 1	Team Member 2
Storyboard		
Modeling		
Texturing		
Lighting		
Rigging		
Animation		
Cameras		
Rendering		
Presentation		



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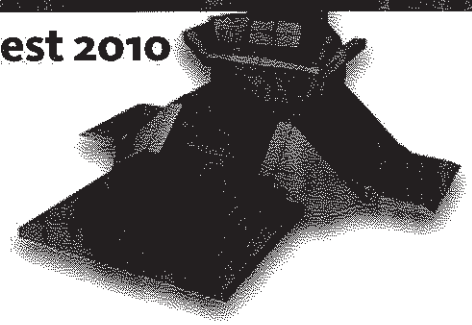

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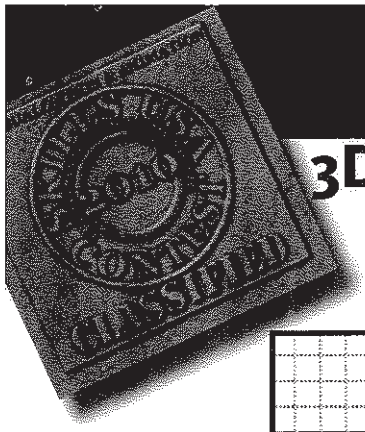
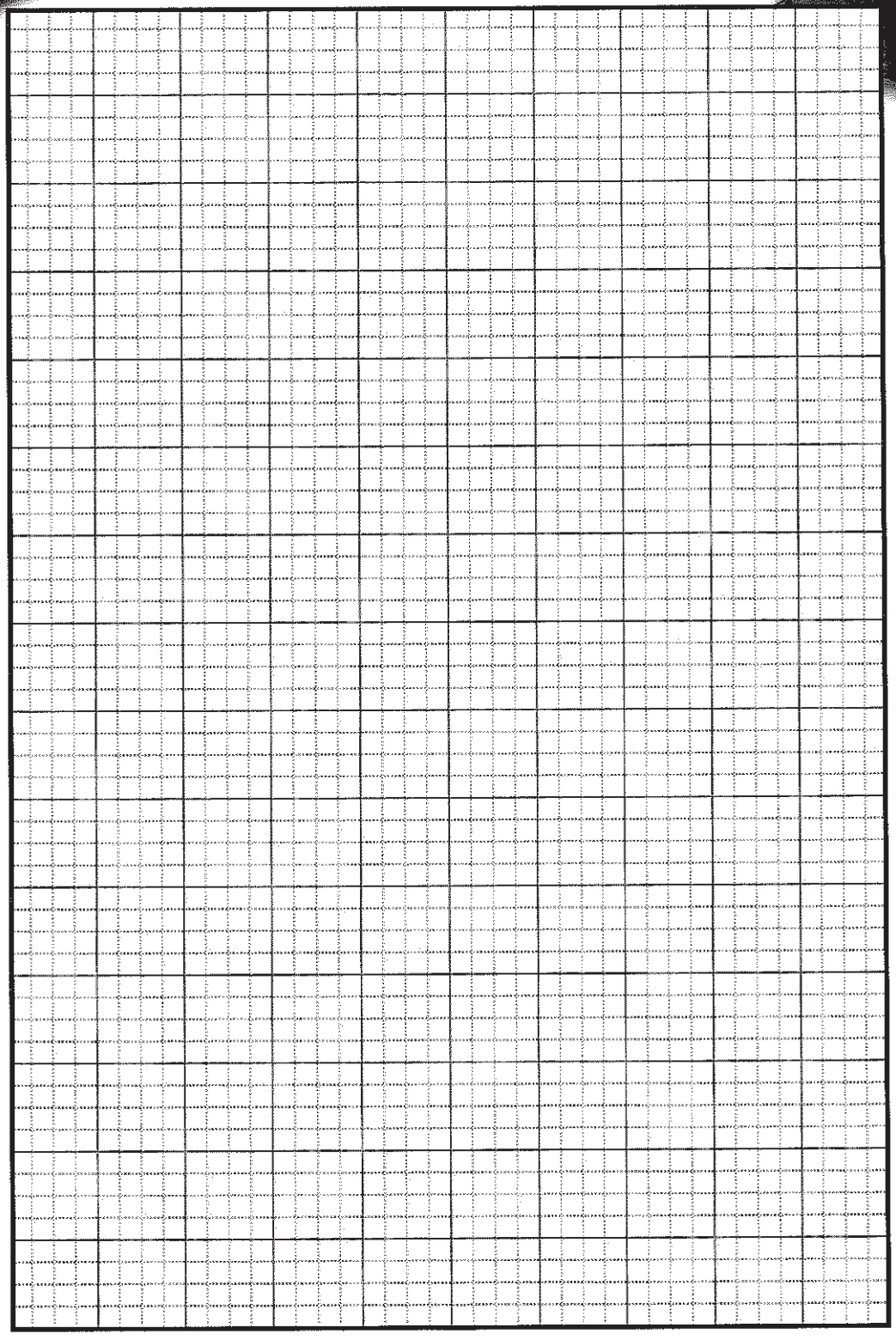


3D Visualization and Animation Contest 2010

Floor Plan



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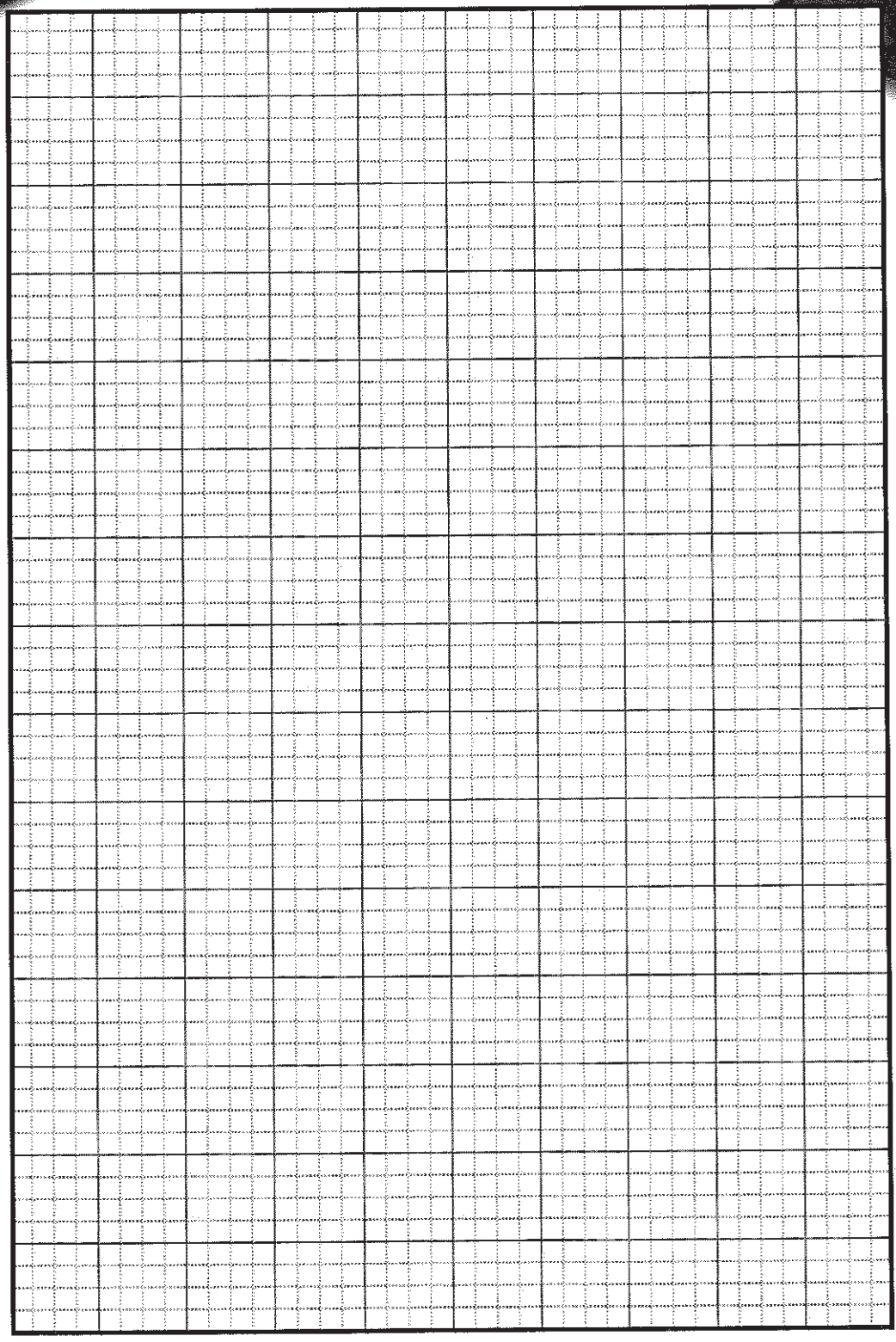
Project Title: _____

3D Visualization and Animation Contest 2010

Floor Plan



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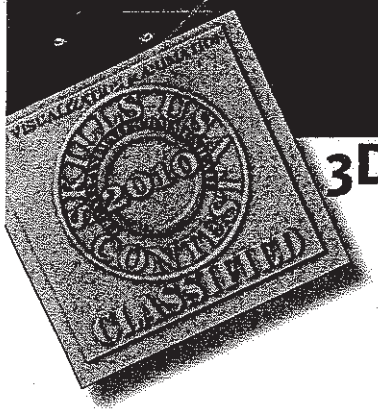
Project Title: _____



3D Visualization and Animation Contest 2010

Written Test

Identification: _____

1. Adding your objects, lights, cameras etc. in layers allows you to:

   a. Organize your scene better and hide/unhide objects quickly

   b. Become a better 3D artist

   c. Link your files back to Photoshop

   d. Link your objects together

2. Setting a project folder is important because:

   a. It saves multiple file formats for your scene

   b. It organizes your scenes, rendered images, and other important data in respective folders

   c. You can't work in 3d before setting one

   d. Projects can be too large if you don't set one

3. Once objects are grouped, you can:

   a. Move, rotate, or scale them as a single entity

   b. Texture them easily

   c. Perform better modeling

   d. Never ungroup them

4. The reason for creating a pre-visualization of a scene is:

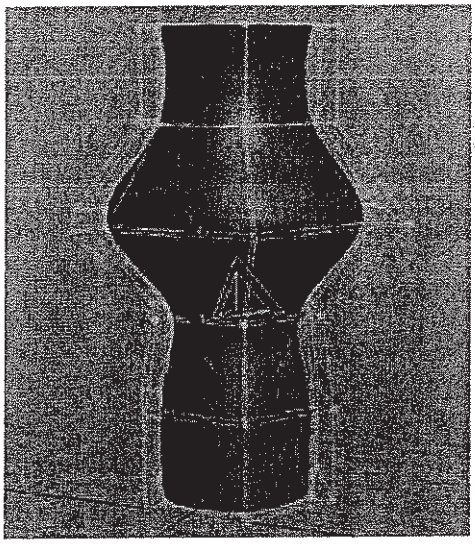
   a. so that lighting, camera placement, and animation can be planned before actual production begins, saving time and reducing errors

   b. to determine how much money to charge the client for the work

   c. to create accurate models for the production

   d. to create content that will be used later in the production phase of the project

9. The following image shows the object making use of:



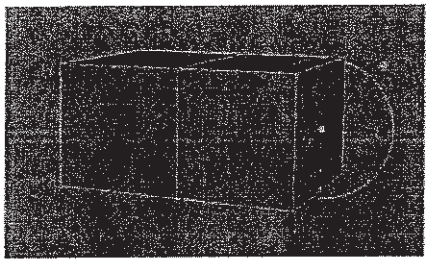
a. Bend

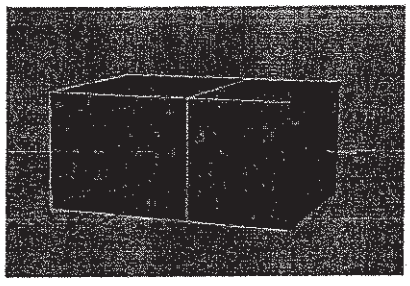
b. Taper

c. Twist

d. Lattice/FFD

10. Which operation is being performed in the following image:





a. Flip Normals

b. Bridge

c. Extrude Face/Extrude Polygon

d. Smoothing

14: Clipping planes allow you to:

a. Exclude polygon objects from the scene while rendering

b. Exclude textures from the scene while rendering

c. Exclude lights and animated objects while rendering

d. Exclude certain portions of the scene while rendering

15: Which of the following is a post effect:

a. Modeling

b. Graph editor

c. Dope sheet

d. Glow

16: Making an explosion simulation look realistic would require what kind of effect :

a. Cameras

b. Lightning

c. Smoke

d. Rendering

17: The following image shows an example of what effect:

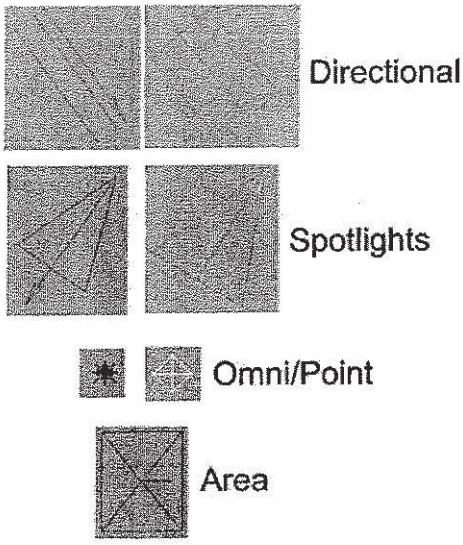
a. Explosion

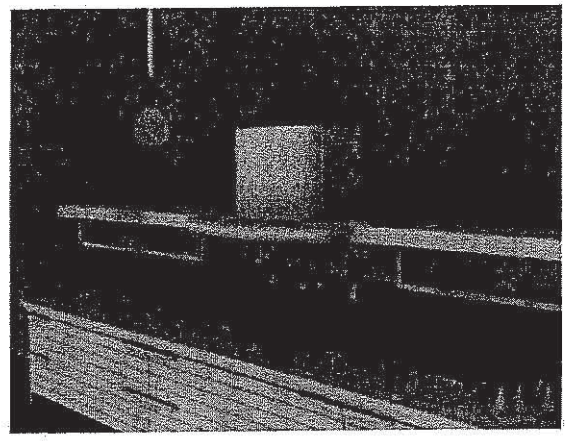
b. Sparks

c. Glow

d. Particle

22. Which light type would be used for the Light Bulb in the following example to go in six directions:





a. Area

b. Spotlight

c. Omni/Point

d. Directional

23. You can convert a sequence of rendered images into:

a. Obj

b. Max

c. Mov

d. Mb

24. AVI stands for:

a. Alternate Visual Interface

b. Audio Visual Interaction

c. Audio Video Interleave

d. Alternate Video Interface

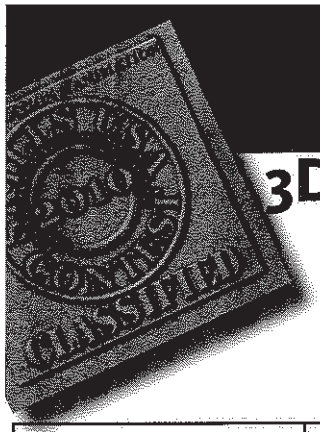
25. The render resolution for a digital standard definition video for NTSC is:

a. 720x480

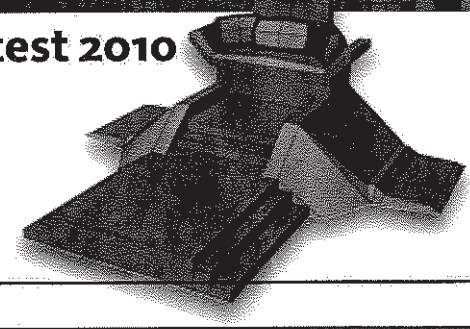
b. 1920x1080

c. 270x840

d. 768x576



3D Visualization and Animation Contest 2010



Judge _____

Team Number				
Topic	**Sub-Topic**	**Points**	**Points Awarded**	**Comments**
Design	Concept	100		
	Floor Plan	50		
	Storyboard	50		
	Creativity	100		
	Production	50		
3D Execution	Modeling	100		
	Texturing	100		
	Lighting	100		
	Camera	100		
	Animation	100		
	Rendering	100		
Test	Written Test	50		
Total		1000		

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	Texturing	100		
	Lighting	100		
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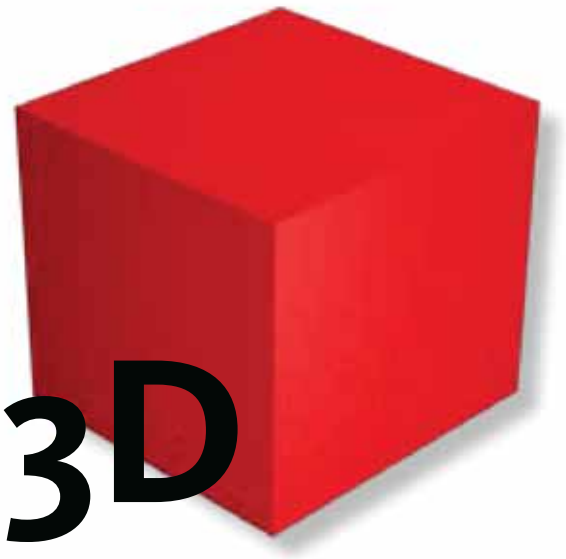
Workbook

SkillsUSA™ CHAMPIONSHIPS

2010

3D Visualization & Animation Competition

This Workbook provided through a generous grant from Autodesk®



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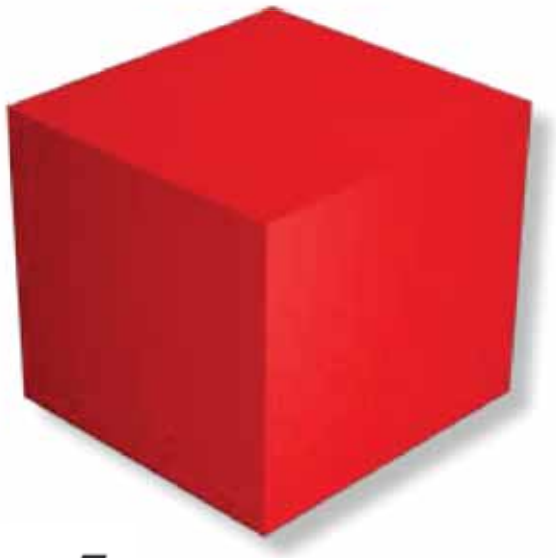


Ideas and Concepts

A good idea that is not well executed is no longer a good idea, but a bad idea well executed is still a bad idea.

So how do you come up with good concepts especially when you have to meet tight deadlines?

Each project you begin has an infinite number of design possibilities. As a artist working with CG software you are also a storyteller, and a technician.

Always start with writing down your ideas and doing rough sketches, this is always a good start! You should be able to explain your concept in a clear and concise way to get the point across, think about reading the short summary about a movie online, what makes you want to go see the movie?

Sketches regardless to how rough are also a great place to begin. Whether it's a character or environment, setting the stage in the earliest stages of the idea will help you flush out what is important and what's not.

Storyboards are very important for organizing how you will tell your story in animation and organize your shots, they will help you bring your ideas to life.

- What are the basics of a good storyline?
- How do I develop an environment that matches my storyline?
- What am I trying to tell my audience?
- How can I make it effective enough so that the audience will understand my story?

In the early stages of concept development you should ask yourself these questions:

- Who?
- Why?
- Where?
- What?
- When?

The story you choose to pursue will be based as much on chance as on research. Your imagination takes every bit of your experience from a daily walk to a favorite film and makes sense of it, combining it in ways no one else can, because no else has your knowledge, personality or experience. The magic of the ideation process is that you start in a familiar place, but then twist that into a new direction.

Let's start with an environment. Suppose we are going to create a set based around one of these ideas?

- The living room of a Superhero in the year 3000
- The Wizard's room
- The Mad Scientist's laboratory, who is inventing a new way to time travel

For our example we will use the Mad Scientist's laboratory!

Brainstorming your idea:

- How will you convey the concept while just showing the lab and not the scientist?
- Is the room scary or a funny?
- What is the time period? Past, present, future?
- Does the room look realistic or more fantastic?
- What are the elements you might find in a laboratory for example test tubes, flasks, beakers, etc.?

Using the concept of a "Mad Scientists Laboratory" or come up with your own idea and write a short paragraph describing the space, then make a list of what you might see in that space after you have answered the questions above.

The environment should give your audience clues about who the space belongs to and make it convincing.

- Think about your target audience and how to will attract their attention.
- Do some quick sketches to illustrate the objects in the space.
- Try to set a mood and tone about the space.
- Things like a rough floor plan can help
- Also create a prop list of what would be good to have in the space.

Ideas and Concepts

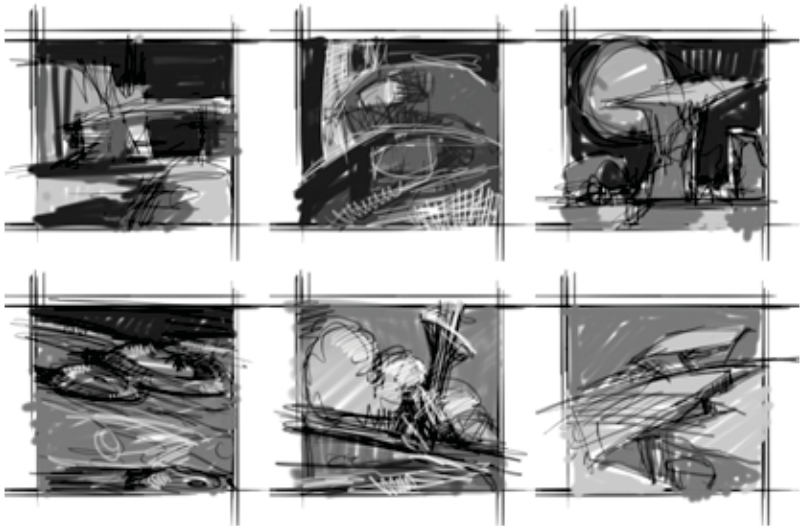
Good brainstorming clearly leads to a good project!

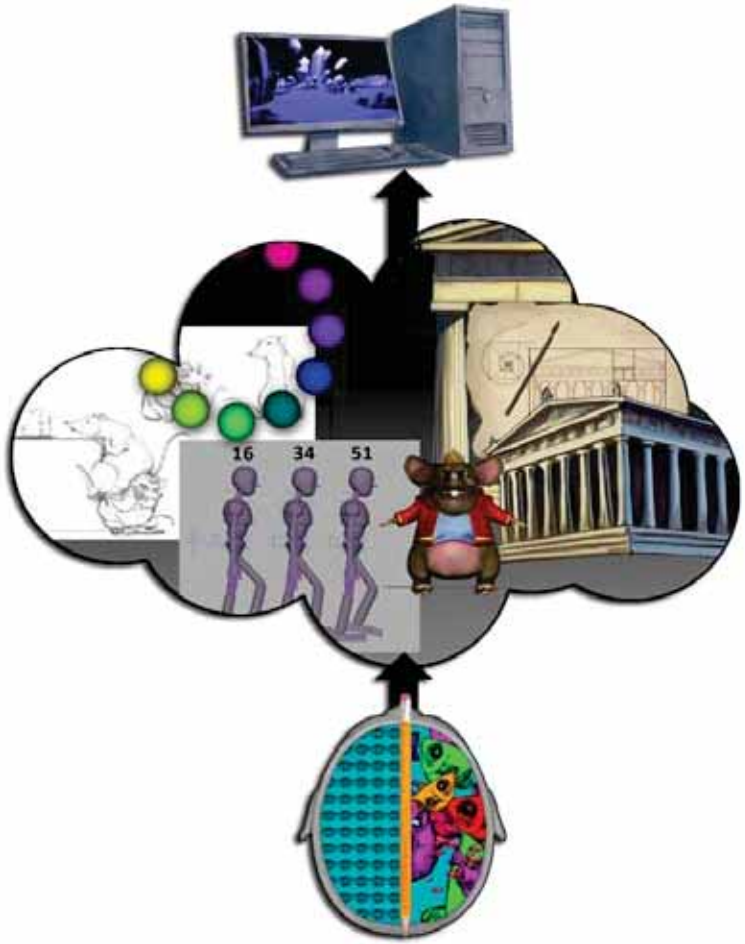
Good ideas are not always your first ideas, it's a process of many iterations and trial and error to get to a great project. Creativity requires a willingness to boldly say what you think, but it also requires a willingness to let ideas evolve, if you are working on a team make sure to have everyone participate and share their ideas, you never know what will be the spark that makes the idea come alive!

Generating ideas

The discussion process can help shape an idea into something it didn't have the potential to be when just one mind was contemplating it. Two minds or three, or eight, or twelve, pursuing the same problem can present hundreds of possibilities for its solution. Even designers who don't normally think out loud can benefit from this process, simply because one idea has the potential to multiply once a group starts discussing it. In this way of working and discussing ideas out loud also helps you as a designer to start to understand the ideas yourself.

Remember without a good idea there is nothing but technique!





Storytelling

Telling stories is as old as music, drawing, and perhaps even speech. We all love stories and we never outgrow them. We go to movies and read novels and even gossip because we want to be told stories and we want to tell stories.
All of us watch movies, play videos games, and watch television. We look at photographs and paintings, and often there will be no character, yet we understand what is happening and can be moved by these images.

- In a movie the camera may lead you through a space glancing at objects that tells us who has been there, unveiling a portion of the story with no character in the scene, showing clues that may play a role later on in the movie.

- In games you often have to discover what is happening by traveling through the environment as the visual clues unveil the story.

- In an architectural visualization of an environment the designer also tells a story to the client about how the space will look and feel like, conveying a mood.

If I walk into the room you live in I would see things around the space that would tell me who lives there. This is what we want you to do here, tell us a story using a place, a room. We need to be able to look at the rendered images and animation and know exactly what is happening, just happened, or is about to happen.

Let's take the example of the Mad Scientist's Laboratory, who is inventing a new way to time travel.

By looking at the images and animation we should be able to answer these questions:

- Who lives or works here?
- What do they do?
- What is the general time period, past, present, future, is it fantasy?
- What type of a person are they?
- Think of the elements you may find in a laboratory for example test tubes, flasks, beakers, etc. to help convey the story.
- The environment should give your audience convincing clues about the mad scientist.
- Light may play a role; maybe you have windows, or skylights or huge doors.

Below are a few more things to consider about storytelling:

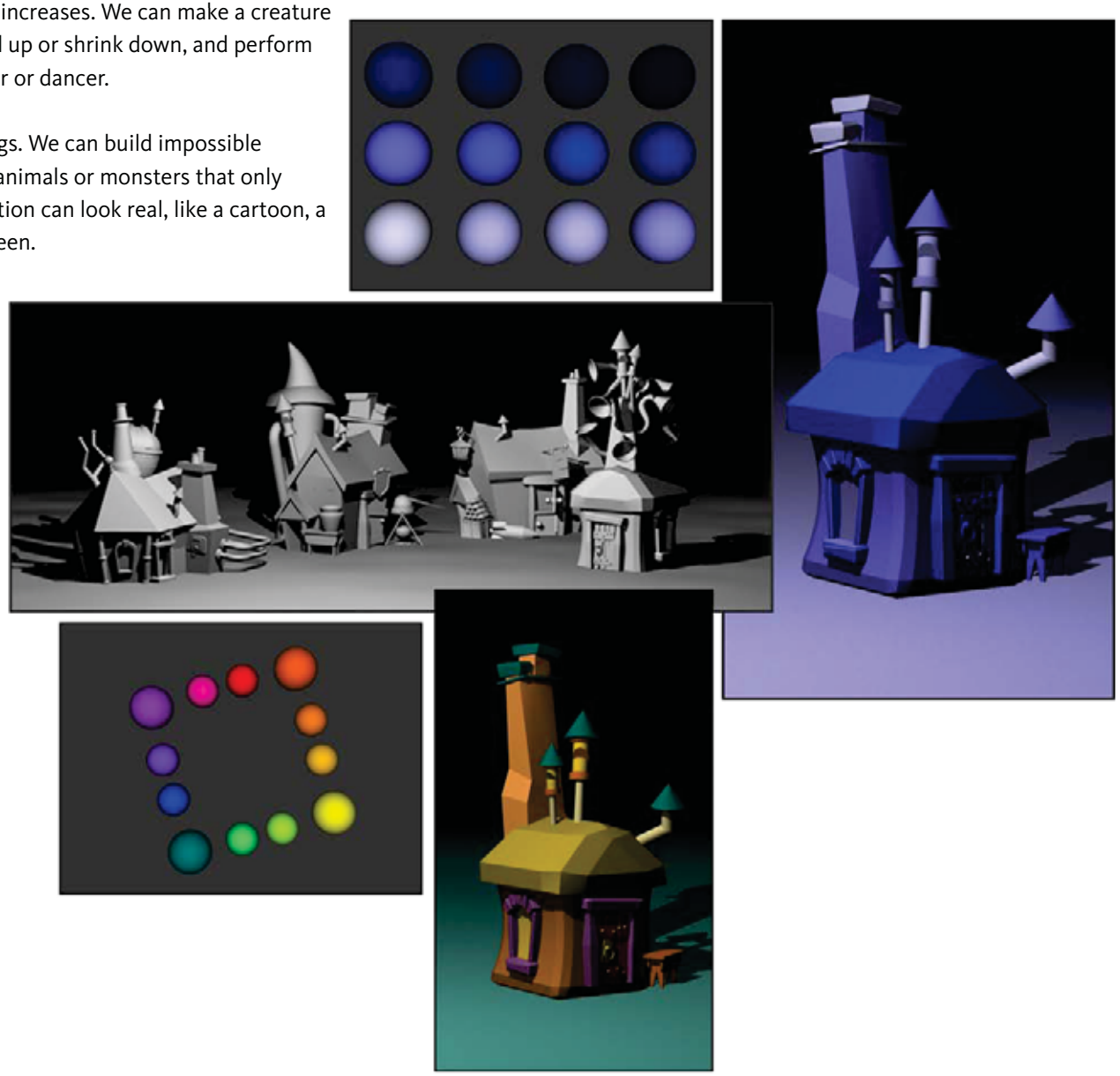
- Storytelling is an art in itself.
- It is based on an idea you want to convey to your audience.
- The idea develops into narratives and visual treatments.
- A script is developed which may consist of characters, scenes, props, etc.
- Storyboard the script.
- Think of camera angles to tell a visually compelling story.
- Lighting can set up the mood for your story.
- Audio can play an integral part in storytelling.
- Transitions from one scene to another along with staging are thought of.
- Timing will play an important role in every visual involved in the storytelling process.
- Dramatic appeal along with a well developed plot that engages the audience is key.
- A story has a beginning, a middle and an end. You can break them down as setup, conflict and outcome. You should have a structure to a story:
    - Character goes on a skydiving trip
    - Character's parachute is entangled in mid air
    - Character has a safe landing
- 3D animation is a great medium for storytelling.

You can show anything you want in the world of animation which can help you think about the impossible while telling a story.

Storytelling

Another strength of animation is that it gives us more freedom to use color, movement, and style. We can make a chase scene more exciting by making the colors get redder as the heat of the moment increases. We can make a creature or vehicle move at exaggerated speeds, swell up or shrink down, and perform moves that would be impossible for any actor or dancer.

We aren't limited to real actors or real settings. We can build impossible landscapes and populate them with mutant animals or monsters that only exist in our imaginations. As for style, animation can look real, like a cartoon, a combination of the two, or anything in between.



Design

Having good design is extremely important in any work of art as it makes something easier to understand and also serves as a visual reference for the information you are trying to provide. Good use of color is an important factor for good design. Composition and focal point are other factors to consider while coming up with good design.

The elements of design are the foundation to all visual imagery including traditional painting, illustration, architecture, graphic design, and 3D art. Think of elements as ingredients such as flour, baking soda, water or vinegar. Principles are the wisdom of how to combine these ingredients or elements. If you want a mild combination, mix water and flour. If you want an exciting combination, mix baking soda and vinegar.

- **Elements of design - These are the building blocks to all visual imagery, from traditional painting to 3D. Below are a few elements of design.**

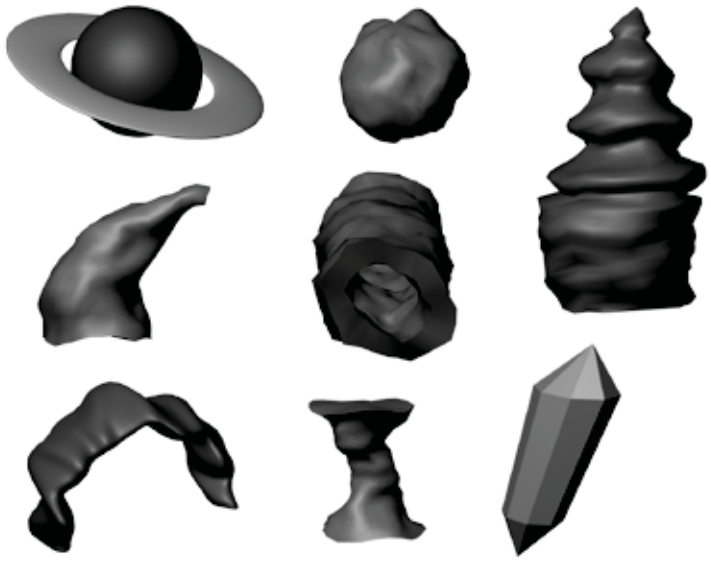
  - **Point** - A point is the most basic of design elements and can be defined as the smallest area of visual attraction in a composition.
  - **Line** - Line could be considered one of the most powerful elements of design. Line is used to define a shape, describe a contour, or be implied by the outside edge of a form.
  - **Shape** - When a line encloses a space, it creates a shape. Shape is two-dimensional only, meaning that it has height and width, but no depth.
  - **Space** - Space is the expanse or area in which all objects and events take place.
  - **Direction** - Horizontal lines suggest stability and project calmness and peacefulness. Vertical lines depict power and height, and diagonal lines can have the feeling of action, movement, or instability.
  - **Size** - Size is simply the how one shape occupies an area with respect to another shape.
  - **Texture** - Texture is the surface quality of an object. Texture can be rough and prickly, like the surface of a cactus, or it can be soft like the fur on a cat.
  - **Color** - Color is the most complex of all the elements. It has a physical presence and creates a psychological response in the viewer.
  - **Value** - Value can be thought of as the darkness and the lightness of color.

- **Principles of design - These can be thought of as how we combine the elements of design to make great art. Below are some principles of design.**

  - **Balance** - Balance is the visual arrangement of elements or objects in a composition that creates a sense of equilibrium. Balance can be symmetrical, asymmetrical, or radial.
  - **Emphasis** - Emphasis creates a focal point or points in a design. It serves as a marker to show what in a composition has hierarchy or importance.
  - **Economy and Continuation** - Economy is a principle of design which emphasizes the simplification of elements to express a message. Only the elements required to express the idea are used. Continuation refers to the “lining up” of visual elements in a design. When elements are placed in a continuous fashion, the viewer’s eye will transition from one element to the next with a feeling of unity.
  - **Rhythm** - Rhythm refers to the repetition of shapes or elements in a design. Rhythm also refers to the movement of the viewer’s eye through a design.
  - **Unity** - Unity refers to visual harmony and agreement among the elements in a design. When the parts work together to create a whole, you have unity.

Design

- **Proportion** - Proportion is the relationship of elements in comparison with each other, or with aspects of a single element or object.
- **Contrast** - Contrast is used to create emphasis through the use of contrasting elements. Elements with strong contrast stand in opposition to one another: light against dark, large against small, round against square, smooth against rough, etc.
- **Repetition** - There are different types of repetition:
  - **Regular** - Regular or systematic repetition is created when the elements and intervals between the elements have a consistency with very little change.
  - **Flowing** - Flowing rhythm is more organic and can have more variation in the elements used to create the composition, much like a winding natural stone walkway or waves of meandering wire.



As you learn to model, texture, and animate in 3D, think about how the elements and principles of design, color theory, and composition apply to your scene.

- **Are your objects interesting shapes?**
- **Are the scale and proportion working?**
- **Are there areas where your eyes can rest?**
- **Are there focal points to draw the viewer to?**
- **Are you using color to tell your story?**

Working in 3D allows you to view your objects in orthographic and perspective views. You are able to create objects and render them from different camera angles. Design, color, and composition are important factors and a larger challenge to control in a 3D space. As you start to layout your project, think about what story you want to tell and how to apply the theories learned to create a clear message for the final viewer of your project.

Storyboarding Techniques

Good quick storyboarding techniques are easier than you think and can really help you visualize your final animation.

Storyboards are sequential drawings that help us understand the story. Animation is hard work. Drawing is hard work, too, but it's much easier to draw out shots to see how they look than to create an animation from start to finish. Storyboards are used during the pre-visualization phase. It's extremely important to have a rough storyboard for your project so that the 3D team understands the process and can communicate it to others.

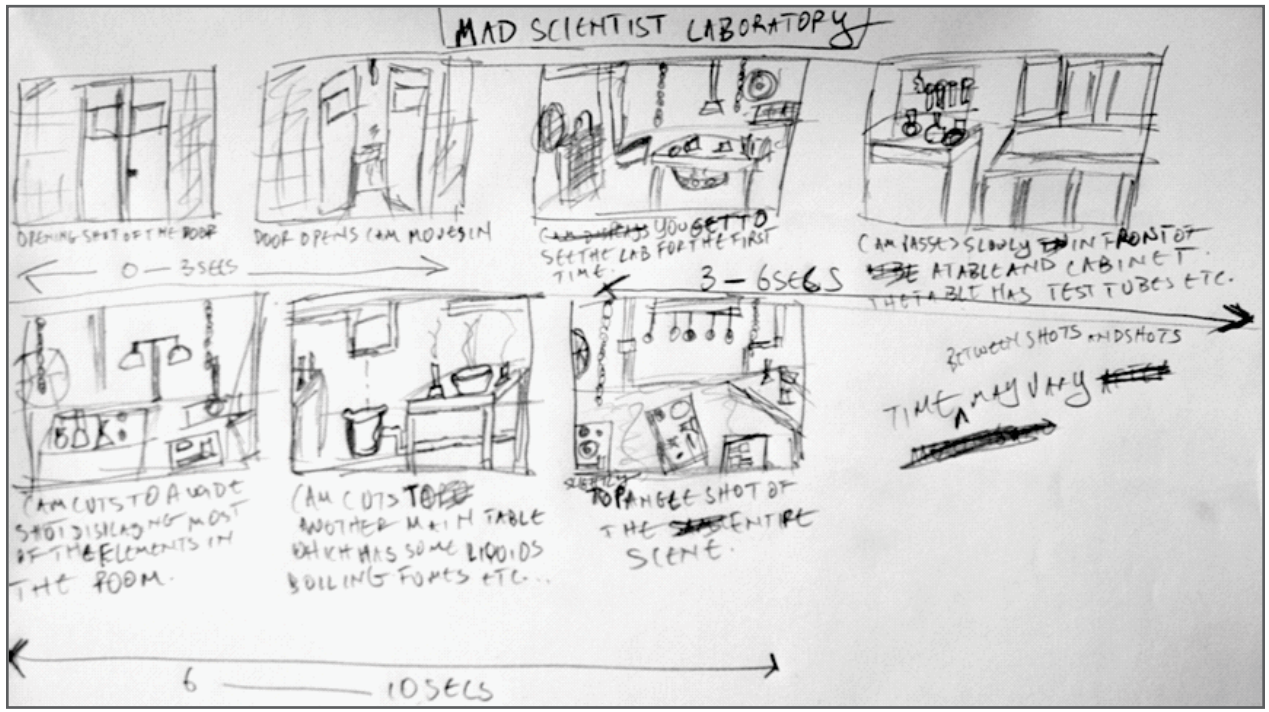
Storyboard help communicate how an animated sequence will look before any work is started on the computer. They make the movie without all the work of making the movie. However, storyboards lack two critical things: movement and sound.

Comics can include word balloons and sound effects because that's part of their style, but storyboards represent the design of film shots, so storyboard artists usually write the dialogue and sound effects below each drawing, and often indicate movement with descriptions or multiple drawings.

One needs to understand animation to make a convincing storyboard. Try getting an idea of where everything is and how the animation can be staged as you read the script. If there is a character involved try envisioning the character as you read the script. After reading the script, try to envision how to expand on it to make it more interesting. You should be excited on starting the storyboarding process after you read the script and should have some idea on the images you are going to create.

Think of camera angles. The shots should tell the story, transitions are important in storyboards. Give a small description for each image.

Storyboards can be loose and sketchy or fully developed and in color. Either way, they are only preliminary. They allow an artist to explore options, to tell the story from one point of view or another and to play with various approaches before committing to one.
Below is an example of a rough, initial storyboard for a 10 second animation of the Mad Scientist's Laboratory. The rough storyboard gives us an early idea of what the animation will look like. It also serves as a foundation for modeling the scene to make it look like a mad scientist's laboratory.



Creating a Digital Presentation

Once your project is complete you will need to create a presentation to turn in, here are some suggestions for example of what might be due as part of a final presentation for our Mad Scientists Laboratory.

A word document explaining your project.
- A maximum of 3 sentences which will help describe your concept (a TV Guide version). Make sure to include the title for your story at the beginning. and the names of all the team members, it's also good to include your email address etc.
- A prop List

A storyboard of rough illustrations explaining the storyline.
- This should be a complete as you can make it in the time allowed to get your point across.
- You can also include any other sketches you may have created.
- A floor Plan Sketch is good to have to explain how you decided to lay out the space, this will also help with your storyboard

Composition Block-in
- These are work in progress (WIP) renders at 640x480 .jpeg images of your process. Two for modeling, two for lighting, two for texturing, Try to maintain a smooth transition for these for example choose two shots and show them from the modeling, texturing and lighting stages.

Ten still renders including a close up and distance showing the room and details (640 x 480 .jpeg)
- These are great for storytelling and process is always good to show.

Ten seconds of an Eye Level Fly-through/Walk-through of the space telling the story showing the details. Ten seconds is 300 frames.
- Render the animation at a maximum of 640x480.
- Render as .tga image sequence; this will give you the best quality.
- Use QuickTime Pro, or some other editing software, to make a movie out of the sequential images.

When you turn in your final presention you will have:
- Concept and Title document
- Prop List document
- Floor Plan Sketch
- Prop Sketches
- Rough Storyboard
- Six Work in Process Renders-Block ins
- Final 300 Frame animation render-10 seconds
- 10 Still Renders showing details

Completing your Project on Time

Tips for completing your project on time:

- Make sure to consider the time you will have to spend rendering the animation
- Check how long one frame of the animation takes to render and then estimate the total time. For example, if one frame takes 10 seconds then 300 frames will take 10x300=3000 seconds, which is 3000/60=50 minutes
- Make sure to go through every setting in the render setting window within your 3D software

Another strength of animation is that it gives us more freedom to use color, movement, and style. We can make a chase scene more exciting by making the colors get redder as the heat of the moment increases. We can make a creature or vehicle move at exaggerated speeds, swell up or shrink down, and perform moves that would be impossible for any actor or dancer.

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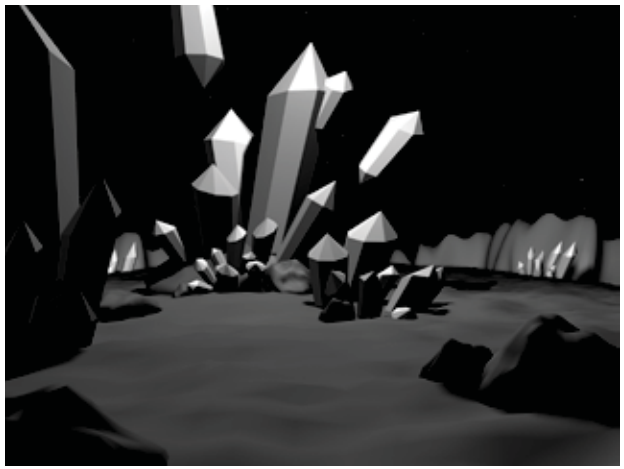


What makes a good project?

- Good design
- Good concept art
- Good story
- Storyboards/Animatics
- Project management
- Workflow techiniques
- Creating a final digital output

A good project starts with focusing on pre-visualization and conceptual design techniques. One needs to understand the importance of concept art and how it will support the storyboarding for an animated sequence. Why story is important and how your audience understands your story is key to keep in mind. Make sure that your audience can easily relate to aspects of storytelling for example characters and emotion, movement, timing and pacing, lights and camera angles all set the mood to tell a story. Story is the backbone and foundation of your project.

Other building blocks to create any work of art are the elements and principles of design. Focusing on the elements and principles of design will allow you to describe the concept with enough artistic depth visually and verbally to allow the viewer to accurately visualize the final 3D output.

Project management can consist of working smart within the software to managing a production schedule to make sure you meet deadlines for the project. Proper workflow techniques are extremely important in a 3D production. Making sure your fundamental concepts in 3D are clear becomes extremely important for any 3D production.

Final presentation is extremely important as that is the final output your audience will see. Making sure you leave enough time for rendering and any post production will play a key role in creating that final impact.

Workflow and Helpful Tips

Having a good pipeline as to how you should approach your workflow is extremely important for a successful project and should be thought out in advance before the production process. This will help in a smooth workflow and you will find yourself on track in a tight deadline driven project.
Below is an example of a workflow and tips related to each element in the pipeline:

Idea and Concept Art

- Spend time on story and concept sketches.
- Remember a story should have a beginning, middle and an end.
- You can break them down as setup, conflict and outcome.

Storyboarding

- Make sure you read the script well before you start making your storyboards.
- In a tight deadline driven project rough sketches will help convey the story best; quickly illustrate the main points to convey the story.

3D modeling

- Importance of pivot points while making 3D models from 2D curves
- Unit setup for scene creation
- Make sure you model from the world origin
- Maintain a good edge loop workflow in your 3D models
- Maintain overall good topology
- Pay attention to quads and tris
- Model with symmetry/mirror
- Smooth only when needed

Lighting

- Make use of basic light theory
- Use three point lighting
- Use lighting linking/include-exclude
- Use shadows effectively

Texturing

- Understand the importance of mapping
- Use 2D and 3D procedural textures
- Understand the importance of UV Texture editor/UVW Unwrapping
- Use Photoshop to make your textures or enhance your existing images
- Understand different shaders

Animation

- Understand set key and autokey
- Path animation
- The importance of curve editor/graph editor
- The importance of dope sheet
- Principles of animation
- Safe frames for animation

Effects

- Have a good knowledge of any effects within your 3D software and use them wisely while keeping render times in mind.

Rendering

- Make sure you understand render resolutions to estimate the amount of time it will take to render animation as still images.

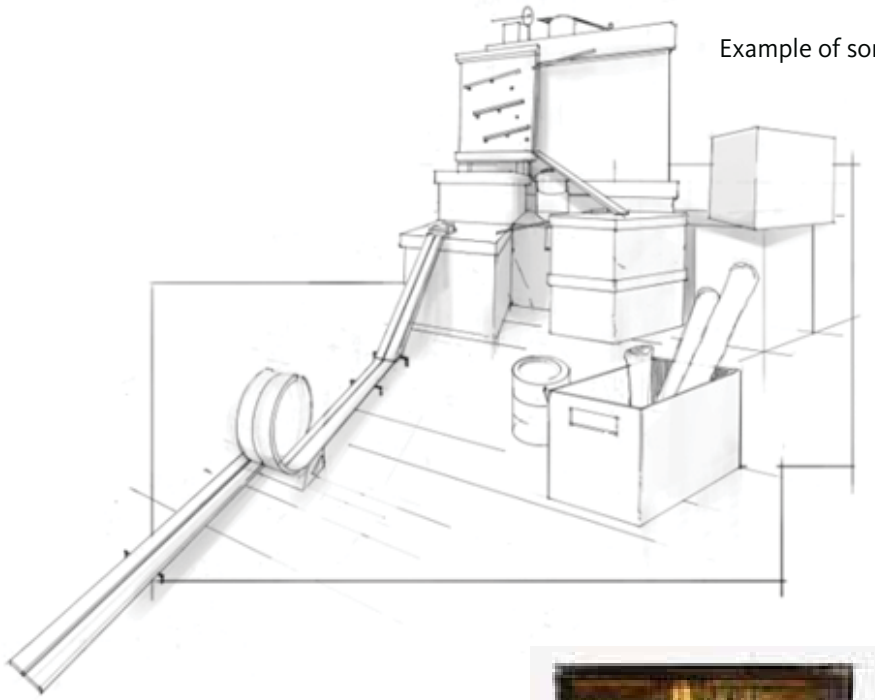
Managing Your Time

Managing your project and staying on your timeline with your production schedule is crucial to completing a great project. Let's look at an example of a project that's worked on and completed over an eight hour period of time.

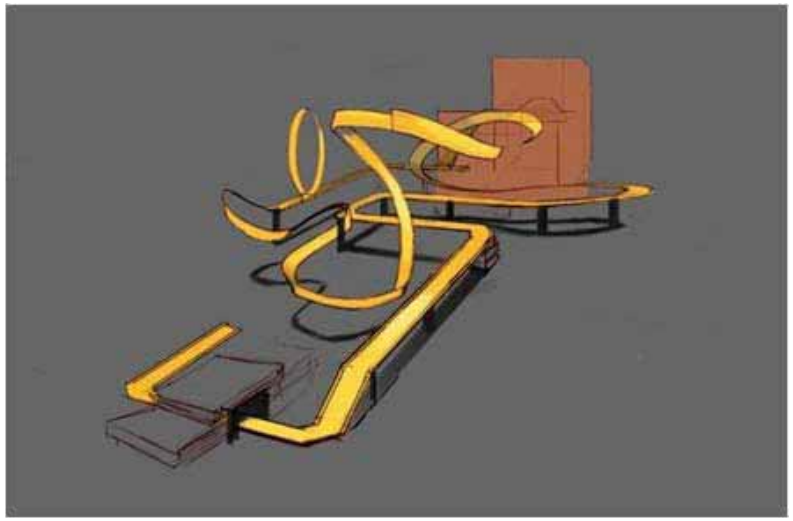
In this example we are going to use the "Mad Scientists Laboratory" as the example, we will just be working on the environment for this part of the project beause characters can be very complicated and take much more time.
The most important thing for any project is to be managed effectively so that you can meet your necessary deadlines. Having a production schedule will help you meet these deadlines in a timely manner. Not following a production schedule will often lead to either an incomplete or an average project. Here is the breakdown for the schedule.

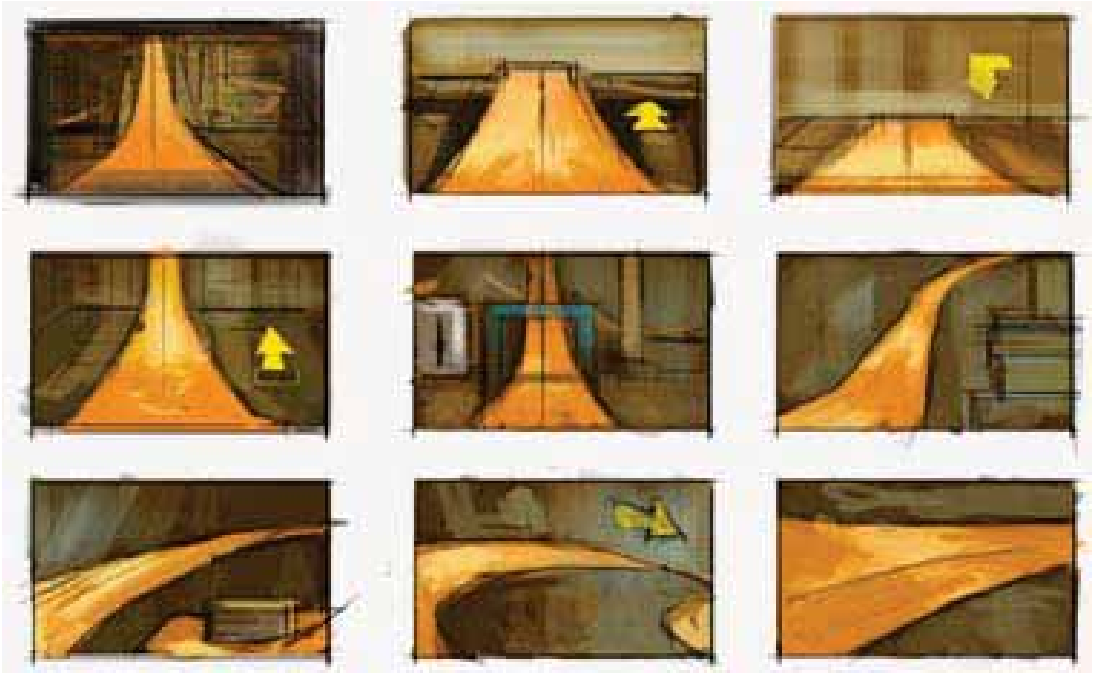
Production Schedule	Time	Managing your project
Come up with a concept, write down your ideas and create some rough sketches.	8:00-8:30 am	Have your project title, descriptive paragraph and some rough sketches complete.
Team breaks out responsibilities to decide who will be doing what tasks. Begin the storyboards and plan camera shots along with a prop list.	8:30-9:30 am	Assign a deadline for each task for example storyboards, modeling (working from prop list), lighting, animation, etc. along with coimpleting storyboards.
Concept, Sketches, Storyboard and Schedule/Workbreakdown are complete at 9:30 am		
Modeling begins, block in environment with basic shapes for composition and set up first lighting pass as team members create assests.	9:30-10:30 am	First pass Lighting set up and environment blocked in. Make sure to establish a proper project pipeline to flow from one task to another and that you will have time to complete all your assets.
Modeling completed, replace block in objects with final objects Review models. Refine second lighting pass thinking about your story.	10:30am to 1:30 pm	All Modeling complete, make sure you followed proper naming conventions. Add objects in layers to manage your scenes.
All Modeling complete! Be Save files often and also back up multiple files in increments.		
Begin Texturing objects, adding simple object animation, effects and final lighting pass.	1:30-3:30 pm	Texturing, object animation and effects complete (Make sure to group objects within your 3D scene to manage the scene better.)
Using your storyboard set up your camera to complete your 10 second fly through animation.	3:30-4:00 pm	Check a test version of the fly through. Keep making animation previews/playblasts to check your animations. 640x480. Render one frame and estimate how much time it will take for the entire animation.
Work Complete Begin Rendering and Presentation!!!		
Render your final animation and complete still images for your presentation.	4:00-4:45 pm	Make sure you can render in this amount of time! Prepare your still images, storyboard, and project description for presentation following the guidelines.
Rendering done! Make the movie and submit your presentation.	5:00 pm	Congratulations!

Process



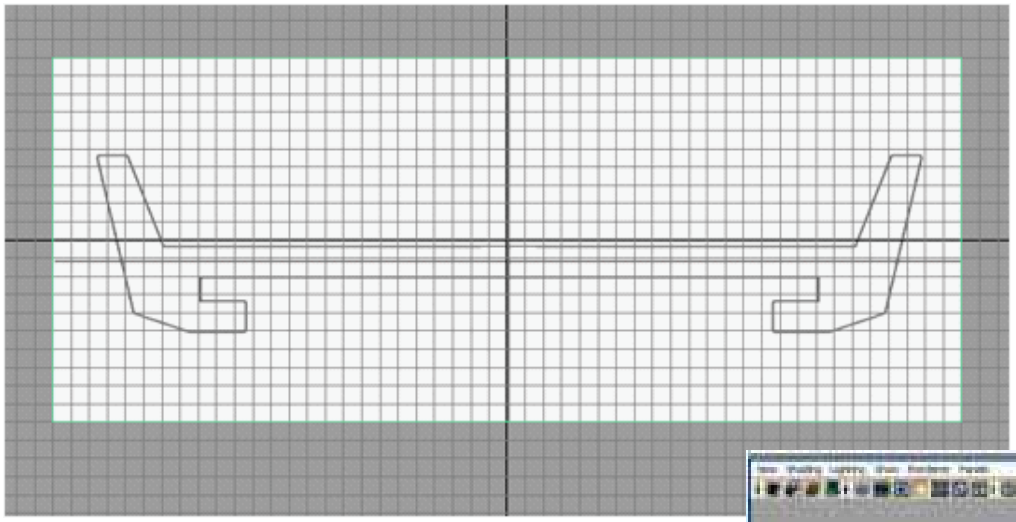
Example of some initial ideas.



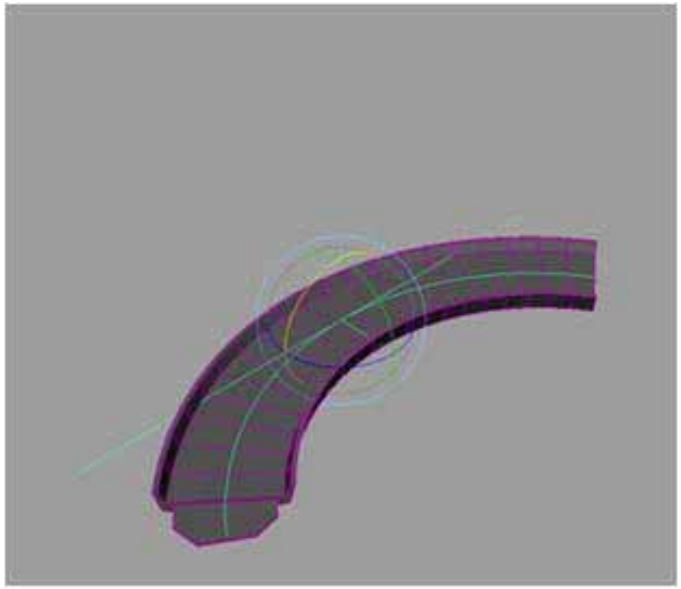


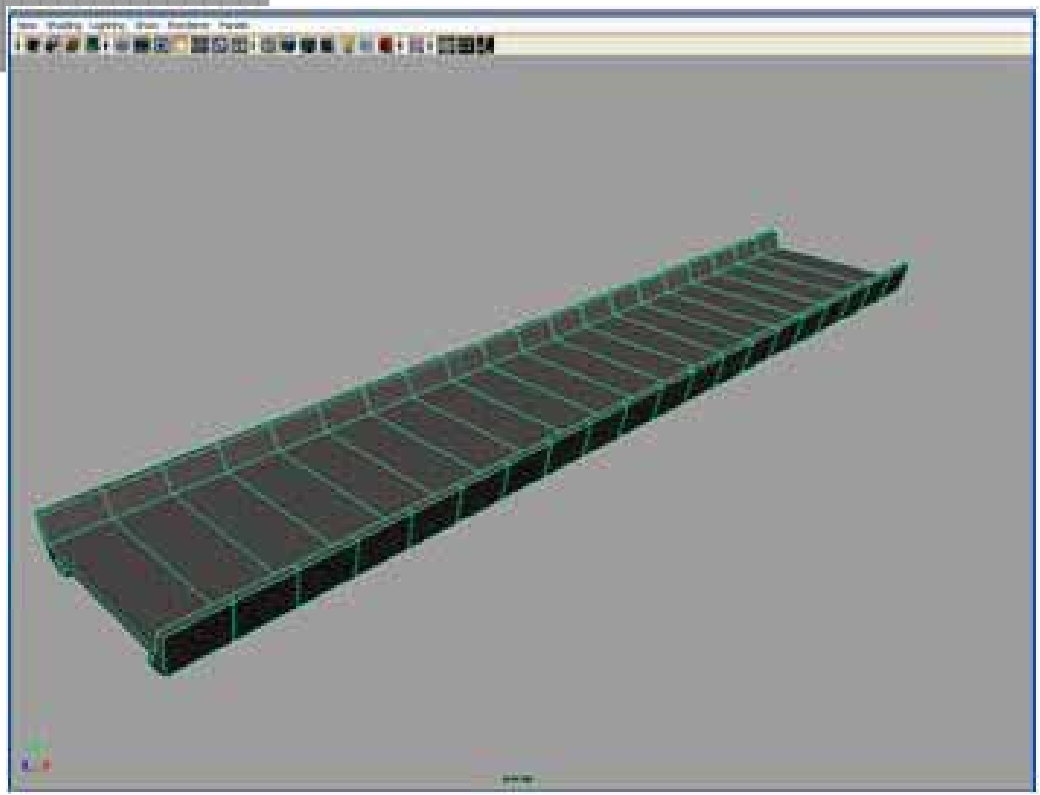
A storyboard displaying the track

Process

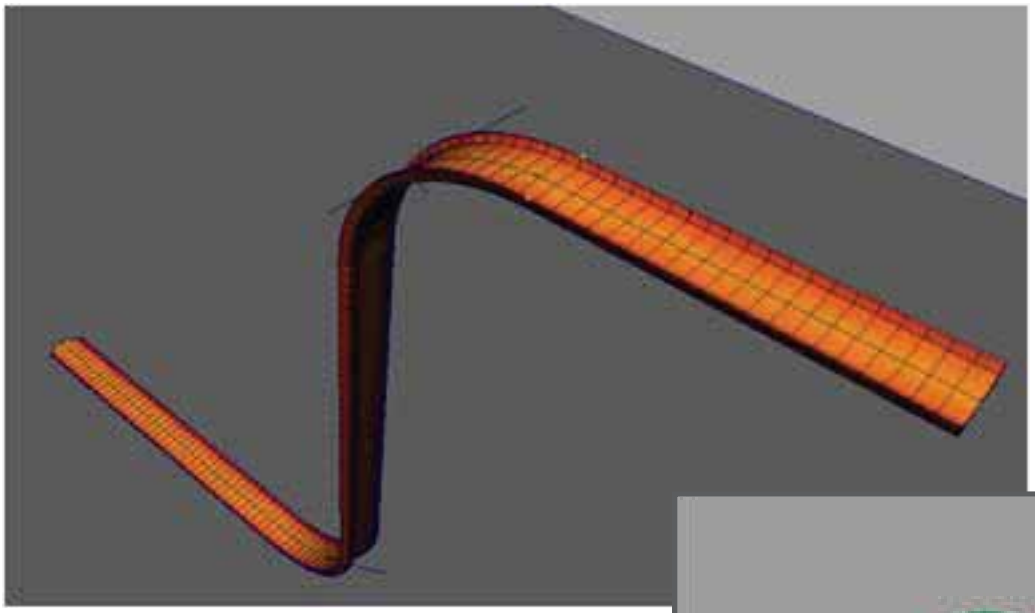


Modeling the track getting the reference images in your 3D software

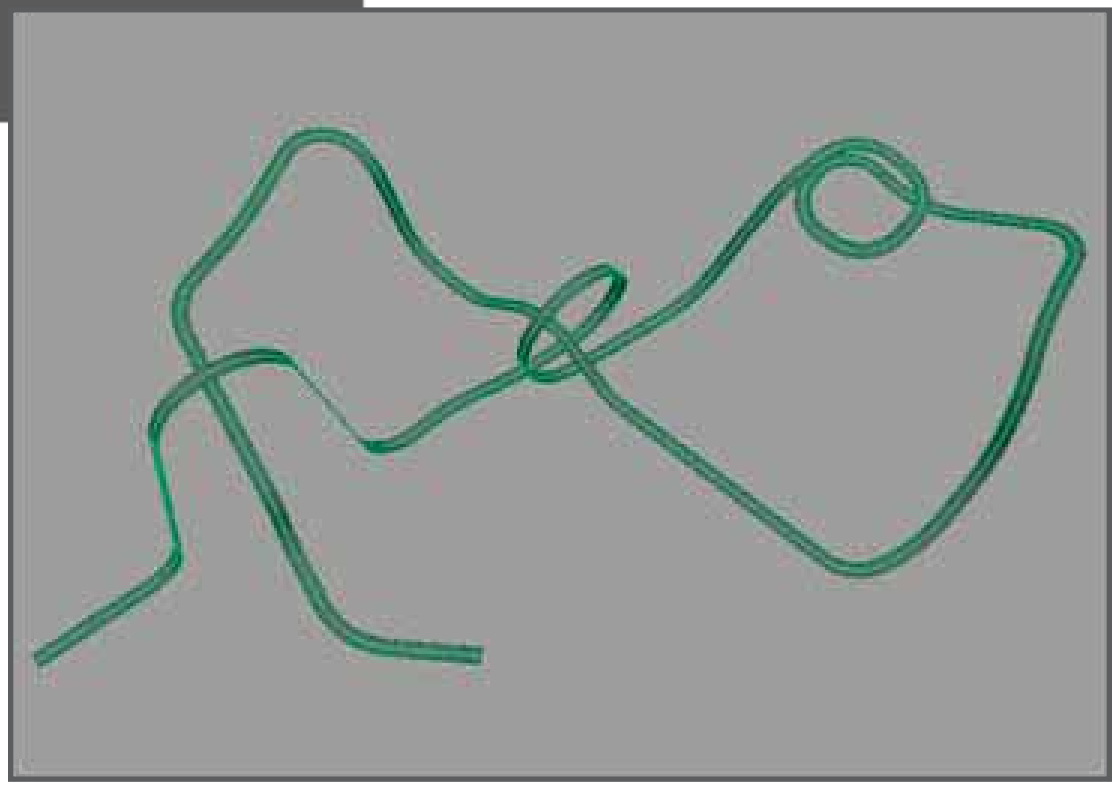




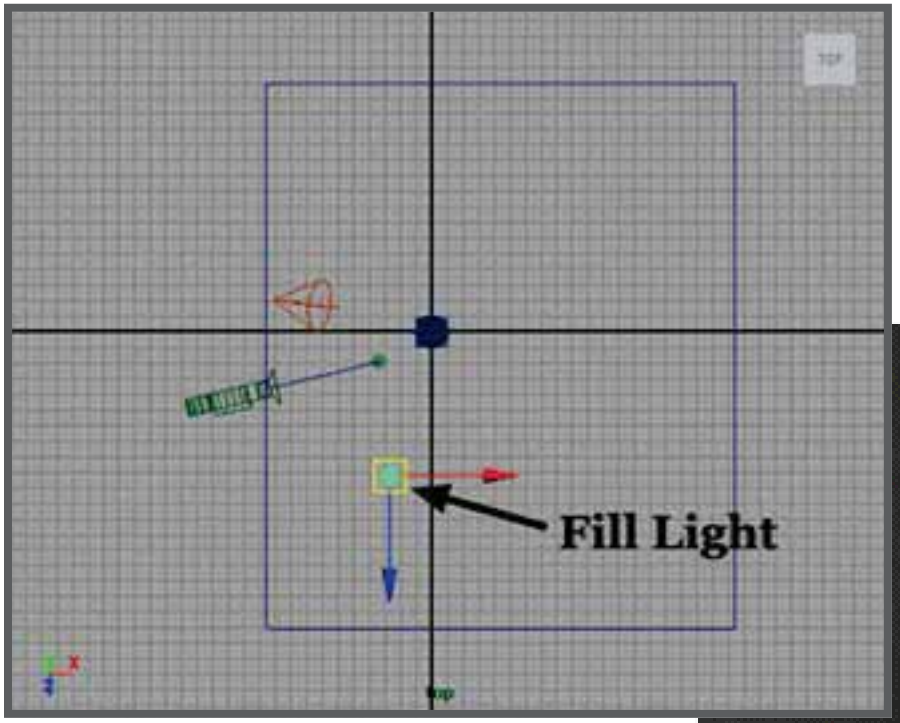
Process

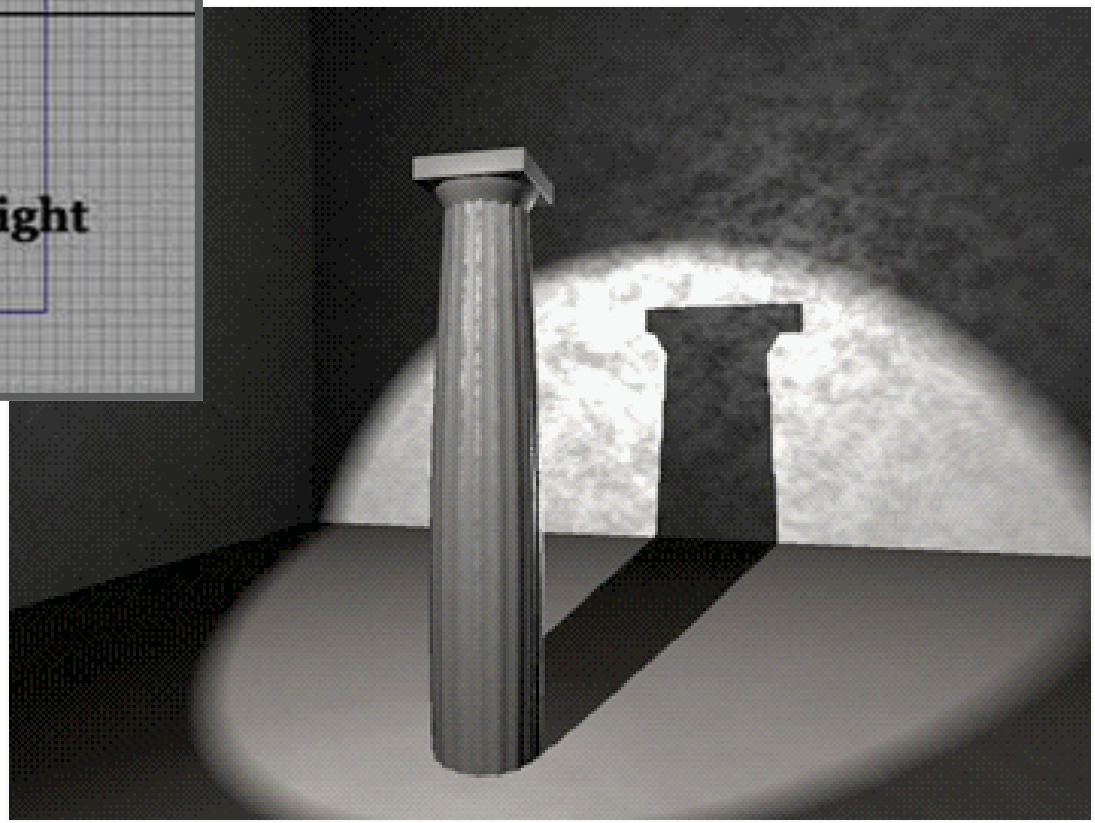


Assembling the track to curve it



Process



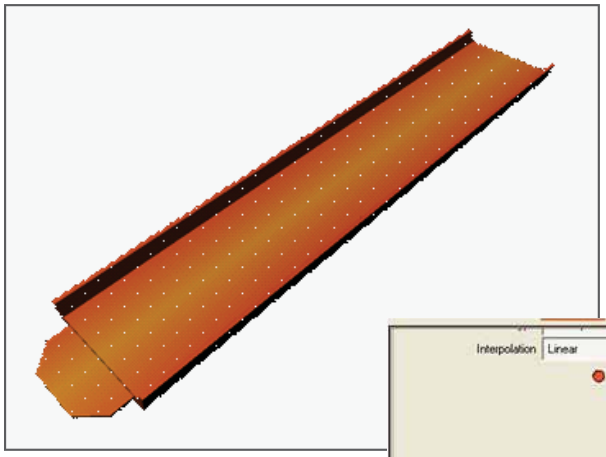


Some lighting studies before you begin lighting the entire scene (The entire scene will be lit not just the track)

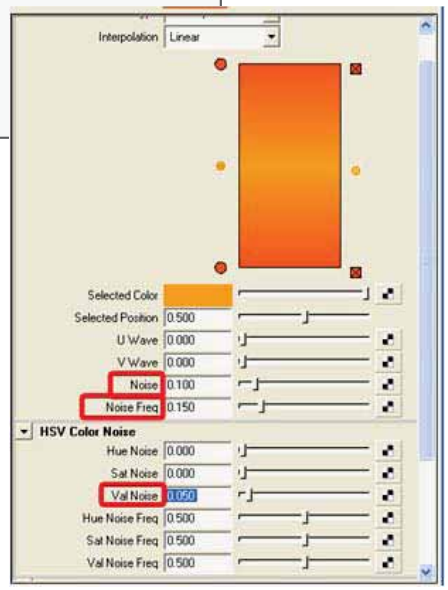
Process

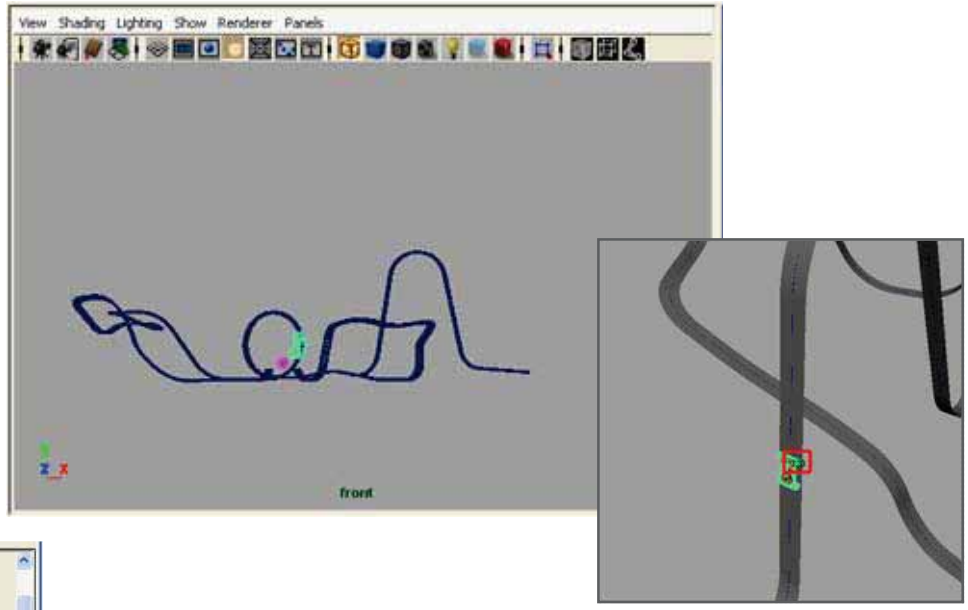
Track lit with the entire scene

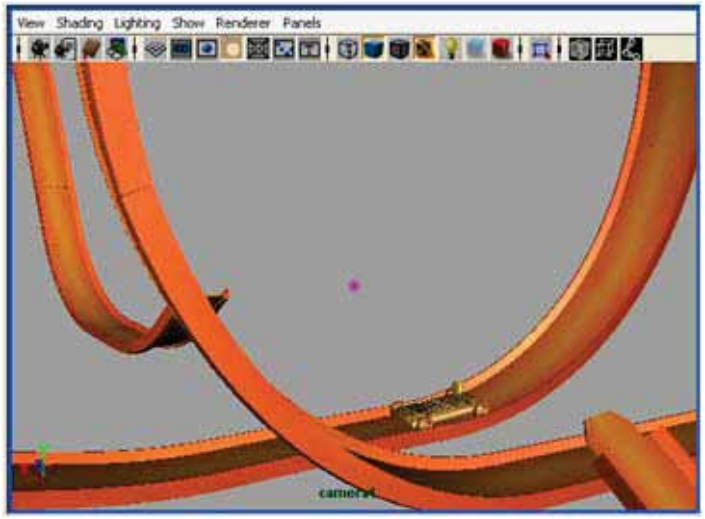
Process



Creating materials for the track



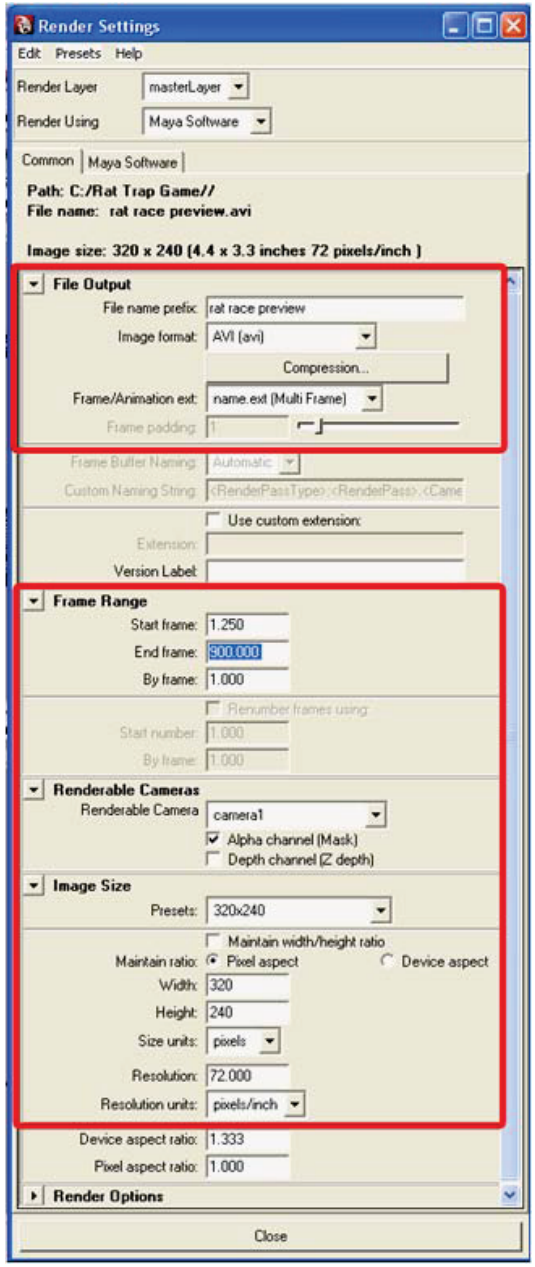




The track used for animating the vehicle

Process

Rendering the scene

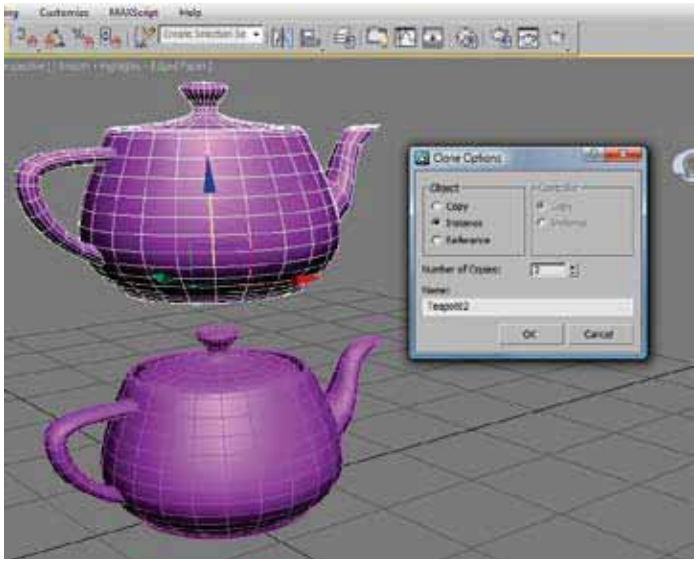


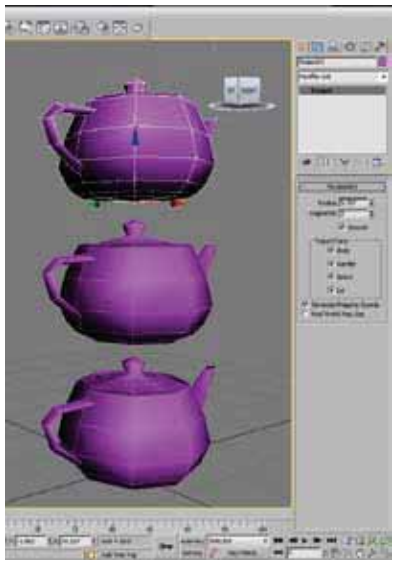
Final Render

Workbook

Interface/Menus

Autodesk® 3ds Max®





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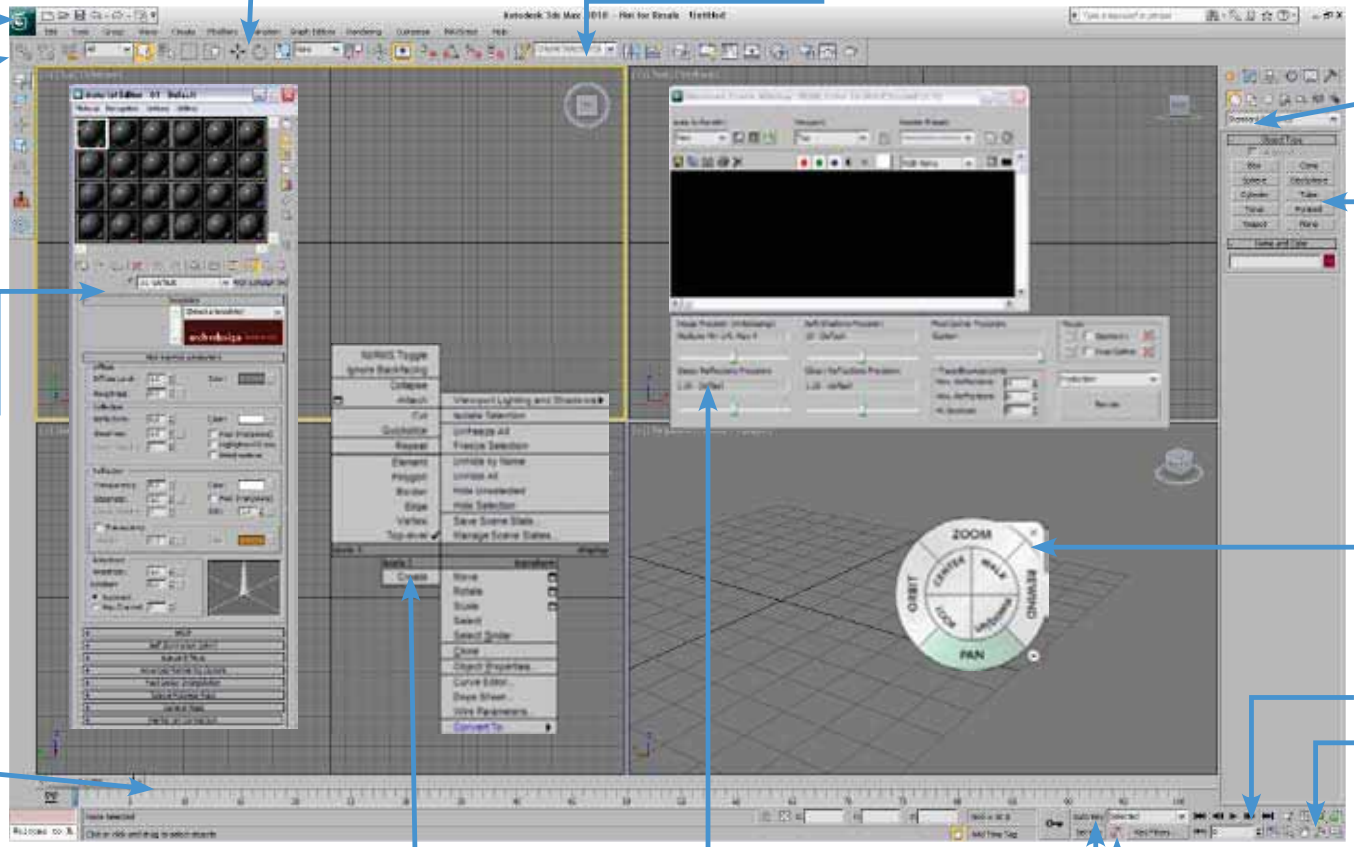
3dsMax Interface

1 - Setting a Project
When you start up 3DS Max, it is best practice to set up a project file. This will allow you to always save work to a specific directory.

2 - Transform, Rotate, Scale
These tools allow you to Select, Transform, Rotate and Scale objects in the scene.

3 - Layers and Selection Sets
Layers allow you to manage the objects in your scene. Selection Sets allow you to add objects to sets for easy selection.

4 - Primitives
In 3DS Max you create primitive 3D geometry as a starting block to modeling detailed 3D objects.



5 - Material Editor
The Material Editor is where all materials and maps are created. It's easy to use and materials can be dragged and dropped onto objects in the scene.

6 - Viewport Navigation
Using the viewport Tools, you can orbit, Pan and Zoom the Viewports.

7 - Quad Menu
The Quad menu can be accessed in the viewport by right clicking the mouse. You will get a different menu dependent on what objects you are working with.

8 - Rendering
When you render, 3DS Max converts a 3D Scene into a 2D Image.

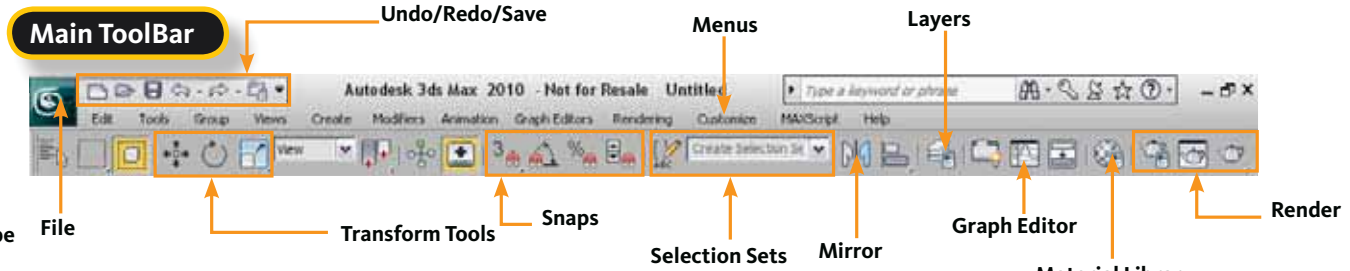
9 - Auto Key
Auto Key allows you to automatically key objects as you scrub through the timeline making transform, Rotate and Scale changes. Any change you make a key will be created.

10 - Animation Settings
Animation Settings allow you to take control over all aspects of your animation setup, from Frame Rate to Number of Frames.

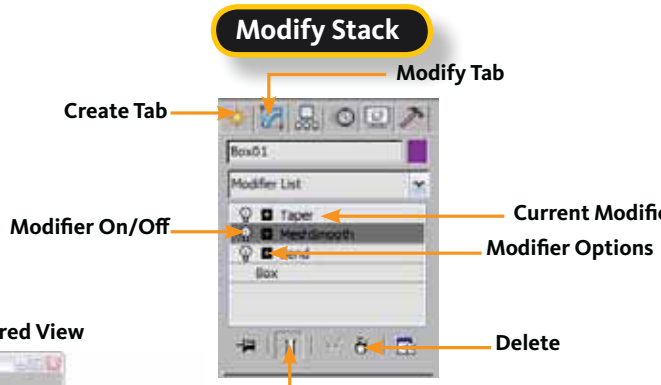
3dsMax Menus

Material Editor

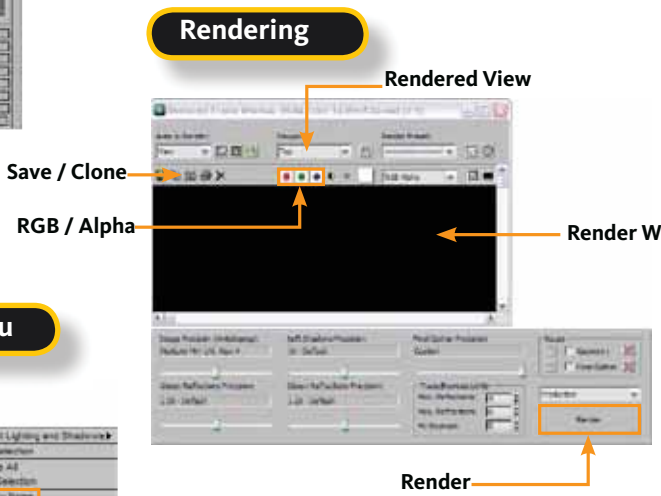
Main ToolBar



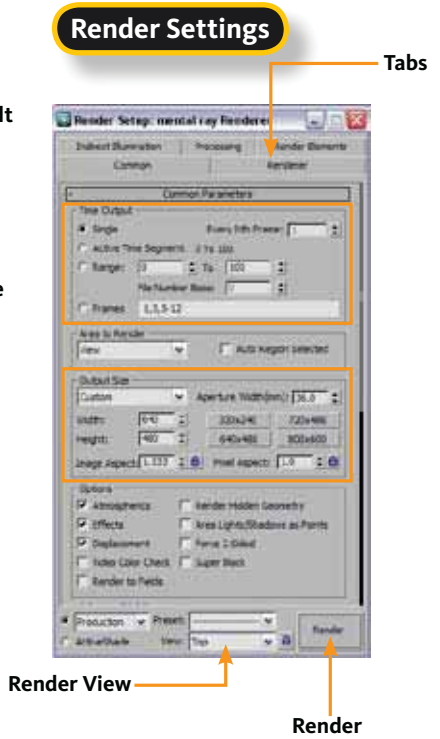
Modify Stack



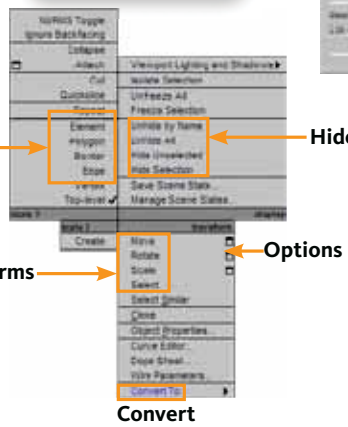
Rendering



Render Settings



Quad Menu

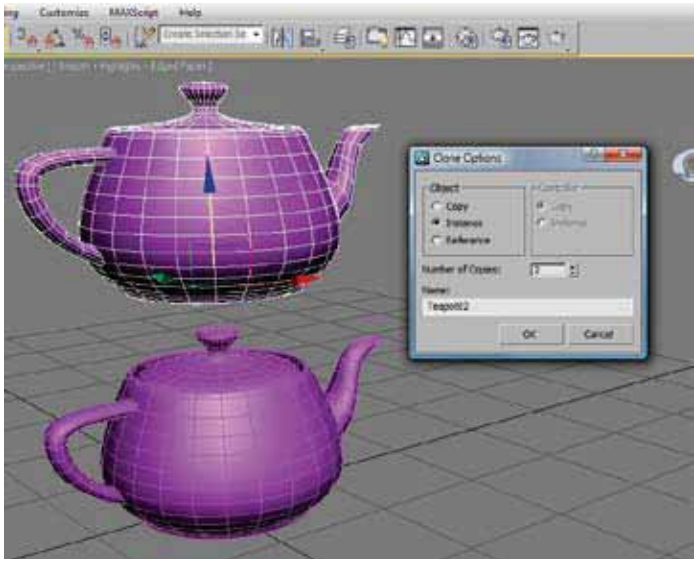


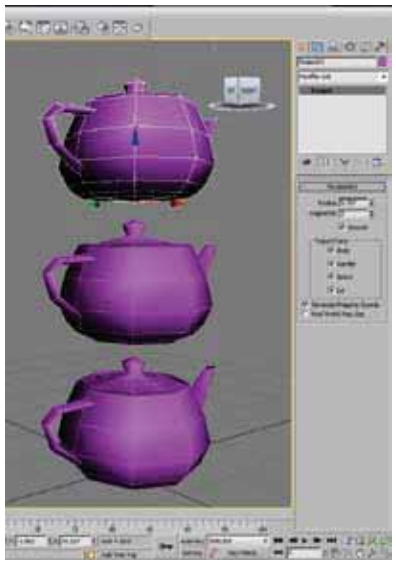
Modifiers

Workbook

Getting Started Tutorials

Autodesk® 3ds Max®





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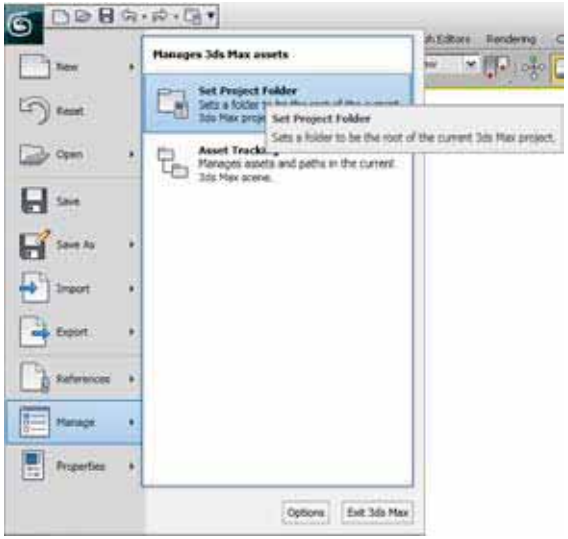
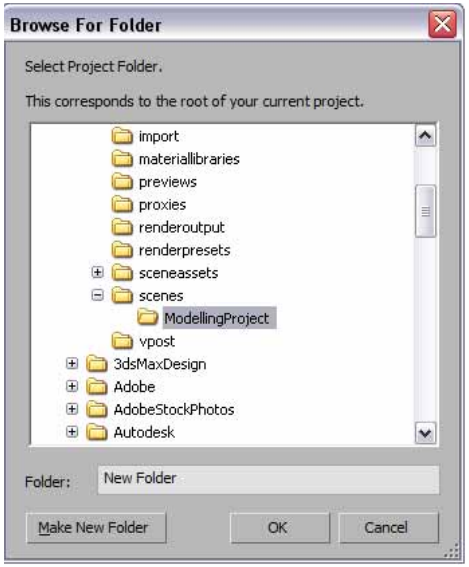
3dsMax Setting Up a Project

1



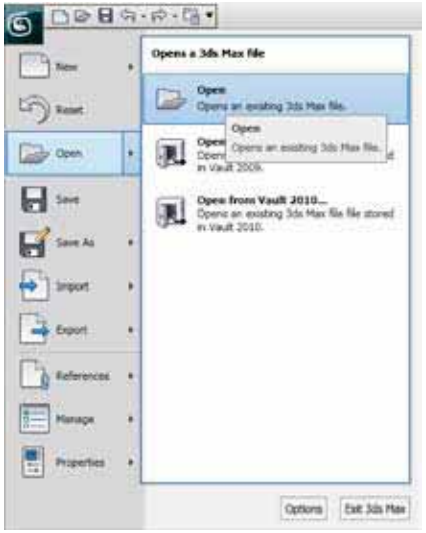
File Management is crucial to the success of any 3D project. By setting a project folder, you are always making sure that files get saved to specific and relevant directories. For example when you set up a project all scene files you save are saved to the Scenes Folder, any materials you save are saved to the Materials Folder etc. First got to File›Manage›Set Project Folder.

2



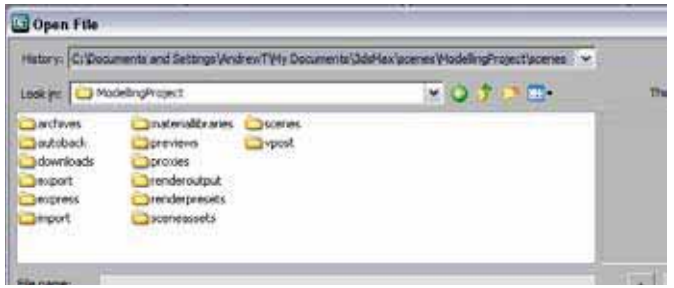
Click on Set project Folder. In the Browse For Folder dialog that appears, navigate to a directory and create a new Folder. This folder should have a name relevant to the project. Once you have created the project folder, click OK. Your project Folder is now set. Every time you hit save the current scene will get saved to this directory.

3



With your project folder now set, if you go to File›Open you will bring up the Open File dialog.

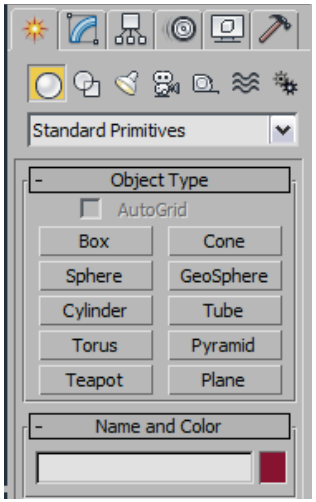
4



The Open file dialog, navigates you directly to the Scenes Folder, in the project Folder you set up earlier. Notice that all your files are laid out in an organized manner. Any files you save, Export, Render are all saved to their relevant Folders making it really easy for you to manage your project and ensure that data doesn't get lost.

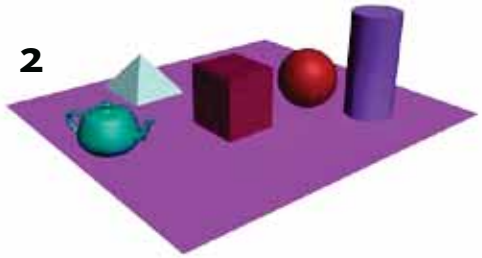
3dsMax Working with Primitives & Editable Polygons

1



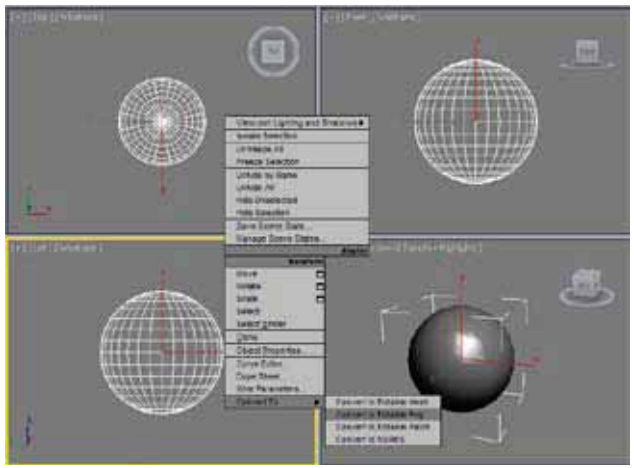
You can create primitive objects by going to the Create Tab in the Command Panel

2



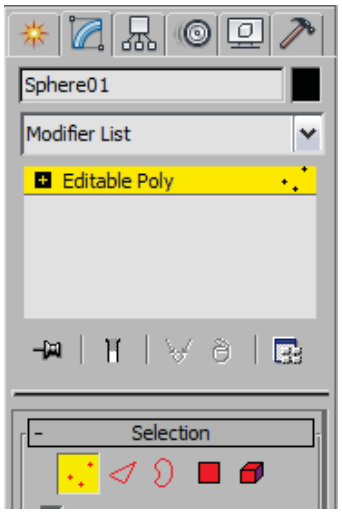
Primitive objects consist of Boxes, Spheres, Cones, Planes, Pyramids and Cylinders. They are easy to create, generally with a 2 click mouse operation

3



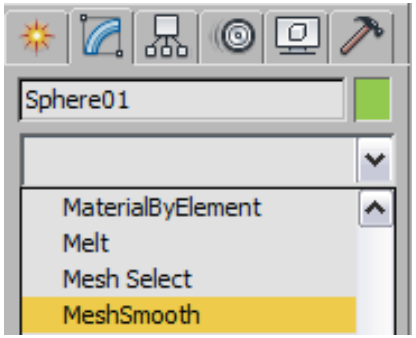
Once you have created a primitive object as your starting block you can convert it to an Editable Poly and then start using some of the Sub-Object modeling tools to develop and refine your model. Any primitive can be converted to an Editable Poly just as a shape can be converted to an Editable Spline. All Editable Polys allow you access to Sub-Object modes.

4



An Editable Poly has 5 Sub-Object levels, Vertex, Edge, Border, Polygon and Element. Each of these levels allows you access to different elements of the Poly.

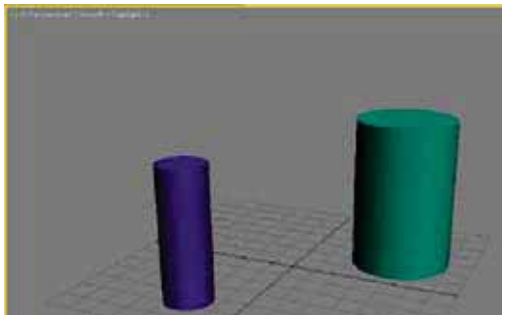
5



Modifiers can also be applied to objects in the Modify Tab, through the Modifiers List. When a modifier is added, it appears above the Editable Poly in the Modifier Stack.

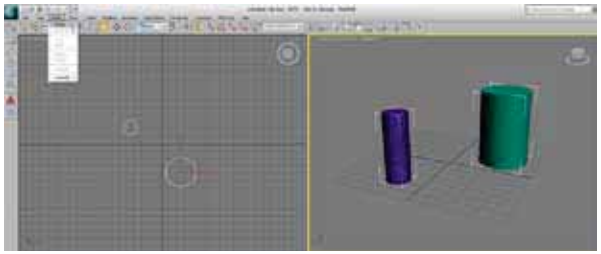
3dsMax Grouping vs. Selection Sets

1



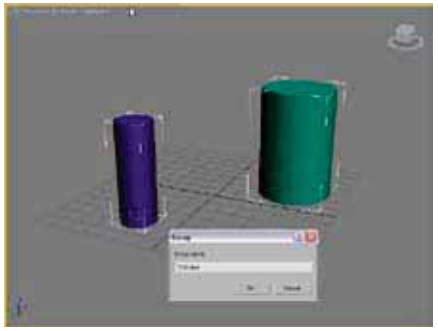
In this tutorial you will get started with creating simple groups and selection sets. It is important to understand the differences between the two, and when to use them. To add objects to a group you will first create two Cylinders in the viewport.

2



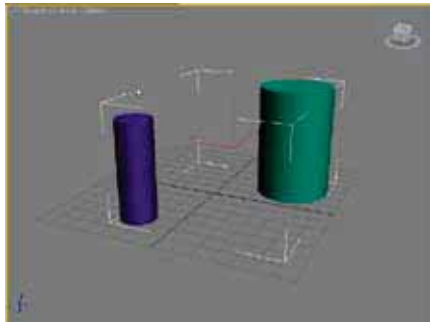
Select the two objects using the Select Object tool from the Main ToolBar. On the Menu Bar go to group Menu>Group.

3



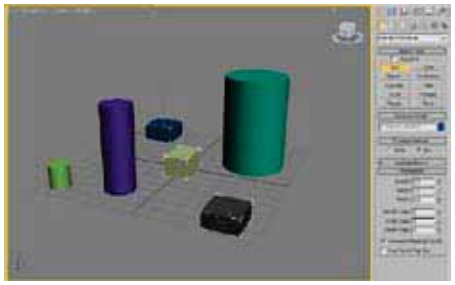
The Group Dialog appears. Give your group a name.

4



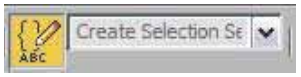
Now if you select either one of the two cylinders they both become selected as a group. With Groups you can only select the objects as a whole group. You can't go in and select individual components of a group. That's where Selection Sets come in handy.

5



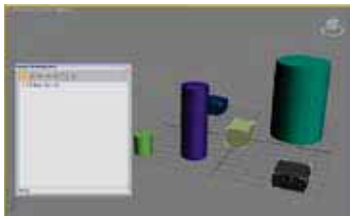
Selection sets let you add objects to sets and select them. This is helpful when objects are hard to see. Create a series of Boxes and Cylinders in the Viewport.

6



From the Main ToolBar hit the Selection Sets Button

7

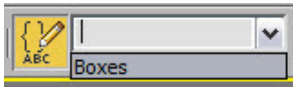


The Selection Sets Dialog Appears. Select the Boxes and hit the + sign in the dialog. This adds the Boxes to a Selection Set.

8

You will see a new Set appears, Double click on it to Rename it. Give it a logical name.

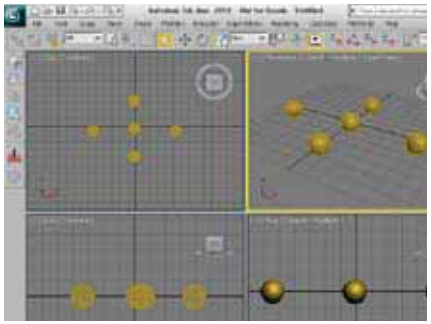
9



From the Selection Set Filter on the Main Toolbar, hit the drop Down Arrow and you will be able to select the boxes easily.

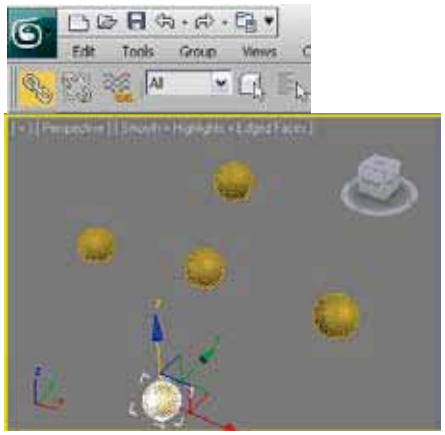
3dsMax Linking & Parenting Primitives

1



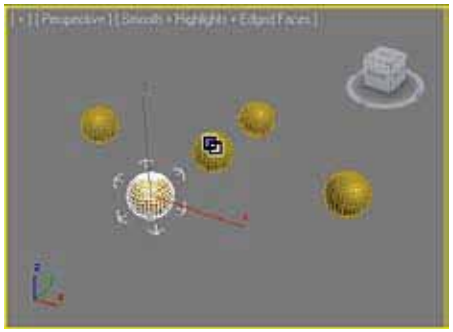
When you link objects in 3DS Max, you create Child-Parent relationships, where the child will always follow the movements of the parent. You will create a set of primitive spheres. You can copy the arrangement you see here or you can follow along. We will link all the outside spheres to the central sphere and have that sphere act as the parent.

2



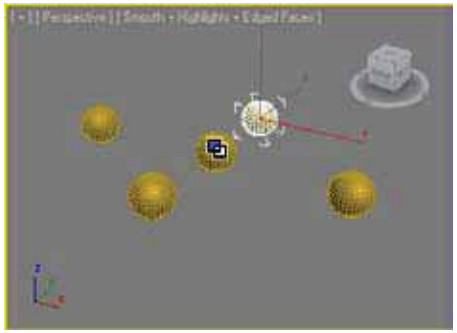
Select the sphere as shown, and from the Main Toolbar go to the Select and Link Tool. Drag from the Sphere to the central sphere. The outer sphere becomes the child and the central sphere becomes the Parent. Always select the Child first.

3



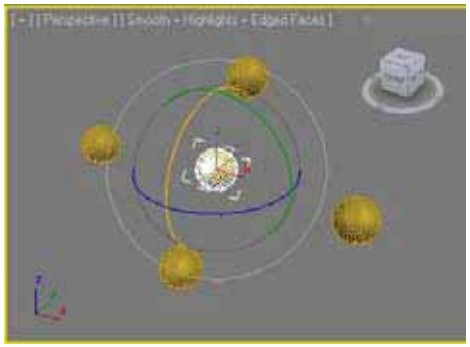
When you drag from the Child to the Parent, you will see a rubber band drawn between the two spheres. Release the mouse over the Parent.

4



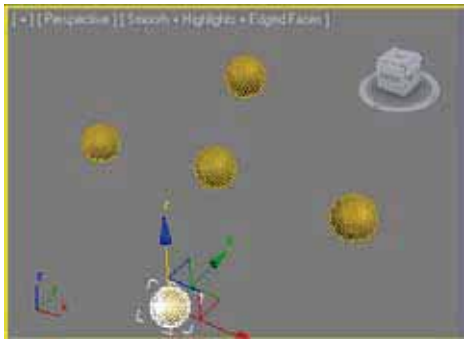
You can now select all the remaining outer spheres and drag to the central sphere, the Parent.

5



Now that you have linked all the outside spheres to the central sphere, or the Children to the Parent. If you select the parent and rotate it in the X-Axis, all the Children will follow.

6



If you select one of the children and move it, it will move independently of the parent. However, when you select the Parent again and rotate it, the Child will be bound to it from its new position.

7

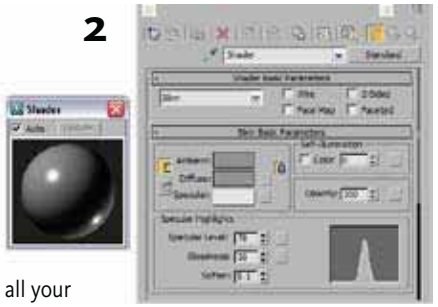
If at any time, you wish to unlink objects, you can do so by selecting all the objects you wish to unlink, and from the Main Toolbar select the Unlink button. This will unlink all Children from the Parent.

3dsMax Creating Materials & Textures

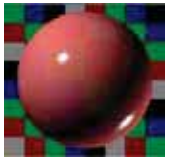
1

The Material Editor is an Easy to use dialog. This is where all your scene materials and textures will be created. The Material Editor allows you to manage individual scene materials in their own individual material slots. You can create Procedural Materials. These are materials created parametrically within 3DS Max. You can also create Bitmap Materials. These use external image files.

2



First you will create a simple Procedural Material. To do this click on an empty material slot. Click the Arch and Design Slot, and from the Material/Map browser select Standard. You are now working with a simple Standard Material. Click the Diffuse Color Swatch and change it to Red.

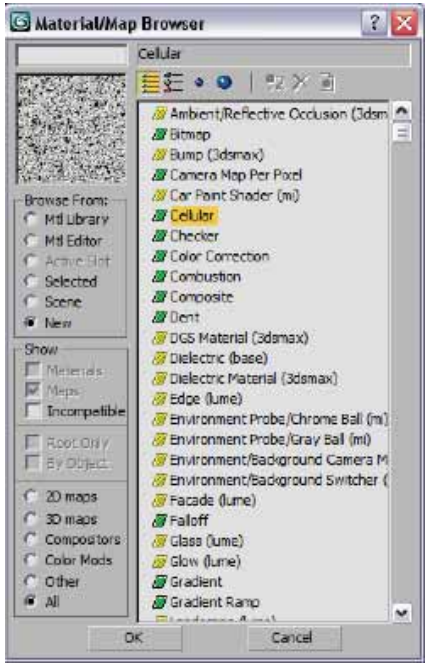


You have created a simple material that is now ready to be dragged and dropped onto an object in your scene.

3

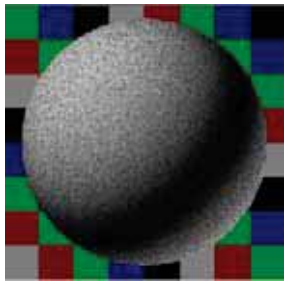
You will now create a material with a Texture Map applied to it. Select an empty material slot, and change it to standard. Click the little grey Map button next to the Diffuse Slot. This will bring up the Material/Map browser and will allow you to select a map for your material.

4



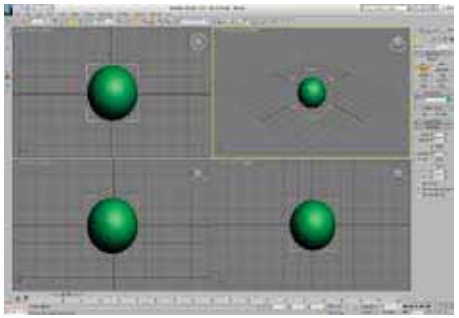
From the Material/Map Browser, select a Cellular Map. This is a procedural texture map, meaning that the texture is controlled via sets of parameters within the Material Editor. If you select a Bitmap file, it is best to save the image to your Images Folder in your Project Directory , and load it from there. This file will also need to be supplied with the scene file when you transfer to another computer.

5

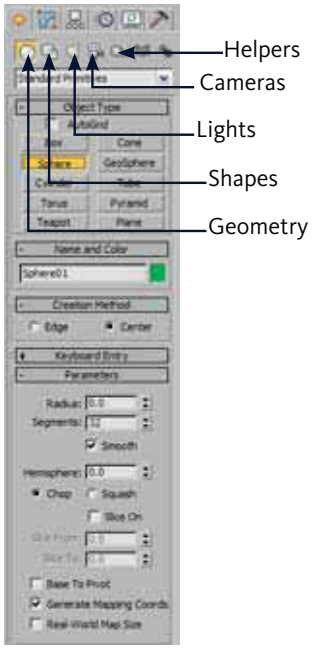


If you double click on the Cellular Map, you will notice it is added to the Diffuse slot of your Standard Material, and the material takes on a new appearance. Maps are great for creating realistic looking textures.

3dsMax Basic Animation

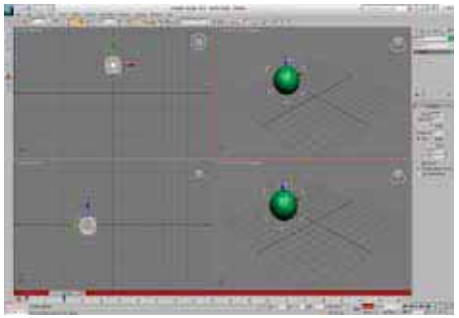


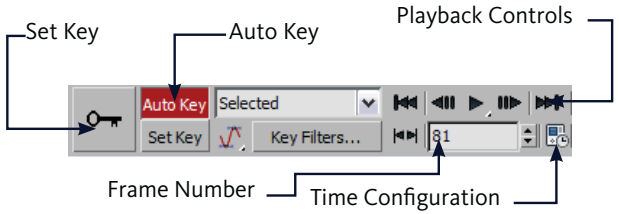
In this tutorial, you will create a simple animation of a sphere moving across the viewport. To start, go to the Command Panel>Create>Geometry>Sphere. Left Click in the viewport and drag out a Sphere. Right click when you are done. Go to the Main Toolbar and select the Move Tool. Select the Sphere. You are now ready to start animating.



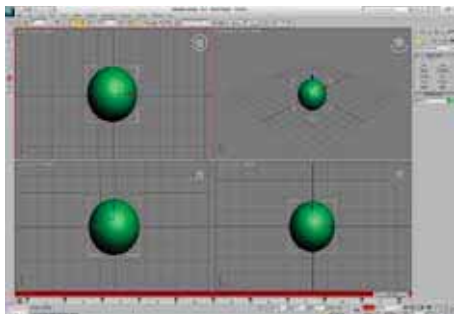
The Command Panel is a very important part of 3DS Max. Its where all objects are created and modified. It is made up of Tabs that are arranged in an easy to use layout. Most object parameters can also be animated using Auto key or Set Key. Lights and Cameras can also be animated.

Go to the bottom right of the interface and hit the Auto Key button. Move the Time Slider to Frame 10 and then move the Sphere to a new position. Notice that two key frames are created. One at frame 1 and one at Frame 10. Move the Time Slider to Frame 20 and move the Sphere.

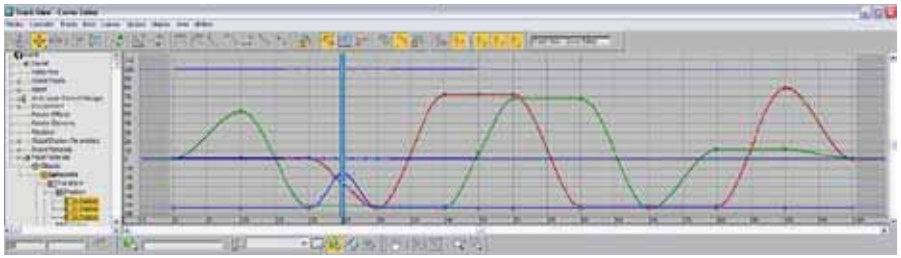




The animation and Playback controls allow you to play your animation in real-time in the 3DS Max viewports. Auto Key, allows you to set an initial key, scrub through the timeline, move your object, and the object will be automatically keyed. It's a quick and easy way to animate objects in 3D space



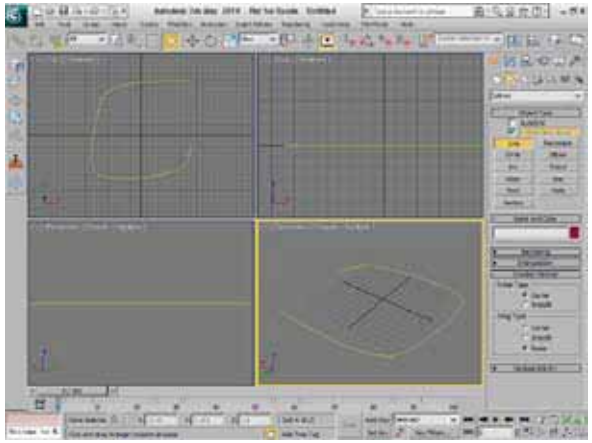
As you move the Time Slider across the Time Line and move the Sphere you will see new keys are created. Set new Keys at Frames 30, 40, 50 etc until you reach 100. When you are done be sure to turn off Auto Key.



Once you have animated your Sphere, Go to Graph Editors>Track View - Curve Editor. With your object selected you will see the animation curves that were created. You can refine your animation using these curves.

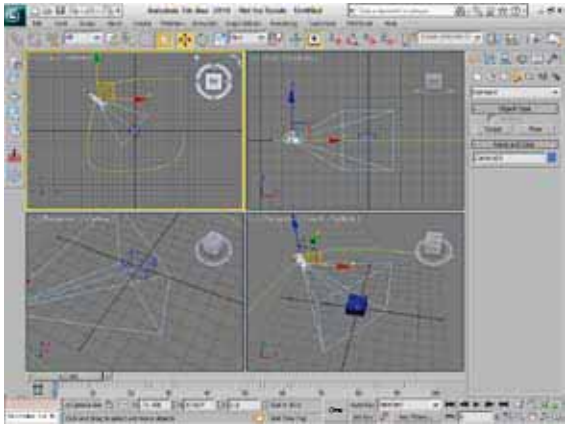
3dsMax Animating a Camera Along a Path

1



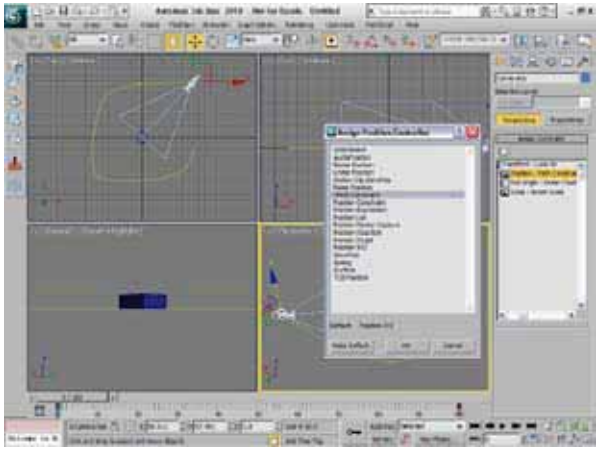
In this tutorial, you will animate a camera along a path. This is a great way of creating camera walkthroughs. You can attach either a Free Camera or a Target Camera to a path. First go to Command panel›create›Shapes›Line and create an open spline. This will be used as the path. The next step will be to create a target camera and an object in the scene for the camera to look at.

2



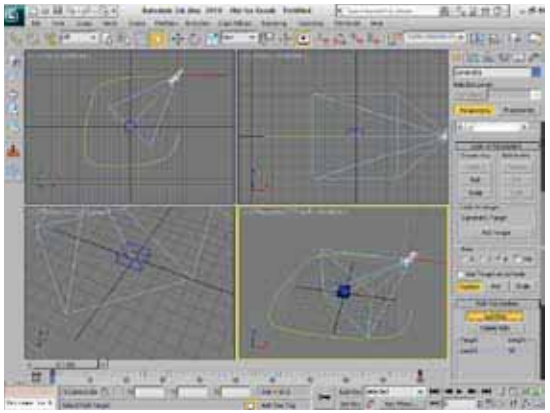
Create a box and put it at the centre of the path. To create the Camera, go to Command Panel›Create›Cameras›Target Camera. In the Top view, place your Camera over the path and drag until the target is over the box. In the next step, you will attach the camera to the path. You will do this using a Transform Controller called a Path Constraint.

3



To create the Path Constraint Controller, select the camera and go to the Command Panel›MotionTab. In the Motion Tab, Click on the Position option in the Assign Controller Rollout so it becomes highlighted in yellow. Next Click on the little button in the rollout to bring up the Assign Position Controller dialog. You will select Path Constraint. You won't see much happen yet other than the Path Controller being added to the Position Transform.

4

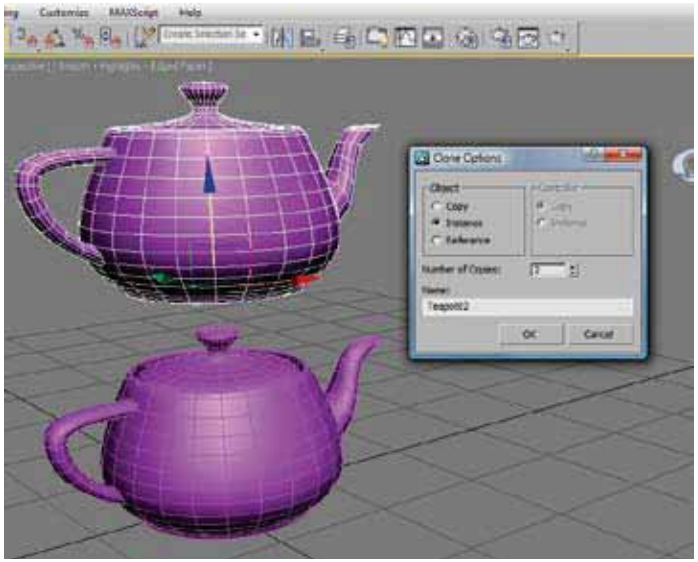


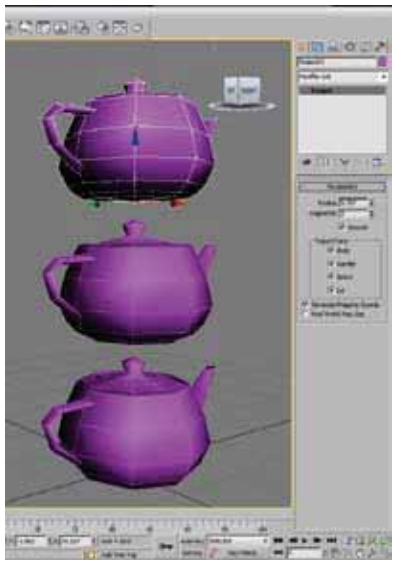
Scroll down the Rollout to the Get Path Button. Press the button, and with the cross hair, click on the path. You will notice the camera jump to the start of the path whilst the target remains over the box. You will also notice that two key frames have been added at the start and end of the Time Line. If you press play in the play back controls you will see the camera move along the path, whilst the target remains over the Box. Press C on your keyboard to go to the Camera View. You cannot move the camera directly anymore, you must move the path and the camera will move with it. Go ahead and try adding a Free Camera to the Path

Workbook

Learning

Autodesk® 3ds Max®





2010

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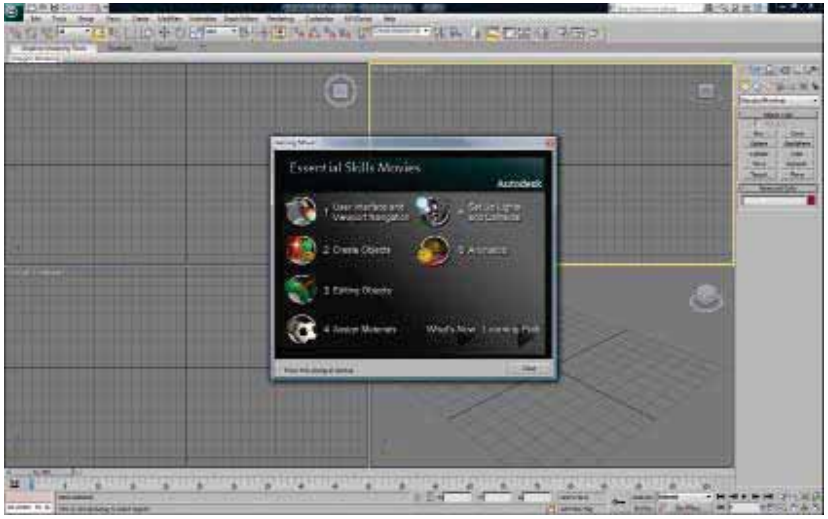
Opening Autodesk 3ds Max 2010

After installing 3ds Max 2010 you can open it two separate ways. One is by simply double-clicking on the icon that 3ds Max will have generated during installation on your desktop.

Alternatively, you can navigate to 3ds Max in Windows® by navigating to **Start→Programs→Autodesk→Autodesk 3ds Max 2010**. Upon launch you should be given two options. If you have purchased 3ds Max 2010 you will have an activation code that came with the software documentation. Follow the steps on-screen during the activation process to launch the software. If you are using 3ds Max on a trial basis, choose that option and the software should load with a 30-day trial that has all of the features of the regular version for a limited time. Once the software loads, you will see 3ds Max software's first splash screen.



3ds Max 2010 startup splash screen.

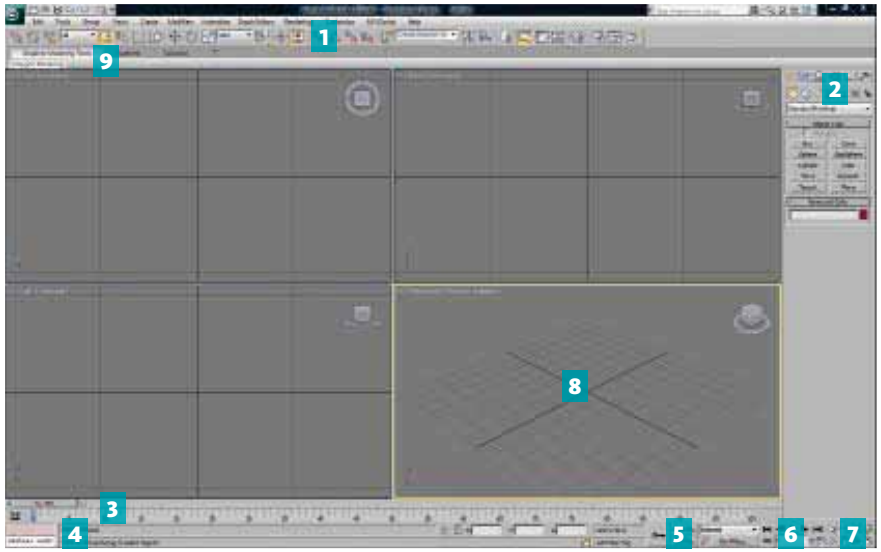
Here you will find that the first splash screen points you in the direction of Essential Skills Movies. These short movies are designed to jump start you in the direction of whatever it is you are using 3ds Max 2010 for. By clicking on any of the six movie choices, 3ds Max will automatically launch your default Internet browser and begin playing a short video, giving you some basic instruction on your topic of choice. These video clips are just a small taste of the help that is available for you when learning the software.

The **What's New** option will launch your default Internet browser and take you to the Autodesk website dedicated to explaining the newest features in this version of 3ds Max. If you are familiar with previous versions of 3ds Max, this site will provide you with additional training and videos on the most recent additions to the software.

The **Learning Path** option will launch your default Internet browser and take you the Autodesk 3ds Max Service and Support website. This site can point you in the direction of a multitude of topics regarding 3ds Max, including tutorials, discussion forums, additional help and documentation, as well as events and seminars. If you are new to 3ds Max, this is a great resource for furthering your education or finding answers to questions you may have while learning the software.

Lastly, on the bottom left of the box you can check on or off under **Show this dialog at startup** to show this popup when you launch 3ds Max or not. If you decide to not have the box pop up at launch, but would like access to any of these features, you can find them under the **Help** menu on the main toolbar. Once you have clicked **Close**, you are looking at the default 3ds Max 2010 interface. Take a moment to get familiar with the basics of the interface as we start to address some of the key

3dsMax Skills



The 3ds Max 2010 interface.

Key Interface Elements

Using the image above as a guide, let's look at some of the main UI elements in 3ds Max 2010.

1 Main Toolbar

The main toolbar provides quick access to tools and dialog boxes for many of the most common tasks in 3ds Max 2010.

2 Command Panel and Menu Bar

The command panel comprises six user-interface panels that give you access to most of the modeling features of 3ds Max 2010, as well as some animation features, display choices, and miscellaneous utilities. To switch to a different panel, **LMB** click the tab at the top of the command panel.

3 Time Slider

The time slider lets you navigate along the timeline and jump to any animation frame in your scene. You can quickly set position and rotation or scale keys by **RMB** clicking the time slider and choosing the desired key from the Create Key dialog box. We will discuss animation and the time slider further in Lesson 11, as well as Projects 5 and 6.

4 Status Bar Controls

The 3ds Max 2010 window contains an area at the bottom for prompt and status information about your scene and the active command. To its right/left is the coordinate display area, in which you can manually enter transform values. To its left, is the MAXScript listener window, where you input single-line scripts.

5 Animation and Time Controls

Between the status bar and the viewport navigation controls are the animation controls, along with the time controls for animation playback within viewports.

Use these controls to affect your animation over time. We will discuss animation and the time controls further in Lesson 11, as well as Projects 5 and 6.

6 Animation Playback Controls

Use these buttons to see your scene in motion through time. We will discuss animation and the playback controls further in Lesson 11, as well as Projects 5 and 6.

7 Viewport Navigation Controls

Use these buttons to navigate your scene within the viewports. As we progress further in this lesson we will explore these features more.

8 Viewport

When you start 3ds Max 2010, the main screen contains four viewports showing the scene from different angles. By default you are looking at the Top, Front, Left, and Perspective views respectively. The Top, Front, and Left views are 2D representations of your scene, also referred to as Orthographic views.

The Perspective viewport, by contrast, most closely resembles human vision in 3D. We will cover viewport navigation further in this lesson.

9 Graphite modeling tools

The graphite modeling tools menu is new with 3ds Max 2010, and it combines a wealth of new polygon-modeling features, including freeform sculpting and powerful loop-modeling tools, with the tried-and-true toolset in a dynamic, configurable new ribbon interface. By clicking the small arrow button at the end of the bar you can minimize and maximize the toolbar.

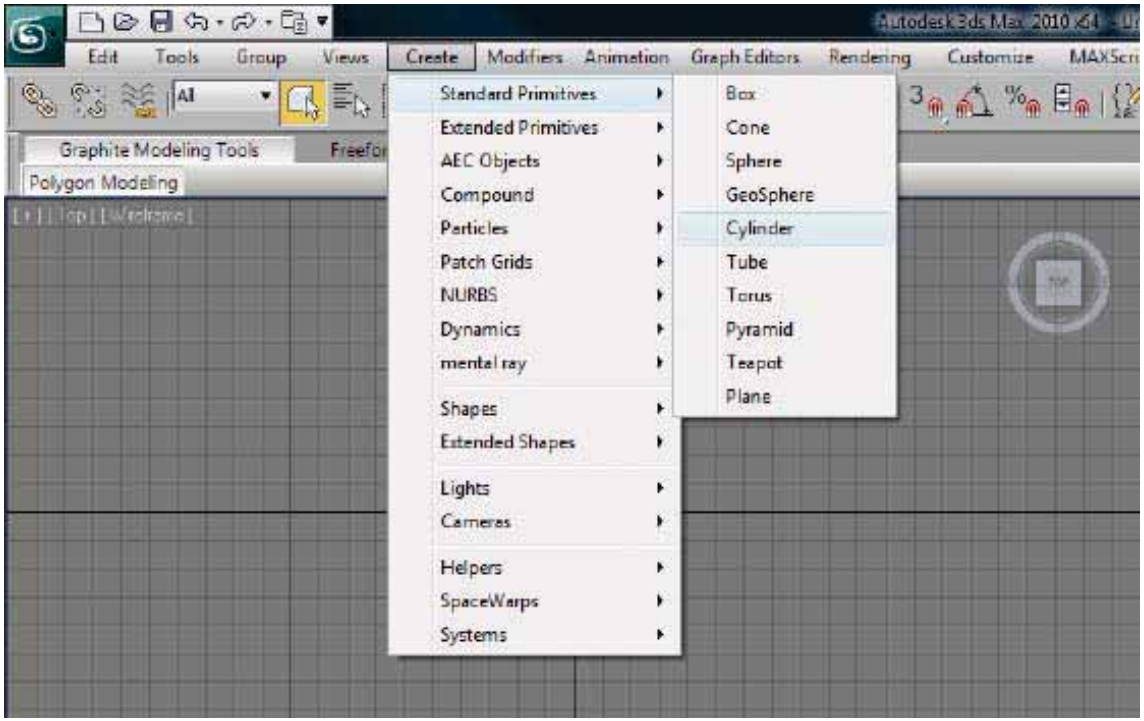
Navigating the viewports, Interface, and 3D Space

Now that we have the very basics of what each element in the UI is, let's focus a little more on some specific tips for navigation and getting around.

Menus, Features, and Moving Around

The menu bar along the top of the interface contains a large number of the most commonly used functions in 3ds Max. For almost every single button or icon you can click on, there is likely a menu function associated with it. As we move forward in the lessons, menu items are referenced as **Menu Name→Submenu→Menu Item**. For example, if you needed to create a cylinder, you could do so by **LMB** clicking **Create→Standard Primitives→Cylinder** in the menu bar.

The default Main toolbar found under the menu bar.



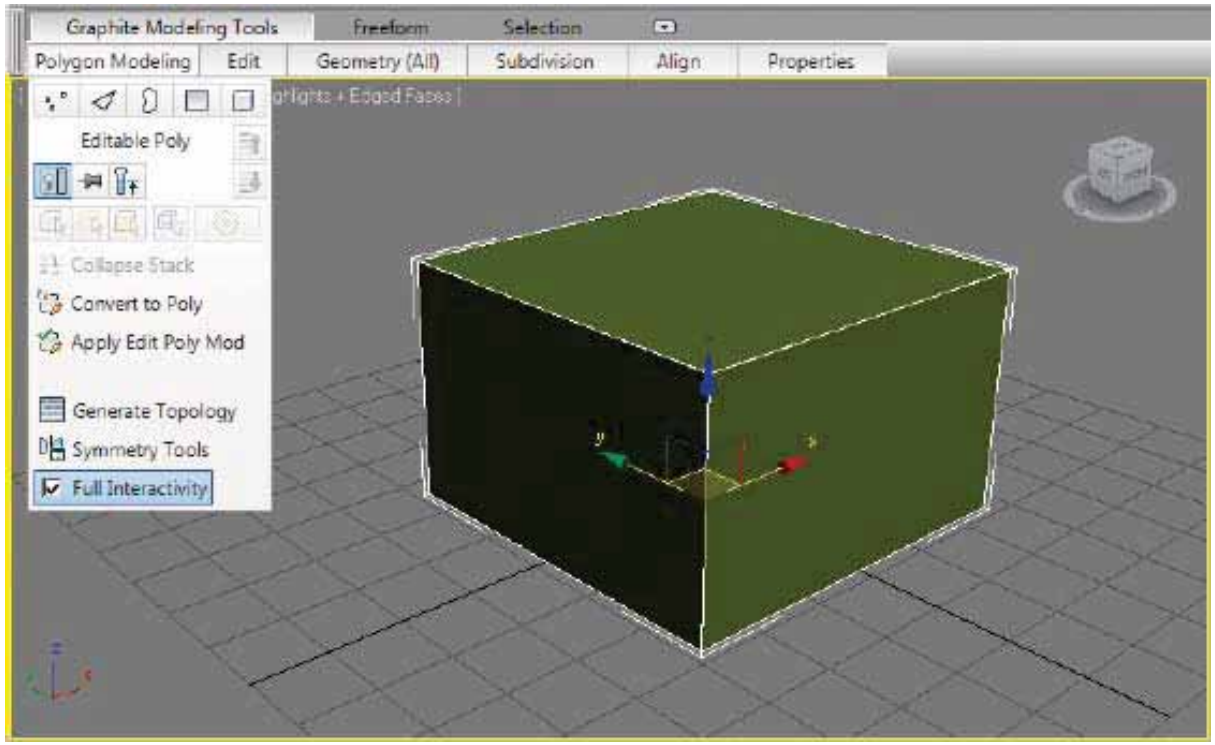
Creating a cylinder using the menu bar.

Directly underneath the menu bar is the Main toolbar. It is primarily a series of icons that take some memorizing to get used to, but handle a large number of the most commonly used 3ds Max functions. These functions are accessed by **LMB** clicking on them. Some of the buttons along the Main toolbar have additional functions by **RMB** clicking on them as well. We will discuss several of these additional features throughout this book.

3dsMax Skills

Directly underneath the Main toolbar are the graphite modeling tools. This new toolset contains a series of tools new to 3ds Max 2010, as well as a neatly organized collection of some of the most commonly used functions while creating 3D geometry. Without having created anything yet you will not see many options, but as you begin to build your assets these tools will come to life with all sorts of features and functions to improve your modeling speed and quality. To expand the menus, simply **LMB** click on any of the tabs to access their features.

A small example of the many features in the graphite modeling toolset.
As you have already noticed, the predominant real estate on screen is four separate windows into 3D space, called viewports. These windows each represent a different view of your scene or asset. To access any of the viewports individually, you do so by **LMB**, **RMB**, or **MMB** clicking the desired viewport. You will see a yellow highlight along the border of the viewport you currently have selected.



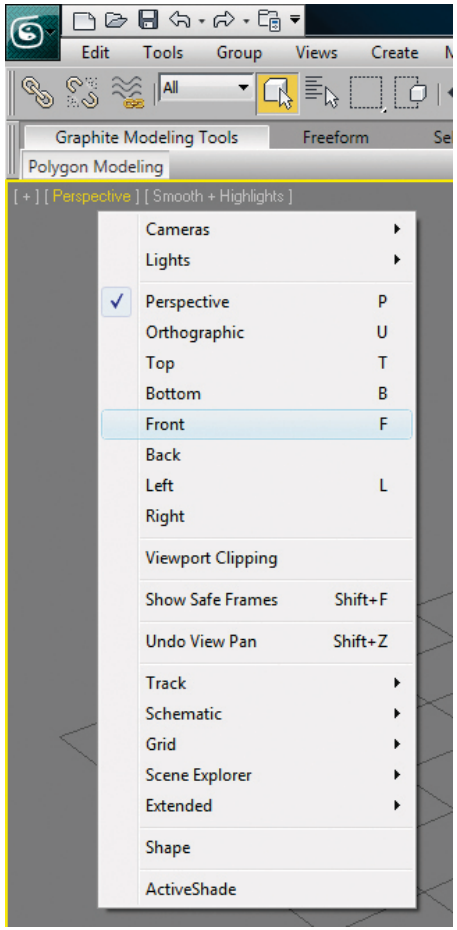
Tip:

Hovering your mouse over a vast majority of the icons and buttons in the Main toolbar will show you the name of that button. If you wonder what that button does specifically, try looking it up in the Help menu.

If you would like to maximize any of the views on your screen, rather than working with all four of them open, you can do so by first accessing your desired viewport and then pressing **Alt** + **W** on your keyboard. Alternatively, at the very bottom right corner of the UI you can also press the **Maximize Viewport Toggle** to maximize or minimize the currently accessed viewport.

Press Alt + W or use the Maximize Viewport Toggle to maximize your selected viewport.

Working with a maximized viewport is a personal preference, but it definitely increases the visual workspace of your scene or asset. To quickly move back and forth between the various viewport options, you have more than one way to do it. **RMB** clicking on the Perspective title in the upper right-hand corner of your viewport can allow you to **LMB** click any of the desired views to choose them. Alternatively, using the hotkeys can be a quick option as well.



RMB click on the name of your current viewport to bring up additional view choices.

3dsMax Skills

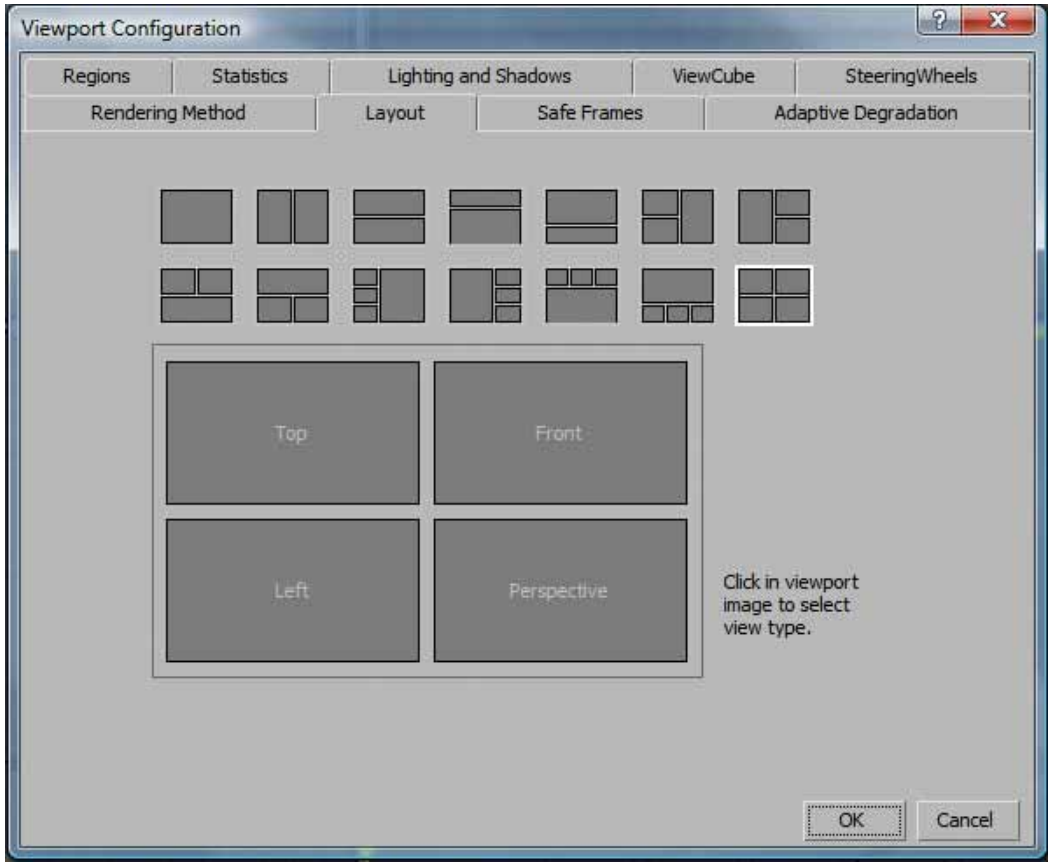
In any viewport, to drag the camera around freely, **MMB** click and hold anywhere in any of the viewports left, right, or up and down, and you will drag the camera in that direction. Keep in mind that this does not actually move anything in your scene, it simply moves the camera that is pointed at your scene.

Tip:

If you want to work with multiple viewport windows, there are a couple options to customize the look of them. LMB click on the very center of the four viewports and you will see the icon change, allowing you to drag the windows to the size you deisre.

Also, you can access preset configurations by clicking the + button at the top of any of the viewport windows and choosing Configure, and choosing the Layout tab. Here you can choose any of the premade layouts and then click OK.

You can also access this window under Views → Viewport Configuration.



The Viewport Configuration window with the Layout tab selected.

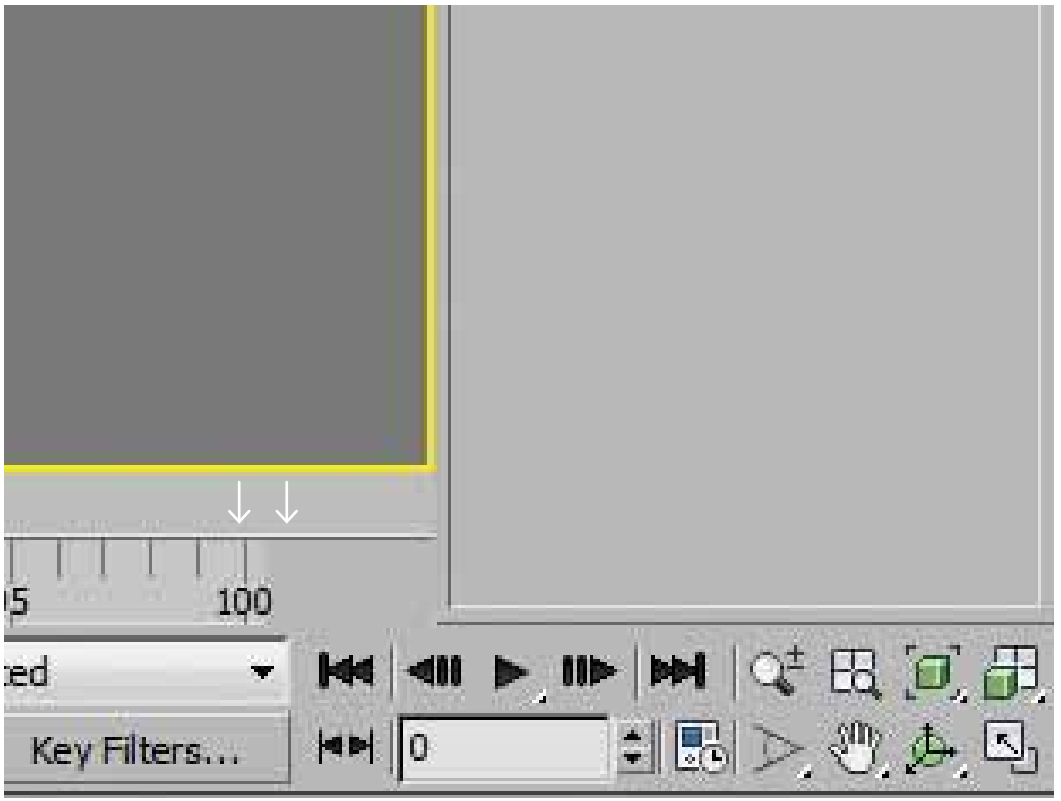
Rolling the **MMB** up or down will cause your camera to zoom forward or back. Holding down the Alt button while rolling the **MMB** will slow the speed of zoom.

Holding down the **Alt** and the **MMB** simultaneously will cause your camera to roll around the object in 3D space.

If at any time during your camera movements you want to get back to the center of the grid (known as 0,0,0) or frame the camera on your selected object(s) you can either click the Zoom Extents to center in just one currently active viewport, or the Zoom Extents All option will frame all of the viewport windows you currently have open.

Tip:

The Z key is the default hotkey for Zoom Extent All Selected. Get used to quickly moving around in 3D Space and then tapping the Z hotkey to quickly reframe your scene.



Use the Zoom Extents or Zoom Extents All choices to frame your selection inside the current viewport.

Navigating the Command Panel

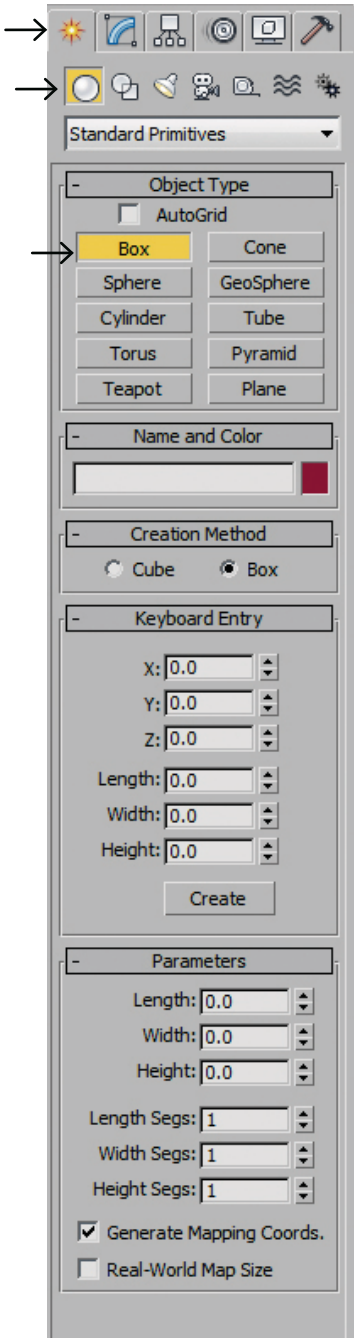
The **Command Panel** along the right side of the UI is where a large number of creation and adjustments are made to geometry. Aside from the new **graphite tools**, this is also where the majority of the polygonal mesh functions are found as well. While there are a large amount of tools to cover, for the first project we will focus on just a few.

To access the various tabs, pull-down, or objects from the **Command Panel**, simply hover your mouse over the desired selection and **LMB** click it.

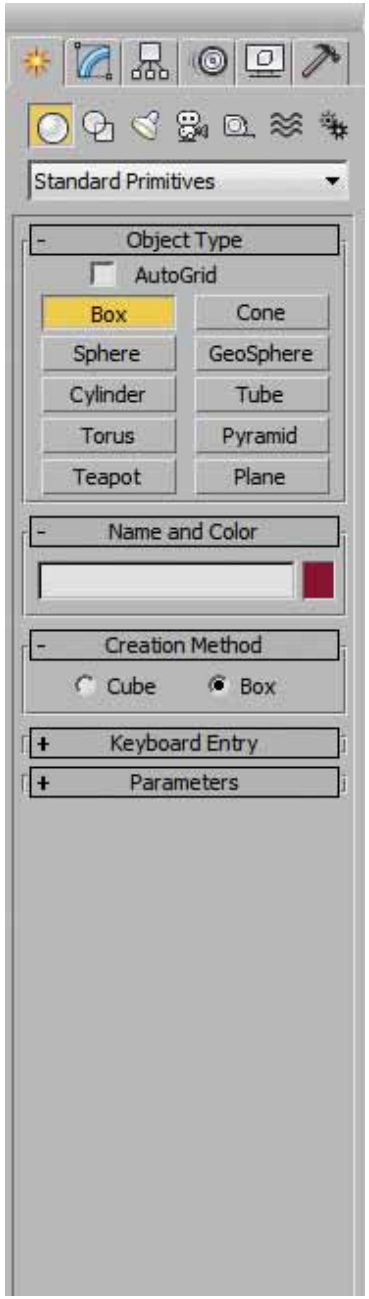
The **Create** tab features the majority of objects to create, ranging from various 3D and 2D shapes, cameras, lights, and more. Under the Create tab there are many other subgroups as well as pull-down menus for all the different things you can create. Keep in mind that any of these shapes or objects are simply building blocks for the objects we will be creating.

The **Modify** tab is where specific adjustments are made to the specific selected objects, as well as the many modifiers we will use when working with 3D. If you have nothing selected it will be blank, because you have nothing selected to modify.

The **Hierarchy** tab is where adjustments to an object's pivot point can be made, or we can utilize the working pivot. We will dive further into this later.
The **Motion** tab is focused more for animation and trajectories.
The **Display** tab allows you to quickly filter what is being shown on screen with various category options.



The Command Panel, with the Create tab selected, Geometry option chosen, and Box selected.



The Command Panel, with several of the submenus collapsed.

The **Utilities** tab has a preset collection of various unique tools and functions. As you may notice, there are several submenus in the Command Panel. In the example to create a Box, you can see **Object Type**, **Name and Color**, **Creation Method**, **Keyboard Entry**, and **Parameters** as the submenus. To expand or collapse submenus inside of the Command Panel, simply hover your mouse over the name of the submenu, and **LMB** click to expand or collapse.

Creating and naming objects in 3ds Max 2010

Now that you understand the very basics of the interface as it pertains to game asset modeling, let's go ahead and create our first object in 3D space. Keep in mind that we will be exploring a large amount of the interface as we move forward, but hopefully you are starting to get familiar with it.

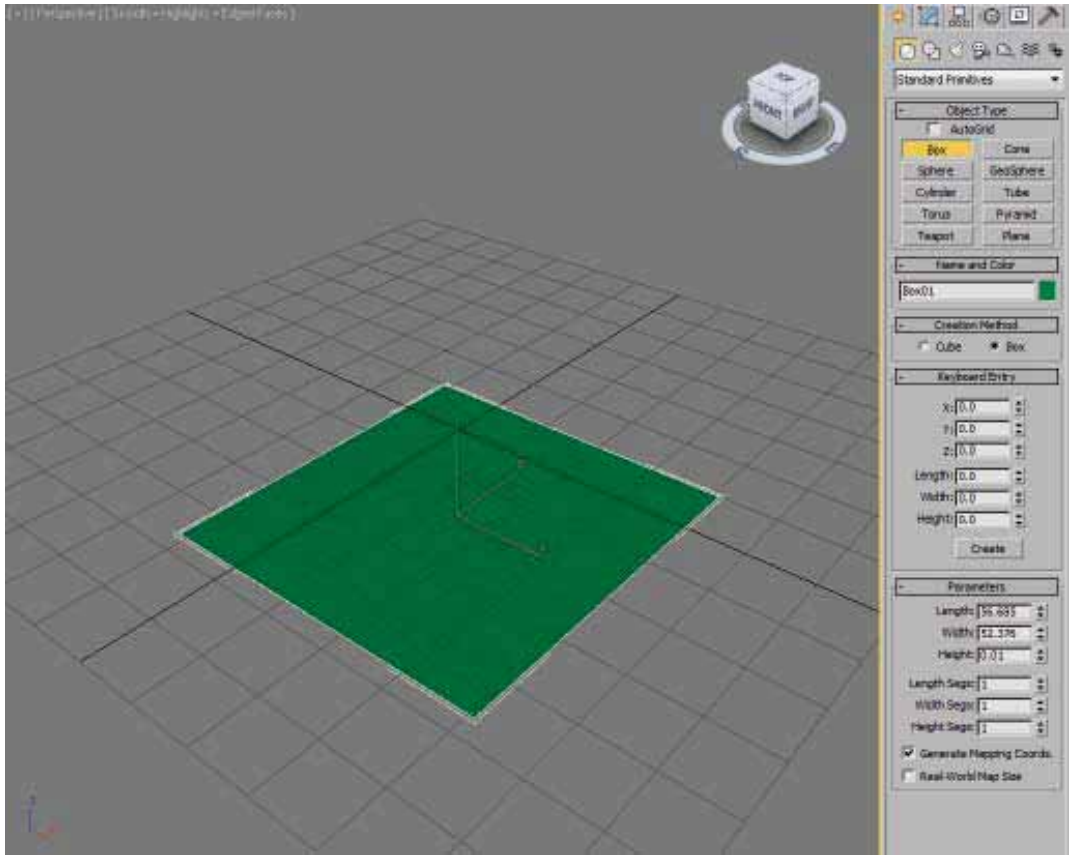
Create a geometry box.

For your first object, let's create a simple box.
In the Command Panel, select the **Create** tab, the **Geometry** option, and the **Box** as the Object type.

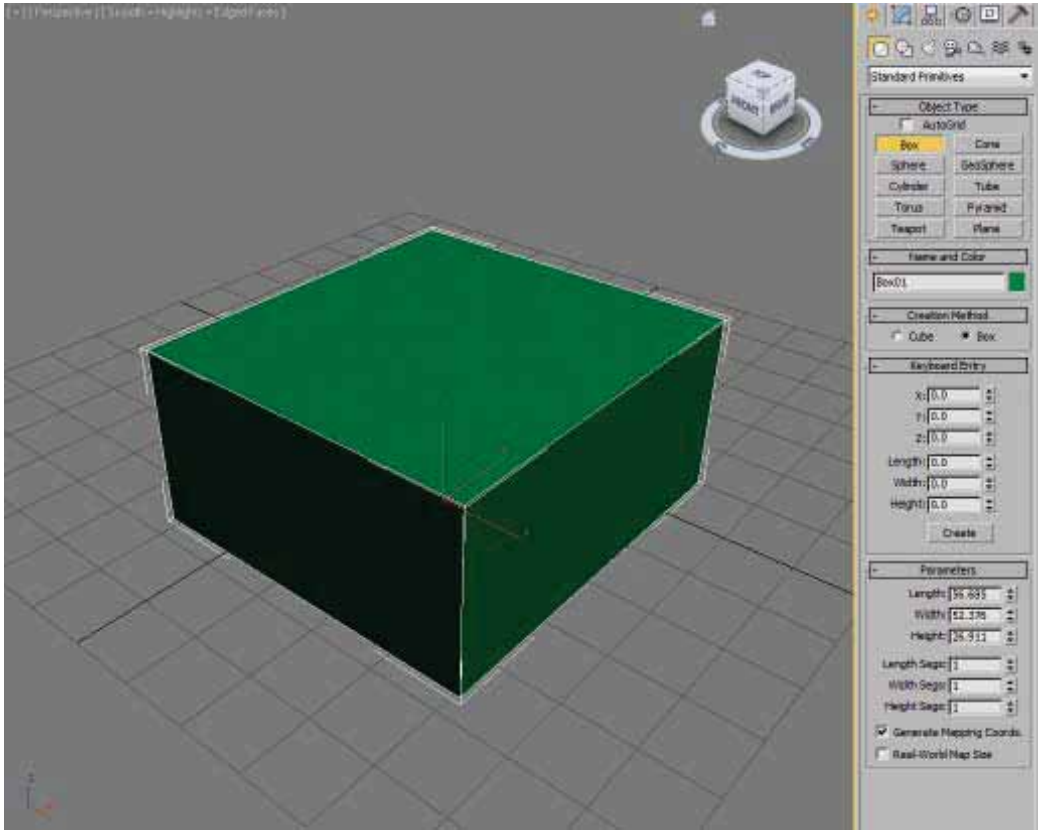
In the **Perspective** viewport, hold the **LMB** and drag it around anywhere in the viewport. As you are moving the box around in the viewport, you are identifying its length and width.

Release the **LMB**, and move the mouse up or down in the viewport. This is identifying the object's height.

When you get a height you are happy with, click the **LMB** again.



Start by dragging the box in the Perspective viewport.



Move the mouse up to identify the box height.

Name the box and change its color.

Now that you have created your first box, let's name it something and change its color.

Start by selecting your box. You do this by **LMB** clicking on the box in the viewport.

In the Command Panel, under the **Name and Color** submenu, type in a new name for your box.

Next to the name, you should see a color box. In my example you can see it as a green box. Yours might be a different color because by default 3ds Max will randomly choose a color for you when you create a new object.

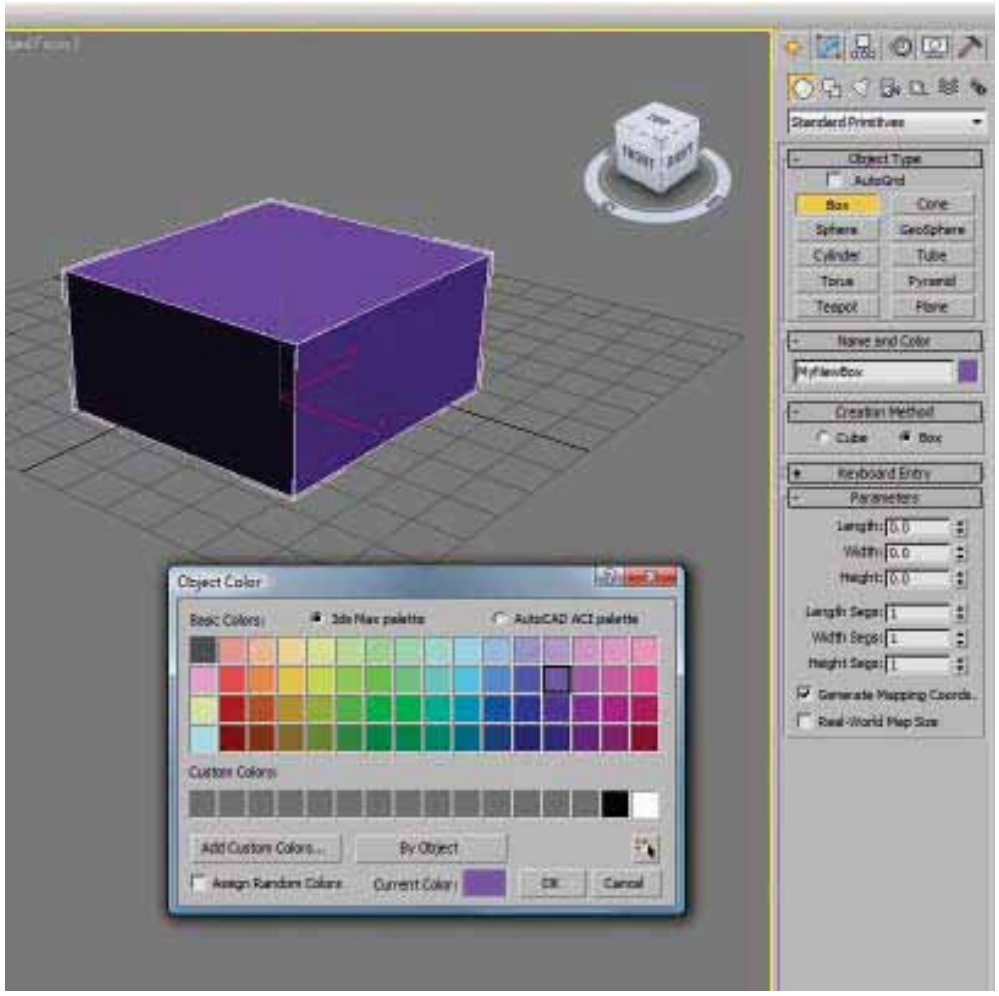
Click the color box using the **LMB** and a new window should appear.

In the **Object Color** window, pick any color you want to change the color of your box.

Tip:

In the Object Color window, you can turn off the random color generation by unchecking the box next to Assign Random Colors. Any color you choose will be the default color of all of your objects you create from now on.

Changing the display of objects you create

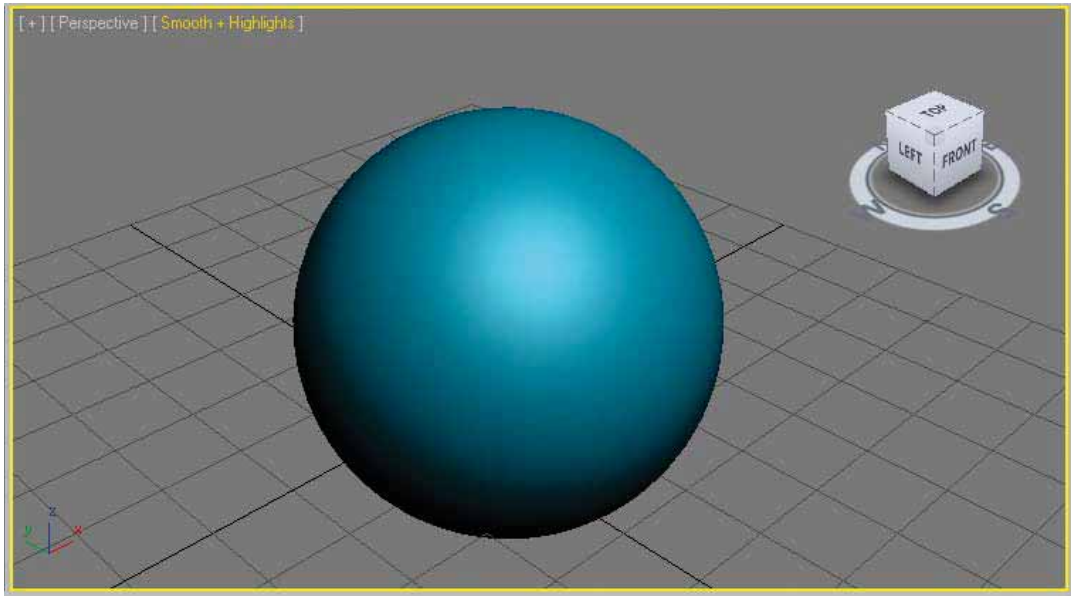


Change the color and name of your box.

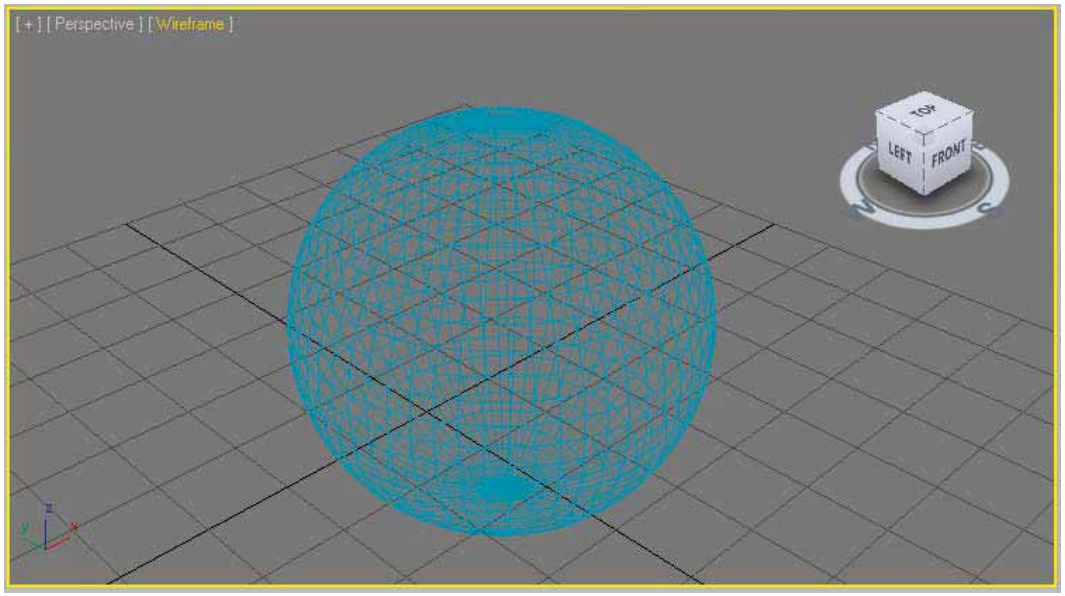
Now that you have created your first object in 3D space, feel free to play around with other shapes. The creation method for many of them is very similar and we will further explore more primitives in the next chapter. Regardless of which shape you create, there are a few methods to adjusting how you view objects in 3D space.

For whichever viewport you are in, you will notice there are several different viewport options in the top left-hand corner of the viewport itself. By default when you start max, the setting should be **[Smooth + Highlights]**, as indicated between the two **[ ]** brackets. This setting is how the object inside the viewport is rendered, in this case, you can see smoothing on rounder or softer geometry, and there will be a lighting highlight. You can change this by **LMB** clicking on the [Smooth + Highlights] option and selecting a different view as you choose.

3dsMax Skills



The Default [Smooth + Highlights] viewport setting on a sphere.

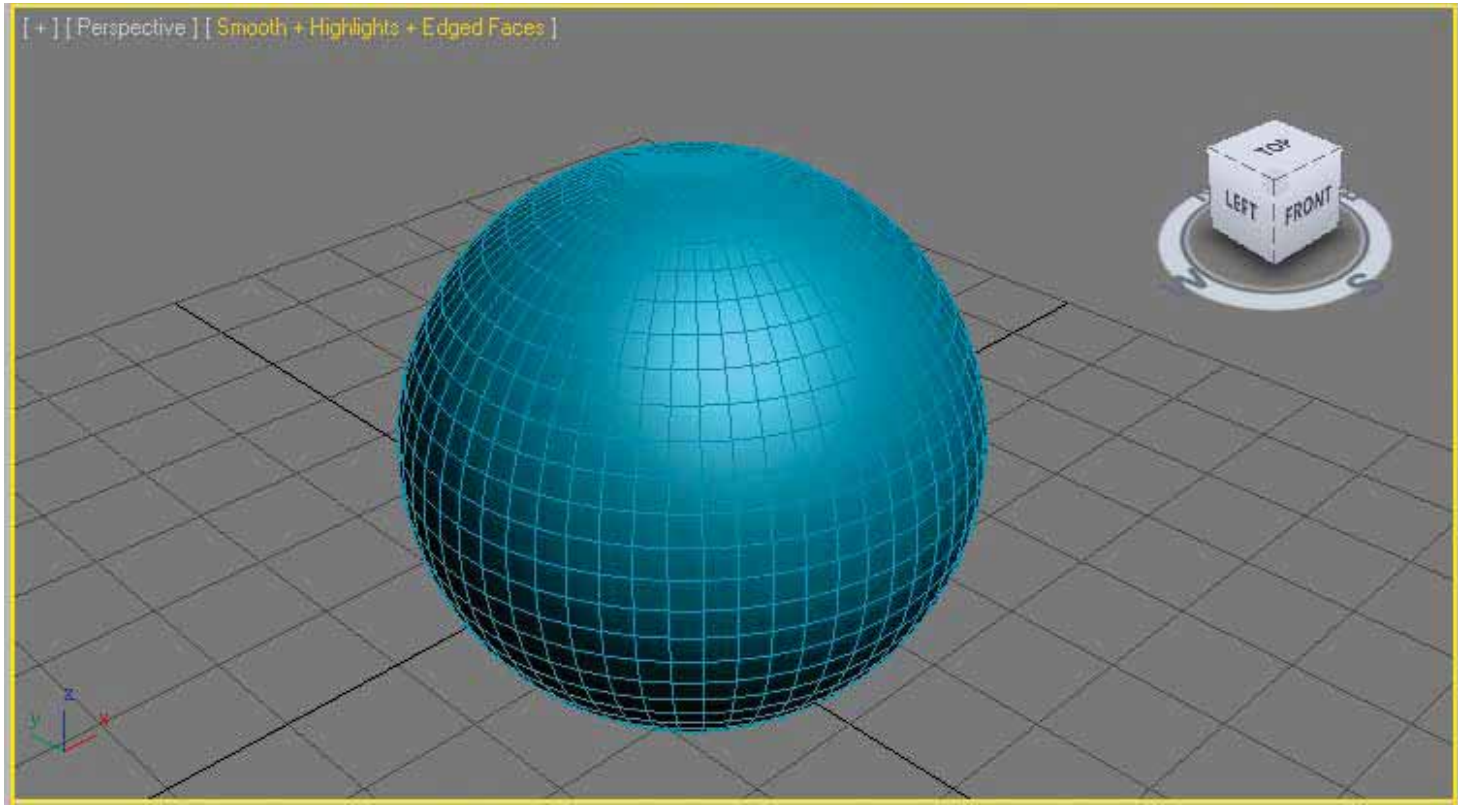


The option changed to [Wireframe] viewport setting on a sphere.

It is also possible to select **[Smooth + Highlights]** and **[Edged Faces]** at the same time as well.

The default hotkey to toggle back and forth between **[Smooth and Highlights]** and **[Wireframe]** view modes is **F3**.

The default hotkey to turn **[Edged Faces]** on and off is **F4**.



The [Smooth + Highlights] and [Edged Faces] both selected in the viewport.

Tip:

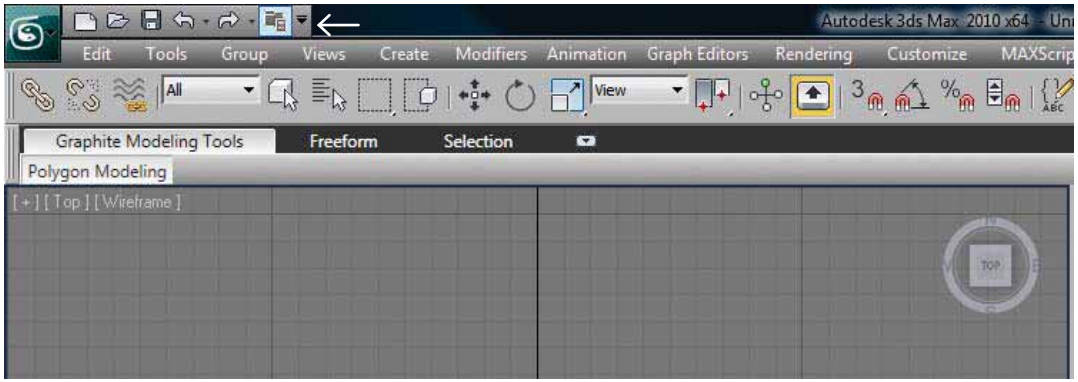
While it is possible to change these visual choices in the drop-down menu, getting used to using the hotkeys for them will greatly speed up your workflow. As you start working with more complex scenes and objects, you will constantly be going back and forth between wireframe, flat shaded, and shaded + edge faces.

Setting a project folder

When you start working with a scene in 3Ds Max, either through the course of this book or on your own, it is a good idea to start getting into the habit of setting up your project folders before you begin. While at first it is simply good to keep track of your 3ds Max files, as your scenes start to get bigger and bigger and contain multiple different assets, you will definitely want to keep track of all of them.

Set your project path.

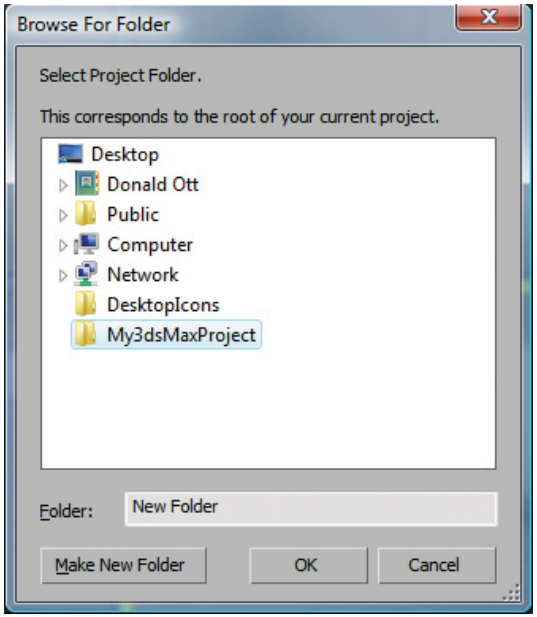
To set up your project path, click the icon in the upper-left corner.



Clicking this icon in the upper-left corner if your UI will allow you to set a path for your project.

Create a new folder for your project.

After clicking this, the Browse For Folder window will pop up asking you for where you want to set the root of your project folder. Think of this as the place on your computer where you want to store everything associated with this project. Navigate to where you want to store your project, **LMB** click the Make New Folder button and rename the folder.



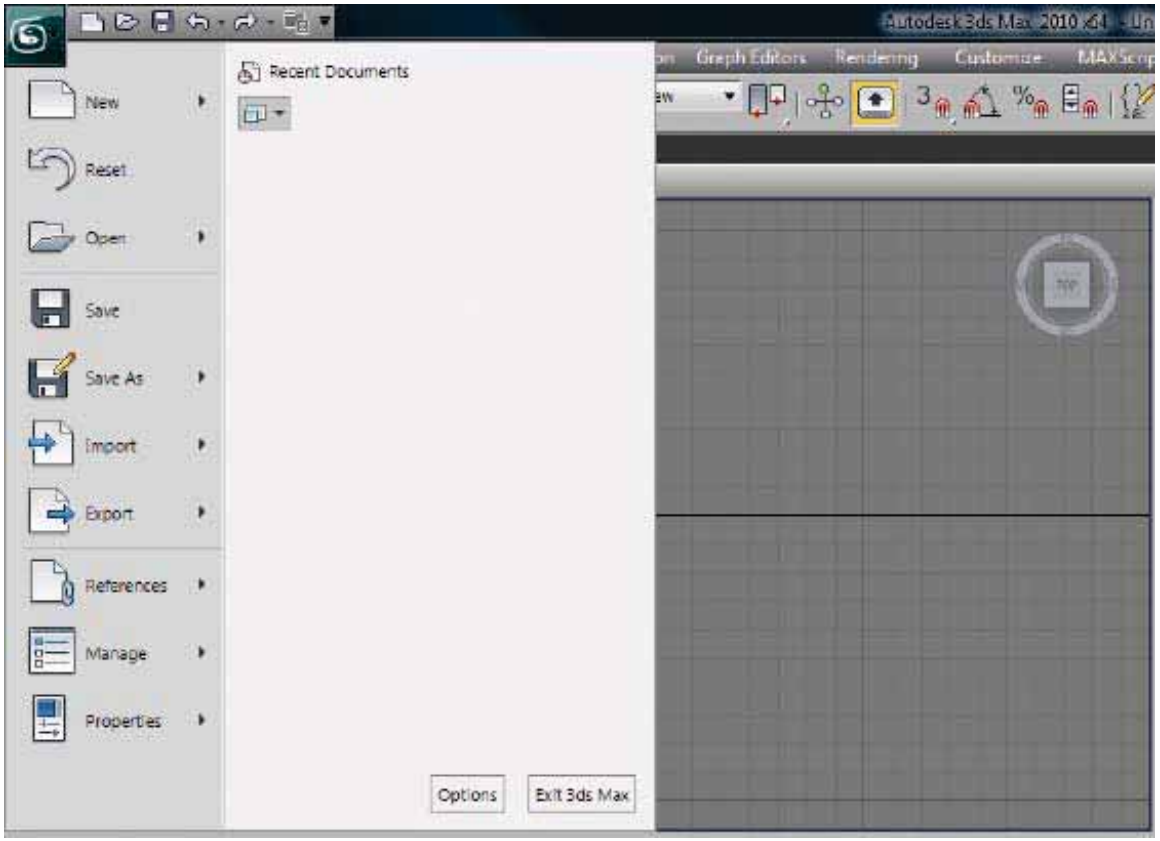
Create a new project folder named My3dsMaxProject on the desktop.

Saving your scene

Few things are more important than saving and backing up your work. Since we set up a project folder, by default when you attempt to save your scene it will drop it under the **scenes** folder inside of your project.

Click the 3ds Max icon to access your file options.

To start with, click the **File** icon (which is the large 3ds Max icon) in the top-left corner of the menu bar to bring up your file options.



Clicking the 3ds Max icon will bring up your file options.

Choose your file options.

As you hover over the different menu items under the File Options, you will see additional options and explanations pop up in the right side of the menu. Some of the more common file options you should be familiar with are as follows.

New—These options can maintain some of your current scene settings, but will create a new 3ds Max scene for you.

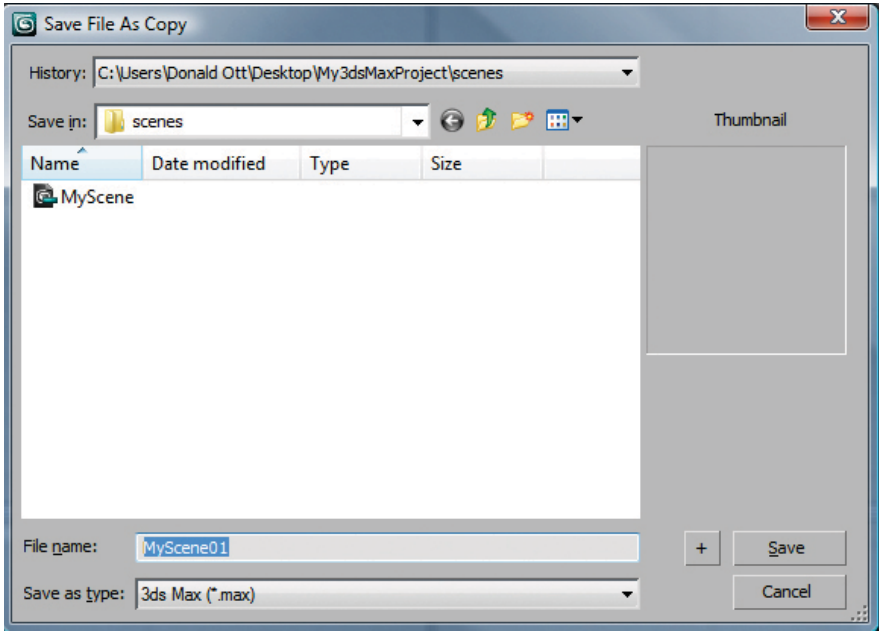
Reset—Think of **Reset** as a whole fresh new scene. This is the same as restarting 3ds Max. You will lose all of your current settings and they will go back to the default.

Open—As expected, this is the option to open previous 3ds Max files.

Save—The default save. The first time you Save it will direct you to the scene folder of your project folder structure. You can, however, choose to save your scene anywhere you wish.

Save As—Similar to the normal Save, but also includes the options to use an incremental save as well as saving only selected objects in your scene. The **Save As→Save Selected** option will take only what you currently have selected in your scene and save that as a completely unique file. The **Save Copy As** option will automatically add a numeric extension to the end of your file. For example, if your scene is called MyScene, using the **File→Save As→Save Copy As** will automatically attempt to save your scene as MySceneo1. This is optional, but it is definitely helpful when you want to be able to save your scenes in chronological order or have a safe point to go back to later.

Import / Export—The **Import** and **Export** options are useful when working with various file types that may have been exported from other software packages, as well as merging 3ds Max files together. We will cover this more in Chapter 6.



File→Save As→Save Copy As will automatically add a numeric extension to your file name.

3dsMax Skills

What primitives are

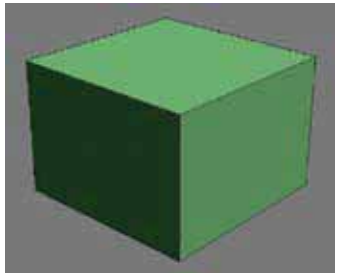
Before you can start building the world's best game level, or the coolest game character anyone has ever seen, the forms and shapes to make those things almost always start with primitives. Primitives are the very basic 3D shapes that make up the foundations of more complex shapes. In 3D modeling, primitives are used as the rough first-pass shapes that an artist may create before adding to the model to make it more complex. For example, a skyscraper or a might start with a box. A fireman's pole might start as a cylinder. A bed sheet—a plane.

Look at the world around you. You are surrounded by boxes, cylinders, spheres, planes, and tubes. This very book you are holding is made up of a series of primitives! Whether you are creating props for a game or a game level, primitives are the building blocks that every artist must control before moving on to more complex 3D modeling. Even Michelangelo started with a box.

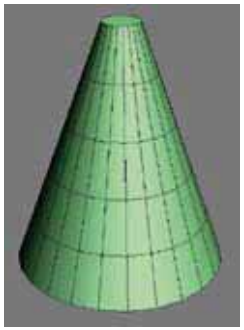
Standard primitives

Let's take a look at some of the more commonly used primitives and a brief description of them. While this is not all of the primitives you can create in 3ds Max 2010, these are some of the more commonly used ones you will want to familiarize yourself with as you begin to work in 3D.

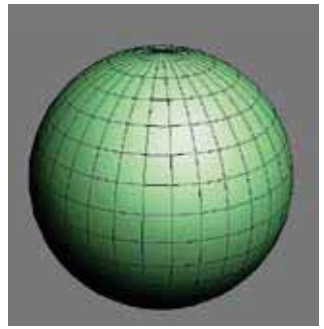
Box—The box is the simplest and most primitive of them all, but from which an enormous amount of shapes can ultimately emerge. Also known as a cube, the box is created with a default six sides.



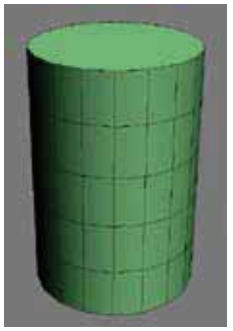
Cone—The cone is a slightly tapered cylinder that can either have two flat ends, or one flat end and one sharp point.



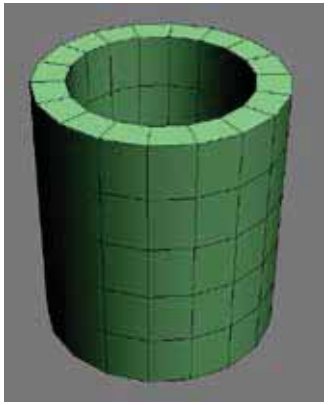
Sphere—The sphere is a round ball. By default, the sphere has a uniform circumference and radius.



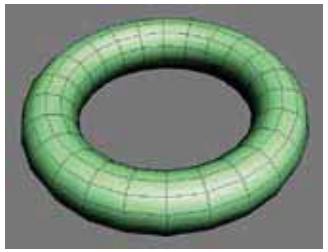
Cylinder—The cylinder is a round primitive that extends along a height parameter, and the radius can be adjusted as well.



Tube—The tube is a hollowed out cylinder that has geometry along the outside as well as the inside.

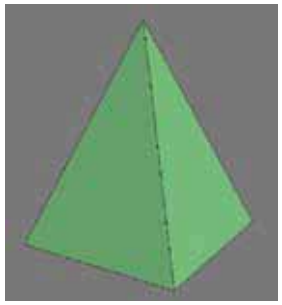


Torus—The torus primitive is a wheel or tube shape that forms a circle.

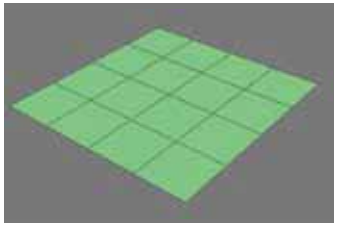


3dsMax Skills

Pyramid—The pyramid is a simple five-sided shape, with four of the sides meeting at a point.



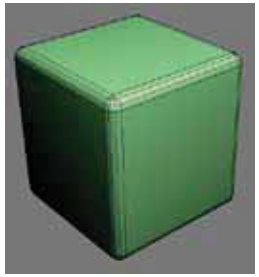
Plane—The plane is a very simple flat piece of geometry with no height or width. Think of it as a flat sheet of polygons.



Extended Primitives

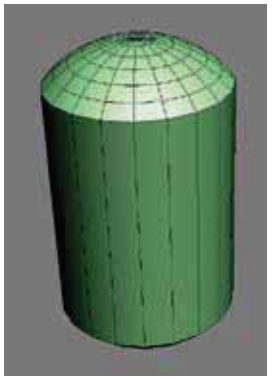
A bit more complex are the extended primitives. These shapes attempt to bridge the gap between the basic primitives and editable polygon objects, which we will discuss further in Lesson 5. We will not list all of them here, but there are a few shapes you might fight useful as you begin to use primitives.

Chamfer Box—The chamfer box is very similar to the regular box primitive, but you have the ability to round off the edges—also known as chamfering.



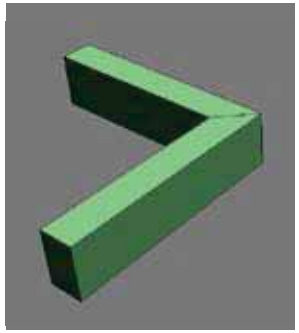
Chamfer Cylinder—The chamfer cylinder is very similar to the regular cylinder primitive, but just like the chamfer box, you can chamfer the edges as well.

Oil Tank—The oil tank is a cylindrical shape with rounded caps on both ends.

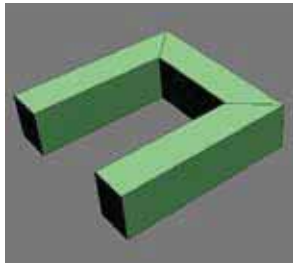


Capsule—The capsule is similar to the oil tank, but fully rounds off the ends.

L-Extent—The L-extent extended primitive creates an elbow joint shape similar to the letter L.



C-Extent—The C-extent extended primitive creates a corner joint shape similar to the letter C.

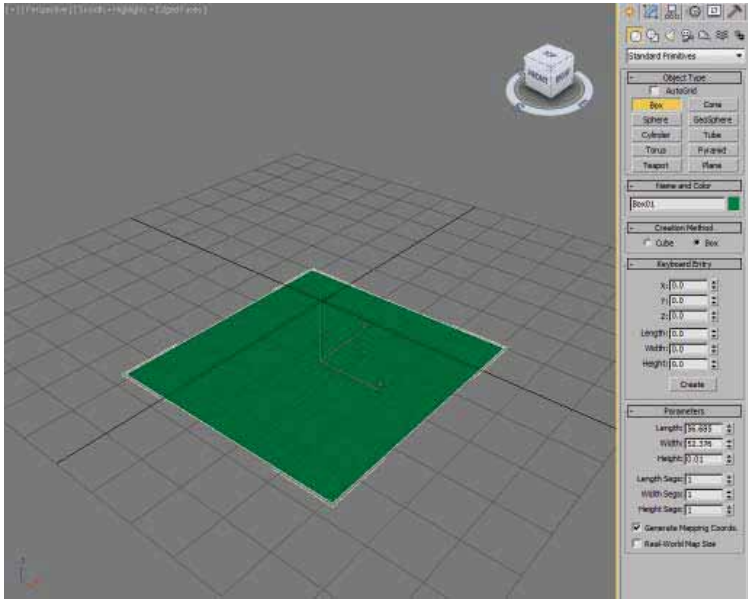


Creating Standard Primitives

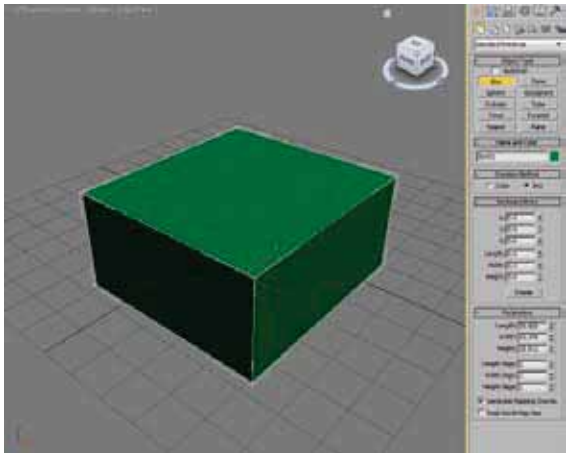
In the previous chapter we briefly discussed how to create your first box. Many other primitives are created in a very similar fashion. Let's discuss some of the more commonly used primitives and identify exactly how to create them.

1. **Create a primitive box.**
   For our first primitive, let's create that simple box again.

- In the Command Panel, select the **Create tab**, the **Geometry** option, and choose the **Box** as the Object Type.
- In the **Perspective** viewport, hold the **LMB** and drag it around anywhere in the viewport. As you are moving the box around in the viewport, you are setting its length and width.
- Release the **LMB**, and move the mouse up or down in the viewport. This is setting the object's height.
- When you get a height you are happy with, click the **LMB** again.



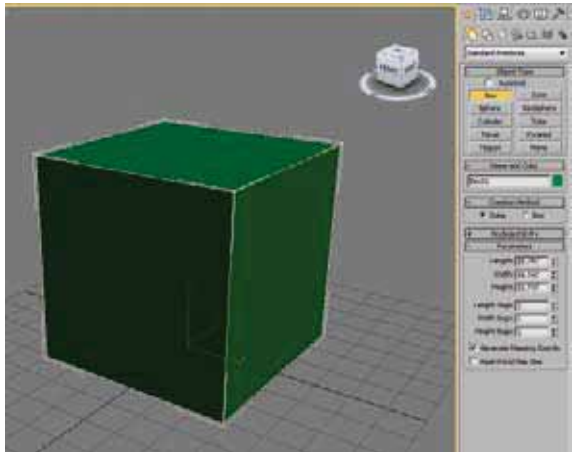
Start by LMB dragging the box in the Perspective viewport.



Move the mouse up to set the box's height.

Tip:

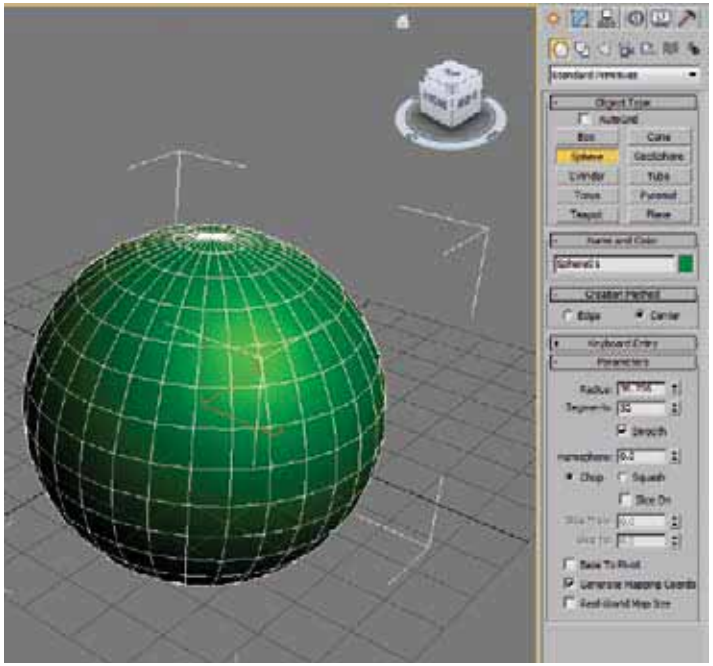
From the Creation Method submenu for the Box, you can choose the option of **Cube** instead of **Box**, and when you **LMB** drag in the viewport, all of the parameters (length, width, height) will be uniform.



Choosing Cube from the Creation Method submenu.

2. Create a primitive sphere.
For our second primitive, let's create a sphere.

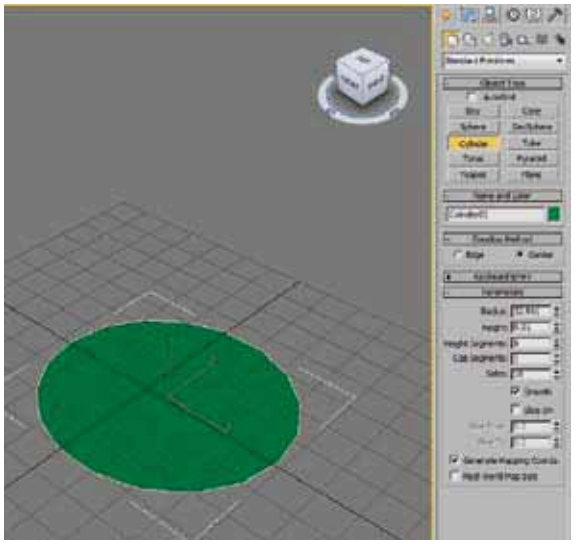
- Select the **Geometry** option and choose **Sphere** as the Object Type.
- In the **Perspective** viewport, hold the **LMB** and drag it around anywhere in the viewport. As you are moving your mouse around in the viewport, you are setting the sphere's radius.
- When you get a radius you are happy with, release the **LMB**.



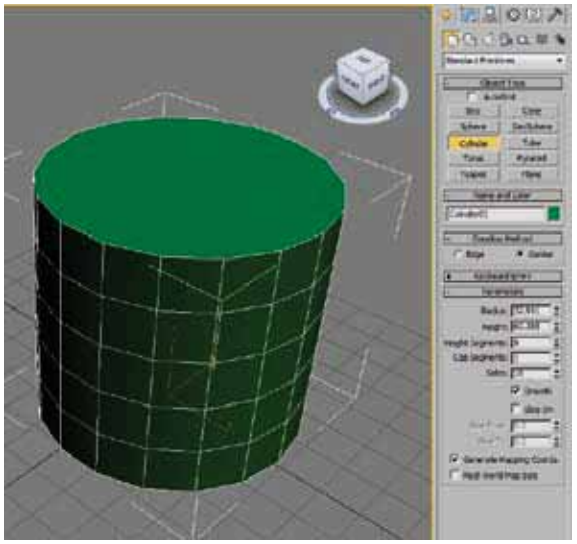
3. Create a primitive cylinder.
For our next primitive, let's create a cylinder.

- Select the **Geometry** option and choose **Cylinder** as the Object Type.
- In the **Perspective** viewport, hold the **LMB** and drag it around anywhere in the viewport. As you are moving the shape around in the viewport, you are setting the cylinder's radius.
- Release the **LMB**, and move the mouse up or down in the viewport. This is setting the cylinder's height.

- When you get a height you are happy with, click the **LMB** again.



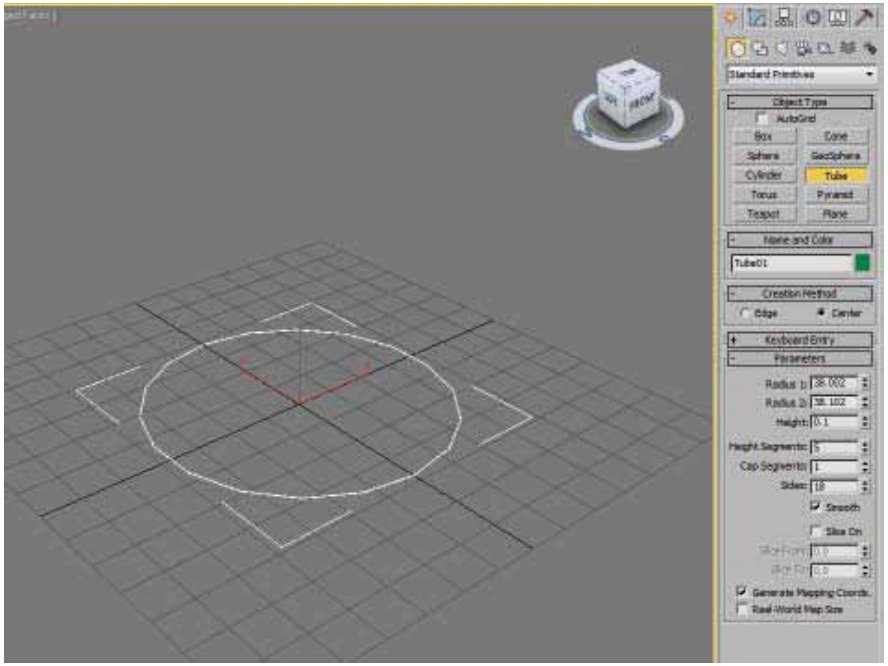
Start by LMB dragging the cylinder in the Perspective viewport.



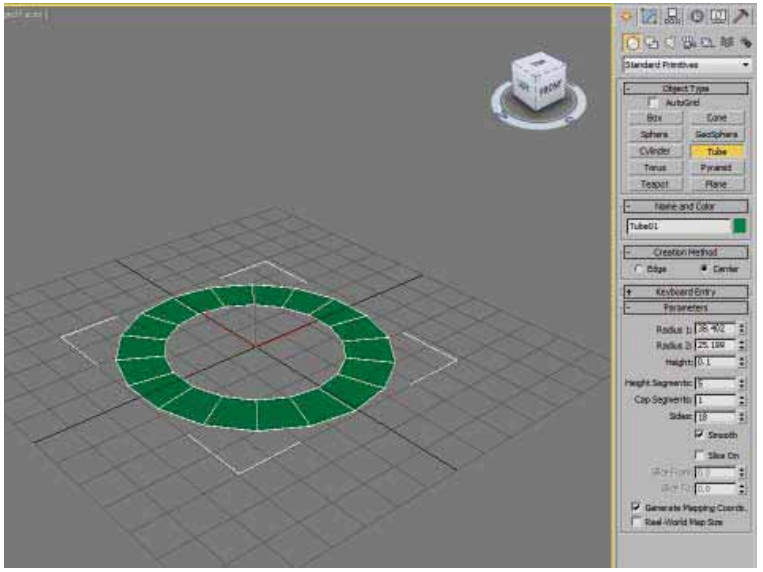
Move the mouse up to set the cylinder's height.

4. Create a primitive tube.
For our next primitive, let's create a tube.

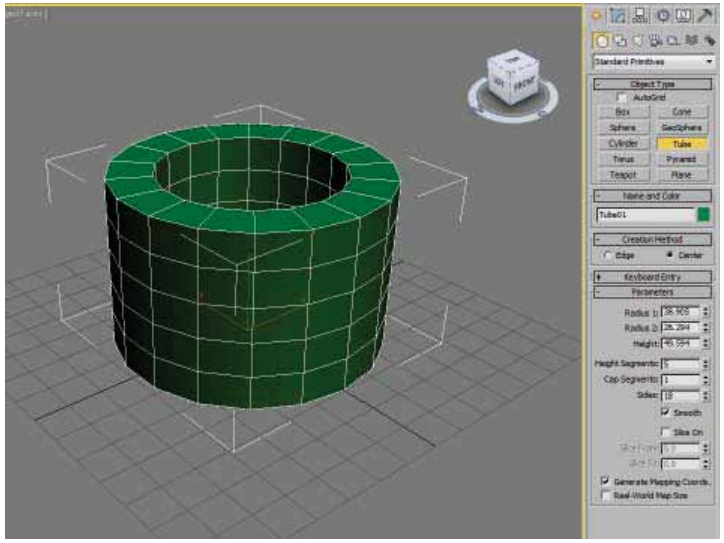
- Select the **Geometry** option and choose **Tube** as the Object Type.
- In the **Perspective** viewport, hold the **LMB** and drag it around anywhere in the viewport. As you are moving the shape around in the viewport, you are setting the tube's **Radius 1**, which ultimately can be either the inner or outer radius.
- Release the **LMB**, and then move the mouse left or right in the viewport. This will determine the tube's **Radius 2** parameter, which is either the inner or outer radius.
- When you get a radius you are happy with, click the **LMB** again.
- Move the mouse up or down in the viewport to determine the tube's height.
- When you get a height you are happy with, click the **LMB** again.



Start by LMB dragging the tube in the Perspective viewport to set the Radius 1.



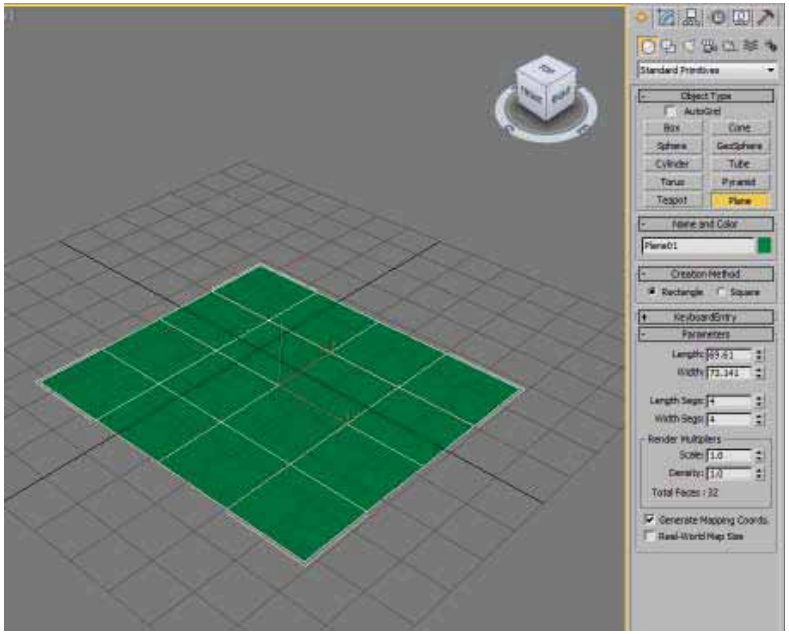
Move the mouse left or right to set the tube's Radius 2.



LMB click, and then move the mouse up or down to set the tube's height.

5. Create a primitive plane.
For our next primitive, let's create a plane.

- Select the **Geometry** option and choose **Plane** as the Object Type.
- In the **Perspective** viewport, hold the **LMB** and drag it around anywhere in the viewport. As you are moving your mouse around in the viewport, you are setting the plane's length and width.
- When you get a size you are happy with, release the **LMB**.



Creating the plane in the Perspective viewport.

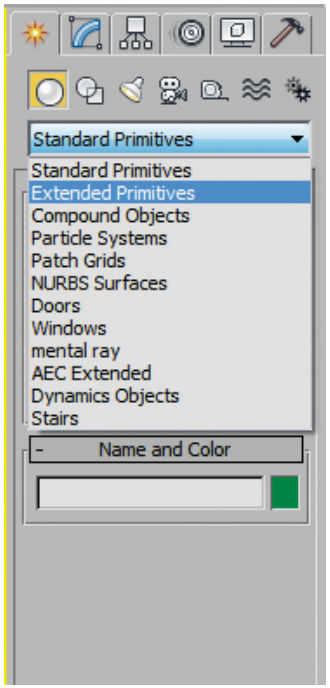
Tip:

From the Creation Method submenu for the Plane, you can choose the option of **Square** instead of **Rectangle**, and when you **LMB** drag in the viewport, both of the parameters (length and width) will be uniform.

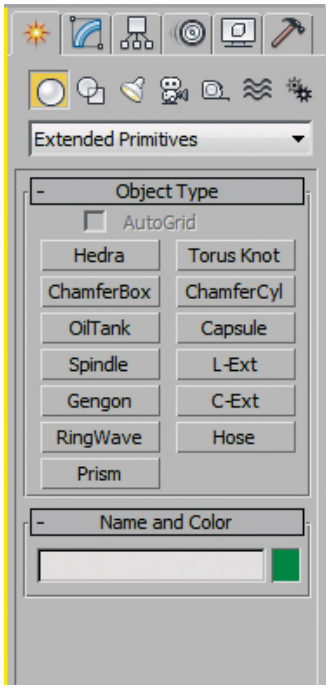
Creating Extended Primitives

Creating extended primitives works very similarly to standard primitives. Like the standard ones, some of the parameters have specific creation requirements depending on the primitive you are trying to make.

As you may have noticed, the extended primitives are not in the same creation area as the standard primitives. To access the Extended Primitives, or other geometric shapes to create, in the Command Panel, select the Geometry option and **LMB** click on the drop-down menu. By default it should be set to **Standard Primitives**. Select **Extended Primitives** to change the different object types and reveal a new set of primitives.



LMB click the drop-down menu and choose Extended Primitives.



A new list of primitives appears.

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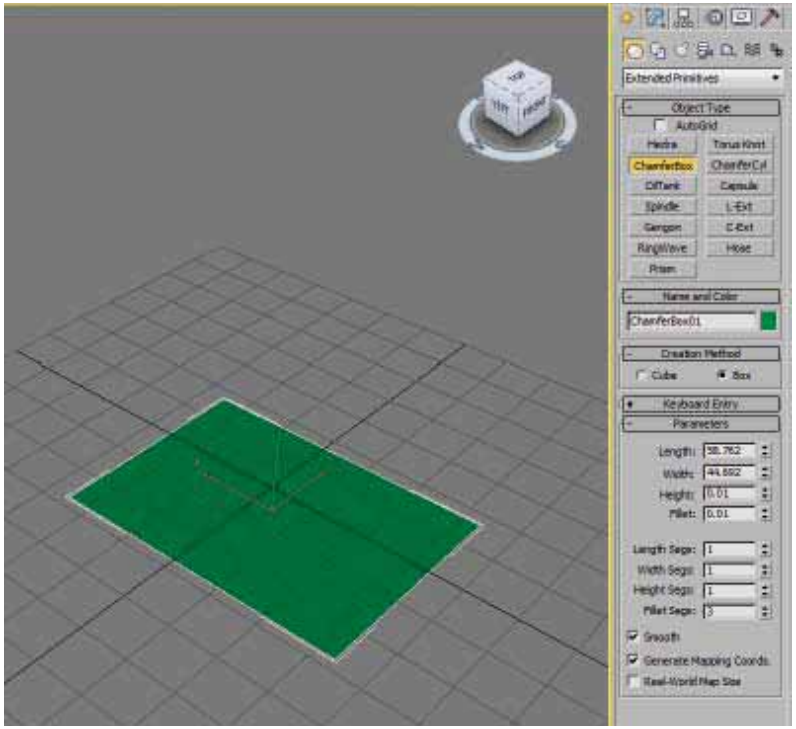
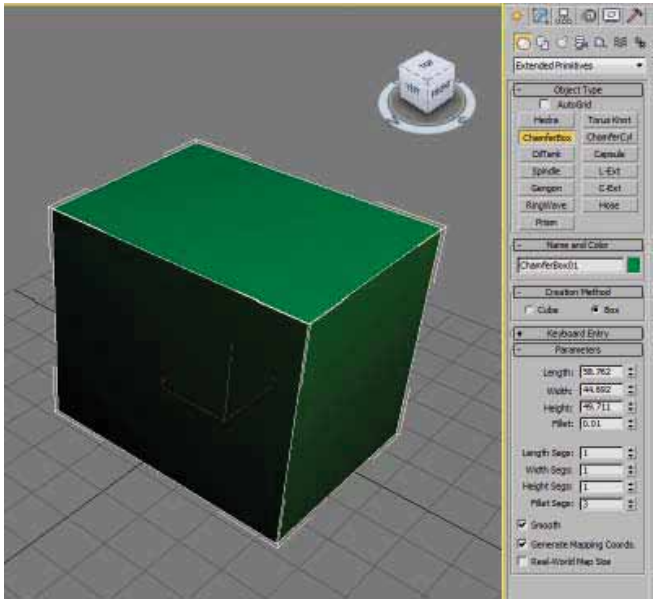
1. **Create an extended primitive chamfer box.**
   For our first extended primitive, let's create a chamfer box.

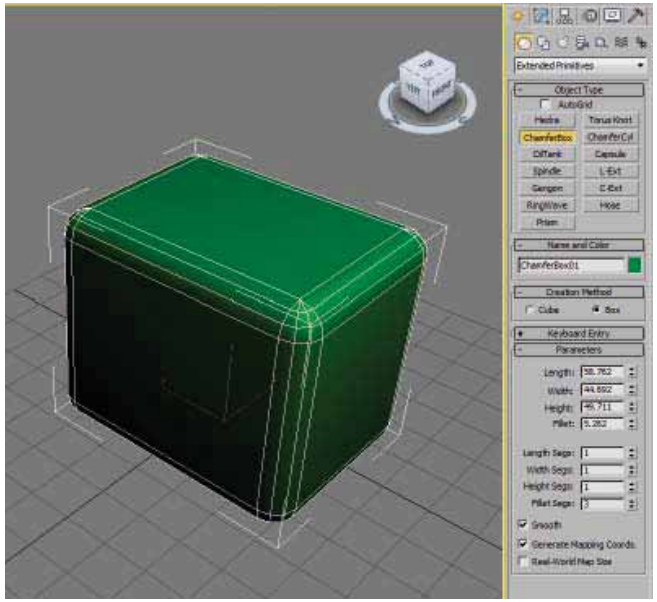
- From the Command Panel, select the **Create tab**, the **Geometry** option, **Extended Primitives** drop-down, and choose **ChamferBox** as the Object Type.
- In the **Perspective** viewport, hold the **LMB** and drag it around anywhere in the viewport. As you are moving the object around in the viewport, you are setting the chamfer box's length and width.
- Release the **LMB**, and move the mouse up or down in the viewport. This is setting the object's height.
- When you get a height you are happy with, click the **LMB** again.
- After clicking the **LMB** to get the height, move the mouse left-to-right to determine the Fillet amount, also known as the chamfer amount.



Start by LMB dragging the box in the Perspective viewport.



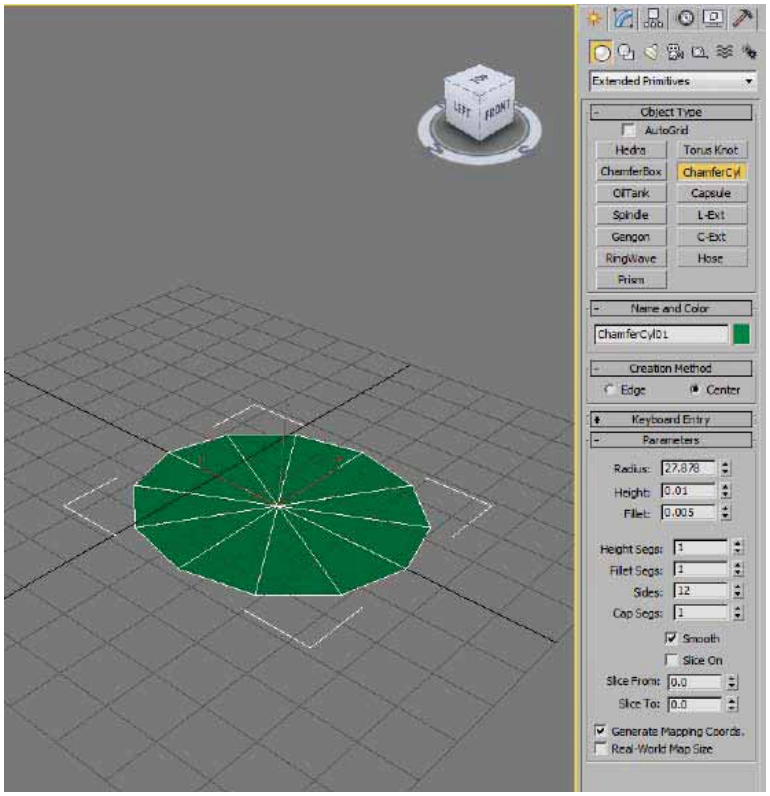
Move the mouse left to right to set the fillet amount.



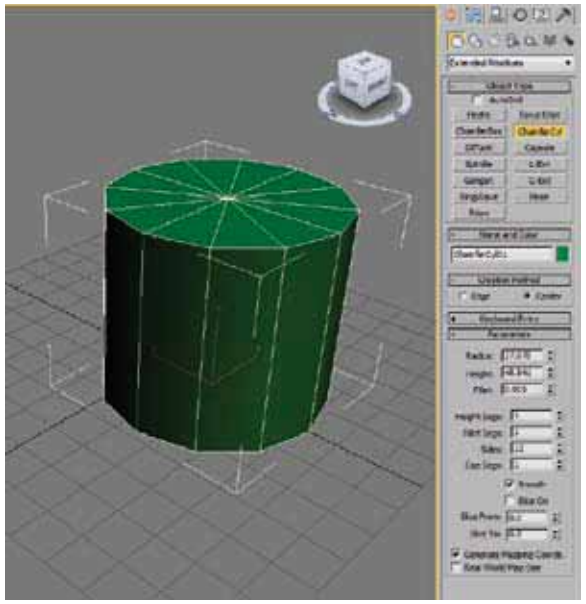
Move the mouse up to set the box height.

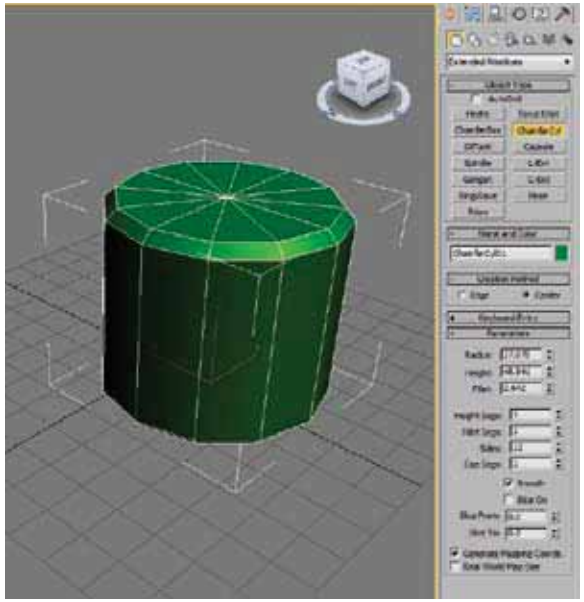
2. Create an extended primitive chamfer cylinder.
For our next extended primitive, let's create a chamfer cylinder.

- Select the **Geometry** option and choose **ChamferCyl** as the Object Type.
- In the **Perspective** viewport, hold the **LMB** and drag it around anywhere in the viewport. As you are moving the object around in the viewport, you are setting the chamfer cylinder's radius.
- Release the **LMB**, and move the mouse up or down in the viewport. This is setting the object's height.
- When you get a height you are happy with, click the **LMB** again.
- After clicking the **LMB** to get the height, move the mouse left-to-right to determine the **Fillet** amount, also known as the chamfer amount.



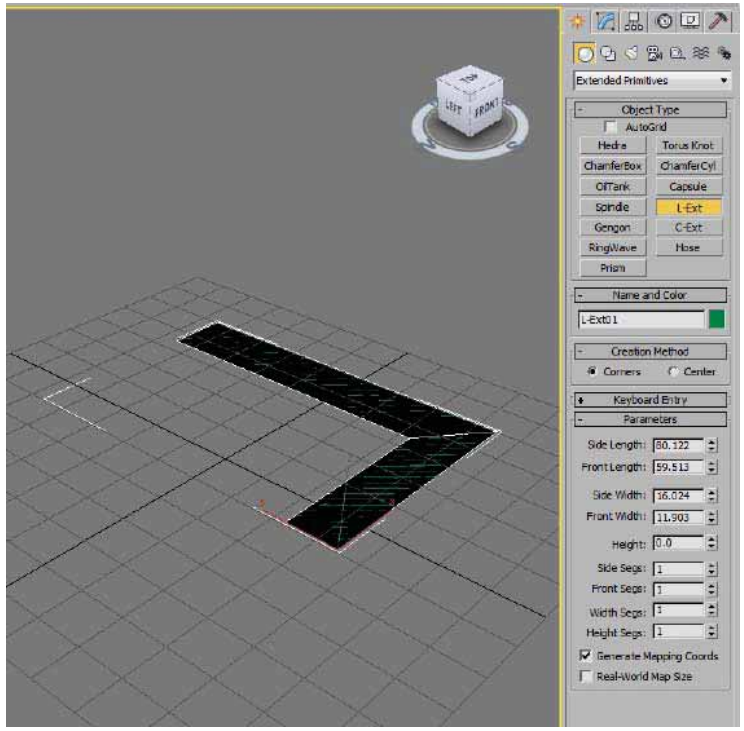
Start by LMB dragging the chamfer cylinder in the Perspective viewport.


Move the mouse left to right to set the fillet amount.

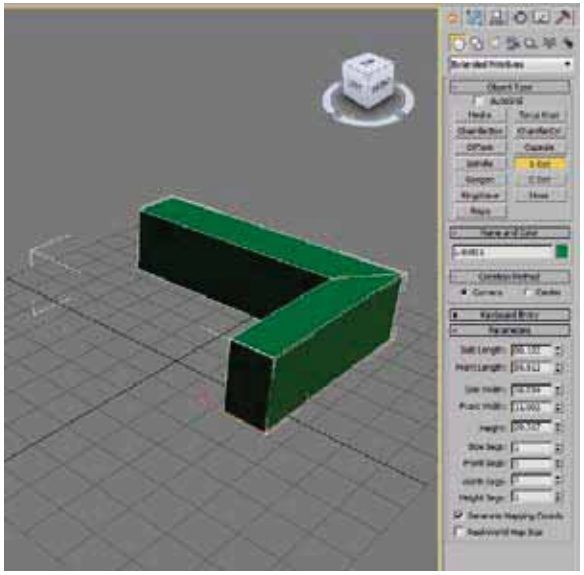

Move the mouse up to set the chamfer cylinder's height.

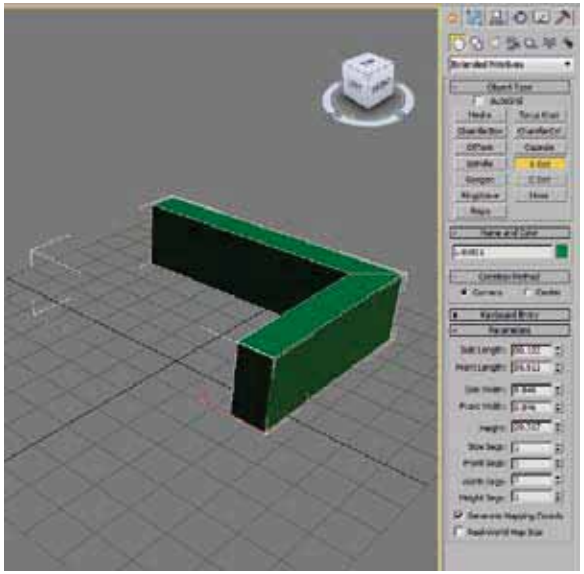
3. Create an extended primitive L-extent.
For our next extended primitive, let's create an L-extent.

- Select the **Geometry** option and choose the L-Ext as the Object Type.
- In the **Perspective** viewport, hold the **LMB** and drag it around anywhere in the viewport. As you are moving the object around in the viewport, you are setting the L-Ext's Side and Front lengths.
- Release the **LMB**, and move the mouse up or down in the viewport. This is setting the object's height.
- When you get a height you are happy with, click the **LMB** again.
- After clicking the **LMB** to get the height, move the mouse left-to-right to determine the Side and Front widths.
- When you get a width you are happy with, click the **LMB** again.



Start by LMB dragging the L-extent in the Perspective viewport.


Move the mouse up to set the L-extent's height.


Move the mouse left to right to set the L-extent's width.

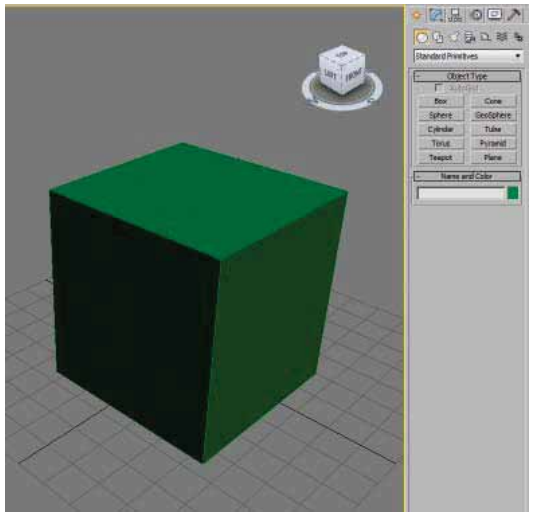
How to alter the parameters of the primitives you create

Regardless of which primitive you create, all of them have parameters that you can adjust. As you can expect, not all of the parameters are going to be the same, but the method for changing various parameters is.

Whatever setting you create a primitive to begin with can be altered to reach your desired result. Adding additional polygons, changing the height or radius, or even the overall scale can all be done even after you have created the primitive. Let's look at how to adjust some of those parameters after you have created a primitive.

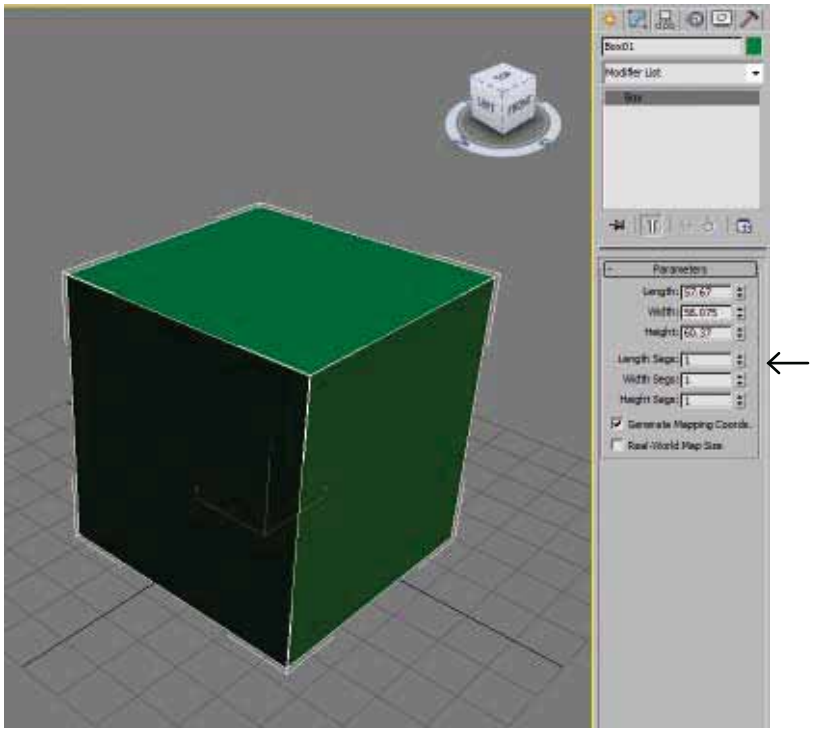
1. **Adjust parameters of a primitive box.**
   For our first test, let's change some parameters of a basic box.

- Start by creating a standard primitive **Box** in the Perspective viewport.
- After you have created the box, **RMB** click anywhere in the viewport to end the creation process. After you do this, you will notice that you no longer have any parameters under the **Create tab**. This is because the creation process is done. Now it is time to edit the object.



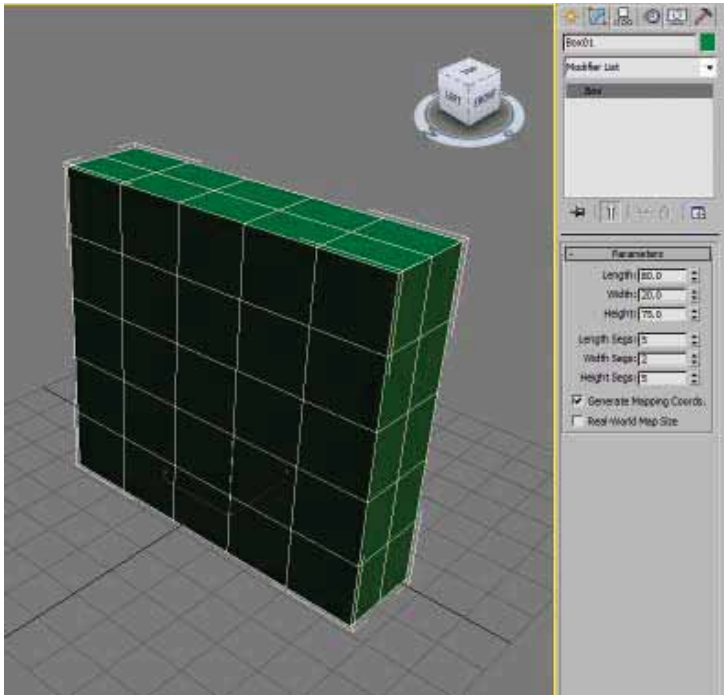
After creating a box, RMB click in the viewport to end the creation process.

- Next to the **Create tab** in the Command Panel is the **Modify tab**. If you have nothing selected you will not see much other than the Modifier List, but by **LMB** clicking on the box, many of the original parameters we saw when we created the box are back.

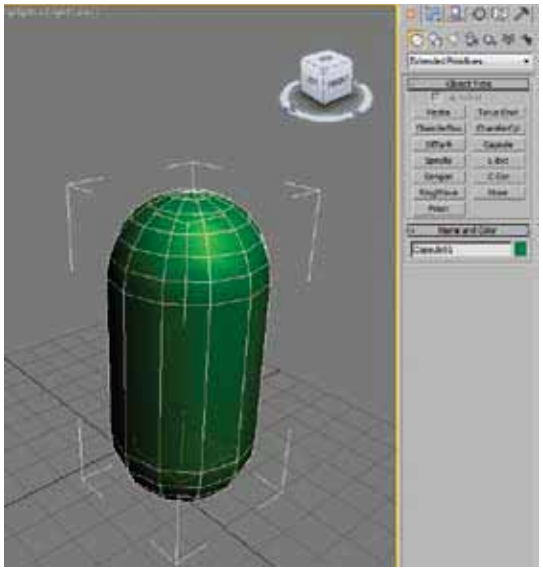


Under the Modify tab, many of the creation parameters are back.

- From the **Parameters** submenu, **LMB** click on any of the Parameter values and type in some numbers in the box, or use the small arrow icon next to the parameter numbers to drag the values up and down with the **LMB**. This is the same as typing the numbers in manually, but is obviously less accurate. You can also add numbers to the length, width, or height segments to change those values as well.



Changing the parameters of the same box to create a customized shape.

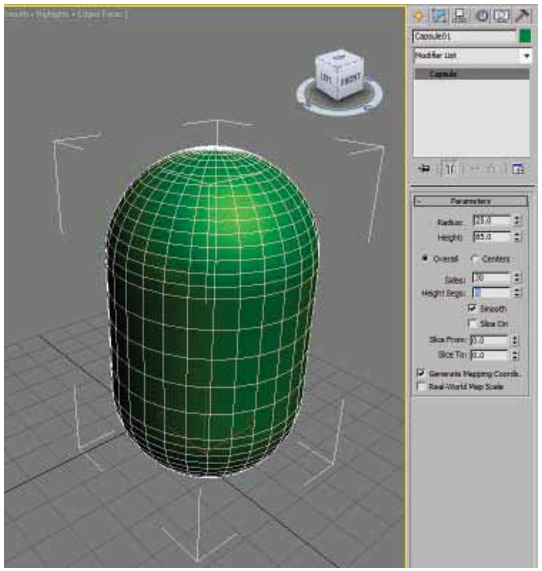


After creating a capsule, RMB click in the viewport to end the creation process.

2. Adjust parameters of a capsule.
For our next object, let's change some parameters of an extended primitive **Capsule**.

- Start by creating an extended primitive **Capsule** in the Perspective viewport.
- After you have created the capsule, **RMB** click anywhere in the viewport to end the creation process.

- Switch to the **Modify tab** and randomly alter the Parameters to get a different shape. Yours might look different than mine, depending on what you type in.

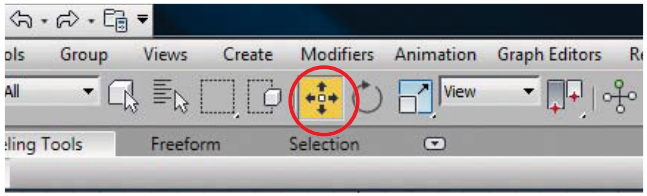


Moving, rotating, and scaling primitives in your scene

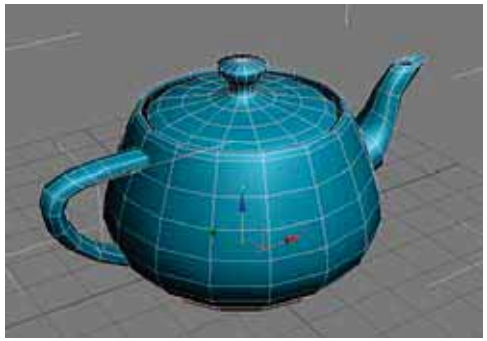
Now that you understand the basics of creating primitives, it is important that you understand how to manipulate them. Once you have created them, you will want to move and alter them around in 3D space, and you can do that with the **move**, **rotate**, and **scale** tools.

1. **Move a primitive.**
   For our next exercise, let's **move** a primitive around in 3D space.

- Select the **Geometry** option, select and create any primitive you want to **move**.
- Ensuring you have the primitive selected, press the **Move** tool on the Main toolbar, or use the **W** hotkey on your keyboard. You will notice an icon appear on your primitive. This is known as the Move *gizmo* or *widget*.



The Move tool selected on the Main toolbar.

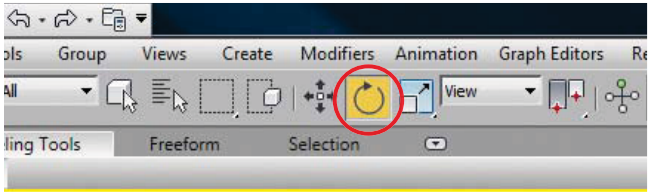


The Move gizmo appears with our Teapot primitive selected.

- **LMB** click and hold the **Move** gizmo on any of the small directional arrows.
- Move the mouse in the direction that the arrow is pointing to move your object in 3D space.

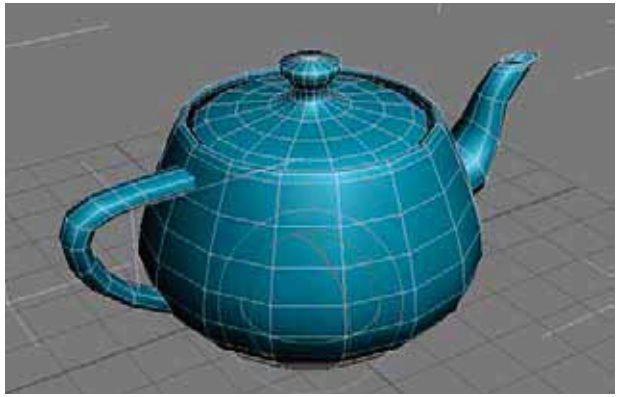
2. **Rotate a primitive.**
   Next, let's **rotate** a primitive around in 3D space.

- Select the **Geometry** option, select and create any primitive you want to **rotate**, or use the same object as before.
- Ensuring you have the primitive selected, press the **Rotate** tool on the Main toolbar, or use the E hotkey on your keyboard. You will notice the icon change to the **Rotate** gizmo on your primitive.



The Rotate tool selected on the Main toolbar.

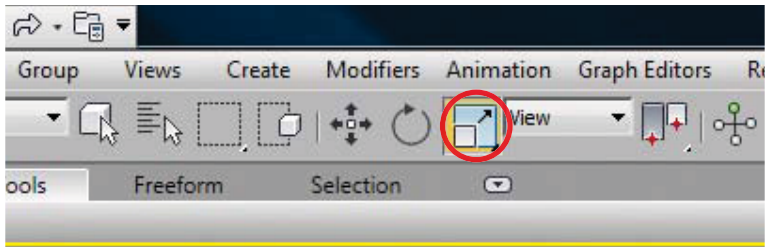
- **LMB** click and hold the **Rotate** gizmo on any of the colored lines to select that direction for rotation.
- Move the mouse in the direction that the arrow is pointing to move your object in 3D space.



The Rotate gizmo appears with our Teapot primitive selected.

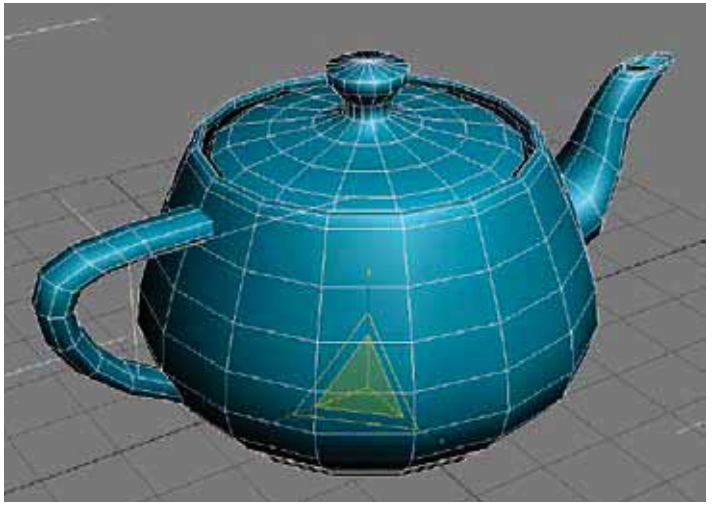
3. Scale a primitive.
Next, let's **scale** a primitive.

- Select the **Geometry** option, select and create any primitive you want to **scale**, or use the same object as before.
- Ensuring you have the primitive selected, press the **Scale** tool on the main toolbar, or use the **R** hotkey on your keyboard. You will notice the icon change to the **Scale** gizmo on your primitive.



The Scale tool selected on the main toolbar.

LMB click and hold on the **Scale** gizmo on any of the colored directional lines to select that direction for scaling.
Move the mouse in the direction that the line is pointing to scale your object in 3D space.
To do a Uniform scale, **LMB** click and hold on the yellow center of the gizmo and drag the mouse in any direction.



The Scale gizmo appears with our Teapot primitive selected.

What modifiers are

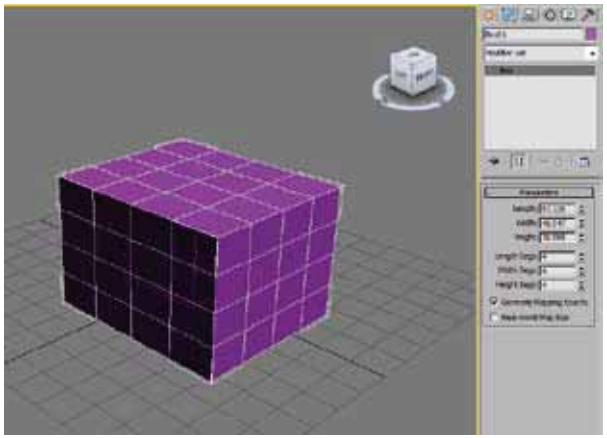
When you start to build geometry in 3D space, you may find yourself wanting to add a little more to the objects you create. You may also find that the default shapes are not exactly giving you the results that you want. Modifiers are tweaks and features that you can add to primitives or geometry in order to alter their original state, and give you a different result from the original.

For example, a Bend modifier may allow you to take a cylinder you made and put a curve into it. One of the FFD modifiers could allow you to stretch and skew your mesh all you want. The Symmetry modifier could save you a considerable amount of time by mirroring your geometry over to the other side so you only have to model half of it. These are just a few examples of the different results you can achieve with modifiers.

How to apply a modifier

While the list of all the different modifiers is quite extensive and their results can be vastly different from each other, the way to apply any modifier to an object is the same. Let's start with a very simple shape, apply a modifier, and then adjust some parameters.

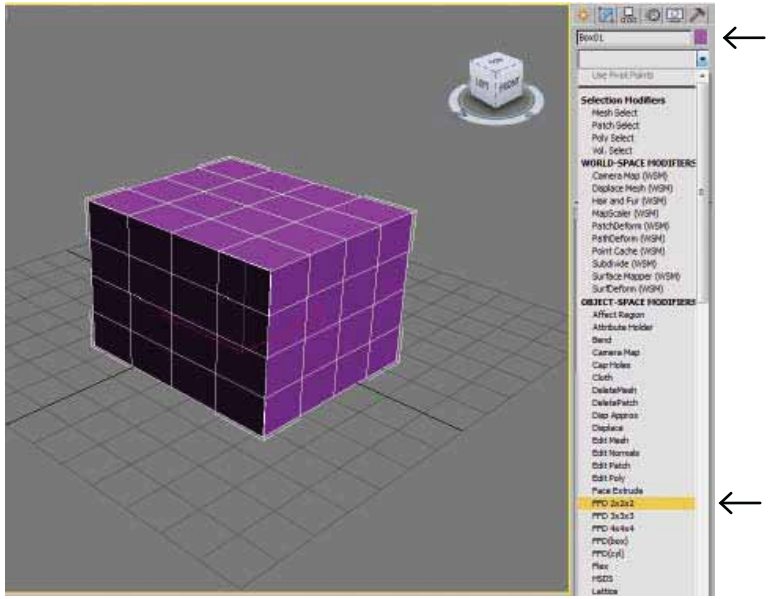
1. **Create a primitive box.**
   For our first modifier, let's add one to a simple box with four length, width, and height segments. Start by creating that box.



Create a box primitive with four length, width, and height segments.

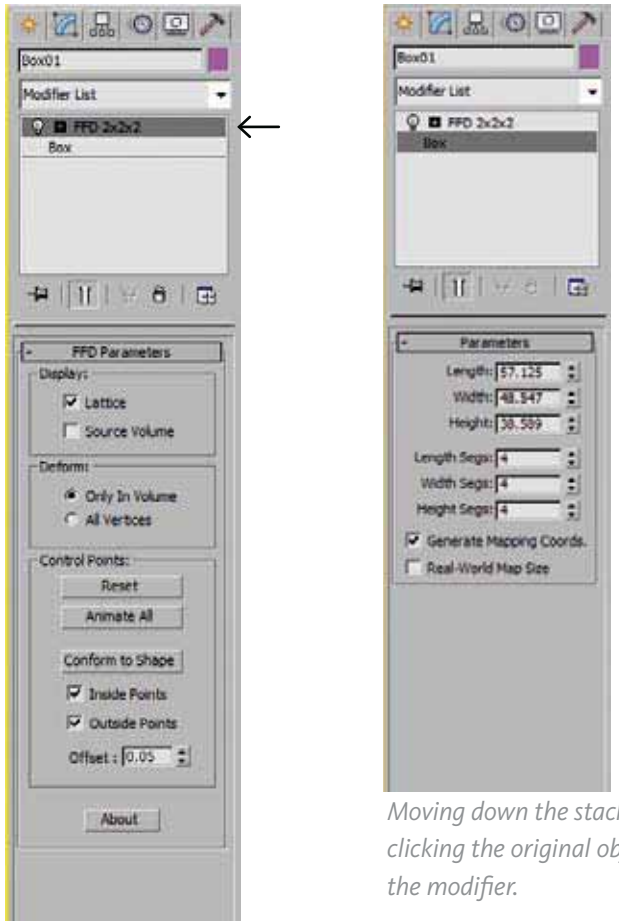
2. **Select the box, and then apply a modifier to it.**
   As you may have noticed, at the top of the Command Panel in the **Modify tab** under the name of the object, there is a drop-down menu titled **Modifier List**. **LMB** clicking anywhere on the **Modifier List** will expand it, and the available modifiers will appear.

- With the box you created selected, **LMB** click the **Modifier List** to expand the available modifiers.
- From the available modifiers listed, scroll down until you find the **FFD 2x2x2** modifier and **LMB** click it to apply it to your box.



Expand the modifier list and select FFD 2x2x2 to apply it to your box.

- Now that you have applied the modifier to your box, there is a new set of available options. You will also notice that the name of the modifier FFD 2x2x2 has appeared above your object's name in the Command Panel. This is known as the **modifier stack**. At the top of the stack we can see that we have the FFD 2x2x2 modifier, and underneath it is the original box. Think of modifiers as "extras" that we are adding to the original object, without losing any of the information of it unless we want to. The original box will stay exactly the same regardless of what we do to the modifier above the stack.



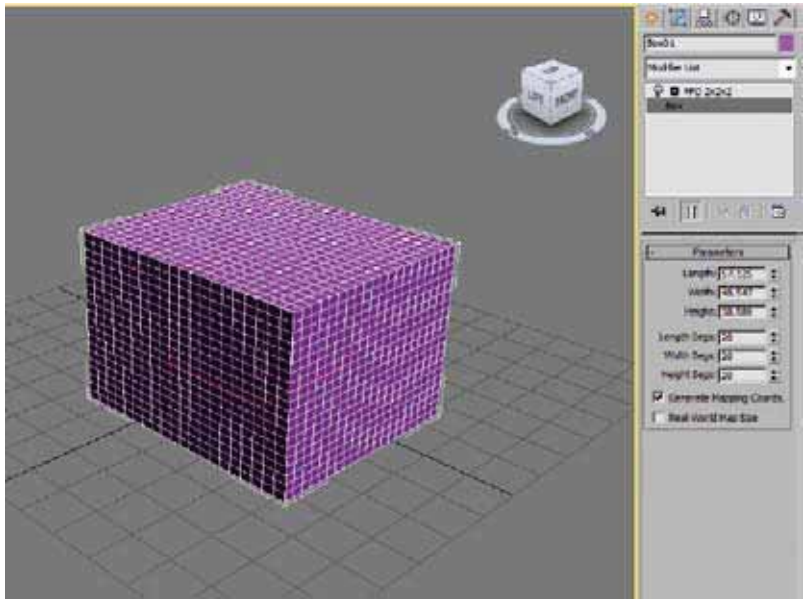
A modifier has been applied to the box, creating a modifier stack.

Moving down the stack by LMB clicking the original object underneath the modifier.

- Currently the top level of the stack is selected, and as you can see the parameters in the Command Panel are specific for the FFD 2x2x2 modifier. However, if we would like to go back down and adjust the parameters of the original box, we can do that by **LMB** clicking the word Box under the FFD 2x2x2 modifier. This is called "Moving down the stack."

3. Move down the modifier stack and adjust the parameters of the original box.
Now that you know how to move down the stack, let's adjust the original box parameters.

- With the box you created selected, **LMB** click on the word Box in the Command Panel to move down the modifier stack.
- Change the Parameters to 20 length, width, and height segments.



Move down the stack and change the parameters to 20 length, width, and height segments.

4. Make some adjustments to the object with the FFD 2x2x2 modifier.
After changing the original box's parameters, go back up to the top of the stack and let's change the shape of the box using the FFD 2x2x2 modifier.

- With the box selected, at the top of the modifier stack with FFD 2x2x2 selected, press the small plus sign next to the name of the modifier to expand the subobject options and select **Control Points**. This is a subobject mode selection of the modifier. We will discuss subobject modes extensively in future chapters.

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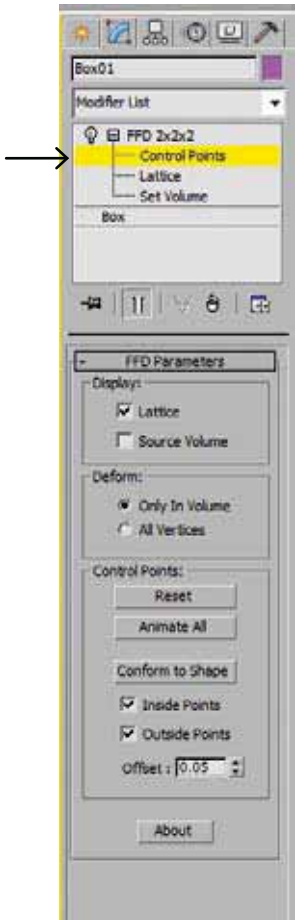
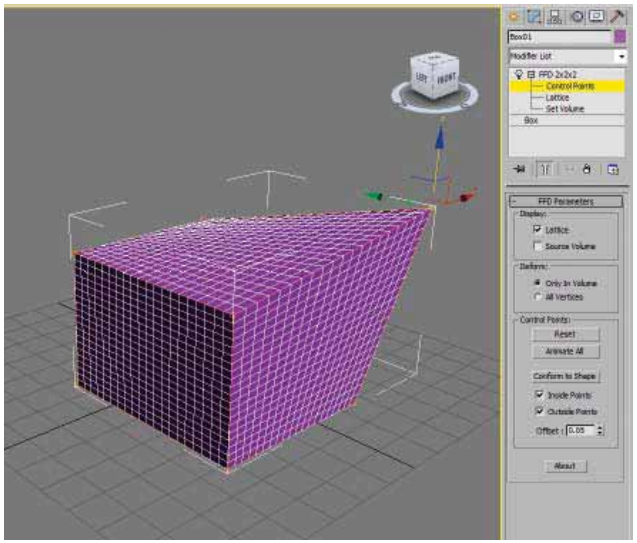


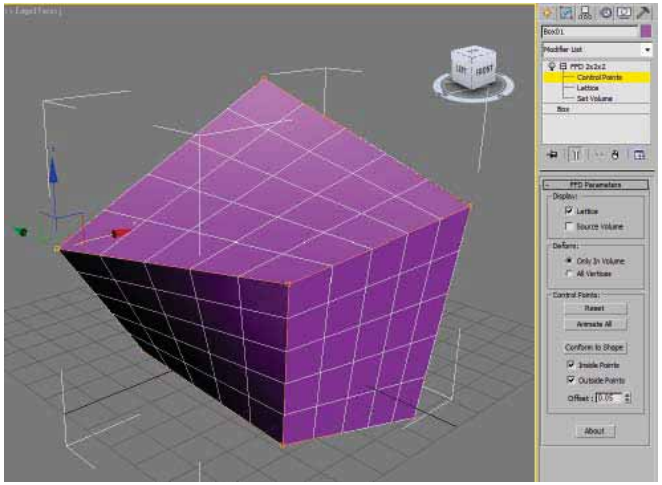
Press the small plus sign next to the name of the modifier to expand its subobject selection modes. When expanded, it will change to a minus sign.

- With **Control Points** option selected, hold the **LMB** and drag select a control point at any of the corners of your object to select them. The FFD modifier has added these control points to allow you to make changes to your object as you wish. Next, with a control point selected, use the **Move tool** to move the control point in any direction, changing the shape of the box entirely.



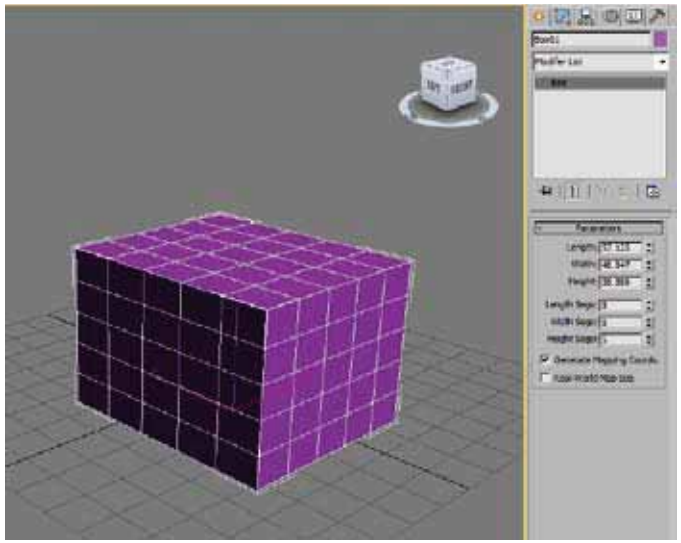
Moving a control point to change the shape of the box.

- Now that you have made an adjustment to your mesh with your first modifier, feel free to move other control points and adjust parameters of the original object and see what sort of results you get with the object.



Random parameter changes and adjustments to the control points to get a different shape.

- If you decide you do not want to use the modifier anymore and wish to go back to the original object, you can delete the modifier by **RMB** clicking on the top of the modifier stack on the name of the modifier, and **LMB** clicking Delete. Alternatively, you can **LMB** select the modifier in the stack, and then **LMB** click on the small Trashcan icon under the modifier stack. Keep in mind that deleting the modifier will remove it forever, and you will not have your custom shape anymore.



Deleting the modifier; going back to the default primitive.

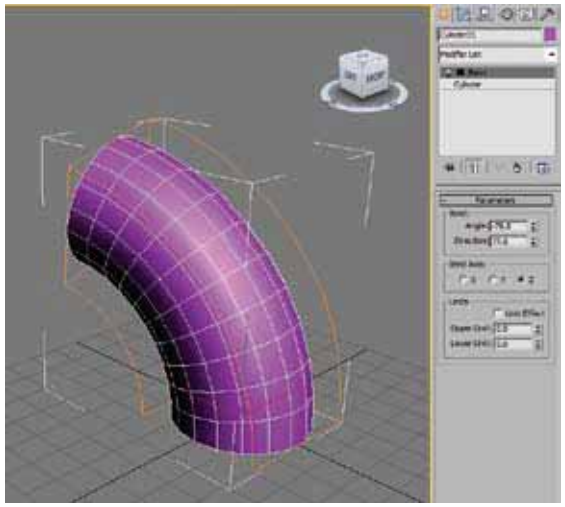
Using Modifiers in your workflow

While we will not cover every single modifier in this book, let's look at just a couple of the commonly used modifiers and a brief description of them.

1. **Apply the Bend modifier.**
   For our next primitive, create a cylinder and add a **Bend** modifier. The Bend modifier attempts to do just like what it sounds like: bend your geometry any way you want it to.

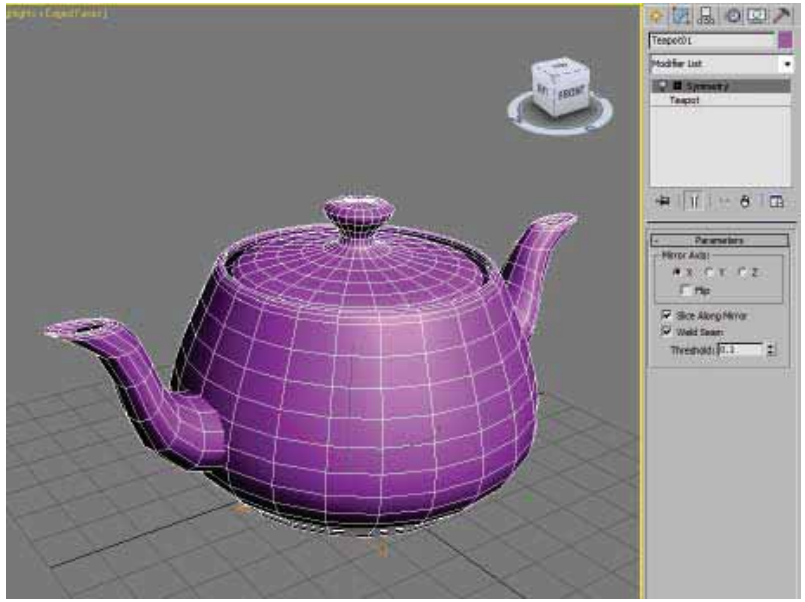
- From Standard Primitives, create a Cylinder and set it to a radius of 20, height of 80, height segments 10, cap segments 1, and sides 18.
- **LMB** click the Modifier List drop-down and choose the **Bend** modifier.

- From the Parameters submenu select the Bend modifier, **LMB** click and hold the small spinners next to Angle and Direction and drag them up or down to randomly change the parameters of the Bend modifier. You can also type in parameters and see what your results are.



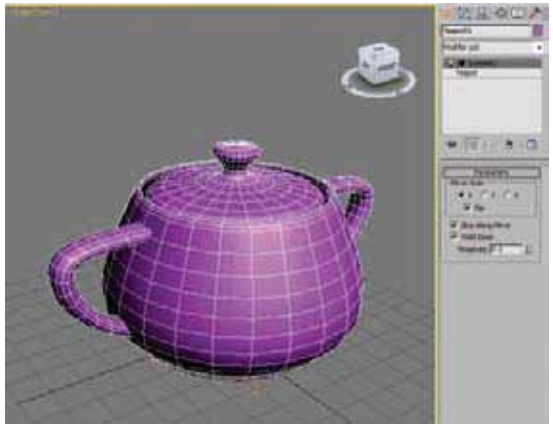
2. **Apply the Symmetry modifier.**
Next, create a teapot and apply a **Symmetry** modifier. The Symmetry modifier works like a mirror along the axis of an object, copying what you have on one side over to the other.

- Select Standard Primitives and create a Teapot with **Radius** set to 40 and Segments set to 6.
- **LMB** click on the Modifier List drop-down and choose the **Symmetry** modifier.



Creating a teapot and applying the Symmetry modifier to it gives it two spouts.

- By default, the Symmetry modifier is set to mirror along the axis of X, and your teapot should have two spouts and no handle. **LMB** click the Flip box under the Parameters to flip the symmetry to the other side, giving the teapot two handles instead.

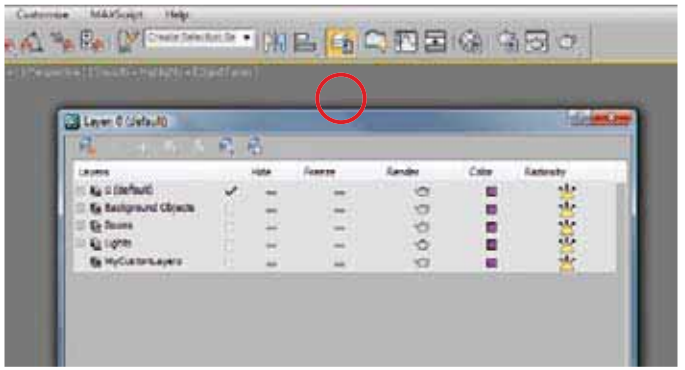


Flipping the Symmetry modifier gives us a teapot with two handles.

Layers

Another important feature of working with 3ds Max 2010 is the built in Layer Manager. Layers play an important role in working with 3ds Max, because they allow you to work with multiple objects or pieces of your scene without having all of them visible all the time. The objects still exist in your scene, but layers allow you to quickly and easily hide or unhide objects in the scene as you wish.

The Layer Manager, available by **LMB** clicking the icon on the Main toolbar, is a tool where you can create and delete layers. You can also view and edit the settings for all of the layers in your scene, as well as the objects associated with them. You can specify the name, visibility, renderability, color, and more.



Access the Layer Manager by LMB clicking the icon on the Main toolbar.

Layer Manager Interface Elements

Create New Layer—Creates a new layer containing any selected objects. The new layer's name is generated automatically (Layer01, Layer02, and so on) but you can change it by clicking the label. Note: The new layer becomes the current layer.

Delete Highlighted Empty Layers—Deletes highlighted layers if they are empty. Note: This button is unavailable if the highlighted set of layers contains any of the following: nothing (that is, no layers are highlighted), the active layer, objects, Layer 0, or nonempty layers.

Add Selected Objects to Highlighted Layer—Moves currently selected objects into the highlighted layer. Note: This button is unavailable if nothing is selected or if more than one layer is highlighted.

Select Highlighted Objects and Layers—Selects all of highlighted objects, as well as all objects contained in any highlighted layers. Note: This button is unavailable if nothing is highlighted.

Highlight Selected Objects' Layers—Highlights layers containing the currently selected objects and automatically scrolls so that highlighted layers are visible in the layer manager. Note: This button is unavailable if nothing is highlighted.

Hide/Unhide All Layers—Toggles the display of all layers.

Tip:

This is most useful if you hide all layers and then display only the layers you want to work on.

Freeze/Unfreeze All Layers—Toggles the frozen state of all layers.

Tip:

This is most useful if you freeze all layers and then unfreeze only the layers you want to work on.

List of Layers—Displays layers, their associated objects, and their properties. To expand or collapse the object list for each layer, click + (plus sign) or - (minus sign), respectively. To modify a property, click its icon. To select all layers quickly, **RMB** click and choose Highlight All. To open the Object/Layer Properties dialog box, **LMB** click on the icon next to the layer or object.

Tip:

You can sort the layers by any of their properties by clicking on the column name.

Layers—Displays the names of the layers/objects. Click a name to select the layer, or to
rename the layer.

> Note:
>
> Clicking the layer icon opens the Layer Properties dialog box for all highlighted layers. Clicking the object icon opens the Object Properties dialog box for all highlighted objects.

Current Layer Toggle—The unlabeled column to the right of the layer name indicates the current layer and lets you make a different layer current. A check mark appears next to the current layer. **LMB** click the check box next to another layer name to make it current.

Hide—Hides and unhides layers. When a layer is hidden, it is invisible. You might want to hide layers that contain construction or reference information.

Freeze—Freezes layers. You cannot select or edit objects on a frozen layer. Freezing a layer is useful if you want to view information on a layer for reference but do not want to edit objects on that layer.

Render—When on, objects appear in the rendered scene. Nonrendering objects do not cast shadows or affect the visual component of the rendered scene.

Color—Changes the color associated with the highlighted layers. You can select another color by **LMB** clicking the color swatch to display either the Object Color dialog box (for objects), or the Layer Color dialog box (for layers). You can set an object's color independently, or turn on ByLayer in the Object Color dialog box to use the associated layer's color.

Radiosity—When on, objects are included in the radiosity solution. Objects not included in the radiosity solution do not contribute to indirect illumination. If these objects are lights, only their direct contribution will be used for rendering.

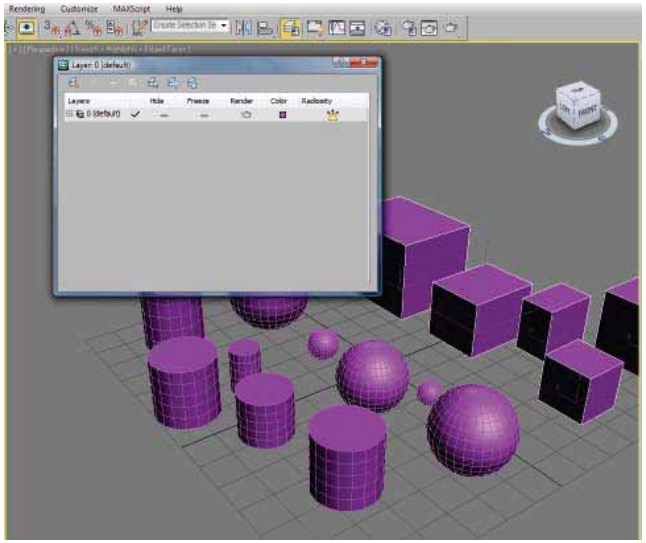
> Note:
>
> Removing objects from the radiosity solution can significantly decrease radiosity processing and rendering time, however it does sacrifice some accuracy in the solution. It can be useful for creating quick test renders.

Working with layers

Now that we have looked at the interface of the Layer Manager, let's create a few pieces of geometry and add them to layers.

1. Create a collection of geometry we will add to layers.

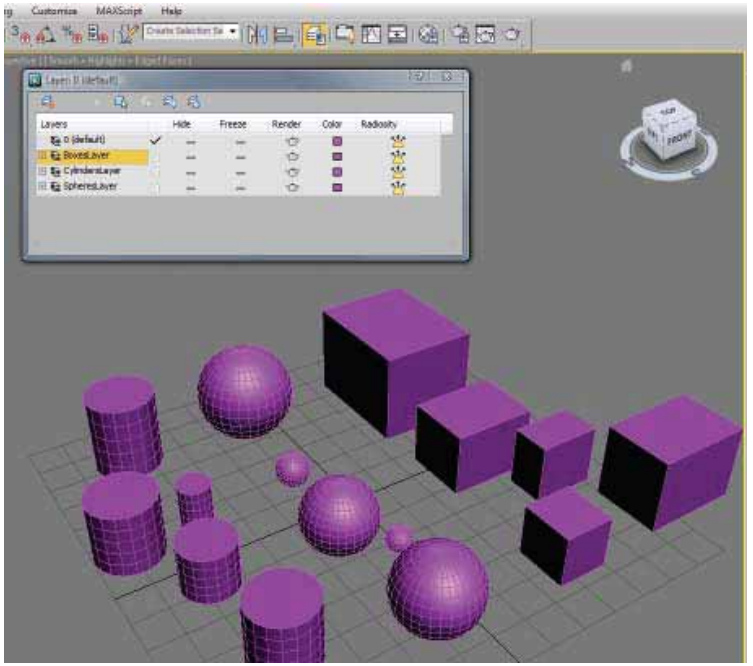
- Using what you have learned, create five standard primitive **Boxes**, **Cylinders**, and **Spheres** in the Perspective viewport.
- **LMB** drag select the boxes in your scene, and bring up the Layer Manager by **LMB** clicking on the icon in the Main toolbar.



Start by LMB dragging the box in the Perspective viewport.

2. Create a new layer and rename it.
Next, let's add the boxes to a new layer.

- **LMB** click on the **Create New Layer** icon.
- A new layer appears on the list, named *Layer01*. By default, since you had the boxes selected, the boxes are now added to this layer.
- **RMB** click on our new Layer01 layer, and then **LMB** click Rename.
- Rename the layer *BoxesLayer*.
- Repeat the same steps for the spheres and cylinders, and create new layers for them called *SpheresLayer* and *CylindersLayer*.

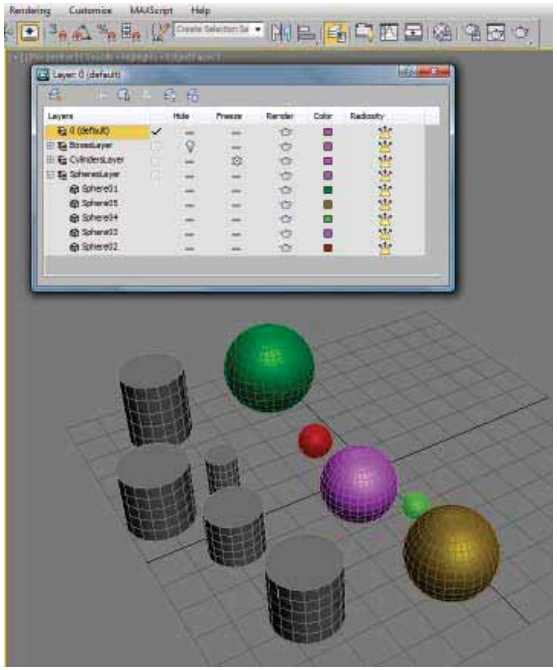


Each of the layers renamed and objects added to them.

3. Adjust the settings of various objects in the layers.
Lastly, let's adjust some parameters of the various layers and the objects inside of them.

- Under the *BoxesLayer* select the icon to hide the layer group. Notice that the layer group disappears. The objects are not lost, but will remain hidden from view until we unhide.

- For the *CylindersLayer*, select the icon to freeze the layer group. Notice that after we freeze this layer the color has changed to gray. This is indicating to us visually that the layer is frozen and we can no longer adjust it until we unfreeze that layer.
- Expand the *SpheresLayer* to reveal the objects in that layer, and change the colors of some of the spheres.



Adjusting the parameters of the various layers and objects inside of them.

Copies, instances, and references

As you start to create more and more geometry, you may find yourself wanting to copy geometry, rather than having to create brand new geometry all the time and trying to match up the parameters. Trying to make 50 spheres one at a time could get rather frustrating! Aside from simply making a copy of an object, you can also create a version of the object that will allow you to adjust parameters of one and have it propagate to the other versions of itself. In 3ds Max 2010, these cloning methods are known as copies, instances, and references.

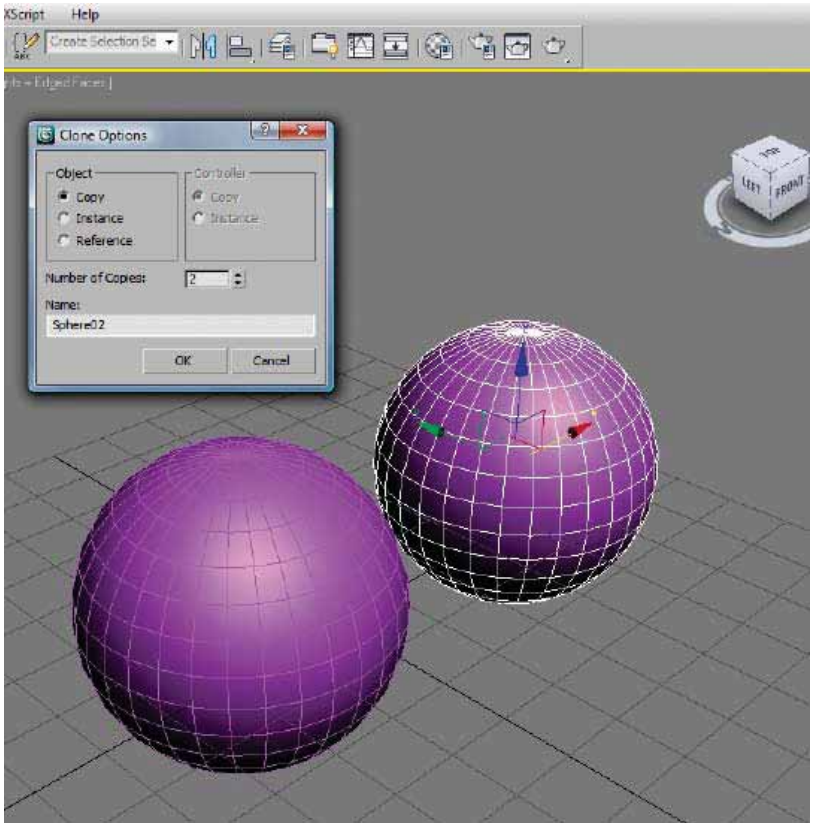
A **copy** is simply a duplicate of an object. The new version will only retain the original shape of the object when copied, but after that it is completely independent of any other object in the scene. Think of a copy just like you would with a copy machine in an office. Once you have that copied piece of paper, if you make changes to the original or the copy, it will not affect the other one.

An **instance** is a duplicate of the original object, but will simultaneously mirror any changes to either versions of the object. For example if I have a Box primitive, I make an instance of that box, and then change parameters of either object, both objects will change together at the same time. The exception to this is moving, rotating, and scaling with the gizmos.

A **reference** is almost identical to an instance in that any changes to one will be applied to both objects. The difference, however, is that a reference can have additional modifiers applied to it, without affecting the other versions of the object, and give you an idea of what the final result will be after those modifiers are applied further down the stack. For example, if I have a Box primitive, I make a reference of that box, I can then apply additional modifiers to that box without affecting the other versions of it.

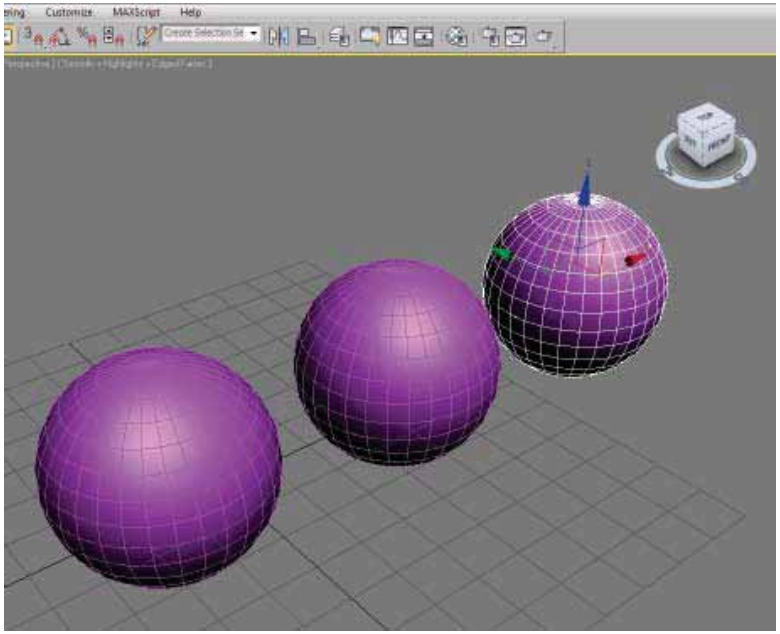
1. **Make a copy of an object.**
   Let's start with making a copy of an object.

- Start by creating a Standard Primitive **Sphere** in the Perspective viewport.
- After you have created the sphere, select the sphere and then select the **Move** tool, or use the **W** hotkey.
- With the sphere selected, choose any direction of the Move tool, and while holding down the Shift button on your keyboard, **LMB** drag that direction, and once you have a distance you are happy with, release the **LMB**.
- The **Clone Options** dialog box will pop up. Make sure that **Copy** is selected, type in **2** for **Number of Copies**, and then **LMB** click **OK** to create the copies.



Hold down Shift and drag the Move tool to bring up the Clone Options.

- You will now have three spheres in the scene—the original sphere you created, and the two copies you made. You should also notice how the spheres are spaced. However far you drug the sphere the first time before releasing the **LMB** is how far apart each of the copies will be from each other.



Three spheres will now be in the scene, evenly spaced.

2. Make an instance of an object.
Next, let's do the same method, but this time choose instance.

- Start by creating a standard primitive **teapot** in the Perspective viewport.
- With the teapot selected, hold down the **Shift** button on your keyboard, **LMB** drag that direction using the **Move** tool, and once you have a distance you are happy with, release the **LMB**.
- When the **Clone Options** dialog box pops up, choose **Instance**, and type in **2** for the **Number of Copies**.

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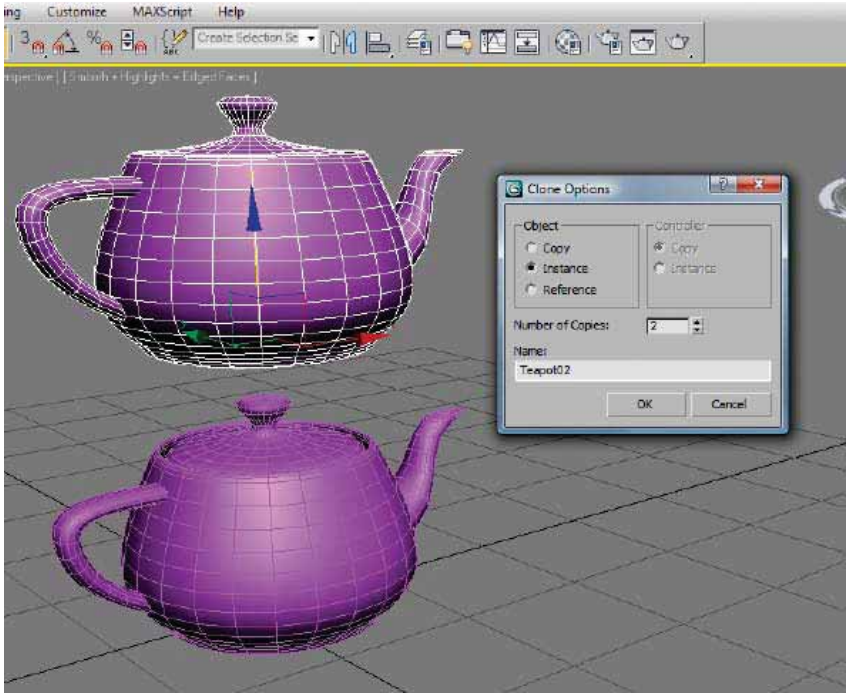
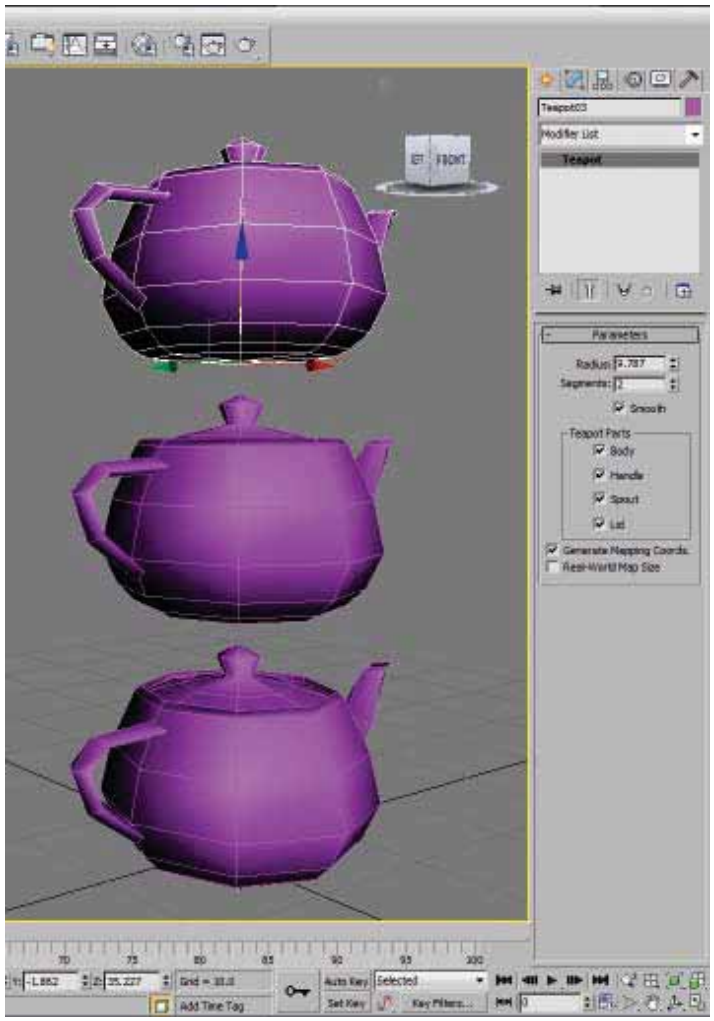


Create a teapot and make two instances of it.

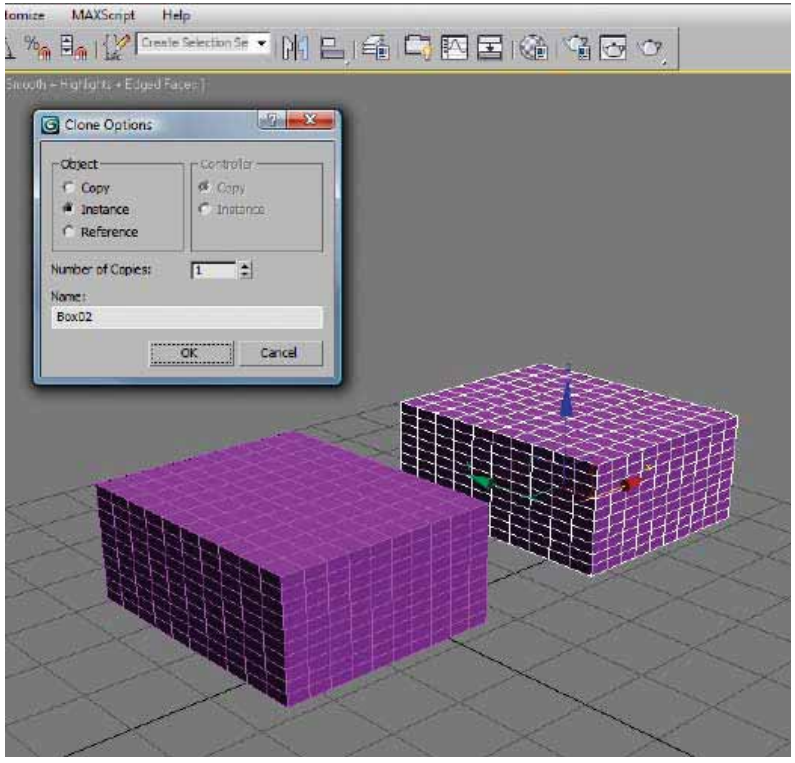
- Several things will have changed as you will notice. The object name in the Command Panel under the Modifier List has been bolded, and any adjustments you make to the teapot's radius or segments will apply to all three of the teapots. If you were to add a modifier to any of the teapots, it too would affect all of the other instances.



Changing the parameters of one instance affects them all.

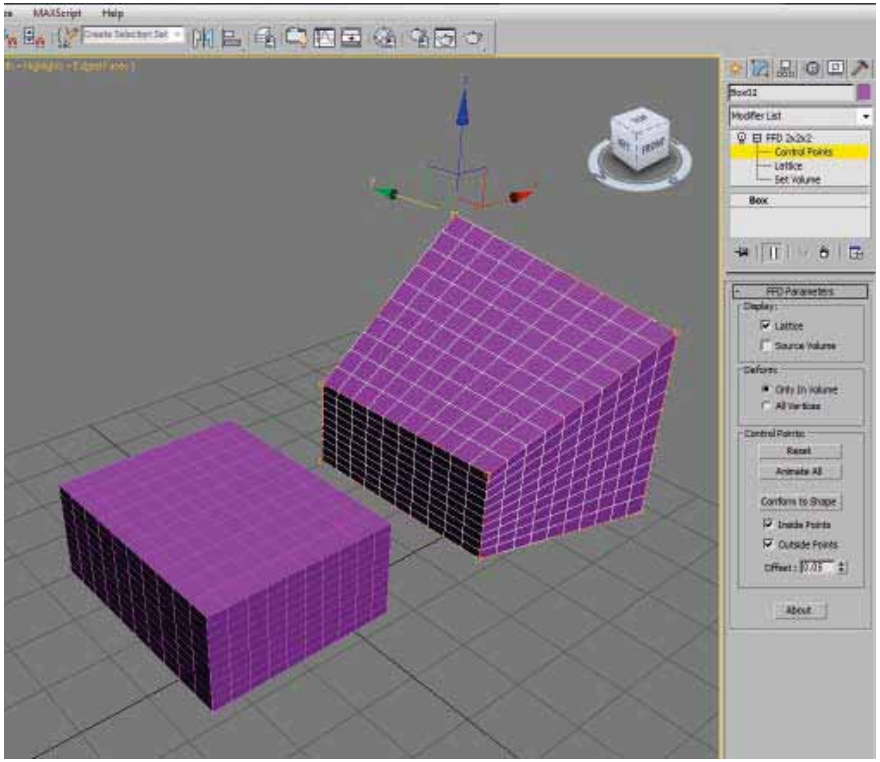
3. Make a reference of an object.
Finally, let's create a reference. A reference will work almost exactly the same as an instance, but we can add modifiers to the reference and see what the final outcome will be as we adjust parameters of the other version of the object.

- Start by creating a standard primitive **Box** in the Perspective viewport, and give it **10** length, width, and height segments.
- With the box selected, hold down the **Shift** button on your keyboard, **LMB** drag that direction using the **Move** tool, and once you have a distance you are happy with, release the **LMB**.
- When the **Clone Options** dialog box pops up, choose **Reference**, and leave the **Number of Copies** at **1**.



Create a Box and make 1 Reference of it.

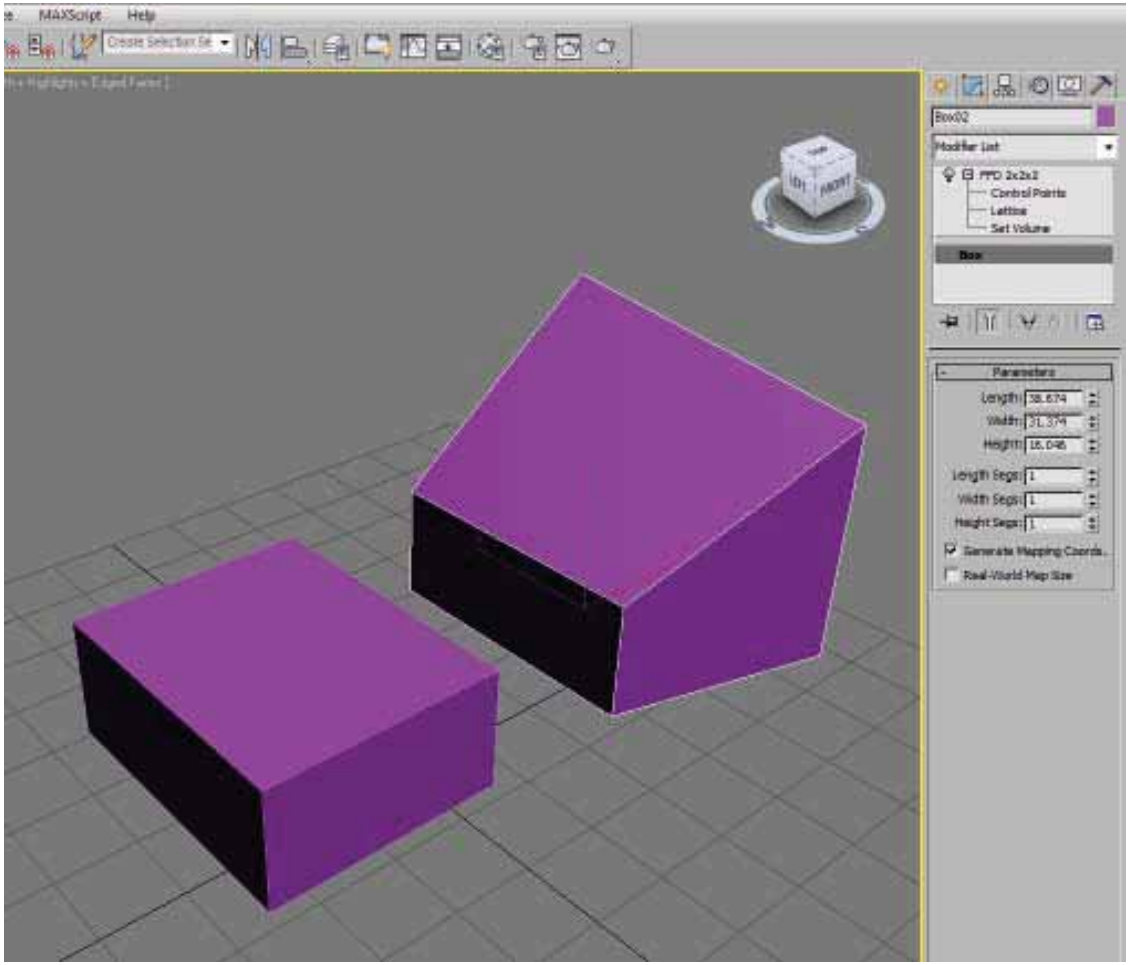
- As you will notice, the object name in the Command Panel from the Modifier List has been bolded just like an Instance, and a new dark gray bar has appeared. This is where new modifiers will appear if you add them to either one of the two references. Add an **FFD 2x2x2** modifier to either of the references and adjust the control points. The gray bar will stay on the modifier stack as an indication that it is used in conjunction with the reference. But, as you notice, the modifier is only affecting one of the boxes.



Changing the parameters of one instance affects them all.

3dsMax Skills

- Lastly, go down the modifier stack by **LMB** clicking the Box in the modifier stack, and change the length, width, and height segments back down to 1. As you see, both of the objects' default settings change, but the version with the modifier on it also retains the effects of the modifier itself.



Changing the parameters of one instance affects them all.

What editable polygon objects are

While each of the basic primitives are a great building block when working with geometry in 3D, even with modifiers they will never give you complete capabilities to create everything you could possibly think of. Editable polygon objects are objects that have been converted to take advantage of the subobject modes that make up those objects.

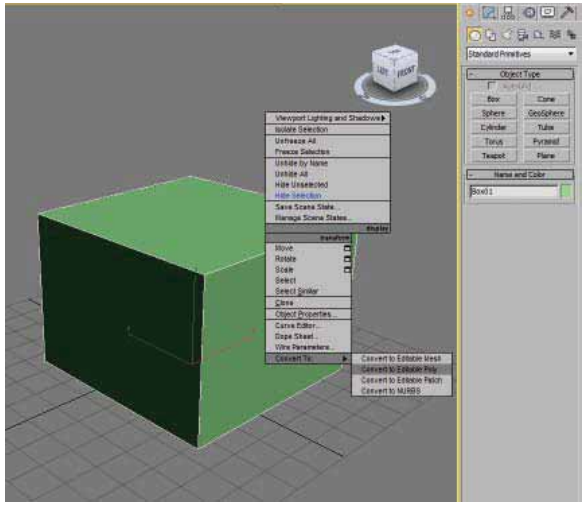
The five subobjects that make up an editable poly are vertices, edges, borders, polygons, and elements. While these subobjects exist on all 3D objects, you can only manipulate them individually by converting your object to a polygonal surface. Cutting up your geometry and adding to it beyond the basic primitives is realistically only achievable with a polygonal object, such as converting it to an editable polygon.

How to convert a primitive to an editable polygon object

There are at least two quick and easy methods to converting your objects to an editable polygon object. Once you have converted them to an editable poly, you will notice the entire Command Panel will change to access new features for the new editable poly object.

1. **Access the Quad menu.**
   The first method to converting an object to an editable polygon object is to use the **Quad** menu.

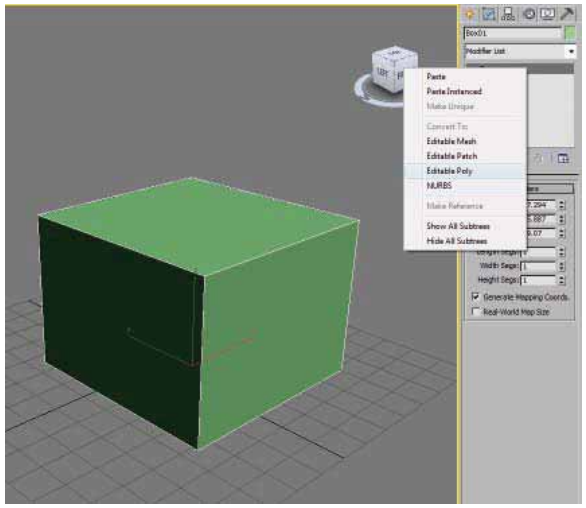
- Create a Box primitive in the Perspective viewport, and then **RMB** click it to bring up the Quad menu.
- At the bottom of the menu, move your mouse down to the **Convert To** option to extend that menu, and **LMB** click **Convert to Editable Poly**.



RMB click on a primitive and choose Convert to Editable Poly.

2. **Change it from within the Command Panel.**
   Another method is to simply convert it in the Command Panel.

- From within the Command Panel, **RMB** click Object from the Modifier List and **LMB** click **Editable Poly** to convert it.

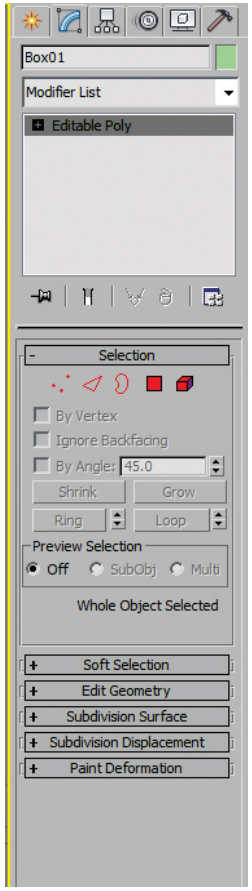


RMB click the object mode from the Modifier List, then LMB click the Editable Poly option.

Navigating the newly changed command panel

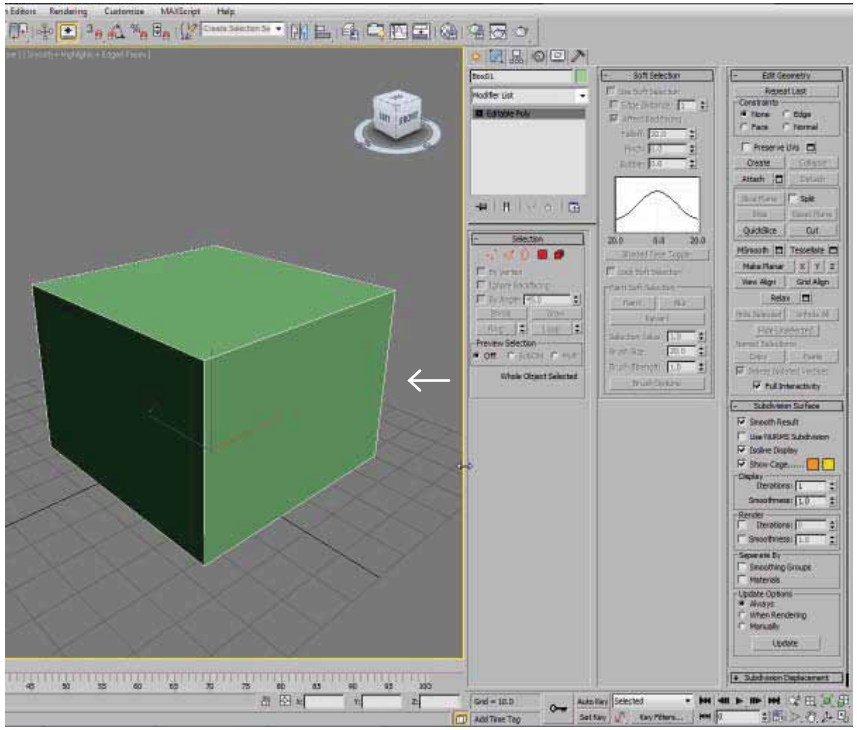
You may have noticed a large amount of new menu items appear after converting your primitive to an editable poly. Do not worry—you will not have to master each and every single piece of information to be a decent 3D artist. But it is important to understand many of the features in order to successfully create the objects you set out to make. There are also several tips you will need to know about navigating this newly changed Command Panel.

Minimize and maximize submenus—We have mentioned this before, but it is important to remember that in order to expand or collapse the submenus in the Command Panel, all you need to do is **LMB** click the box that has the name of the submenu. You will find that when working with editable poly objects you will not need every single menu expanded, so it might be a good idea to collapse the ones you do not need.



The Command Panel with all but one submenu collapsed.

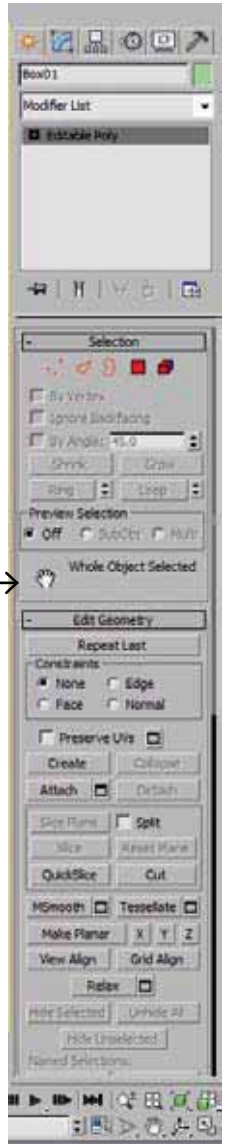
Increase the width of the Command Panel—Another tip for maximizing the Command Panel is to expand the panel altogether. Along the edge of the Command Panel, where the panel meets the viewport, if you hover your mouse slightly you will see the mouse icon change. Holding down the **LMB** and dragging it to the left will allow you to "pull" the Command Panel out further to give more screen space to the different menu options.



Holding the LMB and dragging left at the edge of the Command Panel allows you to stretch its width.

Put the submenus in your preferred order—When it comes to modeling in 3D for games and working with subobject modes, there are some common submenus you will use more often than others. One feature to help with this is to **LMB** click and hold any of the submenu titles, and then drag it up or down to your preferred order. So whether you choose to have expanded the Command Panel or to keep it small, you can choose which order your menus are in.

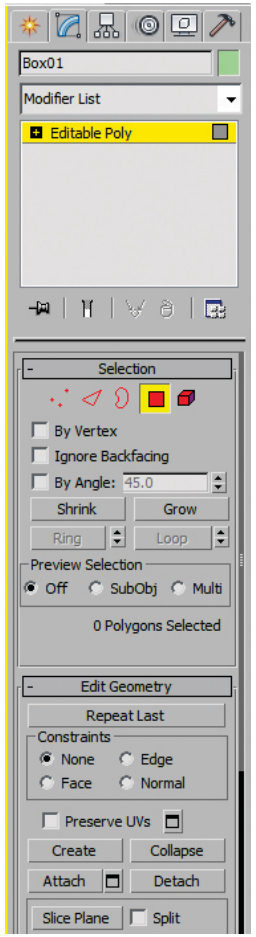
Drag the Command Panel up or down—Lastly, it is important to know how to drag the Command Panel up or down if you choose not to expand it out. If you hover your mouse over any area that is not a button or a submenu, your icon will change to a small hand, allowing you to "grab" the panel and pull it up or down. Alternatively, there is a very small traditional scrollbar at the very furthest left side of the Command Panel. Either of these methods will drag the panel up or down.



When hovering your mouse over the Command Panel, a small hand icon appears allowing you to drag the panel up or down.

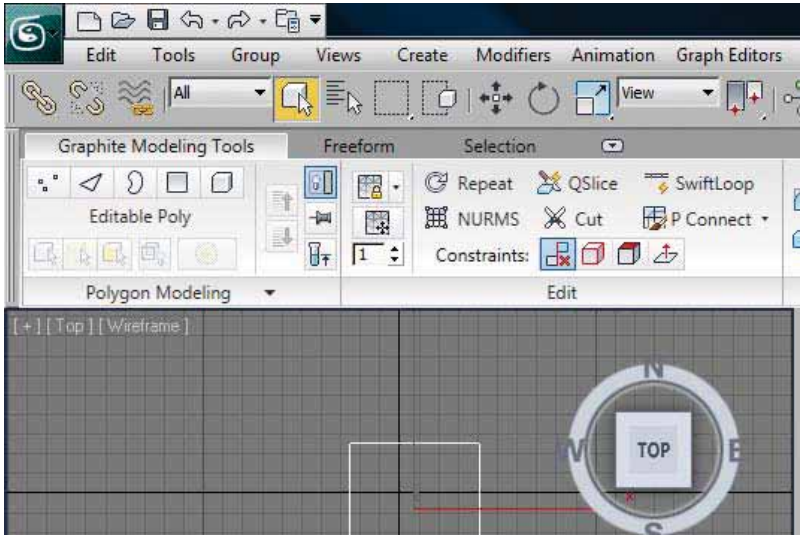
How to change between subobject modes

As you may have guessed, there are multiple ways to switch between the subobject modes. Depending on whether you are taking advantage of the vertex toolset or the polygon toolset, you will want to be able to quickly switch between the different subobjects to take advantage of specific tools available to each of the subobjects.
Using your keyboard, pressing 1-5 will switch between each of the subobject modes.
If you have an Editable Poly object selected, pressing the icon for any of the five subobjects under the Selection submenu will change between them.



An Editable polygon object with the Polygon subobject mode selected.

In the **Graphite Modeling Tools** menu, select the icons for the various subobject modes.



The various subobject modes can be selected from within the Graphite Modeling Tools menu.

Subobject modes

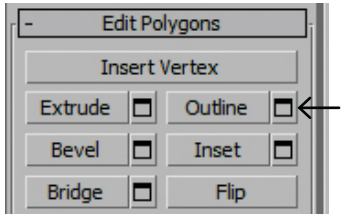
There are literally hundreds of various tools associated with each of the subobject modes. If you have looked at the different submenus under each of them, it is easy to become somewhat confused at the vast amount of options. It is not required to master them all, but feel free to experiment and see what you get! You can always utilize the powerful Help Menu by pressing **F1**, typing in the command you want to learn more about and experimenting on your own.

As you may have noticed as well, once you have converted an object to editable poly, the graphite modeling tools start to spring to life. This handy tool provides graphical icons and drop down menu descriptions that make understanding each of the functions of editable polygons that much easier. For many of the subobject tools, we will identify the name of the function and which submenu it falls under. Whether you choose to access it via the classic Command Panel or the new graphite tools is entirely up to you. The graphite tools do organize them a little more than the Command Panel does as well as provide a graphical icon for many of the functions, so it definitely makes a good learning tool for beginners and advanced modelers alike.

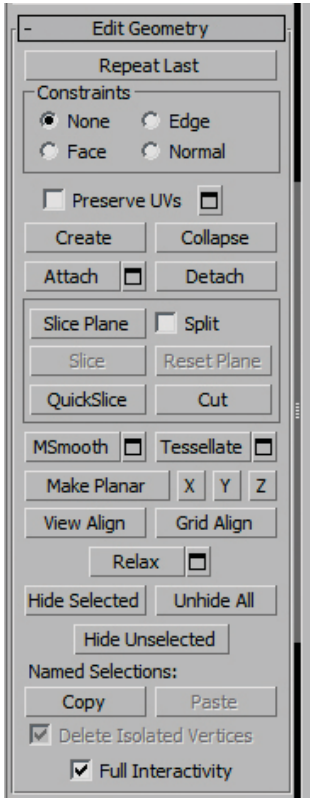
Here we will focus on three of the five subobject modes: Vertex, Edge, and Polygon. As we move throughout the book, we will utilize tools specific to the other subobject modes as well.

Tip:

When we describe the various functions, some of them also contain a dialog box that allows for additional functions or settings than the default function. The dialog box is brought up by clicking the small box icon next to the normal function's name.



To access a dialog box, LMB click on the small box next to the function you are using.



The Edit Geometry options are available to all of the subobjects, and can change slightly depending on the subobject.

Features of the Edit Geometry submenu

The Edit Geometry rollout provides global controls for changing the geometry of the poly object, at either the top (object) level or the subobject levels. The controls are the same at all levels, except as noted in the descriptions below.

Tip:

To select multiple subobject pieces, hold down the **Control** button on your keyboard and then **LMB** click the desired element on your object. For example, to select more than one polygon, switch to the Polygon subobject mode, **LMB** click one polygon, hold down **Control** on your keyboard, and then **LMB** click another polygon to select more than one. To deselect the element, hold down the **Alt** key and **LMB** click or drag the subobject selection to deselect it.

Repeat Last—Repeats the most recently used command.
Constraints—Lets you use existing geometry to constrain subobject transformation.
Choose the constraint type:
None—No constraints. This is the default option.

Edge—Constrains subobject transformations to edge boundaries.

Face—Constrains subobject transformations to individual face surfaces.

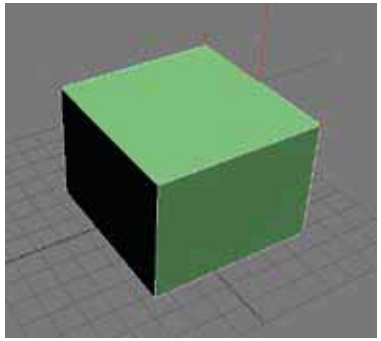
Normal—Constrains each subobject's transformations to its normal, or the average of its normals. In most cases, this causes subobjects to move perpendicular to the surface.

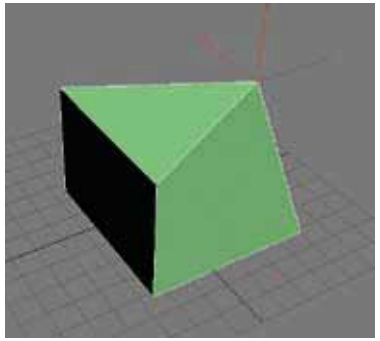
Create—Lets you create new geometry. How this button behaves depends on which level is active:
Object, Polygon, and Element—Lets you add polygons in the active viewport. After you turn on Create, click three or more times in succession anywhere, including on existing vertices, to define the shape of the new polygon. To finish, **RMB** click. While creating a polygon at the Polygon or Element level, you can delete the most recently added vertex by pressing **Backspace**. You can do this repeatedly to remove added vertices in reverse order of placement. You can start creating polygons in any viewport, but all subsequent clicks must take place in the same viewport.

Vertex—Lets you add vertices to a single selected poly object. After selecting the object and **LMB** clicking **Create**, **LMB** click anywhere in space to add free-floating (isolated) vertices to the object. The new vertices are placed on the active construction plane.

Edge and Border—Lets you create an edge between a pair of nonadjacent vertices on the same polygon. **LMB** click **Create**, **LMB** click a vertex, and then move the mouse. A rubber-band line extends from the vertex to the mouse cursor. **LMB** click a second, nonadjacent vertex on the same polygon to connect them with an edge. Repeat, or, to exit, **RMB** click anywhere in the viewport or **LMB** click **Create** again.

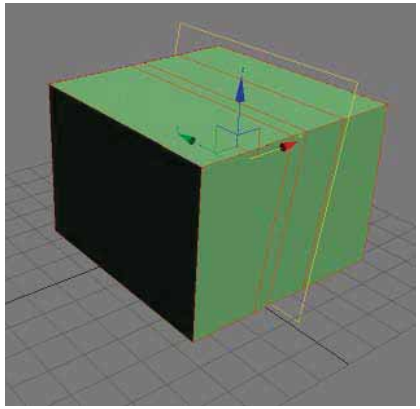
Collapse— (Vertex, Edge, Border, and Polygon levels only) Collapses groups of contiguous selected subobjects by welding their vertices to a vertex at the selection center.





Attach—Lets you attach other objects in the scene to the selected poly object. After activating **Attach**, **LMB** click on another object to attach it to the selected object. The **Attach** operation remains active, so you can continue clicking on other objects to attach them as well. To exit, **RMB** click anywhere in the active viewport or click the **Attach** button again. Attaching a non-mesh object automatically converts it to the editable-poly format.

Detach— (subobject levels only) Detaches the selected subobjects and the polygons attached to them as a separate object or element(s). With an editable poly object, when you **LMB** click **Detach**, 3ds Max prompts for those options in the **Detach Dialog**.



Slice Plane— (subobject levels only) Creates a gizmo for a slice plane that you can position and rotate to specify where to slice. Also enables the **Slice** and **Reset Plane** buttons. **LMB** click Slice to create new edges where the plane intersects the geometry. To perform the slice, **LMB** click the **Slice** button.

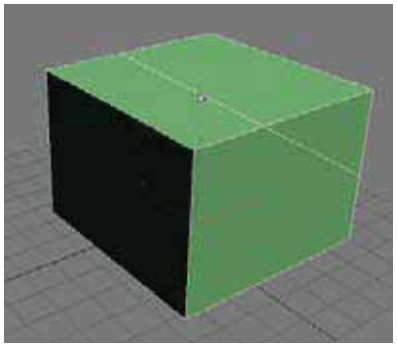
Slice—(subobject levels only) Performs the slice operation at the location of the slice plane.

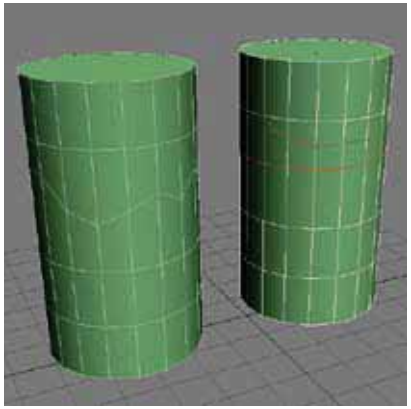
Reset Plane—(subobject levels only) Returns the slice plane to its default position and orientation. Available only when Slice Plane is on.

QuickSlice—Lets you quickly slice the object without having to manipulate a gizmo. Make a selection, **LMB** click **QuickSlice**, and then **LMB** click once at the slice start point and again at its endpoint. You can continue slicing the selection while the command is active. To stop slicing, **RMB** click anywhere in the viewport, or click **QuickSlice** again to turn it off.

Cut—Lets you create edges from one polygon to another or within polygons. **LMB** click at the start point, move the mouse and **LMB** click again, and continue moving and clicking to create new connected edges. **RMB** click once to exit the current cut, whereupon you can start a new one, or **RMB** click again to exit Cut mode. While cutting, the mouse cursor icon changes to show the type of subobject it is over, to which the cut will be made when you click.

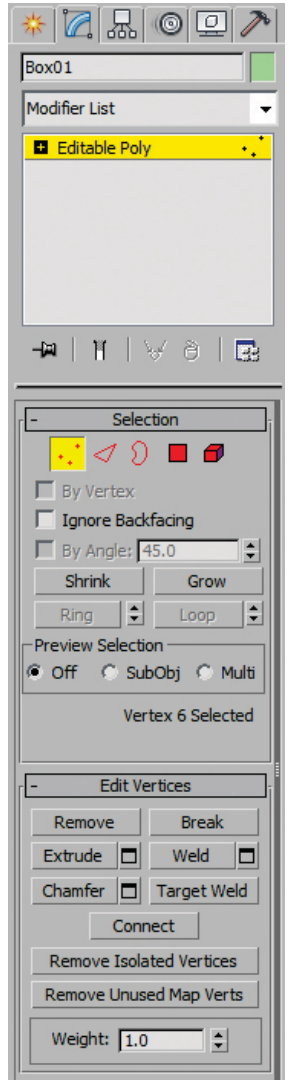
X/Y/Z—Makes all selected subobjects planar and aligns the plane with the corresponding plane in the object's local coordinate system. The plane used is the one to which the button axis is perpendicular; so, for example, clicking the X button aligns the object with the local YZ axis. At the Object level, makes all vertices in the object planar.





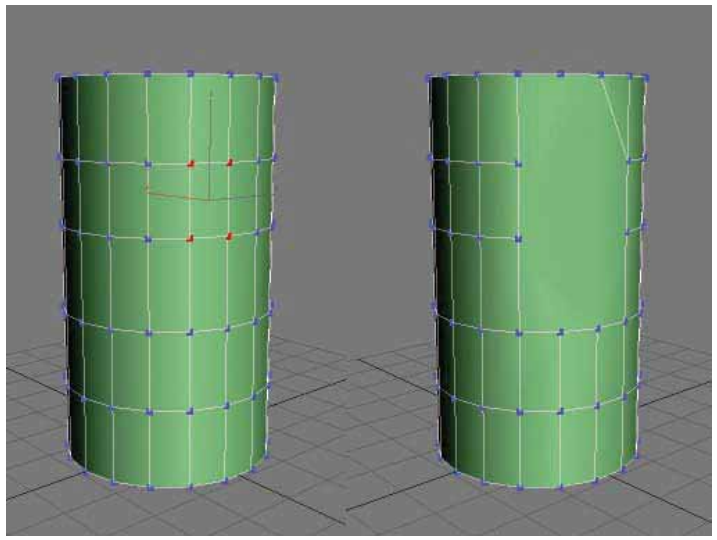
Features of the Vertex subobject mode

Vertices are points in space. They define the structure of other subobjects (edges and polygons) that make up the polygon object. When you move or edit vertices, the connected geometry is affected as well. Vertices can also exist independently; such isolated vertices can be used to construct other geometry but are otherwise invisible when rendering. Some of the vertex-specific tools are as follows.



The Vertex subobject mode.

Remove—Deletes selected vertices and combines the polygons that use them. The keyboard shortcut is **Backspace**.

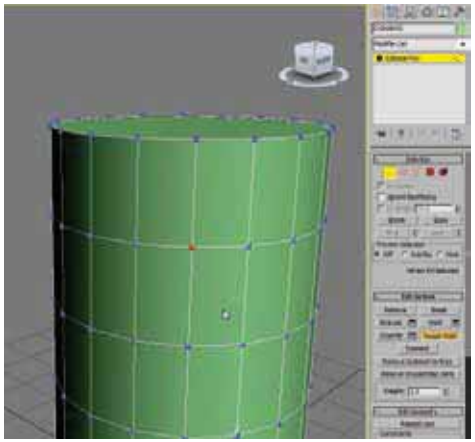


A selection of vertices removed with the Backspace hotkey.

Break—Creates a new vertex for each polygon attached to selected vertices, allowing the polygon corners to be moved away from each other where they were once joined at each original vertex. If a vertex is isolated or used by only one polygon, it is unaffected.

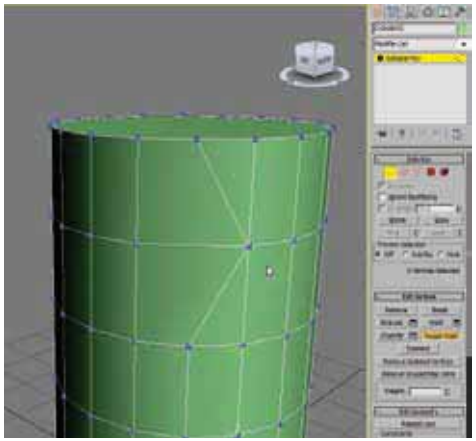
Weld—Combines contiguous, selected vertices that fall within the tolerance specified in the **Weld dialog** box. All edges become connected to the resulting single vertex. Inside of the **Weld dialog box**, you can specify the weld threshold - a number that represents the distance between vertices. The smaller the number, the closer the vertices need to be in 3D space for the weld to work. Weld is best suited to automatically simplifying geometry that has areas with a number of vertices that are very close together. Before using **Weld**, set the Weld Threshold via the **Weld dialog box**.

Target Weld—Allows you to select a vertex and weld it to a neighboring target vertex.Target Weld works only with pairs of contiguous vertices; that is, vertices connected by a single edge. In **Target Weld** mode, the mouse cursor, when positioned over a vertex, changes to a + cursor. **LMB** click and then move the mouse; a dashed, rubber-band line connects the vertex to the mouse cursor. Position the cursor over another, neighboring vertex and when the + cursor appears again, click the mouse. The first vertex moves to the position of the second and the two are welded. Target Weld remains active until you click the button again or **RMB** click in the viewport.

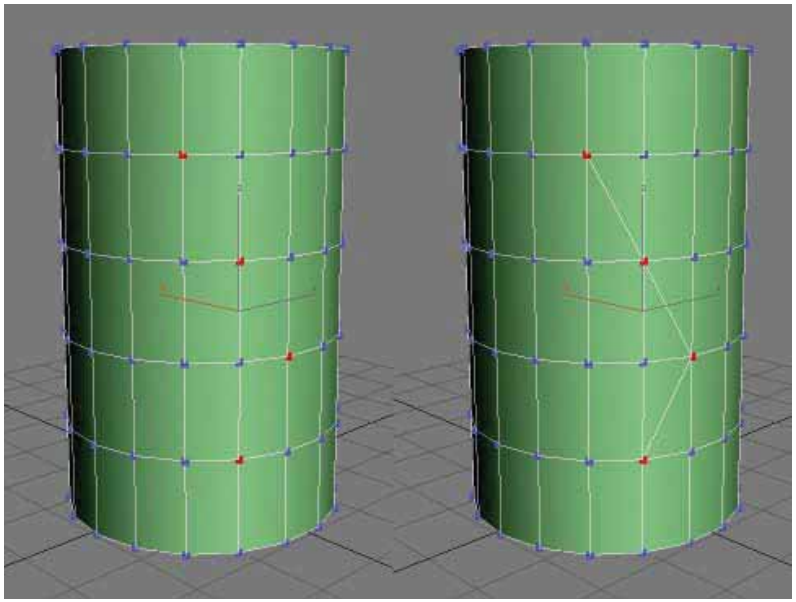


Using the Target Weld to pick the original vertices to weld over.

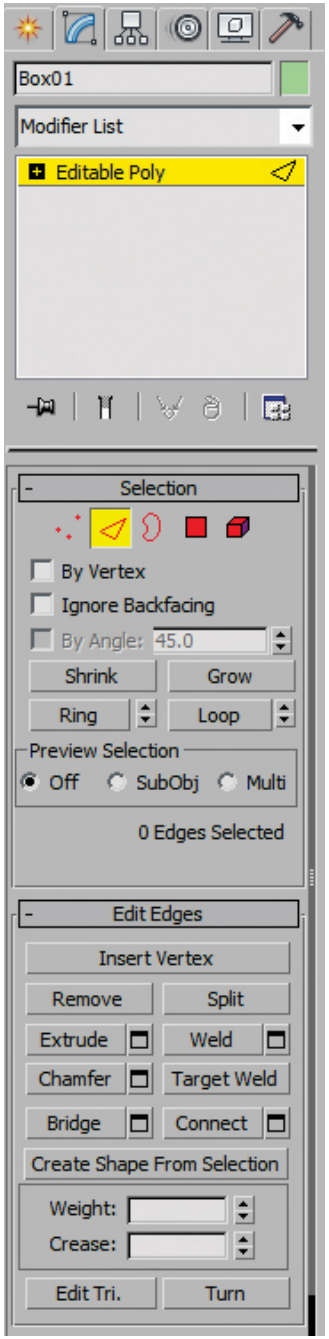
Using Target Weld, the vertex is welded over to the vertex next to it.



Connect—Creates new edges between pairs of selected vertices. Connect does not let the new edges cross. For example, if you select all four vertices of a four-sided polygon and then click **Connect**, only two of the vertices will be connected.



Selecting a series of vertices and using the connect tool.

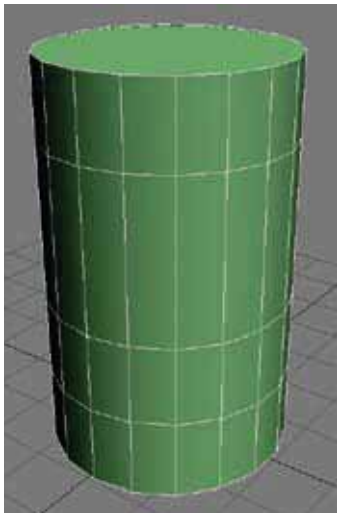


The Edge subobject mode.

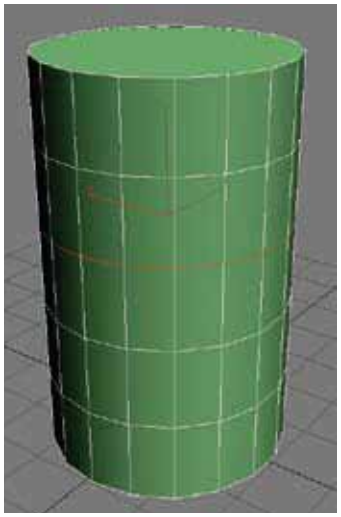
Features of the Edge subobject mode

An edge is a line connecting two vertices that forms the side of a polygon. An edge cannot be shared by more than two polygons. Some of the Edge subobject tools are as follows.

Remove—Deletes the selected edges and combines the polygons that use them. Removing one edge is like making it invisible. The mesh is affected only when all or all but one of the edges depending on one vertex are removed. At that point, the vertex itself is deleted and the surface is retriangulated. To delete the associated vertices when you remove edges, press and hold **Ctrl** while using the **Remove** operation, either by mouse or with the **Backspace** key. This is called a Clean Remove, and it ensures that the remaining polygons are planar.



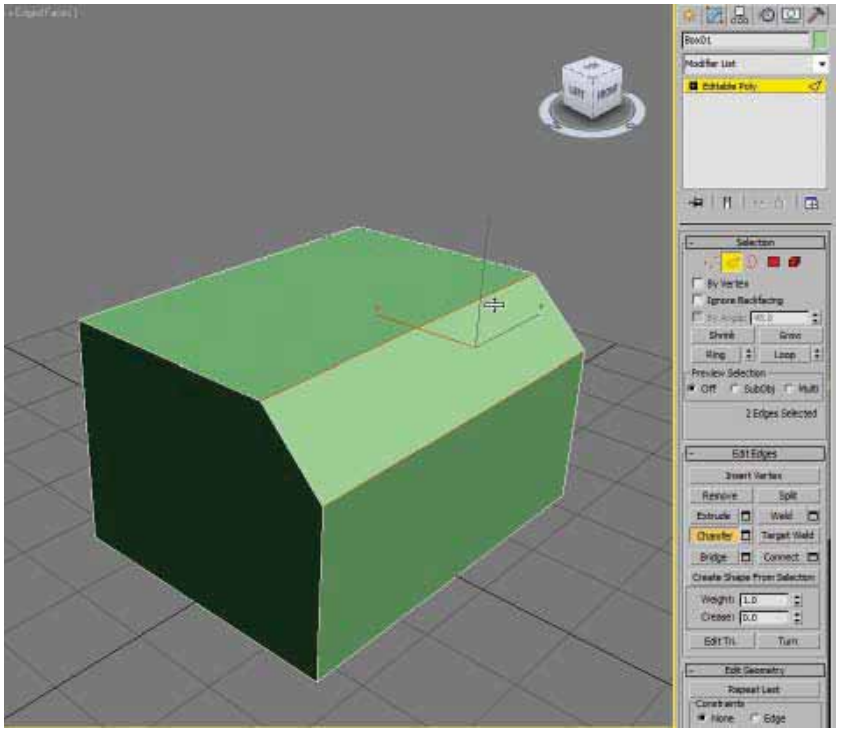
Performing a clean remove of the edges with the Ctrl + Backspace hotkey.



Selecting a series of edges for removal.

Chamfer—Click this button and then drag edges in the active object to execute a **Chamfer**. To chamfer edges numerically, **RMB** click the **Chamfer Dialog** button and change the **Chamfer** `Amount` value. If you chamfer multiple selected edges, all of them are chamfered identically. If you drag an unselected edge, any selected edges are first deselected.

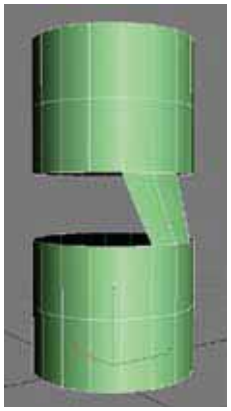
An edge chamfer "chops off" the selected edges, creating a new polygon connecting new points on all visible edges leading to the original vertex. The new edges are exactly *‹chamfer amount›* distance from the original edge along each of these edges. For example, if you chamfer one edge of a box, each corner vertex is replaced by two vertices moving along the visible edges that lead to the corner. Outside faces are rearranged and split to use these new vertices, and a new polygon is created at the corner.



Chamfering the edge of a box.

Chamfer Settings—Opens the **Chamfer Edges** dialog box, which lets you chamfer edges via interactive manipulation and toggle the **Open** option. If you click this button after performing a manual chamfer, the same chamfer is performed on the current selection as a preview and the dialog box opens with Chamfer Amount set to the amount of the last manual chamfer.

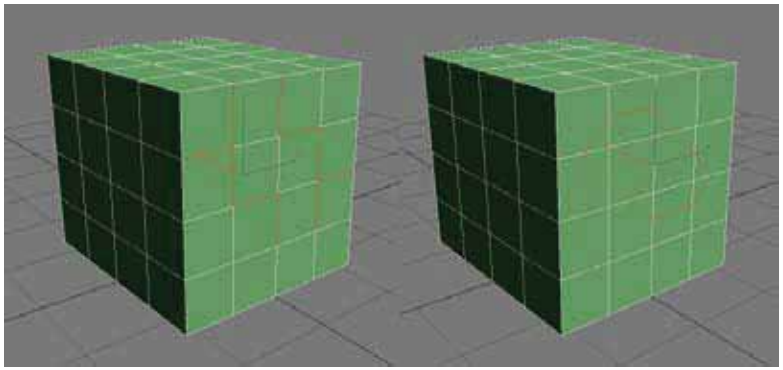
Bridge—Connects border edges on an object with a polygon "bridge." Bridge connects only border edges; that is, edges that have a polygon on only one side. This tool is particularly useful when creating edge loops or profiles.
Using the bridge tool to connect two sets of disconnected edges.



Connect—Creates new edges between pairs of selected edges using the current **Connect Edges** dialog box settings. **Connect** is particularly useful for creating or refining edge loops.

Note:

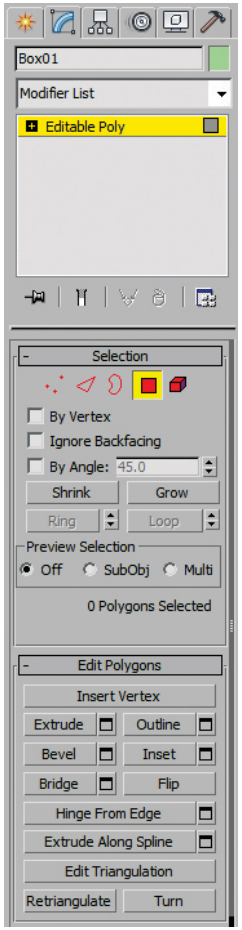
You can connect only edges on the same polygon. Also, Connect will not let the new edges cross. For example, if you select all four edges of a four-sided polygon and then click **Connect**, only neighboring edges are connected, resulting in a diamond pattern.



Performing the Connect function on a series of selected edges.

Features of the Polygon subobject mode

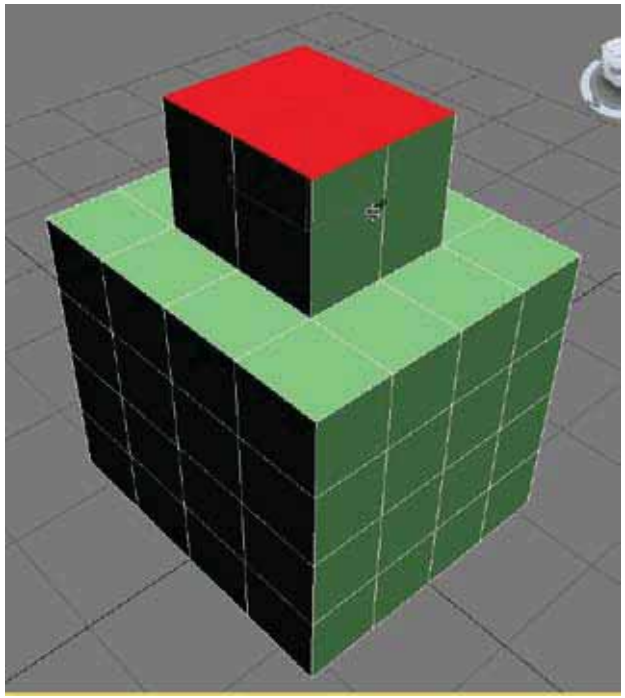
A polygon is a closed sequence of three or more edges connected by a surface. Polygons provide the renderable surface of editable poly objects. Some of the polygon subobject
tools are as follows.



The Polygon subobject mode.

Extrude—Lets you perform manual extrusion via direct manipulation in the viewport. **LMB** click the button, and then drag vertically on any polygon to extrude it. Extruding polygons moves them along a normal and creates new polygons that form the sides of the extrusion, connecting the selection to the object. Following are important aspects of polygon extrusion:

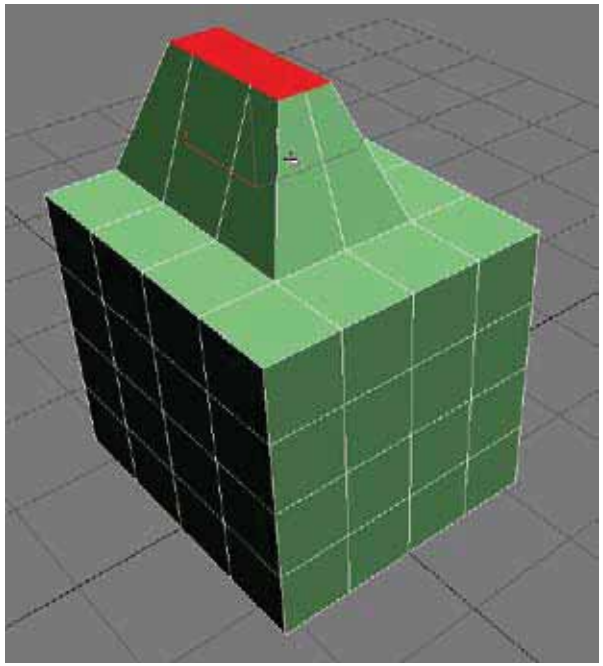
- When hovering over a selected polygon, the mouse cursor changes to an **Extrude** cursor.
- Drag vertically to specify the extent of the extrusion, and horizontally to set the size of the base.
- With multiple polygons selected, dragging on any one extrudes all selected polygons equally.
- You can drag other polygons in turn to extrude them while the **Extrude** button is active. **LMB** click **Extrude** again, or **RMB** click anywhere in the active viewport to end the operation.



Performing the Extrude function on a group of polygons.

Bevel—Lets you perform manual beveling via direct manipulation in the viewport. Click this button, and then drag vertically on any polygon to extrude it. Release the mouse button and then move the mouse vertically to outline the extrusion. **LMB** click again to finish.

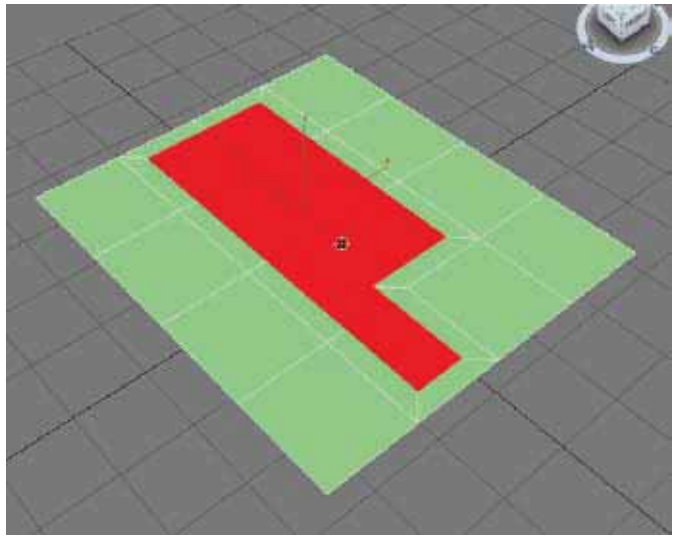
- When over a selected polygon, the mouse cursor changes to a **Bevel** cursor.
- With multiple polygons selected, dragging on any one bevels all selected polygons equally.
- You can drag other polygons in turn to bevel them while the **Bevel** button is active. **LMB** click **Bevel** again or **RMB** click in the active viewport to end the operation.



Performing the Bevel function on a group of polygons.

Inset—Performs a bevel with no height; that is, within the plane of the polygon selection. **LMB** click this button, and then drag vertically on any polygon to inset it.

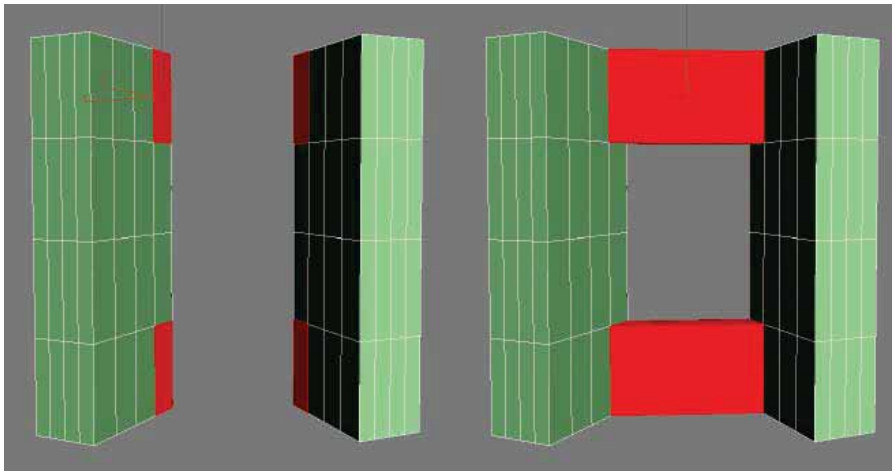
- When over a selected polygon, the mouse cursor changes to an **Inset** cursor.
- With multiple polygons selected, dragging on any one insets all selected polygons equally.
- While the **Inset** button is active, you can drag other polygons in turn to inset them. To end the operation, **LMB** click Inset again, or right-click anywhere in the active viewport.



Performing the Inset function on a group of polygons.

Bridge—Connects two polygons or polygon selections on an object with a polygon "bridge." There are two ways to use Bridge in Direct Manipulation mode (that is, without opening the Bridge **Dialog Box.**)

- Make two separate polygon selections on an object, and then **LMB** click **Bridge**. This will create the bridge immediately, using the current **Bridge** settings, and then deactivates the **Bridge** operation.
- If no qualifying selection exists (that is, two or more discrete polygon selections), **LMB** clicking Bridge activates the button and places you in **Bridge** mode. First, **LMB** click a polygon and move the mouse; a rubber-band line connects the mouse cursor to the clicked polygon. Click a second polygon to bridge the two. This creates the bridge immediately using the current Bridge settings; the Bridge button remains active for connecting more pairs of polygons. To exit **Bridge** mode, **RMB** click anywhere in the active viewport or **LMB** click the **Bridge** button again.



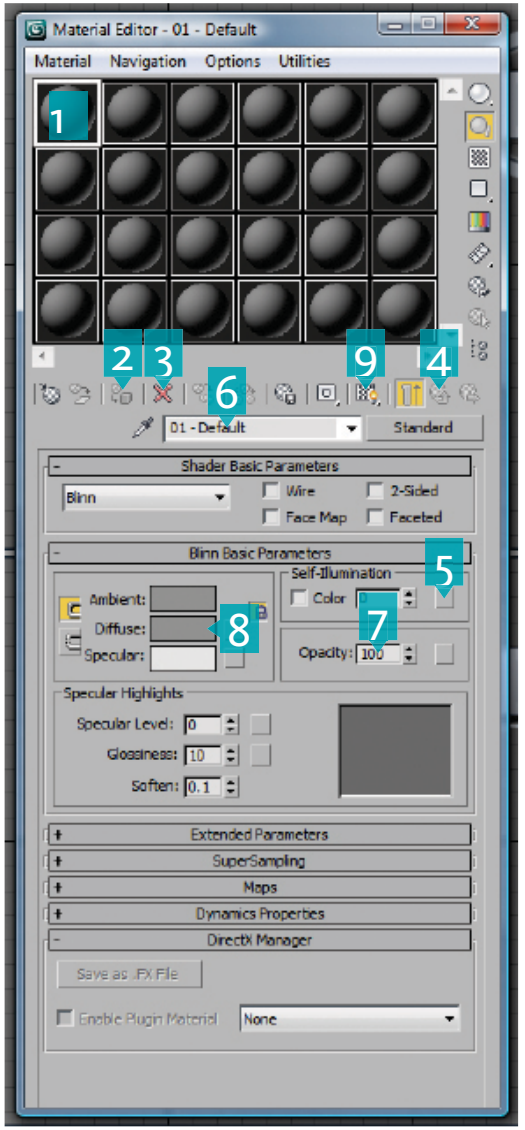
Selecting a series of adjacent polygons and using the bridge tool to connect them.

Working with the Material Editor

Let's start by opening the Material Browser. You can find the icon along the top of the Main toolbar, or use the keyboard hotkey **M**.

Tip:

It is easy to get lost with all the buttons and menus with the Material Browser when you are first getting started. When in doubt, you can always use the Go to Parent button to find your way back to the top of a material node. You can also simply delete the material and start over.



The Material Browser interface.

When you first open the Material Browser, there are plenty of new options and buttons to greet you. First, let's get familiar with some of the most important buttons as they apply to this book, and a description of their usage.

1 **Material Node**—These are the icons that act as a visual representation of your material, with a small preview of what the material looks like. Double-clicking the **LMB** will bring up a scalable pop-up window that allows you a closer look at your material.

2 **Assign Material to Selection**—Once you have a material created, this button will apply it to the object you have selected in your viewport.

3 **Reset Map/Mtl to Default Settings**—This button will essentially delete your material and all of the setups in it back to the default state.

Tip:

Remember that with any submenu in 3ds Max 2010, you can expand and collapse the menu by clicking anywhere on the box that has the name of the submenu. You can also "drag" the menu up and down by clicking anywhere in the gray area of the interface that is not a button and **LMB** click dragging it up or down. The icon will change to a hand when your mouse is anywhere that you can drag in a menu.

4 **Go to Parent**—This button is basically the "go back to the beginning" button that will take you to the very top level of your material. As you begin to work with materials and textures, and the more complicated your materials are, you will want to remember this button to get back to the top level

5 **Empty Box Input Nodes**—any of these empty boxes represent a map or input that can be used for that parameter. For example, if we have created a diffuse (also known as color) map, **LMB** clicking the small box next to Diffuse" will give us the ability to add that map. When you have a map or a parameter value plugged into these nodes, the letter **M** will appear over these otherwise empty boxes. You can also **RMB** click on these nodes and choose **Clear** to remove the maps completely. This is helpful if you have accidentally clicked a node and added something you did not intend to.

6 **Material Name**—Each of the materials will have a number and the word Default next to it when you first begin work on your scene. If you wish to rename your material to something more relevant, simply replace the text in this box with the name of your choosing to replace it.

7 **Opacity**—Adjusting this value will alter how see-through your material is. 100 is the default meaning it is not see-through at all, and the closer you get to 0 the less visible the material is.

8 **Default Color Picker**—These gray boxes are color pickers. If you would like to create a material with just a color value, **LMB** click the gray box next to the word Diffuse to bring up the color picker and select a color of your choice.

9 **Show Standard Map in Viewport**—Causes the material to show on the 3D object in the viewport. When rendered the material will generally always show up, but this button allows you to see it in 3D.

Creating your first material

For our first material, we will set up a simple ground texture that could be used as a ground or floor piece in a level. Before we can even begin to texture our object we need to think about the surface it is going to be. If I am making something out of stone, a marshmallow texture might not work!

So, the first thing I might do is find a 2D image that looks close to what I am attempting to re-create. In future chapters we will discuss further some of the art involved with texture painting, but for now let's start with a simple image.

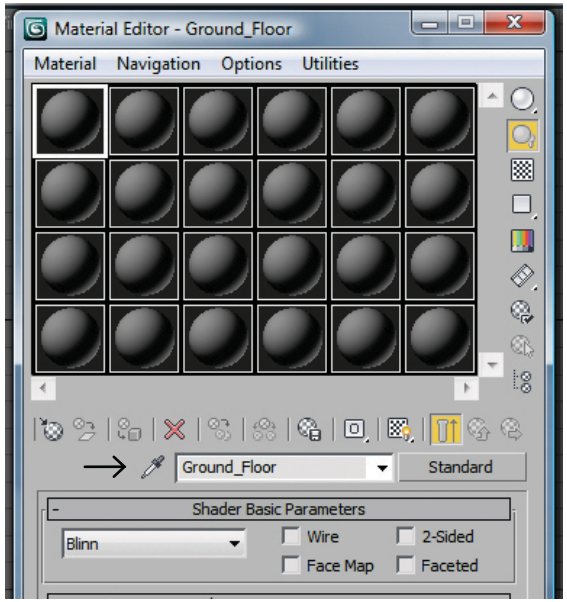
A basic cobblestone ground texture.

This texture works well because it is flat, does not have many sharp or harsh shadows on the surface, and is not warped by any sort of odd perspective problems. Looking at this image alone, you could almost imagine it being laid out flat on geometry to create a road. Quality texture maps do not need a lot of cleanup or fixing to start with. If the image had a sharp shadow in it, what would happen in your game if you shined a flashlight on that spot? The shadow would show up and that would spoil the sense of reality on the surface.
The next important step of texture maps is to ensure that the size remains relatively close to the size of the target geometry. If we took this square shaped picture and tried to squeeze it into a really long and thin picture frame, it would not look right at all.

So for our first texture, we will take a square 2D image and put it onto a square shape in 3D.

1. Set up a new material node.

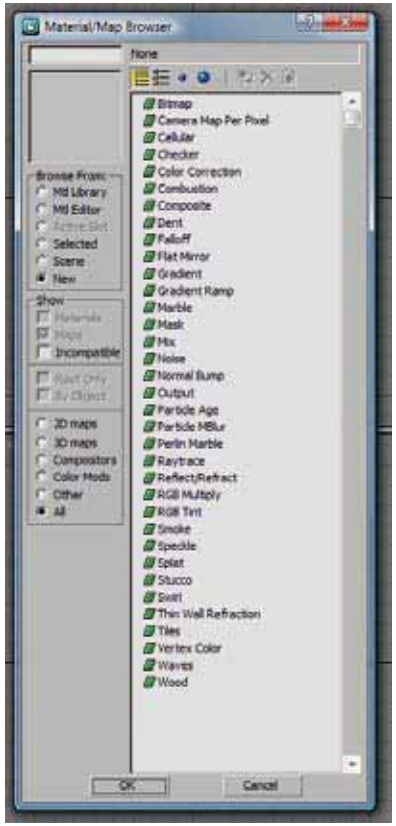
- Press the **M** hotkey on your keyboard to open the Material Browser, or **LMB** click the icon on the Main toolbar.
- On the very top-left blank material node, **LMB** click it to select it. A white outline appears over the material node to indicate it is your currently selected node.
- Rename this material *Ground_Floor*. After you have entered the new name, you should also see the name appear at the top of the Editor window, indicating it is the current material node selected.



Select a new node and rename it.

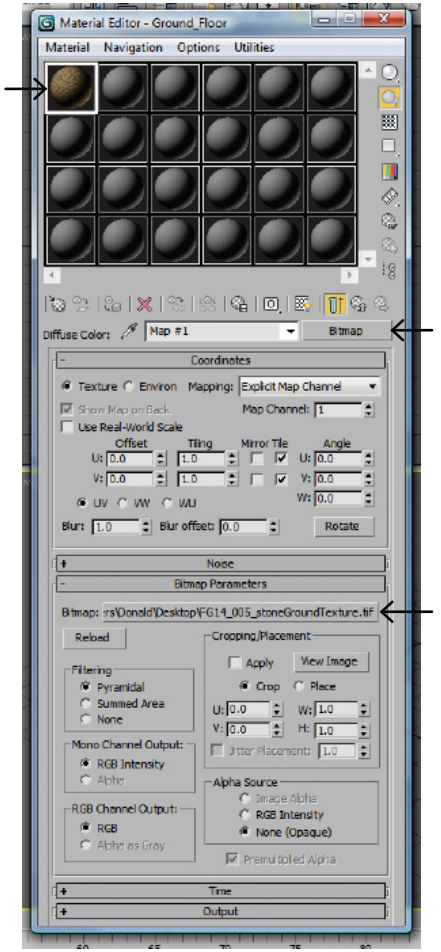
2. Import your diffuse color map.

- Under the submenu **Blinn Basic Parameters**, next to the diffuse, **LMB** click the empty node (the small empty box next to the gray color). This brings up a new window called the Material/Map Browser.



Select a new node and rename it.

- The Material/Map Browser contains a multitude of various types of prebuilt maps, parameters, and input types; 2D texture maps are called bitmaps.
- Select Bitmap at the top of the Material/Map Browser by double-clicking the **LMB**.
- After you have clicked it, a browser pops up asking you where the image is.
- Navigate to *support_files/Project1/Lesson6/FG06_Ground.tif* on the DVD for this ground texture to select it.
- You should now see the surface of the ground replace the gray sphere in the Material Editor, giving you a small representation of what it looks like.
- You will also see that you are in a different set of menus than previously. This is because you are now looking at the exclusive parameters of that diffuse texture and not the material as a whole. You will also see that the icon changed from Standard to Bitmap, indicating that you are working with a 2D bitmap, and not a standard material.

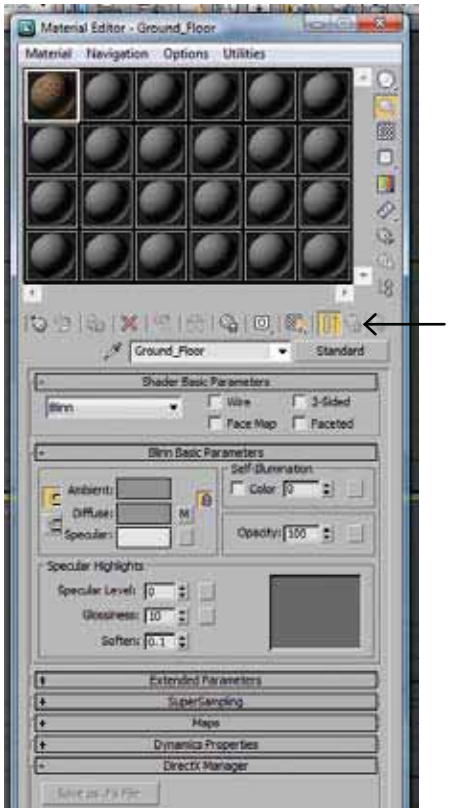


Select a new node and rename it.

- Under the Bitmap Parameters submenu, you also notice that the path to the image is listed here. If you want to change it to a different texture, you could do so by **LMB** clicking on the box and redirecting the path.

3. **Go back to the parent of the material.**

- Under the collection of material nodes, **LMB** click the **Go to Parent** icon to get back to the top of the material.



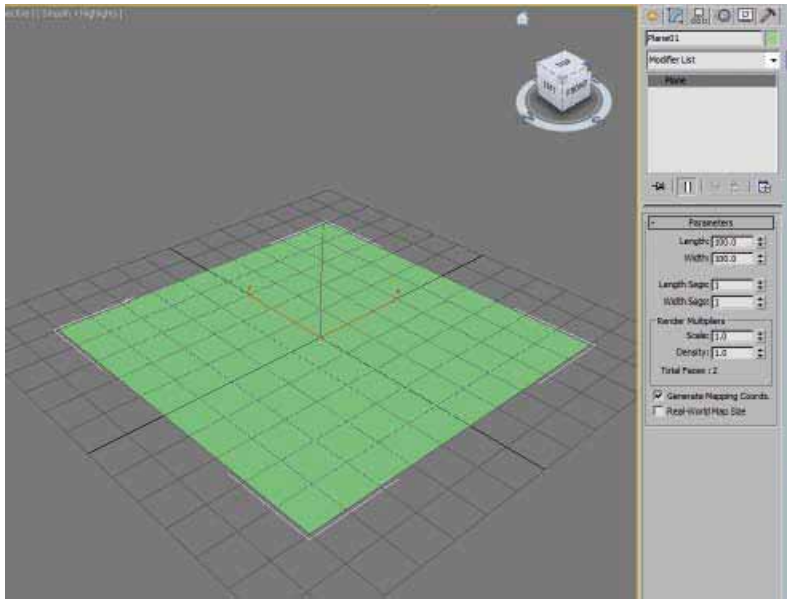
Creating the sphere in the Perspective viewport.

How to apply a material to an object

Now that we have created our first material, let's create a simple plane apply the material to.

1. **Create a standard primitive plane.**

- In the Perspective viewport, create a plane and give it a length and width value of **100**.
- Set the length and width segments to **1**.

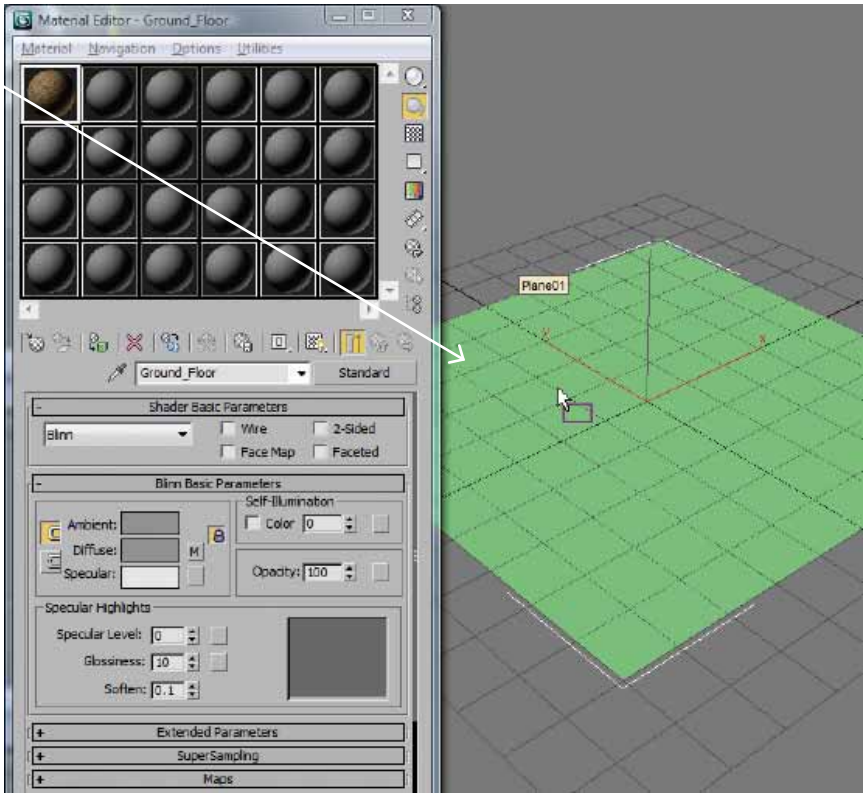


Create a standard primitive plane in the Perspective viewport.

2. **Apply the material to the plane by dragging it.**
There are two quick methods for applying a material to an object. The first method is to drag the material node onto the object.

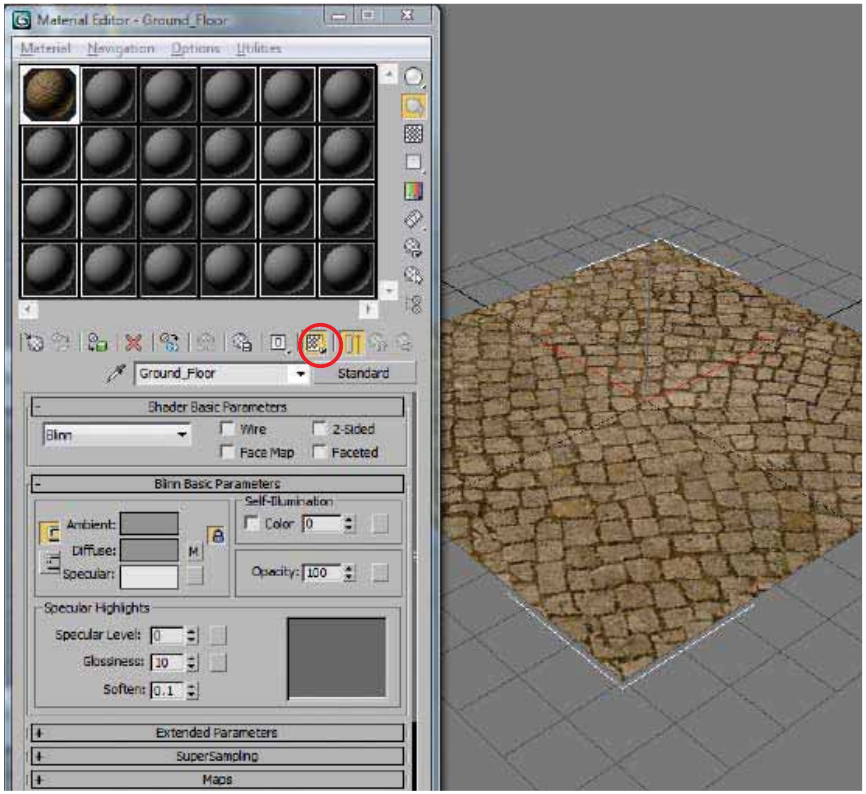
- Open the Material Editor window if you have closed it with the keyboard hotkey **M**.
- In the **Perspective** viewport, ensure that the plane primitive you created is in view.

- While holding the **LMB**, click and drag the *Ground_Floor* material onto the plane. When you do this, you will notice the icon change to a small square. Release the **LMB** to apply it.



LMB click and drag the material onto the plane.

- After you drop the material onto the object, your plane should turn gray. This is because we have not turned the material on to show up in the viewport. We do that by **LMB** clicking on the **Show Standard Map in Viewport** icon. This works as sort of an on and off switch to show the texture in the scene.

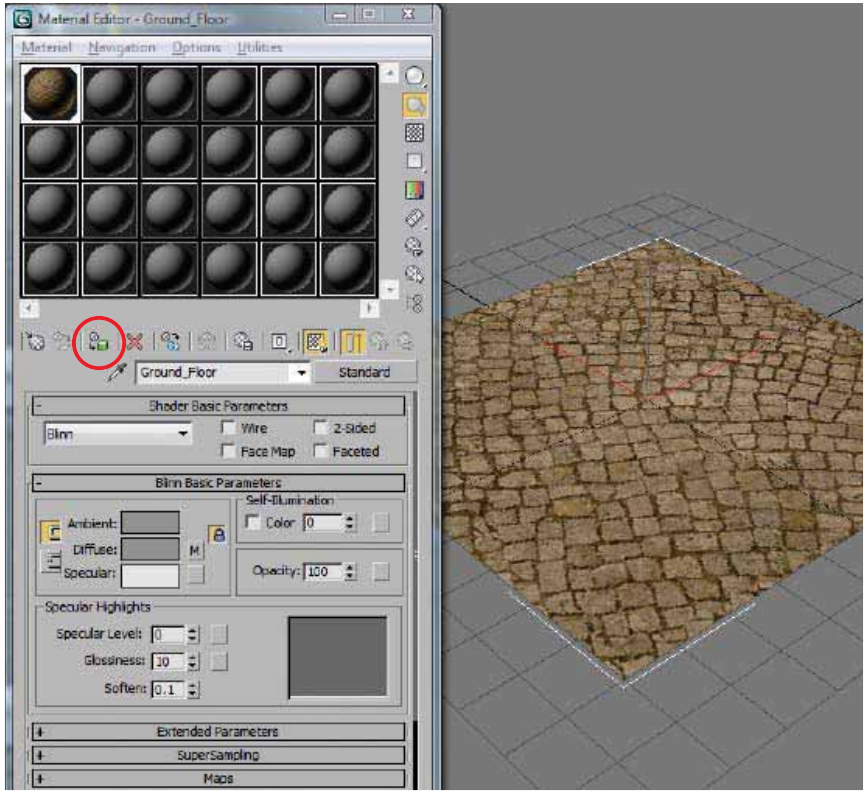


After applying the material, turn on the Show Standard Map in Viewport to have to appear.

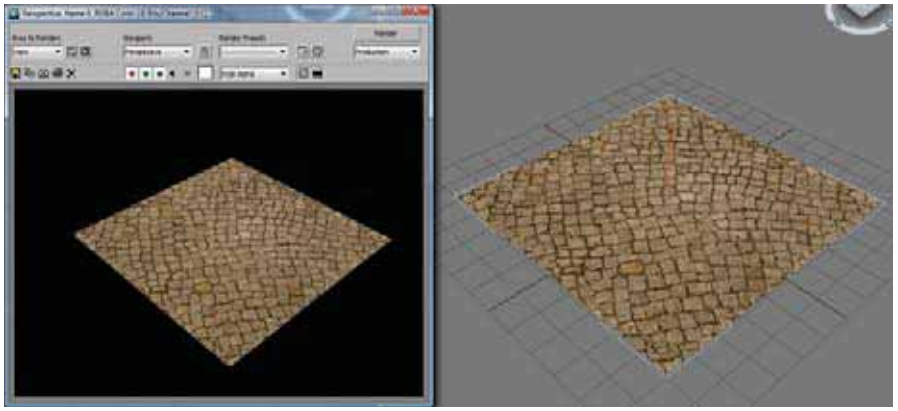
3. Apply the material to the plane with the Assign Material to Selection function. The second method to applying a material works almost exactly the same as the previous. The only difference is that you do not need to drag the material node at all, simply select the object and apply it.

- Open the material editor window if you have closed it with the keyboard hotkey **M**.
- In the **Perspective** viewport, ensure that the plane primitive you created is in view.
- With the plane selected, **LMB** click the **Assign Material to Selection** button to apply the material to the plane.

- If you have not already, make sure you turn **Show Standard Map in Viewport** on to see it.



LMB click the Assign Material to Selection to apply the material to a selected object.



A standard render of the plane, next to the viewport view of the object.

- Close the **Material Browser**. You have now correctly applied a material, composed of a diffuse color map, to an object.
- You can render the object with the keyboard hotkey **F9** to see what it would look like at its highest quality, but we will cover more on rendering and composition in later chapters.

Unwrap UVW Key Interface Elements

The Unwrap UVW modifier works just like any other modifier to apply it. After you apply it, you are given three subobject modes **Vertex**, **Edge**, and **Face**. These are the three editable elements you will work with when it comes to UVs. Just like most all windows in Autodesk® 3ds Max® 2010 software, you can **LMB** click and hold along the border of the window to resize it as needed. You can also move the window to another monitor if you have that. Let's look at some of the key elements of the interface to get started.

1 Edit UVW Window

This is the primary window where you will be working with the UVs of your object. To bring up the window, click the **Edit...** button under the Parameters rollout.

2 Currently Selected Subobject

When working with UVs, the subobject you select in the Edit UVW window will also appear shaded on your geometry in the 3D viewport. Switching between subobject modes works the same as an editable poly using the **1**, **2**, and **3** hotkeys.

3 Move, Rotate, Scale, Freeform, and Flip Tools

These are some of the most commonly used tools in the set. As with many features in 3ds Max, **LMB** clicking them and holding down the button will reveal a rollout of various other tools as well. Similar to working in 3D, the hotkeys for **Move**, **Rotate**, and **Scale** are the same in the UV tools.

4 Quick Planar Map

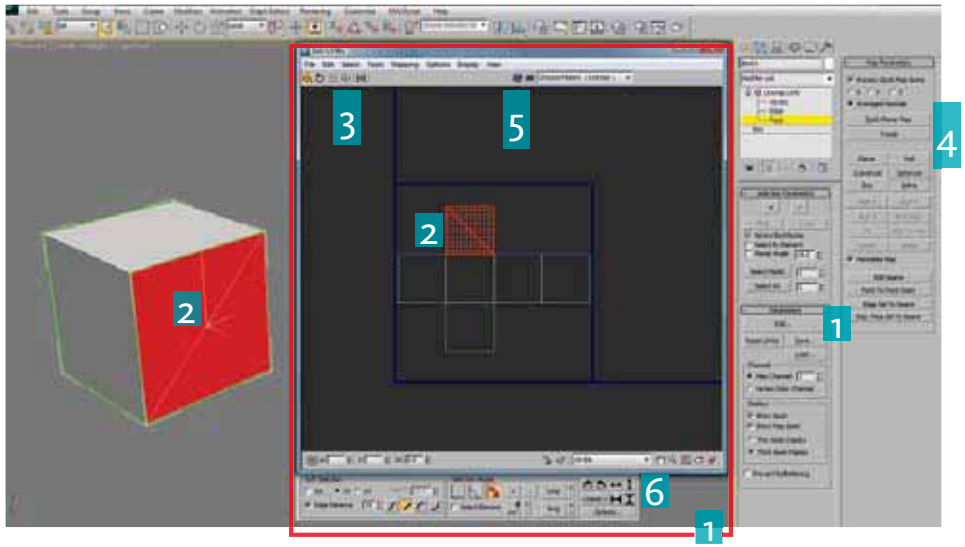
We will be using this tool quite a bit when working with Unwrapping. Using the X, Y, or Z axis in 3D, we can use this tool to quickly lay out a selection of UVs.

5 Show Map Toggle

This toggle will show a selected image in the window, or a checkerboard pattern by default.

6 Rotate and Align UV Tools

Use these tools to rotate UV chunks, or align subobject selections. Hover over each of them for a description.



The Unwrap UVW Interface

Tip:

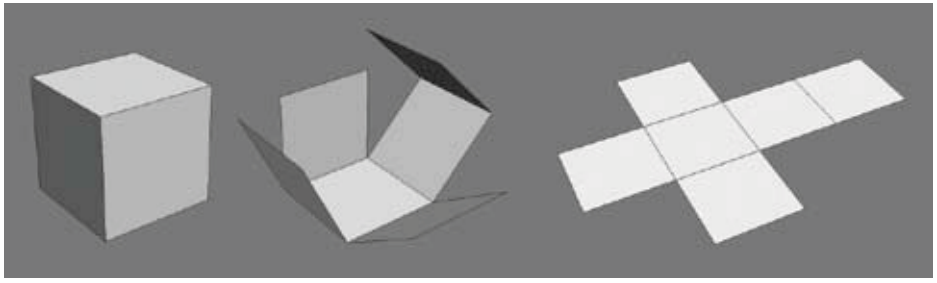
While inside the Edit UVW window, hold down the **MMB** to drag the viewport around, and scroll the **MMB** up and down to zoom in and out .

UVW unwrapping explained

When working in 3D, UVW unwrapping is used to describe the process of laying your object's faces out flat into an informational 2D plane so that you can apply textures and materials to your object. The UVW coordinates of an object are basically a set of stored information inside of a piece of geometry that defines how a texture will look if applied to it.

The UVW coordinate system with regards to 3D is similar to the XYZ coordinate system you should be familiar with when modeling. However, when it comes to UVW unwrapping, the U and V axis of a texture map correspond to the X and Y axis, while the W axis correspond to the Z axis, and is generally only used for procedural maps, which we will not cover here. This is also why it is sometimes referred to as UV mapping or working with UVs and the W is omitted.

When unwrapping an object, you do not physically modify the actual geometry itself, you are simply modifying the UVW coordinates , which is what all of the object's faces might look like in 2D if they were rolled out flat. To illustrate, imagine a simple box made up of six polygons. To easily paint a texture map onto that box, imagine the box unfolding and laid out completely flat. Since texture painting is done in 2D, we could then take all six of those flattened faces of that box and paint them with the UVW coordinates of the box accurately, and then apply the texture to the box. This is the process of UVW unwrapping.

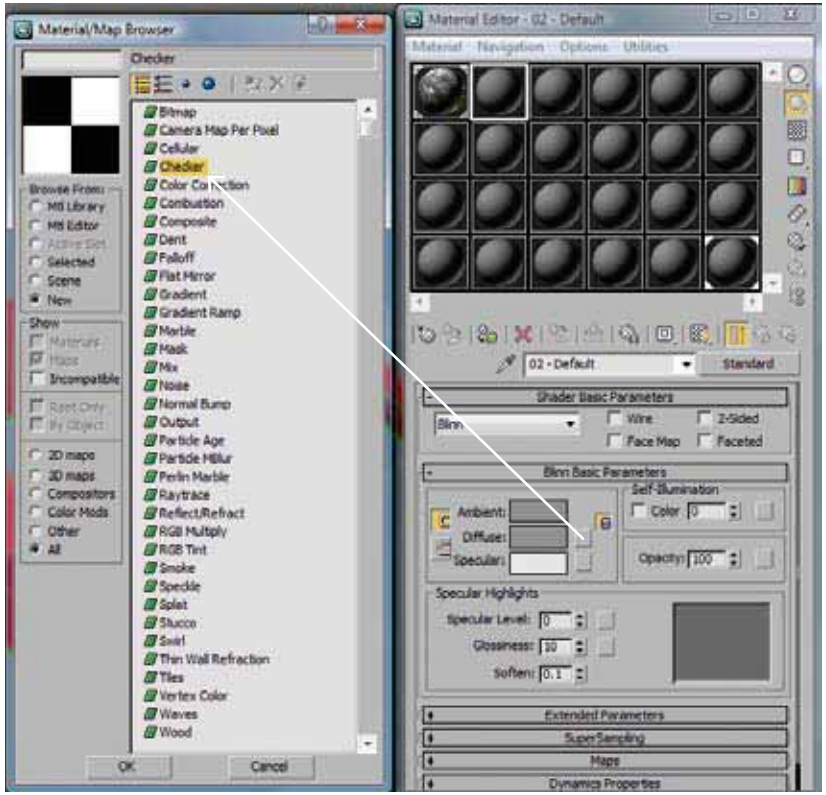


When unwrapping, imagine a box being split apart and laid down flat. We will not actually change the original geometry, but when working with UVs, this is the goal in order to get a clean and easy surface to paint a texture on.

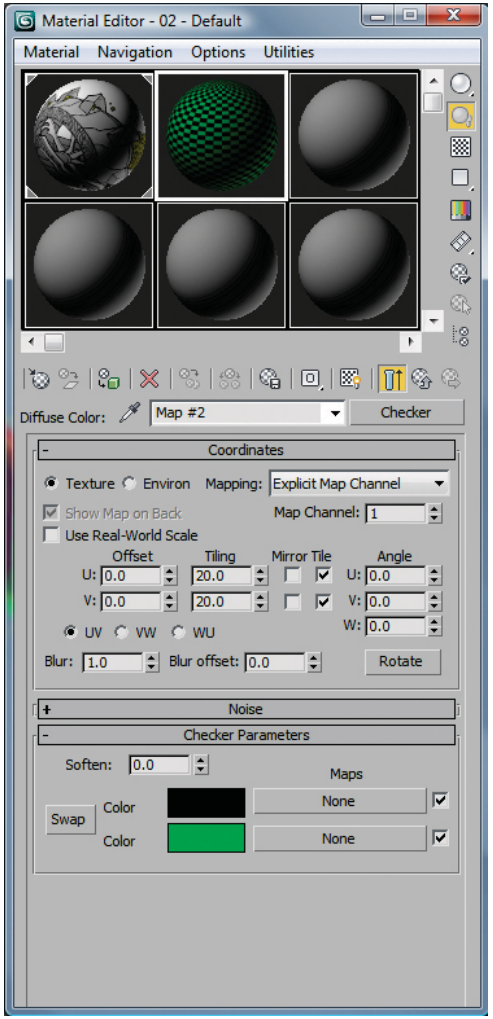
Create a checkerboard texture

As we begin to texture, we will want to assign a checkerboard pattern to our objects to make sure that there is not any unusual stretching or skewing of our UVs. Imagine for a moment that you make that box again, but the UVs are stretched and not laid out flat. The texture of that object would also look skewed and stretched if the UVs are not relatively the same dimensions of the object itself. A checker pattern will allow you to visually ensure there is no unusual stretching or skewing of the UVs.

- Start by opening the Material Editor.
- Select an unused Material node, and **LMB** click on the box next to the Diffuse slot.
- When the **Material/Map Browser** window pops up, choose Checker as the map type by double-**LMB** clicking it.



Click the box next to the Diffuse slot and choose Checker as the map type.



- By default, it is a black-and-white checker pattern with only a 1x1 tiling. The more you tile the texture, the smaller it will be repeated across the surface, which is fine for a checker pattern. So for now, change the tiling to 20x20. Under the **Checker Parameters** rollout,
  feel free to change the colors as you desire by **LMB** clicking the color box and choosing your own.

Animation concepts

Animation is based on a principle of human vision. If you view a series of related still images in quick succession, you perceive them as continuous motion. Each individual image is referred to as a frame.

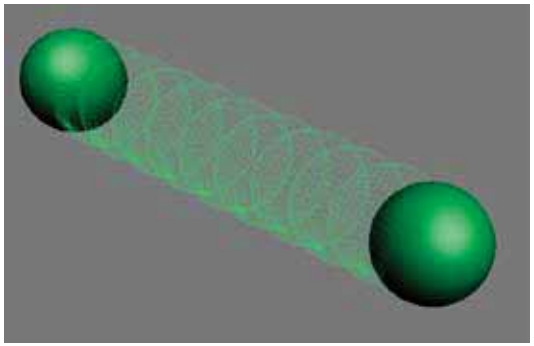
Historically, the main difficulty in creating animation has been the effort required of the animator to produce a large number of frames. One minute of animation might require between 720 and 1800 separate images, depending on the quality of the animation. Creating images by hand is a big job. That is where the technique of keyframing comes in.

Most of the frames in an animation are routine, incremental changes from the previous frame directed toward some goal. Traditional animation studios realized they could increase the productivity of their master artists by having them draw only the important frames, called keyframes. Assistants could then figure out what belonged on the frames in between the keyframes. The in-between frames were called tweens.

Once all of the keyframes and tweens were drawn, the images had to be inked or rendered to produce the final images. Even today, production of a traditional animation usually requires hundreds of artists to generate the thousands of images needed.

How it works in 3ds Max

3ds Max 2010 is your animation assistant! As the master animator, you create the keyframes that record the beginning and end of each animated sequence. The values at these keyframes are called **keys**. 3ds Max calculates the interpolated values between each key to produce the completed animation.



In traditional animation, the master animator could determine the keyframes at the beginning and end of the ball rolling, and the assistant would fill in the frames with the tweens. In 3ds Max, you identify the keyframes and 3ds Max fills them in for you!

3dsMax Skills

Autodesk 3ds Max can animate just about any parameter in your scene. You can animate modifier parameters, such as a bend angle or a taper amount, material parameters, such as the color or transparency of an object, and much more. Once you have specified your animation parameters, the renderer takes over the job of shading and rendering each frame. The result is a high-quality animation.

The majority of the animation tools can be found along the bottom of the UI.

Key Interface Elements

Let's look at some of the main animation tools in 3ds Max 2010, and a brief explanation of them.

1 Time Slider

The Time Slider is along the top of the Track Bar, and shows the current frame of animation you are on. It also lets you move to any frame in the active time segment. To move the Time Slider along the Track Bar, **LMB** click it and hold, while moving left or right along the Track Bar. **RMB** clicking the slider bar opens the Create Key dialog box, which lets you create position, rotation, or scale keys without using the Auto Key button.

2 Auto Key and Set Key Modes

Auto Key mode toggles the keyframing method that when turned on, any changes made to the object's position, rotation, and scale are automatically keyframed (recorded). Set Key mode allows you to create keys only when you want. Unlike Auto Key, Set Key mode gives you control over what you key and when.

3 Set Keys

When in Set Key modes, use this button to create a keyframe with the selected object.

4 Animation Controls

These controls include **Go To Start**, **Previous Frame/Key**, **Play/Stop**, **Next Frame/Key**, and the **Go To End** functions respectively. Hover over each for their function.

5 Time Configuration

This will launch the Time Configuration window that will allow you to adjust the Frame Rate, Time Display, Playback options, and more. This is also where you can specify the animation Start, End, Length, and Frame counts.

SKILLS

Lighting Basics

The 3D artist is a lot like a photographer. The 3D artist has the ability to arrange the lights in a scene to suit their needs. In fact, the 3D artist has significantly more freedom than a photographer. The 3D artist is not constrained by gravity. They can place their lights anywhere in the environment without worrying about them tipping over, if the extension cord is long enough to reach the light, if the heat of the light is going to set things on fire, and how long the light bulb will last before burning out. In fact the 3D artist can also have lights that cast shadows or not, lights that remove light from their scene, and lights that simulate a specific time of day or natural effect. In essence the 3D artist has much more creative freedom than a photographer because of their ability to determine the light in a scene.

Lighting is the basis of a great looking image or animation. Lighting sets the mood and gives the viewer clues about what may or may not happen in both still images and animations. At its foundation the lighting in a scene will tell the viewer whether it is day or night. Just as good value relationships in an image can save an average image, good light in a 3D scene can make models and textures appear much better.

Here you will take a look as some of the traditional light arrangements you might use as a starting point when lighting a scene. We will then take a scene that lacks any light at all and show you how effective lighting is built and why each step works. We will take a look at how the color of a light affects the objects in a scene. Finally, we will take a look at some of the lighting features that are found in Autodesk®3ds Max®.

There are a few basic things every 3D artist should consider before beginning the process of lighting a scene.

- What mood are you trying to create in your scene or animation? In many cases this is the first question you should ask yourself because it will determine where in the scene you place the light or lights.
- What colors should your lights be? Colored lights will affect all the models and textures in a scene. It does you no good to light a scene with orange and red lights if the textures on your models are predominately green and blue.
- Do you want harsh or soft lighting? Often the feeling of how harsh or soft the light in a scene is depends on how the shadows being cast appear. Sharp shadows tend to indicate harsh lighting and softer shadows indicate softer light sources.

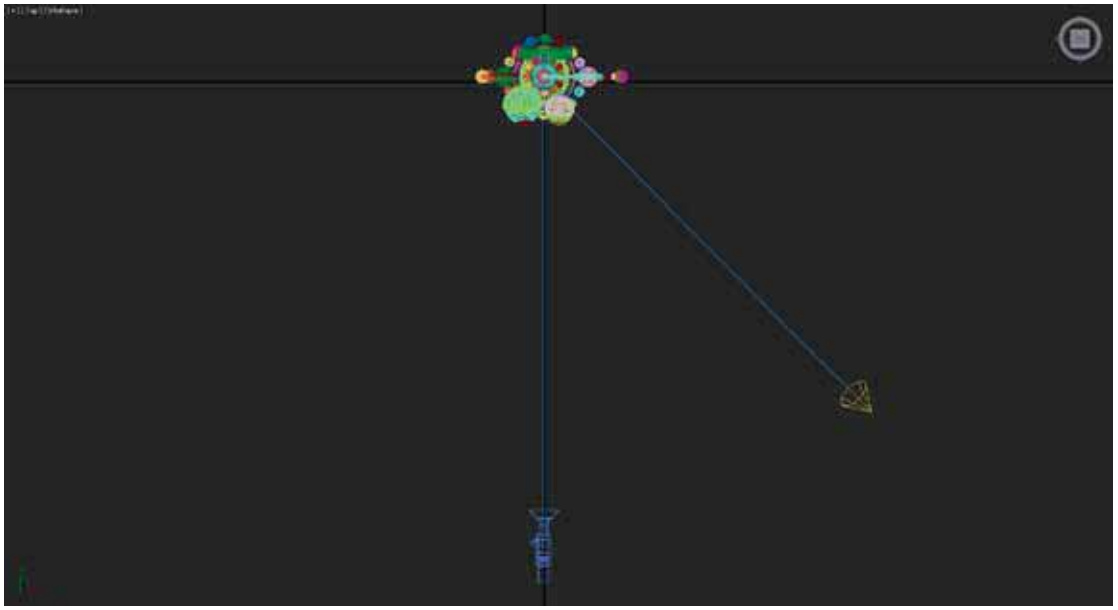
Adding Lights to a 3D Scene

The types of lights you create are determined by the menus in an application and the type of rendering you plan on using and can include spot lights, Omni lights, distant lights, and so on. Lights in a photographer's studio and in a 3D scene are referred to by specific names that indicate their function. The function of the lights you create is determined by their placement in a scene. In the following each function (name) or a light will be described.

Once the light's functions are described, some general lighting schemes will be diagramed that will give you a good starting point when it comes to lighting your own scenes.

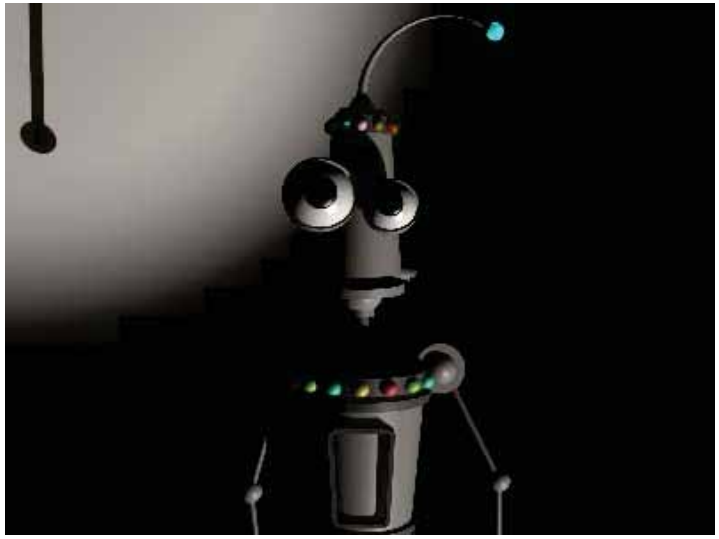
Types of Lights

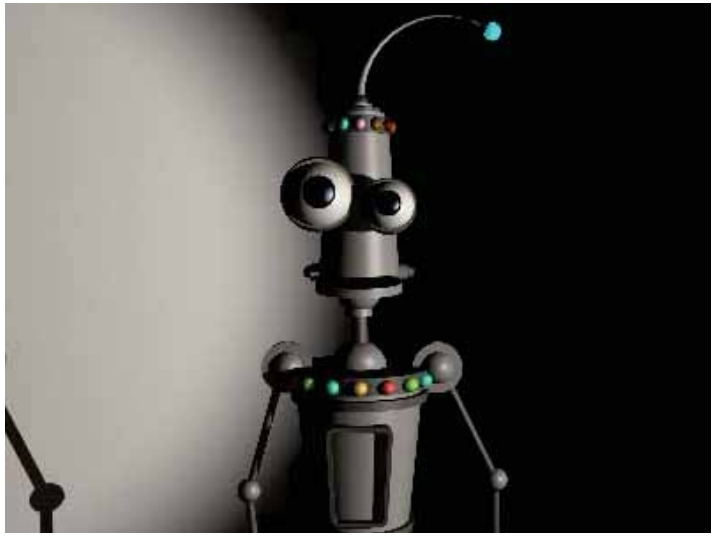
- Key or main light. This is the predominant and brightest light in most scenes. Every 3D scene will probably have a key light. The position of the light depends on what you, the artist, are trying to say. Traditionally, the key light is positioned at a 45-degree angle from a line drawn directly between the camera and subject.



Figureo1b

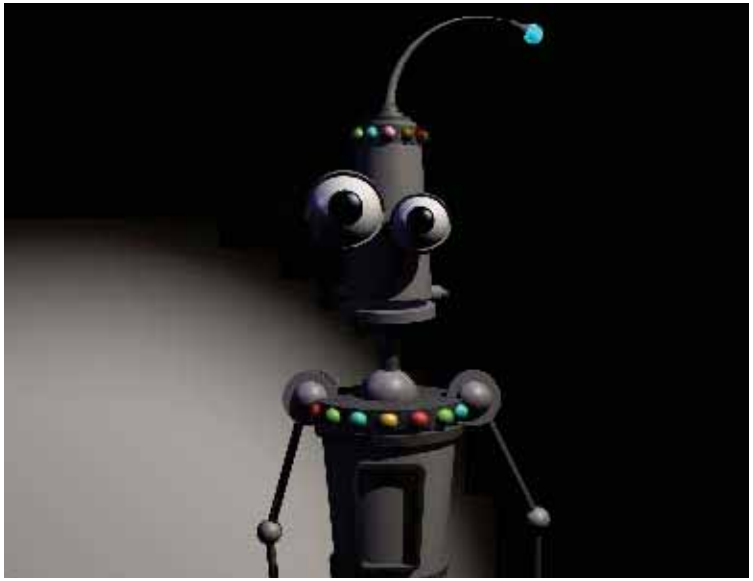
3dsMax Skills





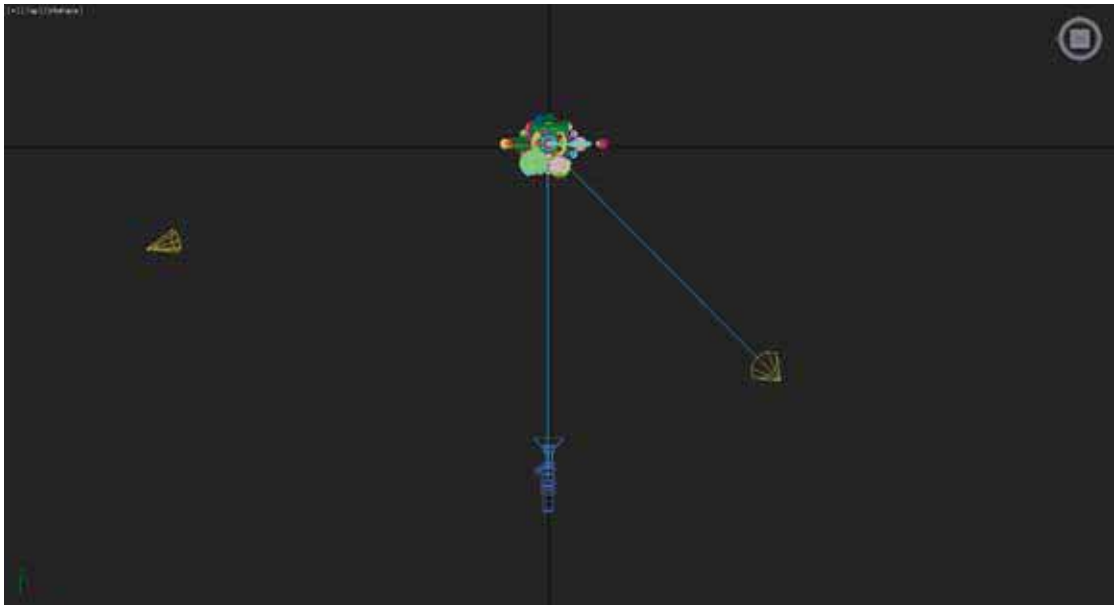
Positioning the key light in the vertical plane relative to the subject will depend on the mood of the scene

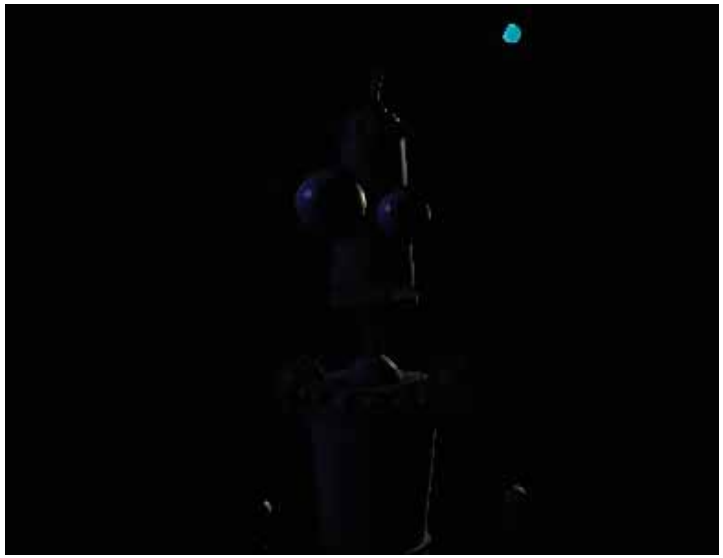
- A higher light will appear quite natural, like sunlight
- A lower-positioned light will appear more theatrical
- A key light that is positioned at eye level will look slightly strange



Fill or secondary light

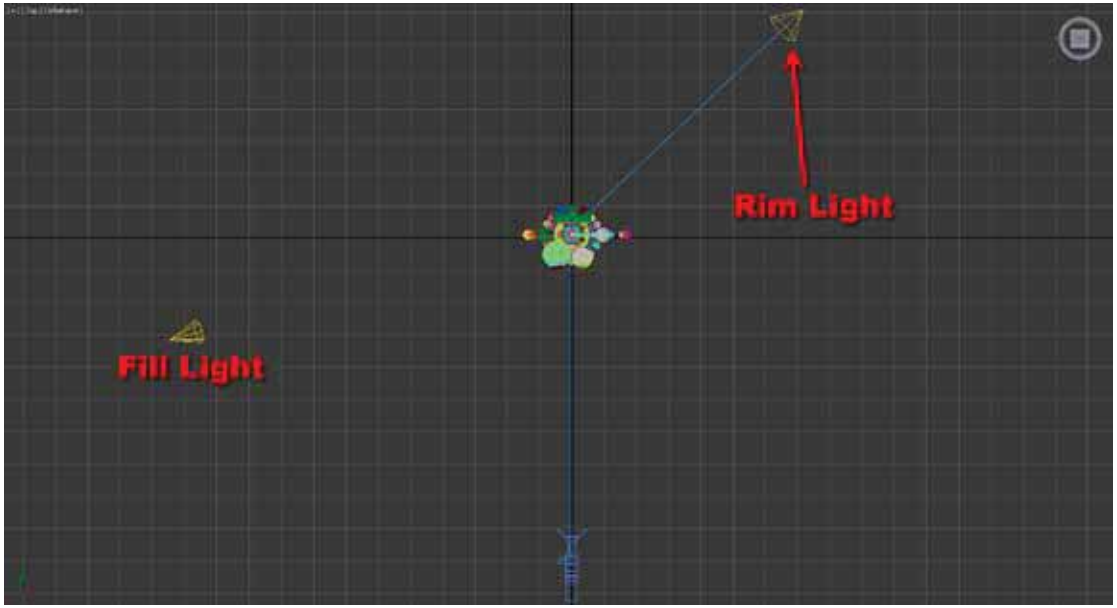
The fill light is positioned opposite the key light. Without a fill light in a scene the shadows on objects would be too dark and opaque. The fill light should be significantly less intense than the key light. While there is no set percentage for its intensity, generally it will be less than 50 percent as intense as the key light.

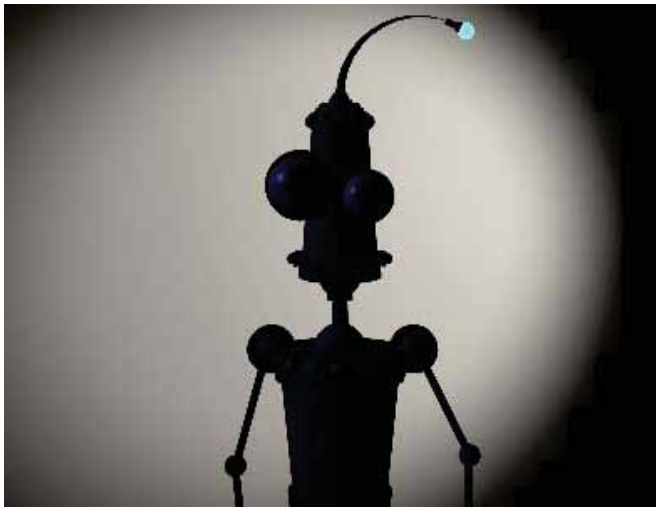




Rim lights

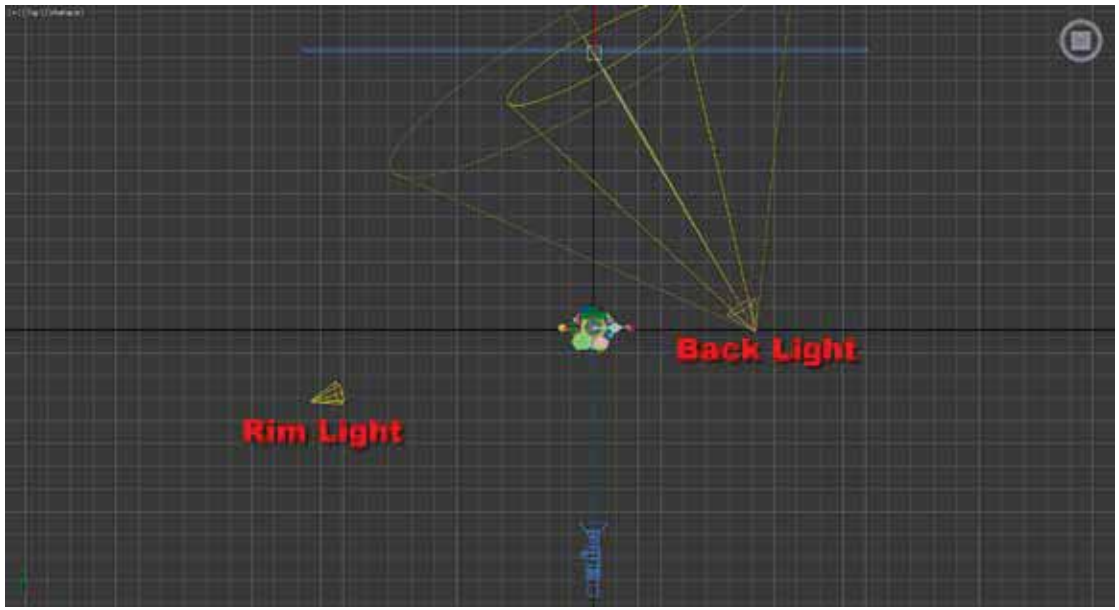
If there is a light source in view in a scene, you will probably want to add a rim light to the scene. Placing this light at a 135-degree angle behind your subject on the side of the visible light is a good starting point. Rim lights are used extensively and can add a nice border between the subject and background.

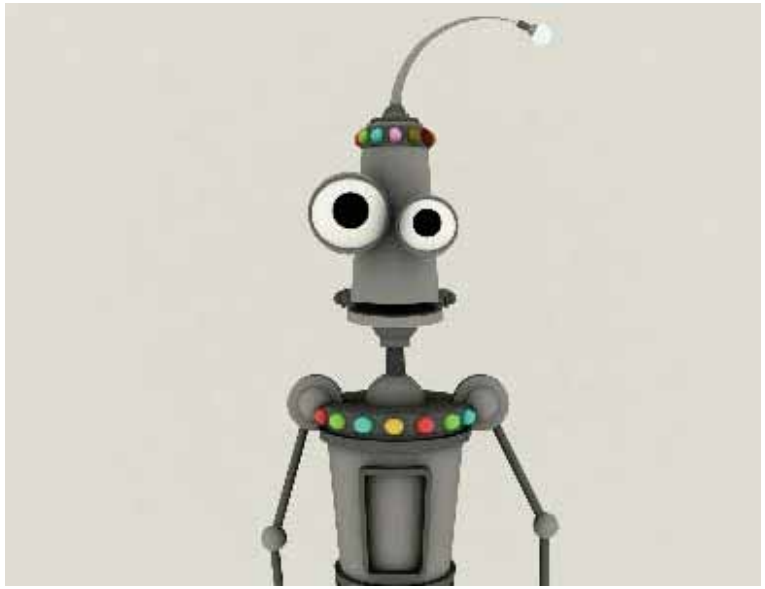




Backlights

Generally backlights are used to separate the main subject from the background. They are pointed at an object in the background, throwing the subject into a higher-contrast relationship.

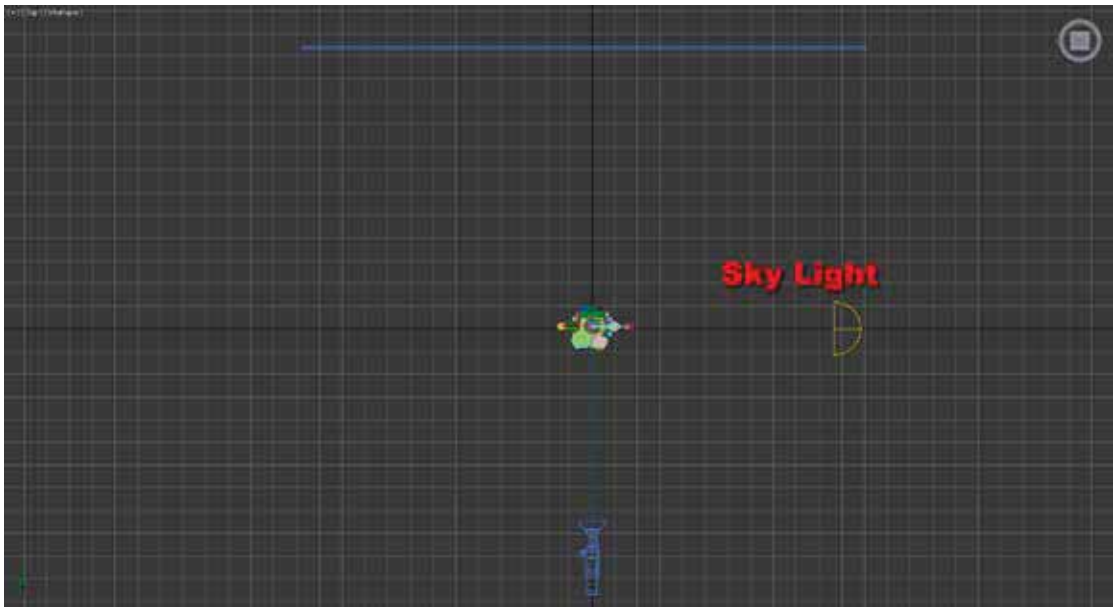




Sunlight light

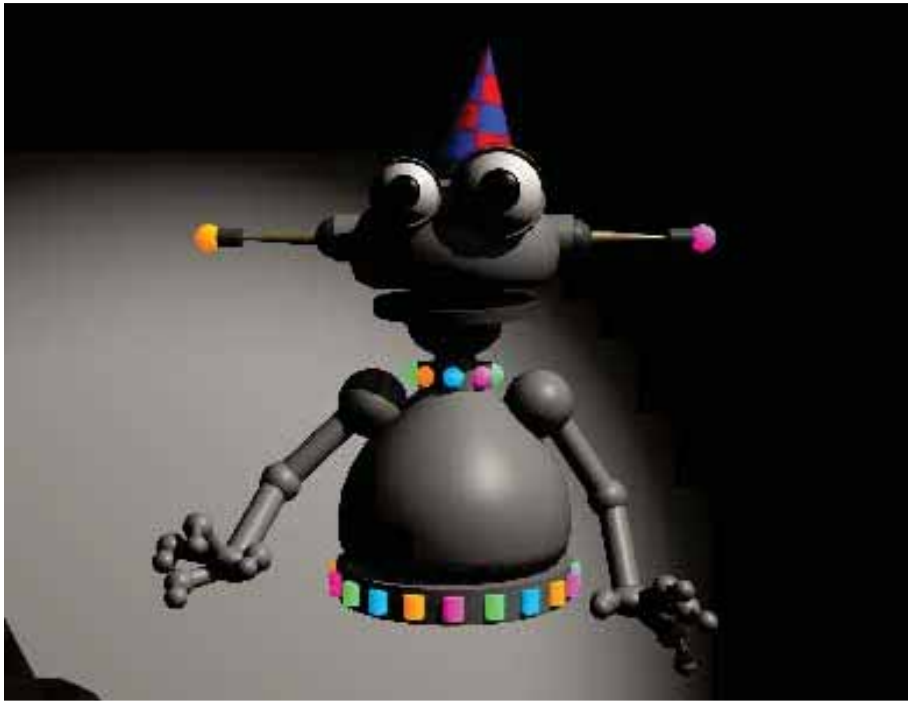
There is usually a light in 3D programs that simulates sunlight. In 3ds Max, sunlight is called *skylight*. Skylight light is one of the ways it is possible in 3ds Max to imitate daylight in a scene. You can set the color of the sky or assign a map to it. The sky is represented as a dome above the scene. The position of the skylight and how far it is located from objects has no effect on how bright the lighting appears. The skylight object is simply a representation of the lighting that always comes from above.

Skylight should be used with the light tracer. The light tracer produces soft-edged shadows and bleeds an object's color into the surrounding for bright scenes. A sunlight scene would be considered a bright outdoor scene. The light tracer does create an accurate representation of sunlight, but it is easier to use than some of the other ways of imitating sunlight.



3dsMax Skills

Ambient light. While not actually a light source, it is intended to simulate the natural light that bounces around a scene. Intense light will need less ambient light than weaker lights. Figure07 shows the ambient light in the scene increased from nothing to a dark blue.

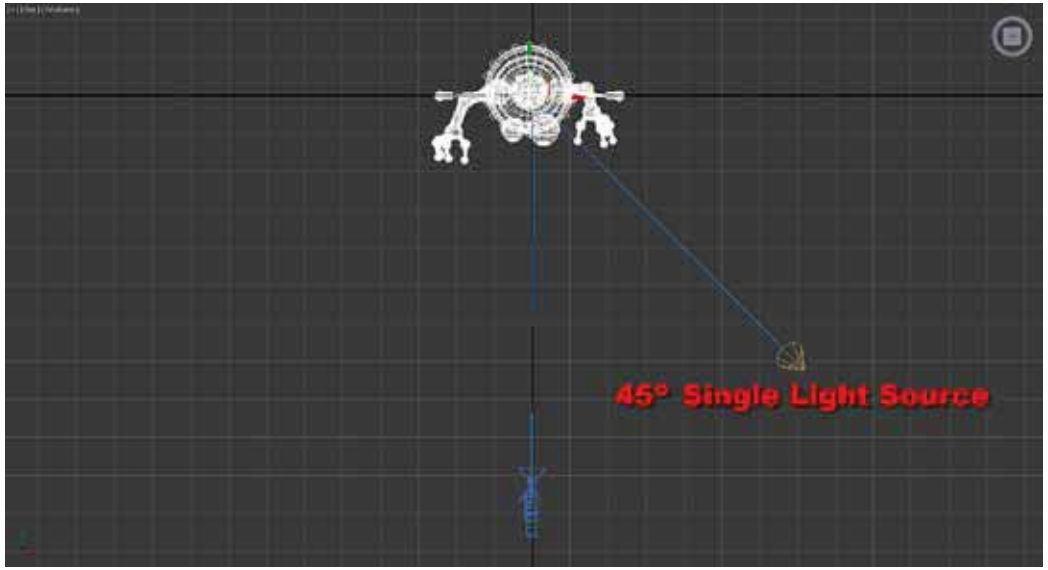


Standard Lighting Schemes

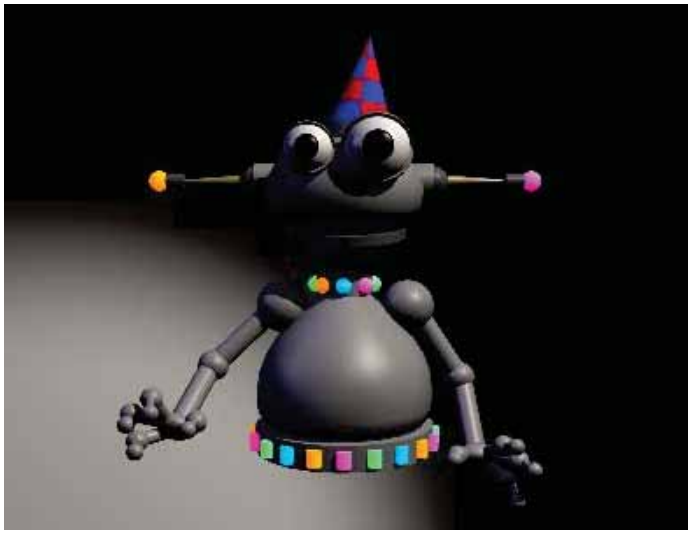
This section shows some basic lighting setups often used in photography studios. These arrangements are good starting points for the 3D artist when deciding how to light a scene they are creating.

These lighting setups are pretty self-explanatory and will not need much description, if any at all. Each image shows the subject, camera, and lights along with a rendered version.

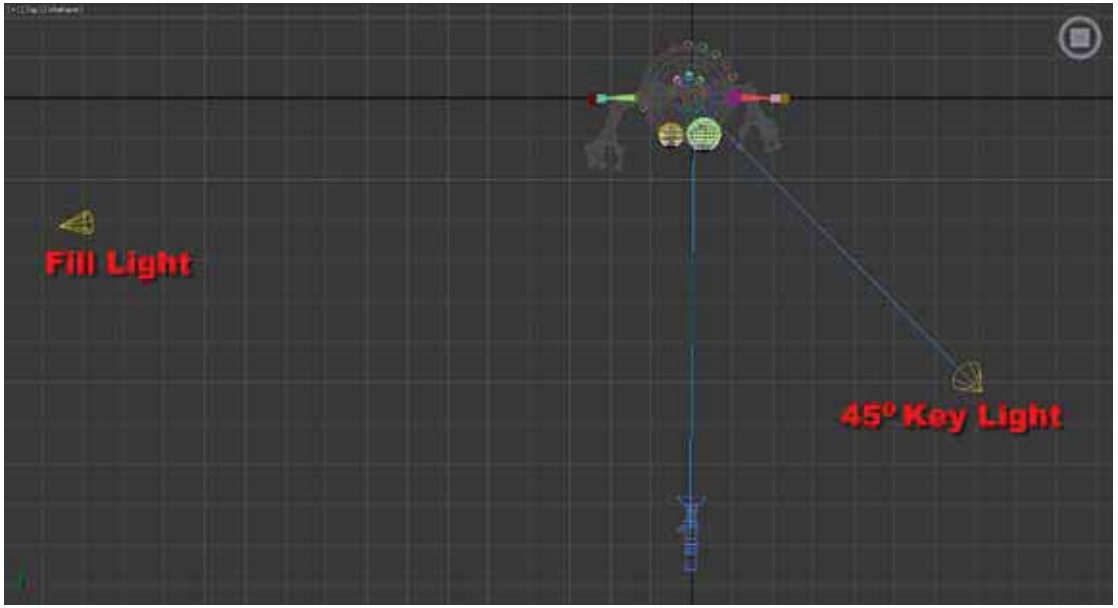
- 45-degree single light source.



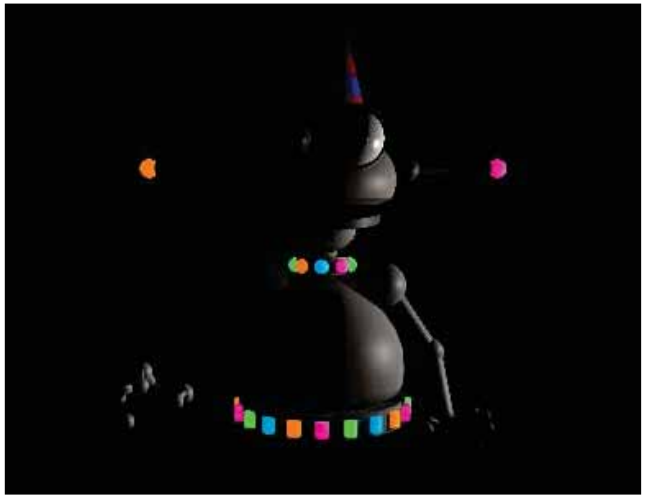
3dsMax Skills



- 45-degree key light with additional fill light.

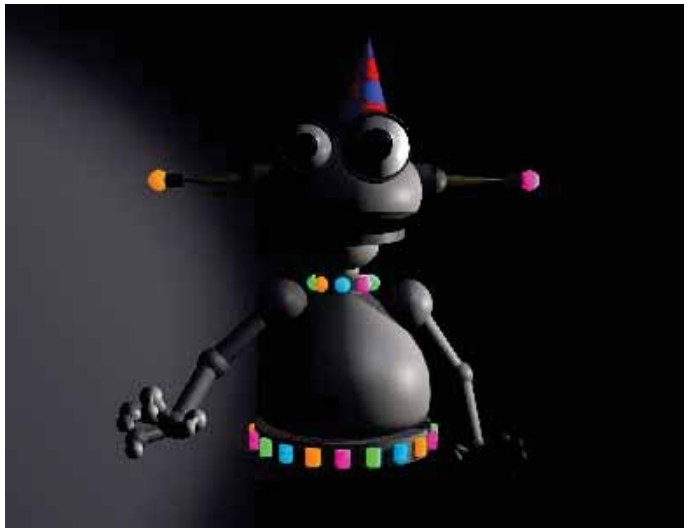


3dsMax Skills

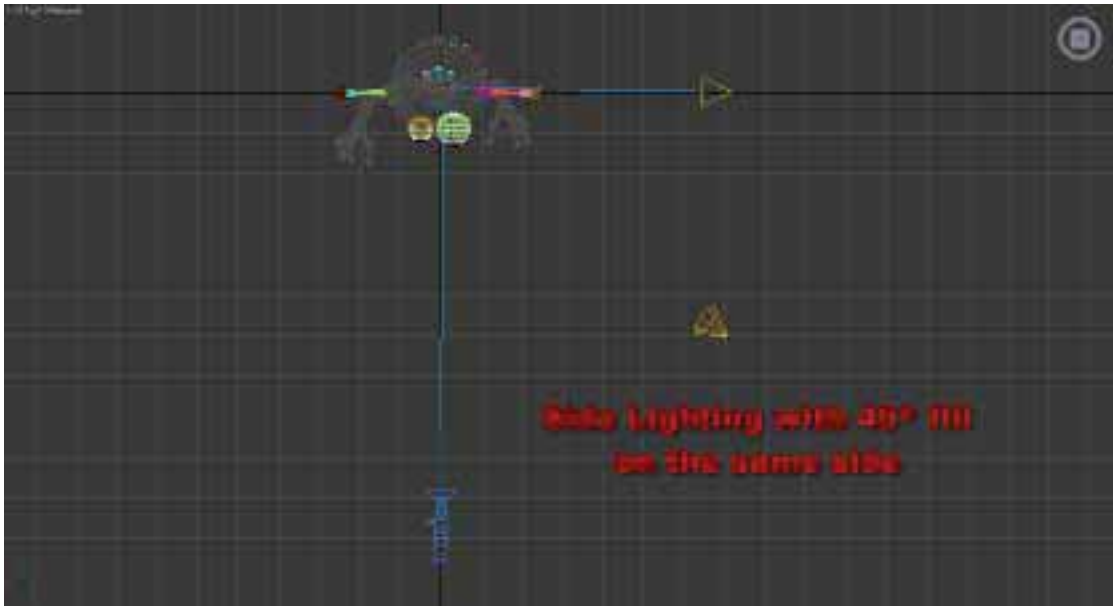


- 90-degree single light source (side lighting).

3dsMax Skills



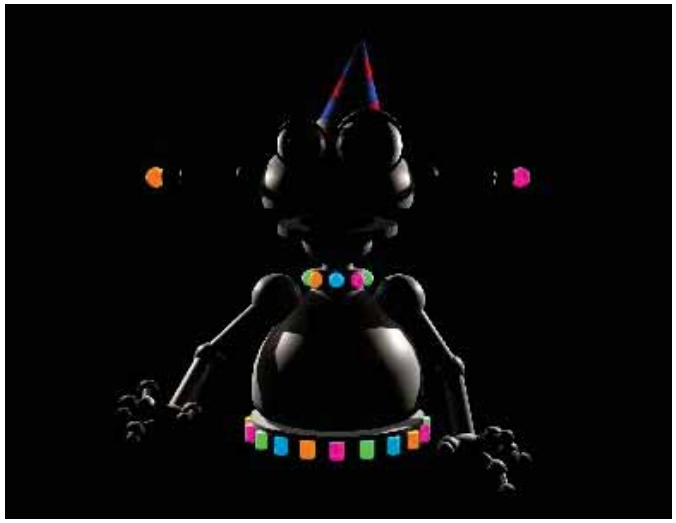
- 90-degree single light source with 45-degree fill light.



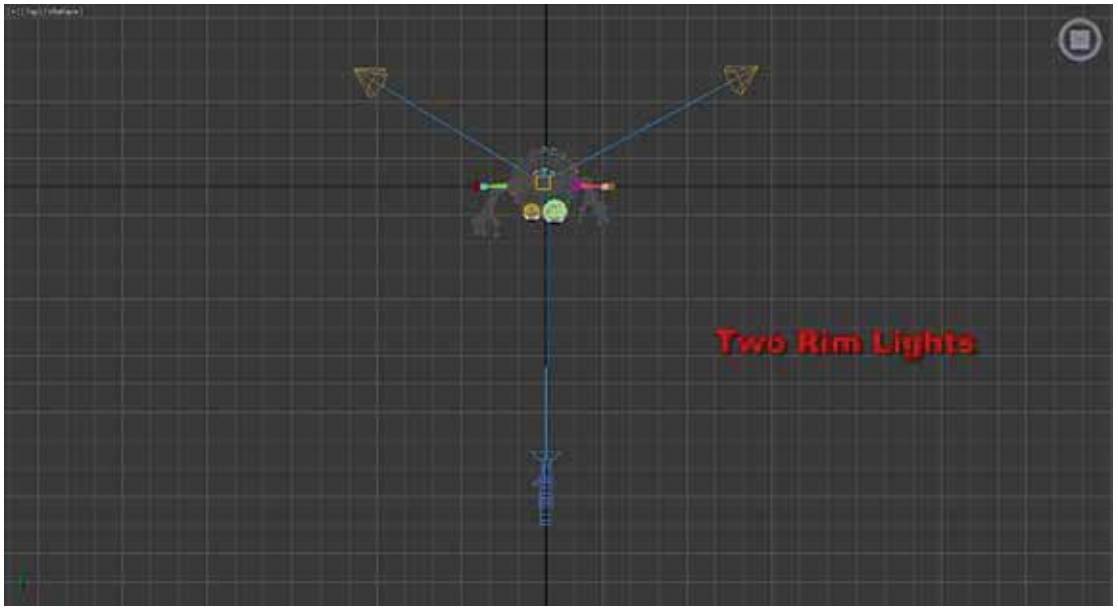
3dsMax Skills

- 135-degree rim light source.

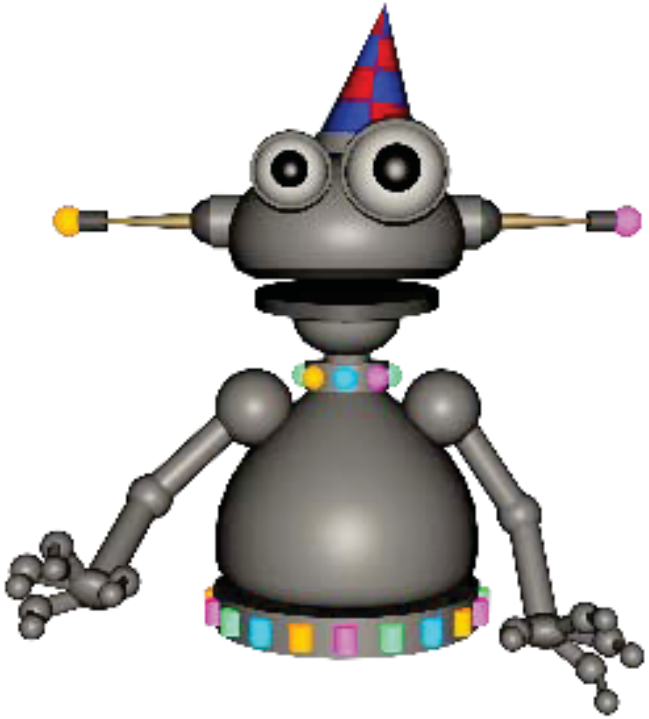
3dsMax Skills



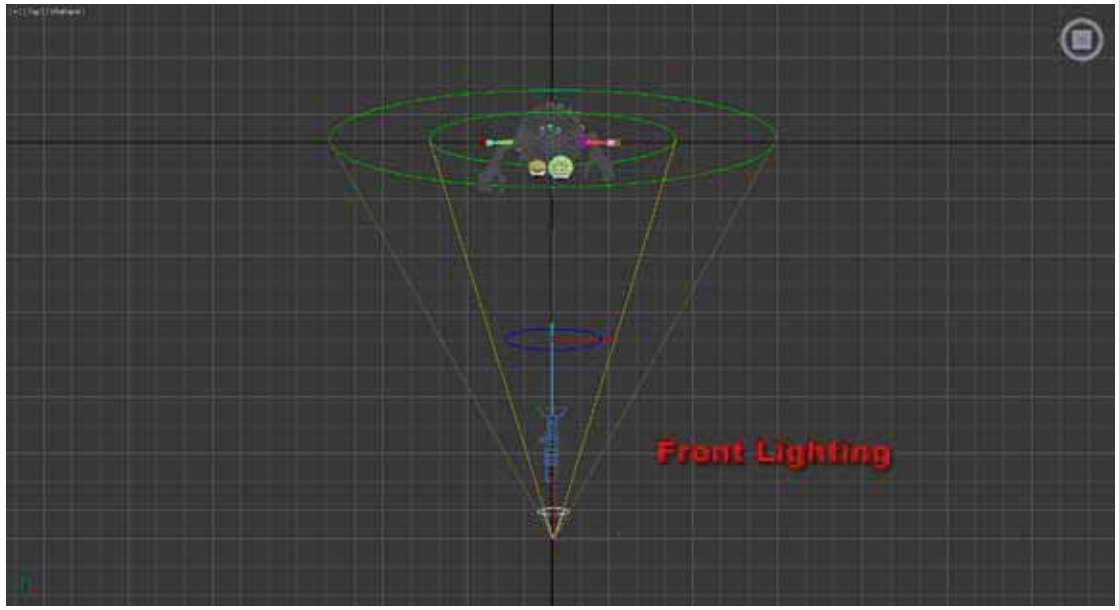
- Two 135-degree rim light sources produce very harsh and stark images. Great for intense action shots where silhouette is important.



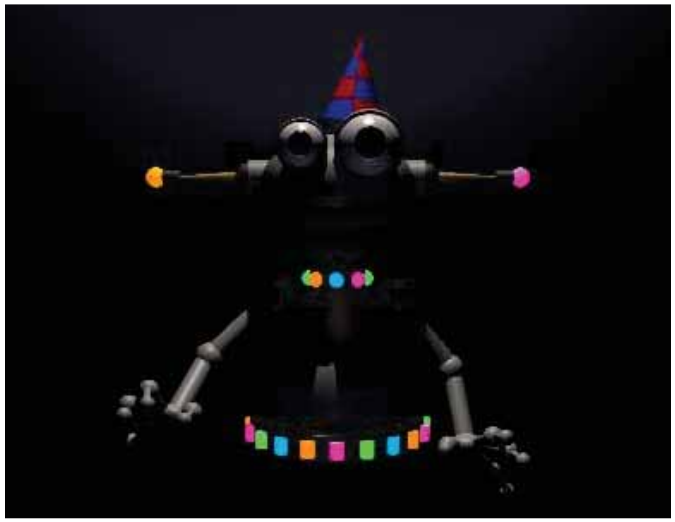
3dsMax Skills



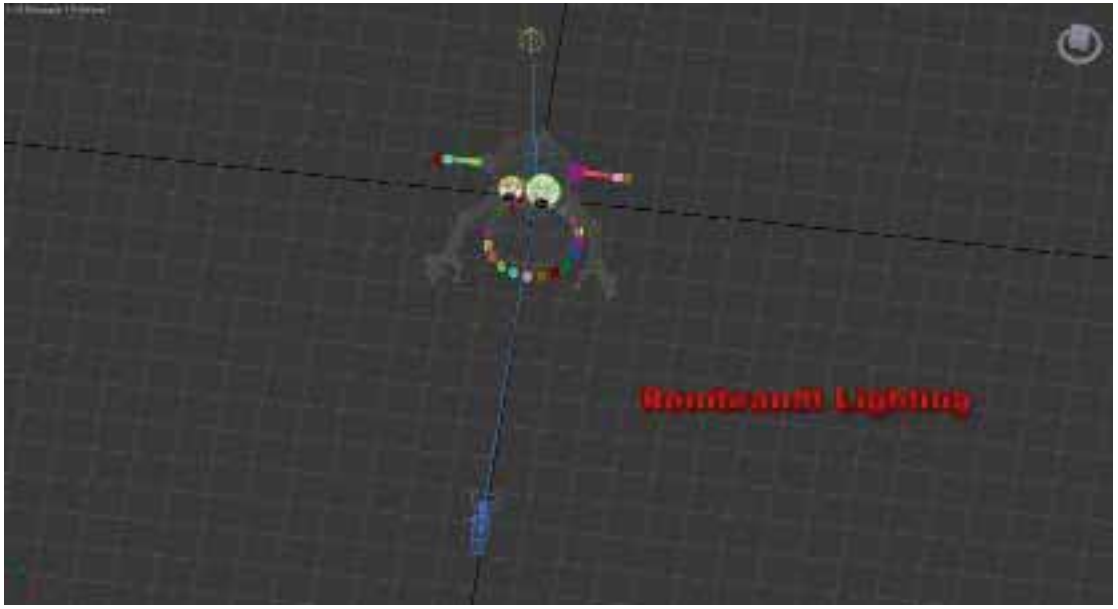
- Frontal lighting at camera level, produces a very flat image.



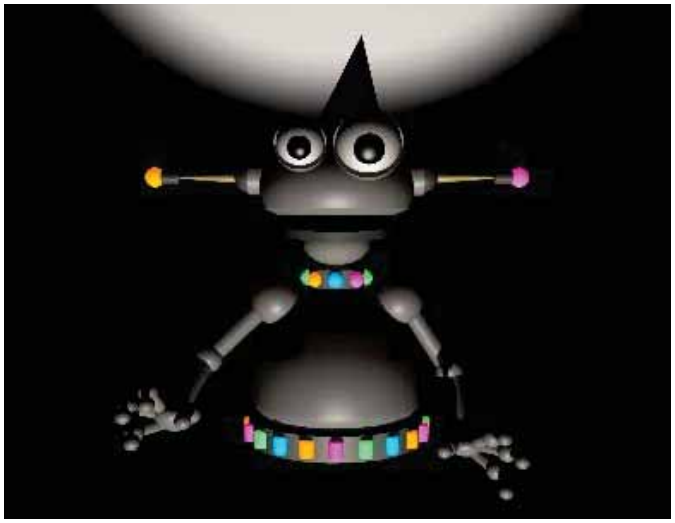
3dsMax Skills



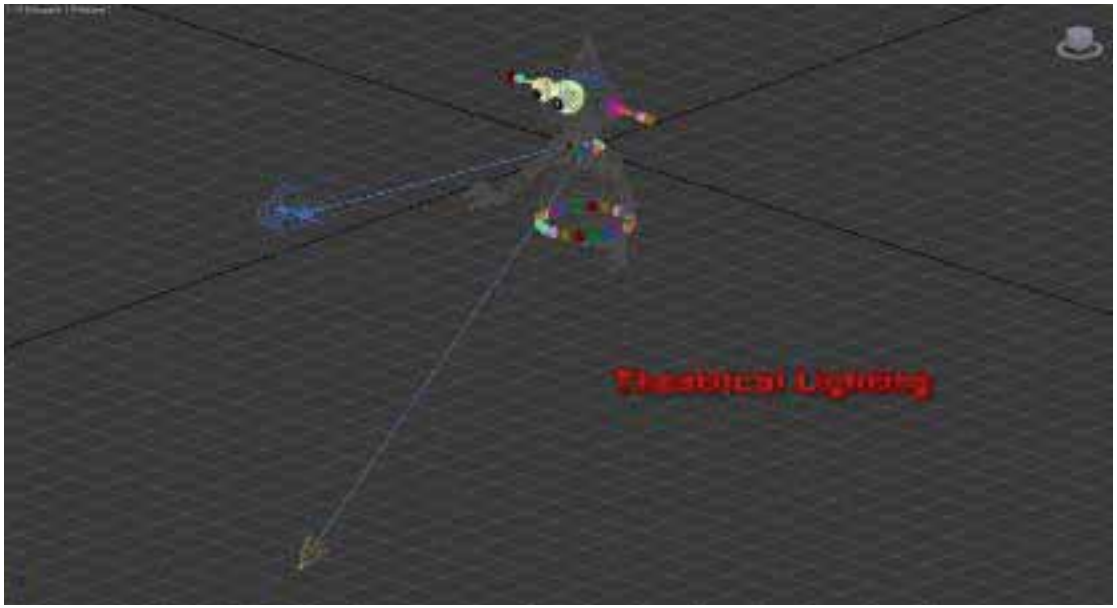
- Rembrandt lighting where the light source is almost directly above the subject and shadows are left very dark and opaque.



3dsMax Skills



- Theatrical lighting where the light source is placed low in comparison to the subject. Generally shadows are also very dark and opaque.



3dsMax Skills

Here we will look at how lighting affects a scene beginning without any light source at all.

- In the beginning when there is no light, we cannot see anything in the scene. We have no idea where objects are located or if something is going to reach out and grab us.
    - Figure 01

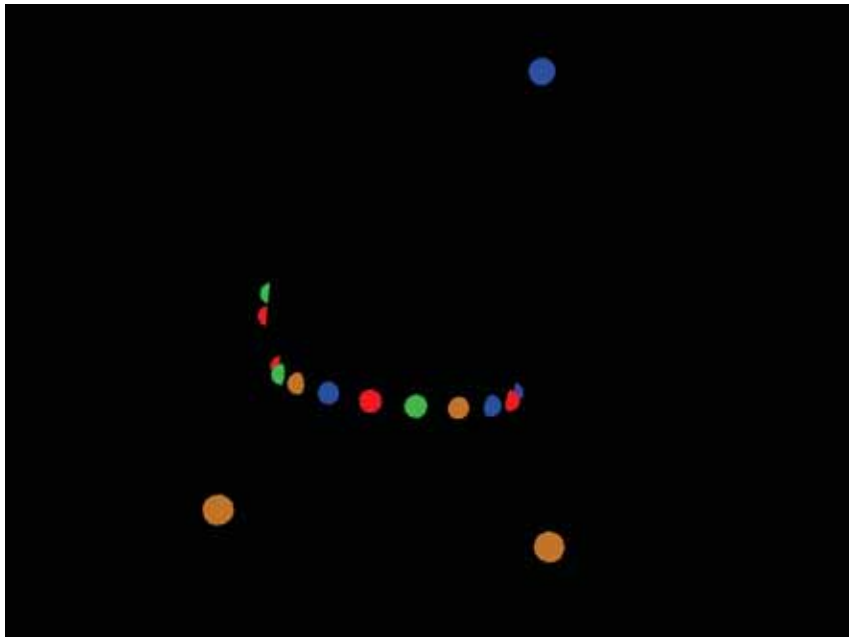


Figure 01

- So, let's add a light. Right now it is a white light without any color. Now you can tell there is an object on some kind of surface but very little beyond that. You can tell that the object is opaque or very nearly so since there is a cast shadow on the flat surface. Since you can see the object, you may be able to make some assumptions about its nature.
    - Figure 02

Figure1 02

- Up to this point the image is only various shades of gray. So, let's add some color to the object. It makes the image more interesting to look at but having only a single color in a scene looks rather strange.
    - Figure 03

Figure 03

- Add a fill light opposite the key light and low to the ground. Because we are in a colored environment at this point, make the fill light lean slightly toward the color of the environment. This light will help lighten the stark contrast of the shadows and add a touch of color to them, imitating color being reflected from the light bouncing around the environment.
    - Figure 04

Figure 04

- The scene is looking more natural at this point. We still do not have any visual clues to the nature of the material composing the object. We could change the surface characteristics of the object to gives us an idea of what it is made of but this will be covered more in the next section on texture, so we will leave things as they are right now.

- Let's change the color of the light and see what happens.
    - Figure21

While the object has a local color (just like an apple is red), you can see that changing the color of the light dramatically changes the color of the object. If the reflected light is strong enough, you may see some of the object's local color but very subdued. You may also be able to see some of the object's local color along the terminating edge between the light and shadow side.

Just for fun, let's continue to change the color of the light source and see the effect on the object. We will pick colors for the light from around a standard 12-spot color wheel. We will change the color of the fill light to the complement of the key light color.

The next six images show the influence of colored lights on our scene. Both the environment and object can be effected in unexpected ways. When you plan your light scheme you absolutely must take into consideration the color of the lights you use.

- Figures 05-09

Figure 03

Figure 06

Figure 07

Figure 08

Figure 09

Figure 10

Figure 11

Summary

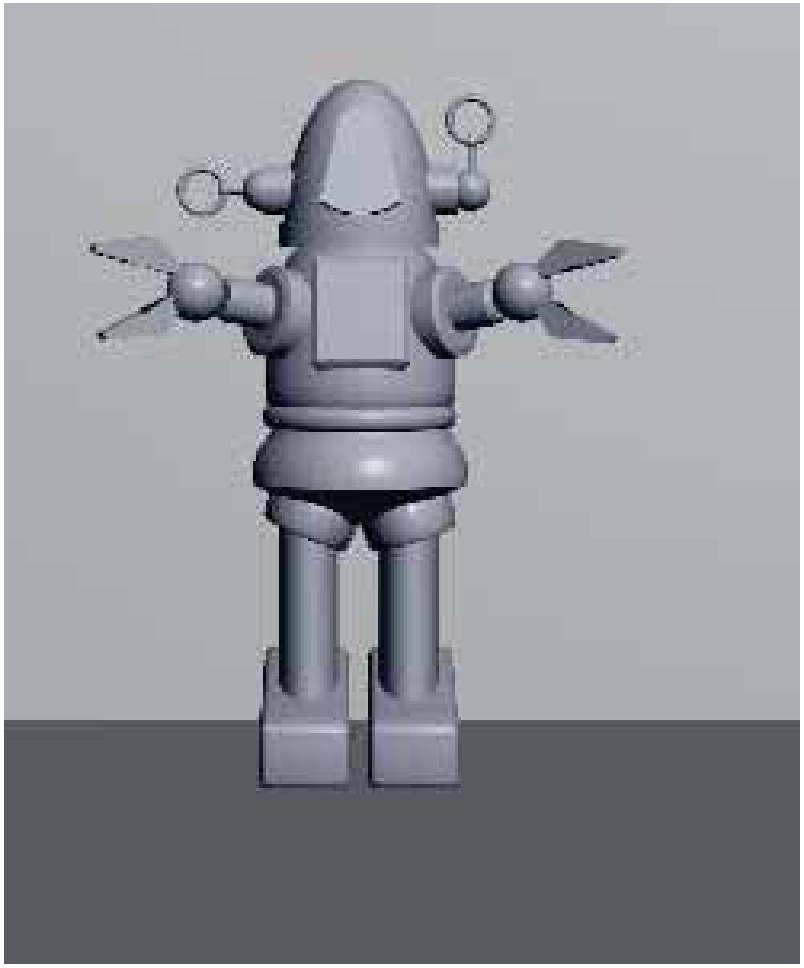
In this section we looked at lighting and some basic arrangements that could be used as a starting point in a scene. We also looked at the influence the color of lights can have on objects within your work.

Careful planning when adding lights will give your images and animations that extra something special and take your work above the mundane.

Setting Up the Basic Scene

Setting Up the Basic Scene

When you start 3ds Max it automatically creates a scene with some default lighting, so you can at least see what you are doing. However, it is not a lighting scheme that you probably want to use for your final scene.



Let's add a general lighting scheme to the scene that contains a key light, fill light, rim light, and an additional light at or below the ground plane to simulate light from the ground plane bouncing back into the shadows created by the other lights.

Autodesk 3ds Max comes with two types of lights: photometric lights and standard lights.

Photometric lights let you more accurately simulate light in a real-world environment. You can set many different parameters to control such things as intensity, color, color temperature, and so on. To get the most accurate real-world simulation, use the mental ray® renderer with photometric lights.

Standard lights will do for most situations. They can simulate almost any kind of light you can think of from the sun to flashlights. They are not meant to accurately simulate real-world lighting.

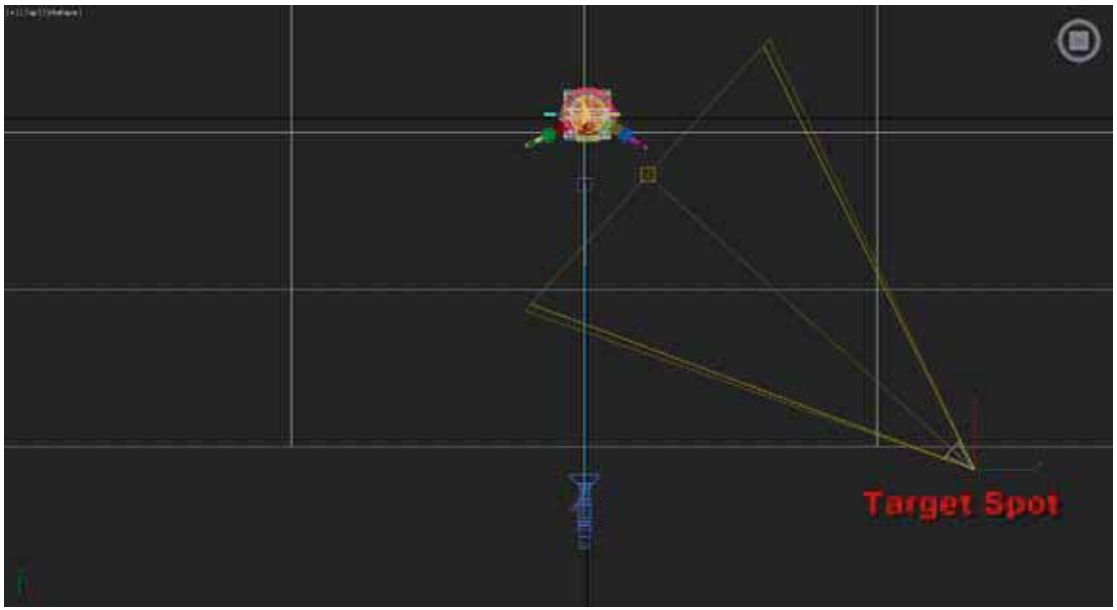
All the different types of lights are displayed as objects when added to a scene. Most of the lights have many of the same controls, so as you learn to use one kind the others will not be difficult to use when needed.

Adding Lights

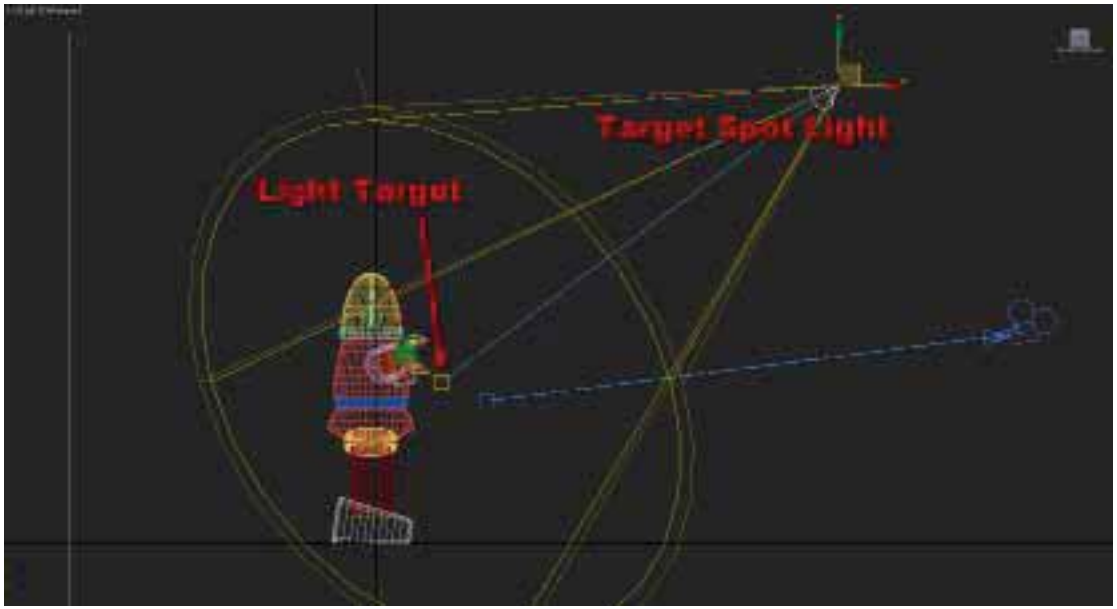
The Key Light

To begin, we will add a key light using a spotlight. Remember that the key light is usually the brightest light in the scene and is the light that will be responsible for the shadows of the different objects.

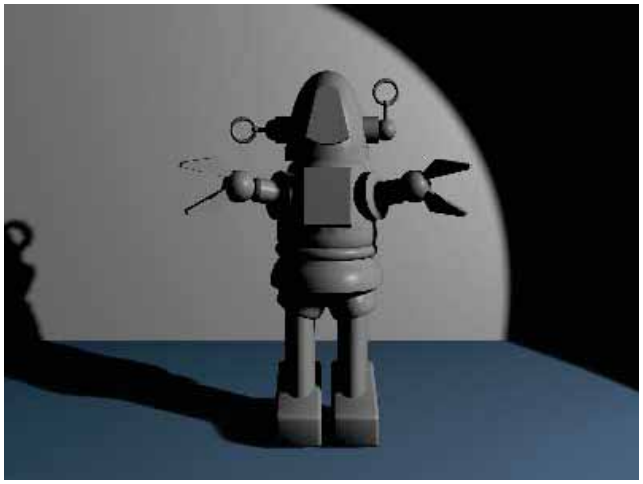
From the create panel, select lights and either a Target Spot or a Free Spot to add to your scene. Make sure that you check the on box in the General Parameters/Shadows rollout that appears when you select the Target Spot or Free Spot light.



- In the top viewport, place the light at about a 45-degree angle from the line of sight between the robot and the camera. If you use a Target Spot, it is recommended that you do not place the light target directly over the object. It is just easier to select the target should you need to move it if it is not directly on top of the object.



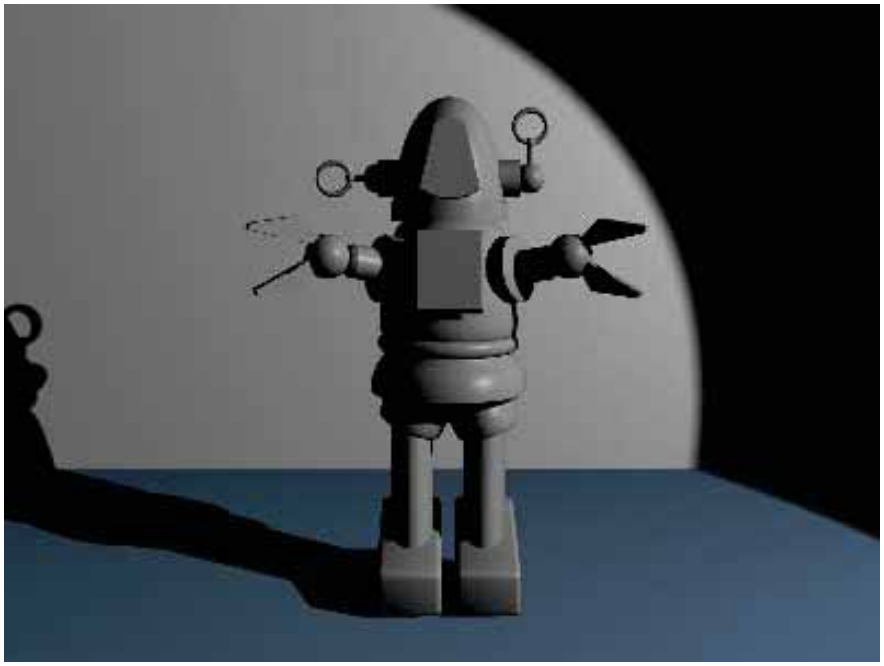
- From the Left or Right viewport, place the target object about midway up on your object. Raise the Target Spot light to about 45 degrees above the object.



When you begin to add your own lights, the default lights created when a scene is created are removed.

- Render from the camera view to see how the addition of a key light has changed the scene.

The edge of the light on the back plane is a bit harsh and the curve of the light comes very close to the right clamp hand of the robot, creating a tangent which in turn creates a point of tension in the image. We will fix this, but first we should look at and evaluate the shadow of the object itself.



Creating good shadows is a critical skill you need to master when working in 3D. While it is beyond the scope of this section to go deeply into each shadow type, it is worthwhile to show a few renders using each shadow type.

Creating Shadows

The shadow of the robot itself is acceptable, but where it is cast on the vertical wall it becomes a bit blocky and does not represent the objects casting the shadow well. There are a number of different ways for 3ds Max to create shadows. These methods include:

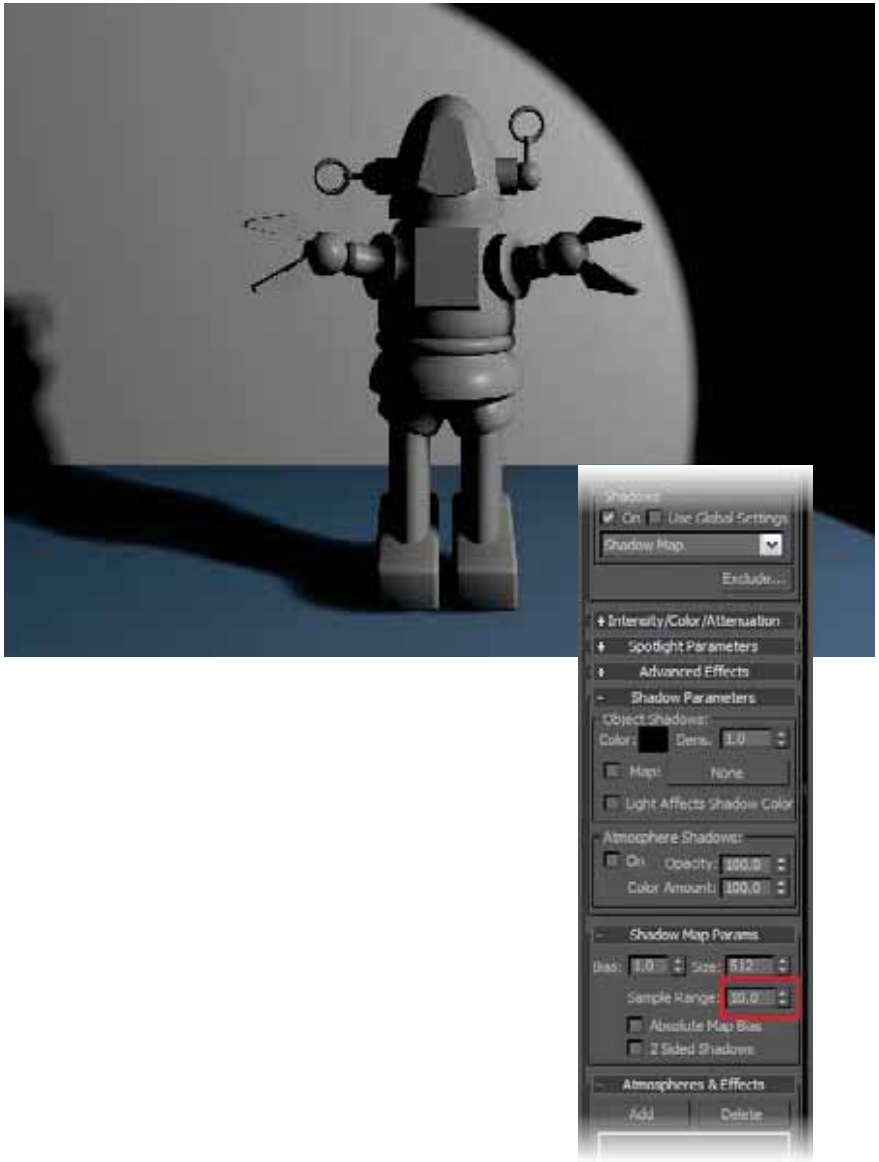
- Area Shadows
- Ray-Traced Shadows
- Advanced Ray-Traced Shadows
- Shadow Maps
- mental ray Shadow Maps

In the rendering that was just finished, the shadow was created using Shadow Maps. Shadow Maps are real bitmap images that 3ds Max renders and then combines into the finished render to create the shadow.

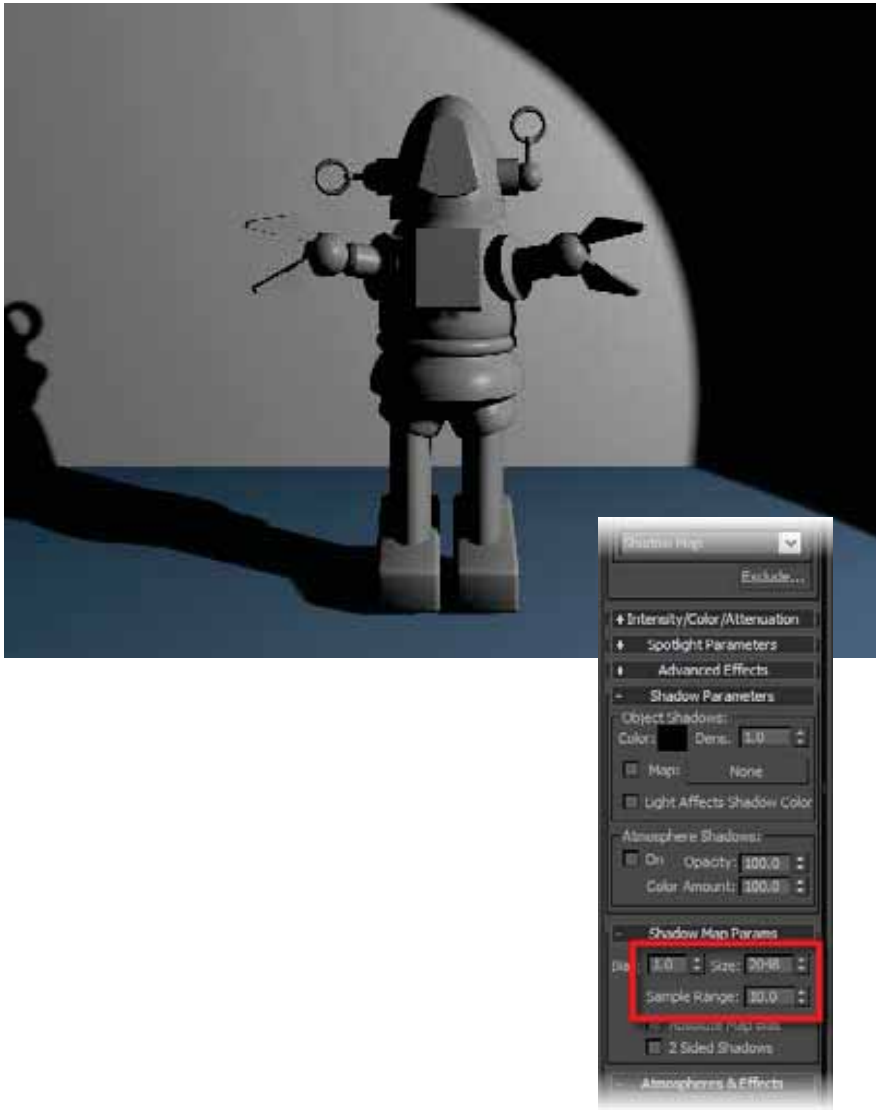
There are several things you can do to change the way the Shadow Maps appear:

- Increase the size of the Shadow Map. This does require more memory to calculate, so if you are not on a computer with lots of memory, be careful doing this. The figure shows the difference in the rendered shadows when the Shadow Map size increased from 512 to 2048.

- You can also smooth out the shadows if you increase the Sample Range of the Shadow Map, which will smooth their appearance.



- You can, of course, increase both the Sample Range and Size to get very nice results.



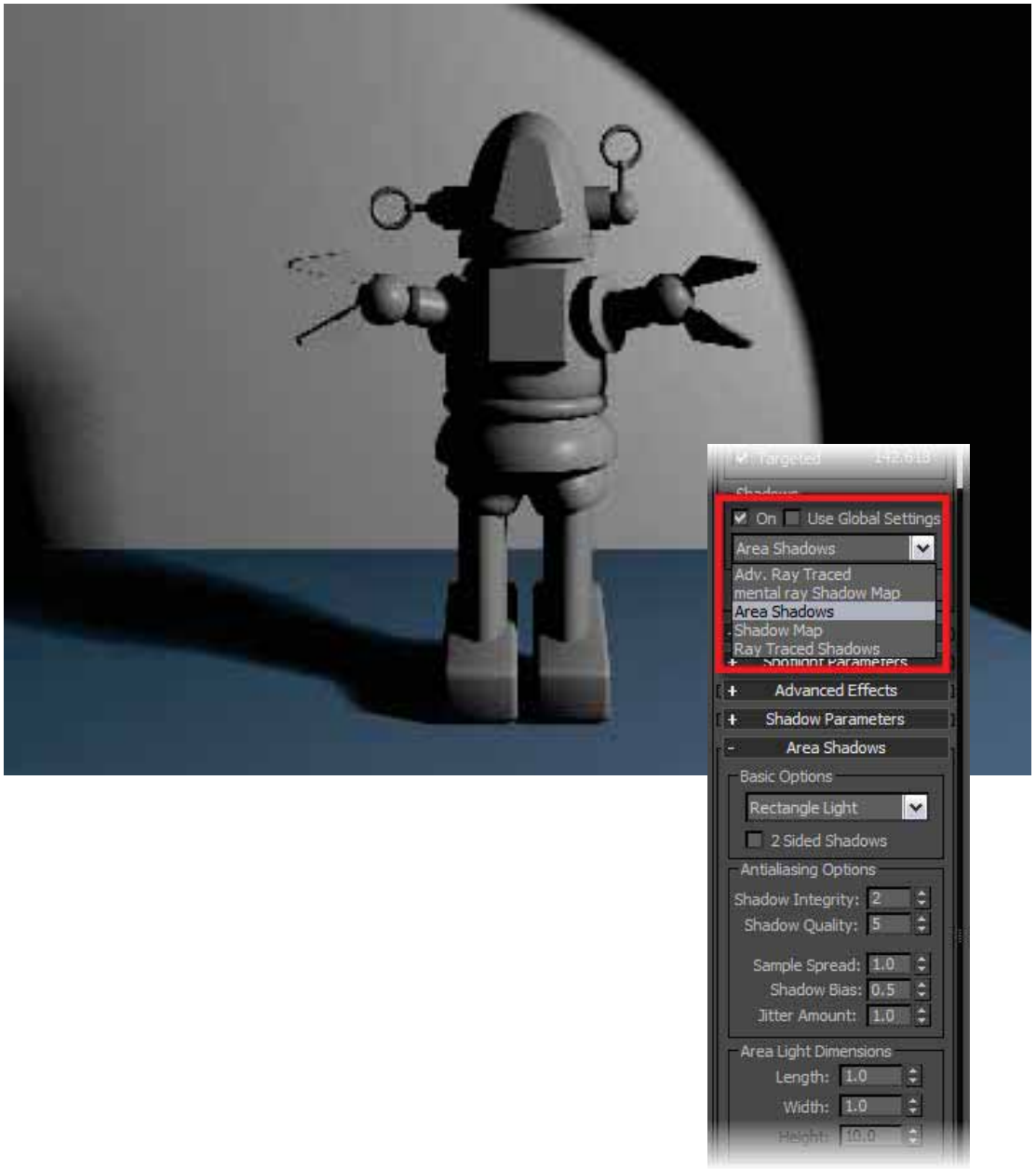
3dsMax Skills

One disadvantage of Shadow Maps is that they will not render as expected when using transparent objects. Specifically, they treat all objects as opaque.

So let's change the shadow type and see what happens with the rendered robot.

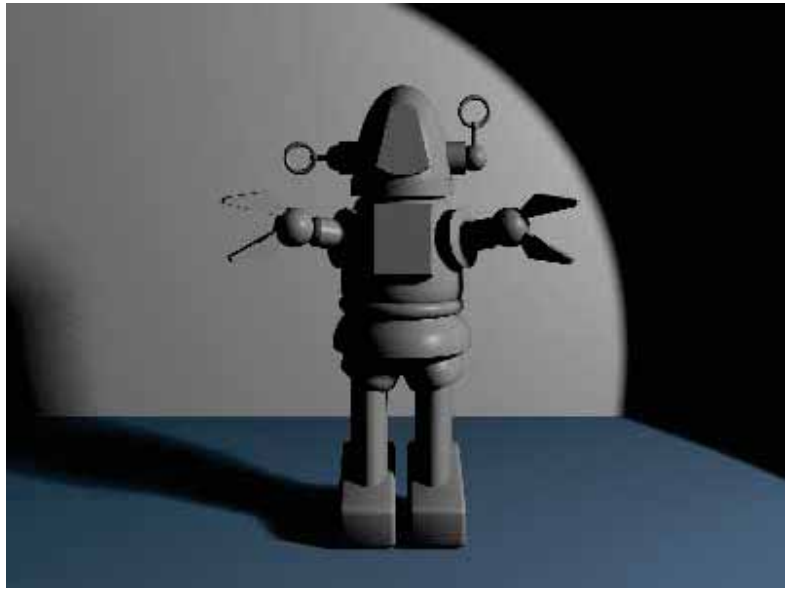
To change the shadow type you do not need to change the current light source.

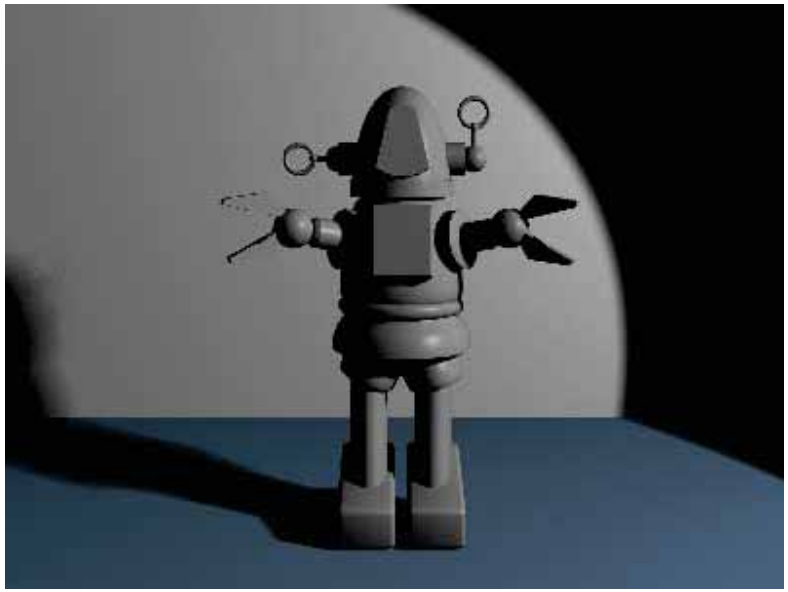
- Select the Shadow drop-down menu, and choose Area Shadows. Leave everything at the default settings and render the robot.

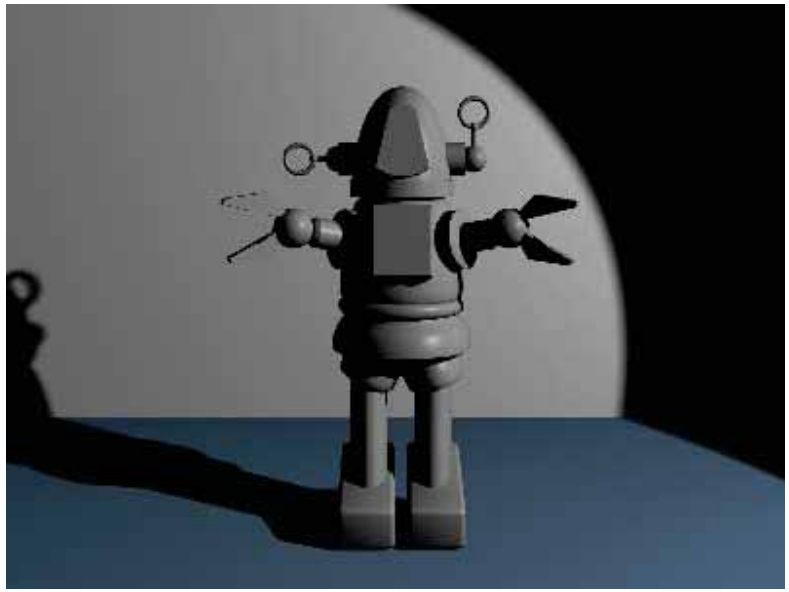


3dsMax Skills

Area Shadows can take a long time to render. They produce very soft shadows; and they get softer as the shadow gets further from the object. There are a number of different options with this shadow, including the basic shape of the light the shadow is calculated from. You should spend some time exploring the various settings. Changing the Area Light Dimensions will have a dramatic effect on the softness of the shadow. The following shadows were rendered with Area Light Dimensions at the default 10 for the length and width (Figure10a), changed to 5 in both the height and width (Figure10b), and finally with the settings at 1 (Figure10c). As you can see from the images, the lower the setting, the sharper the shadow.



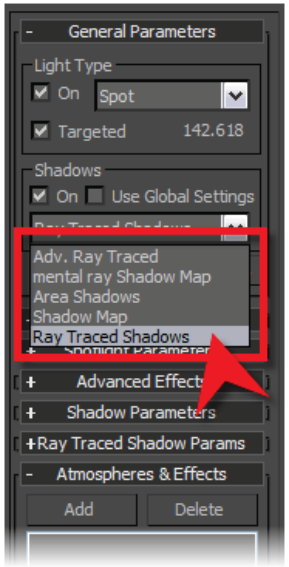


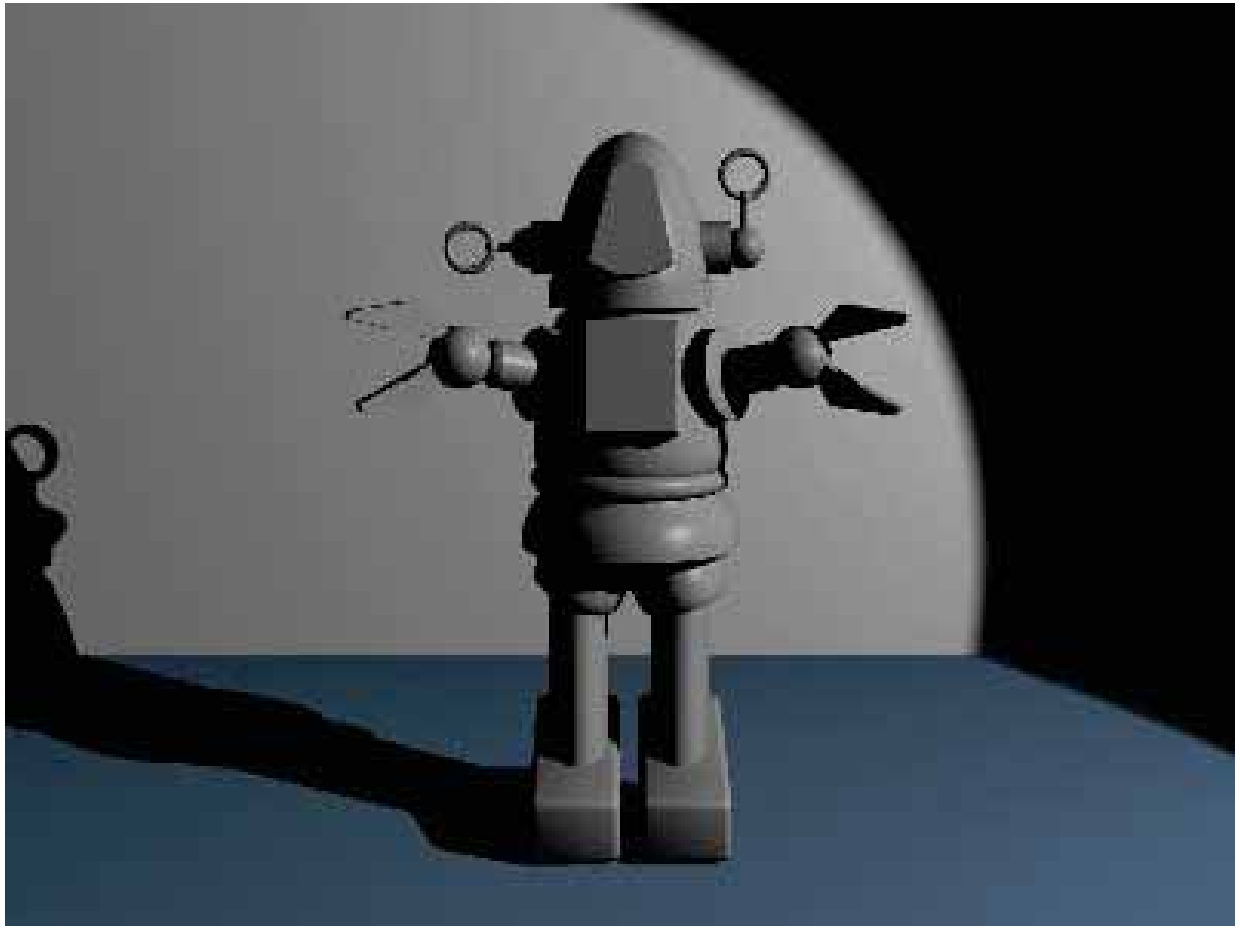


3dsMax Skills

Now let's look at Ray-Traced Shadows. Ray-Traced Shadows are calculated by tracing the ray of light's path from the light source to and beyond the object. Ray-Traced Shadows are more precise than shadow-mapped ones, though they always create a shadow with a hard edge. Ray-Traced Shadows work with transparent, translucent, and wireframe objects in a scene.

- Select Ray Traced Shadows from the Shadows drop-down menu.
- The robot is rendered with Ray-Traced Shadows. Notice how crisp the shadows are along their entire length when compared to Area and Shadow Map shadows.

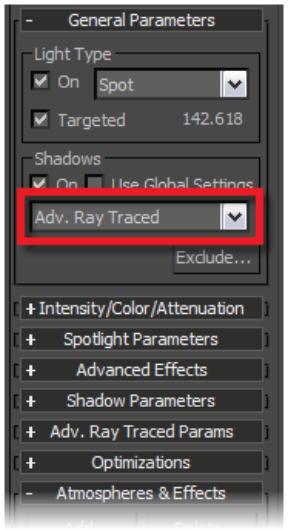


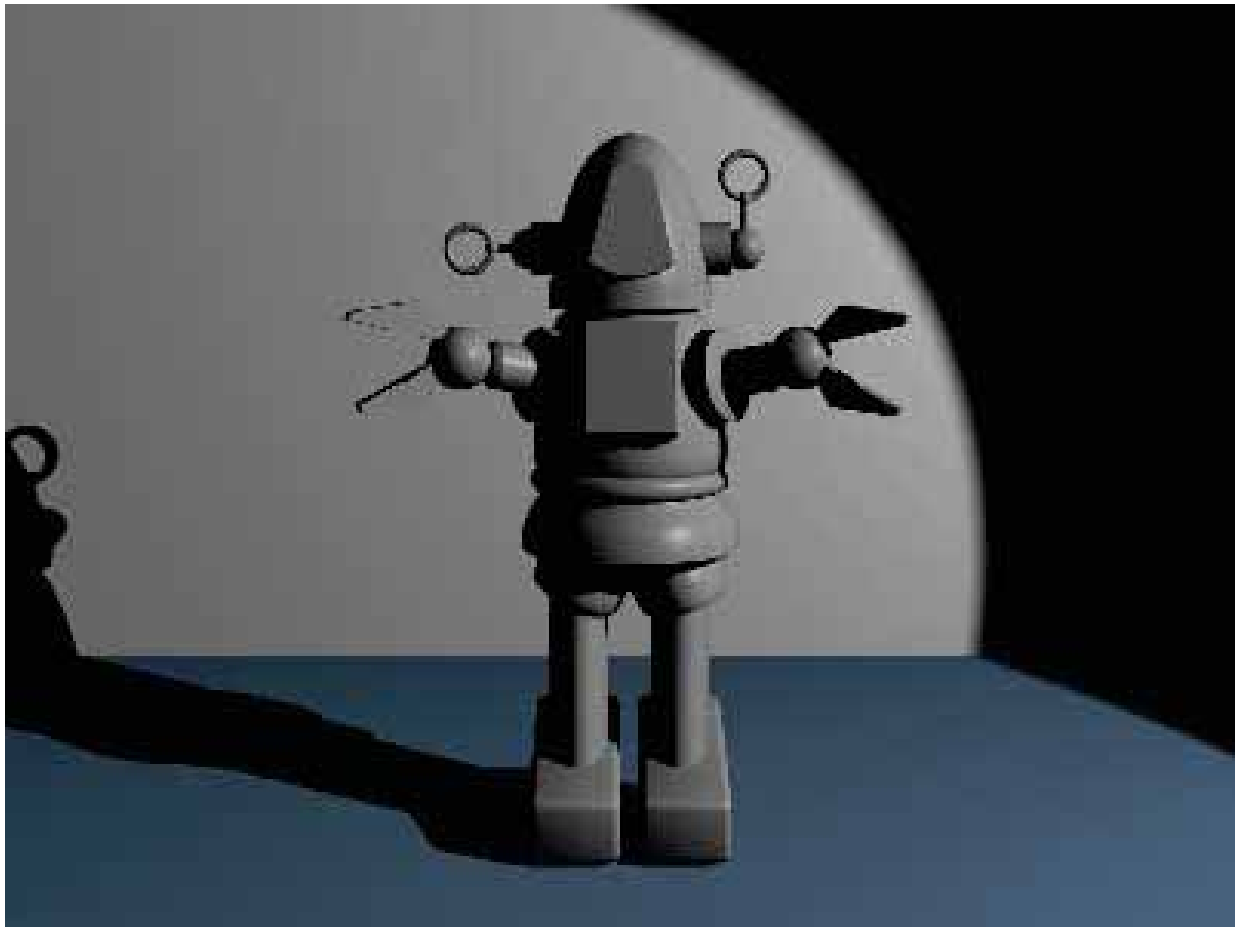


3dsMax Skills

Let's now choose Advanced-Ray-Traced Shadows. Advanced Ray-Traced Shadows are like Ray-Traced Shadows, but you have more control over how the shadows look. One of the major differences is the ability to soften the edges of the shadows so they are not so crisp and sharp.

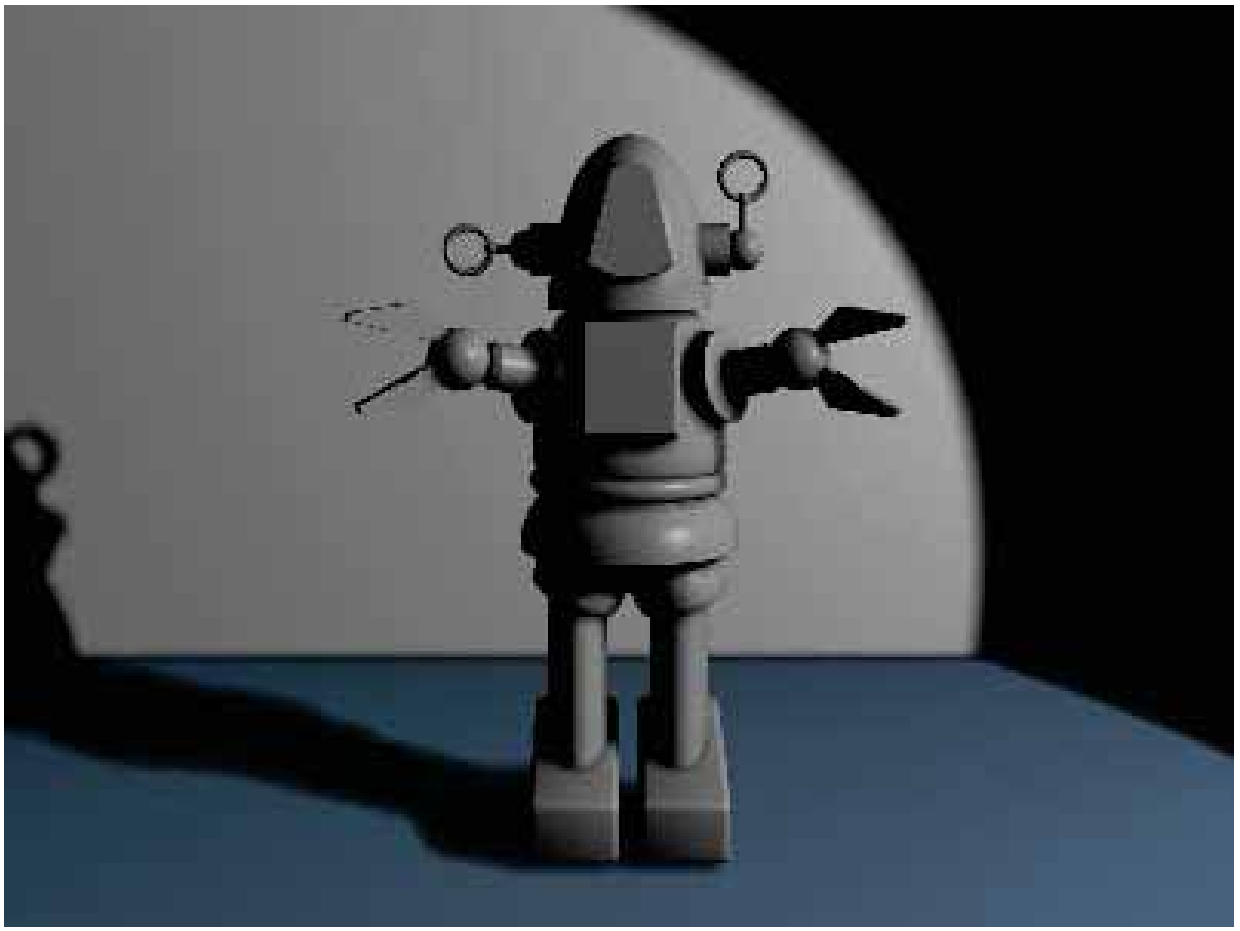
- Choose Advanced Ray Traced shadows from the Shadow drop-down menu.
- The robot is rendered with Ray -Traced Shadows. With the default settings, the shadows are still very crisp along their edges.

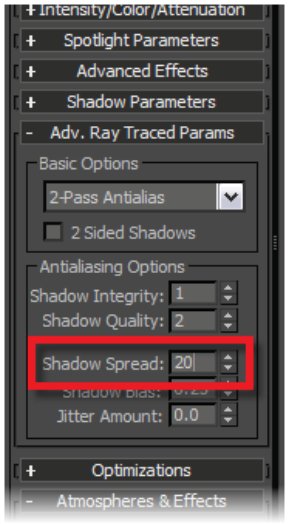




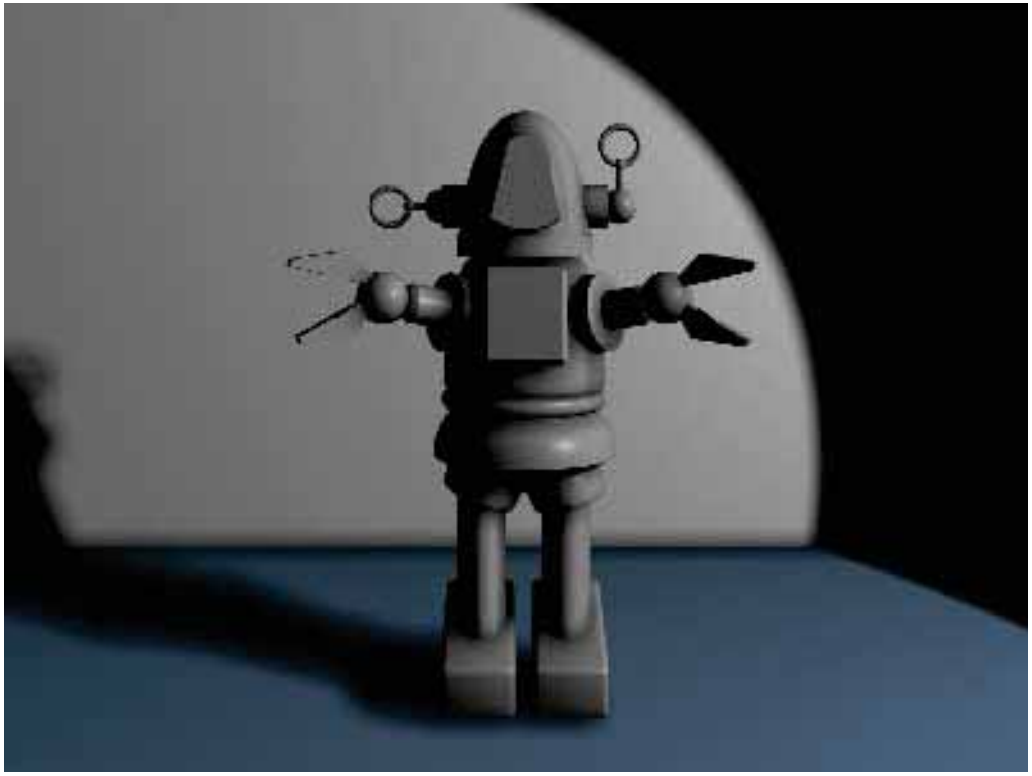
3dsMax Skills

- By increasing the Shadow Spread value, the edges of the shadows can be softened. When you do increase the Shadow Spread, you also need to increase the Shadow Integrity, Shadow Quality, and Jitter Amount. Figure 14 shows the robot rendered with the Shadow Spread value of 20, Shadow Integrity to 6, Shadow Quality to 6, and Jitter Amount to 2.





- Figure 15 shows the Shadow Spread value set to 50. The other settings have been left as they were in the previous image. Raising the Shadow Integrity and Shadow Quality settings can significantly increase the render time required.

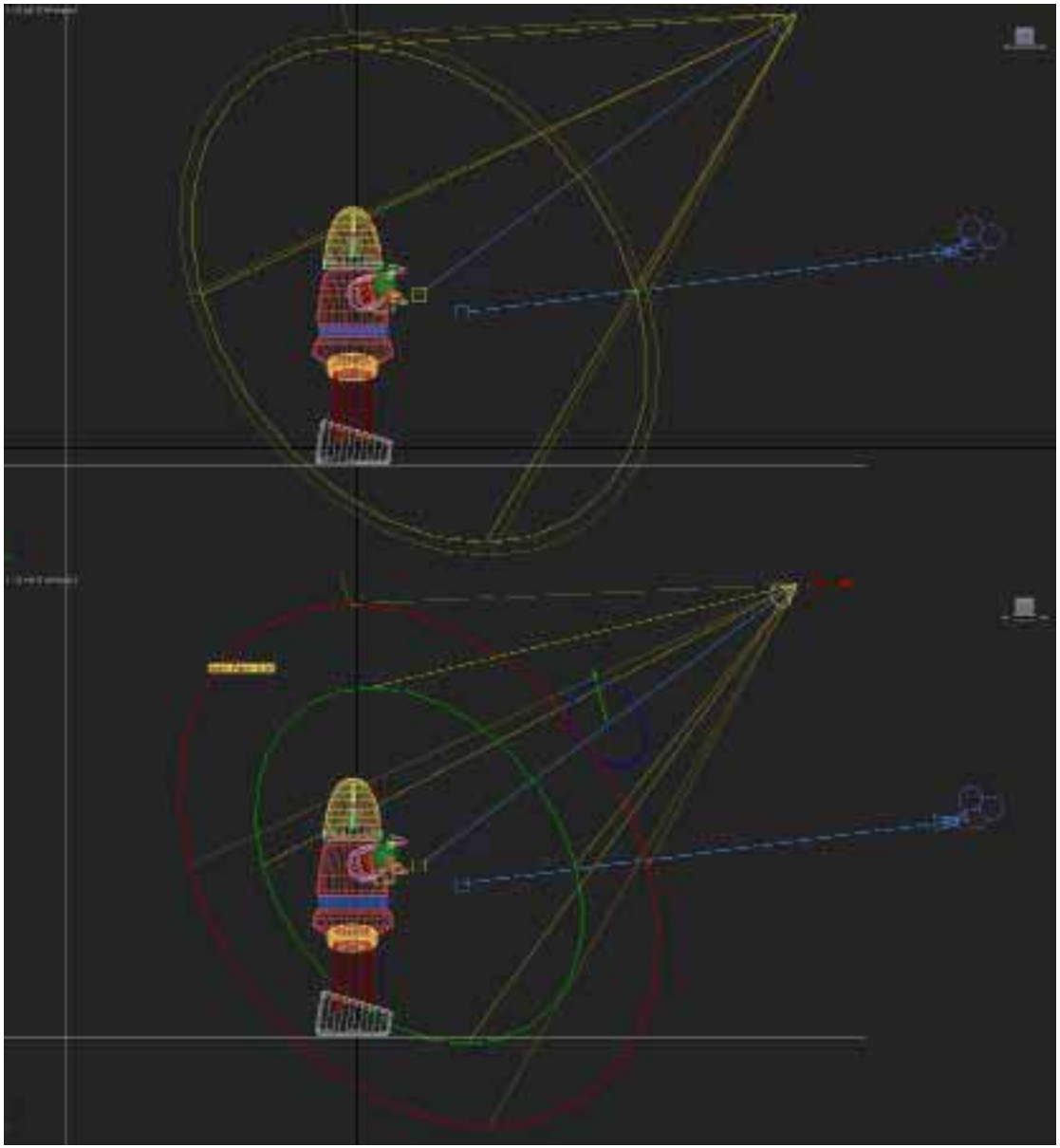


Before we add any more lights, let's adjust the softness of the edge of the spotlight so the light shining on the back vertical surface is not so harsh.

The transition between the light and shadow of the Spot Light is called falloff. It is represented in the scene when the spotlight is selected and Light Cone is visible. The light cone is visible by default. Adjusting the falloff of the spotlight is easy and can be done using the Hot Spot and Falloff spinners located in the Spotlight Parameters rollout or using manipulators located on the default Main Toolbar.

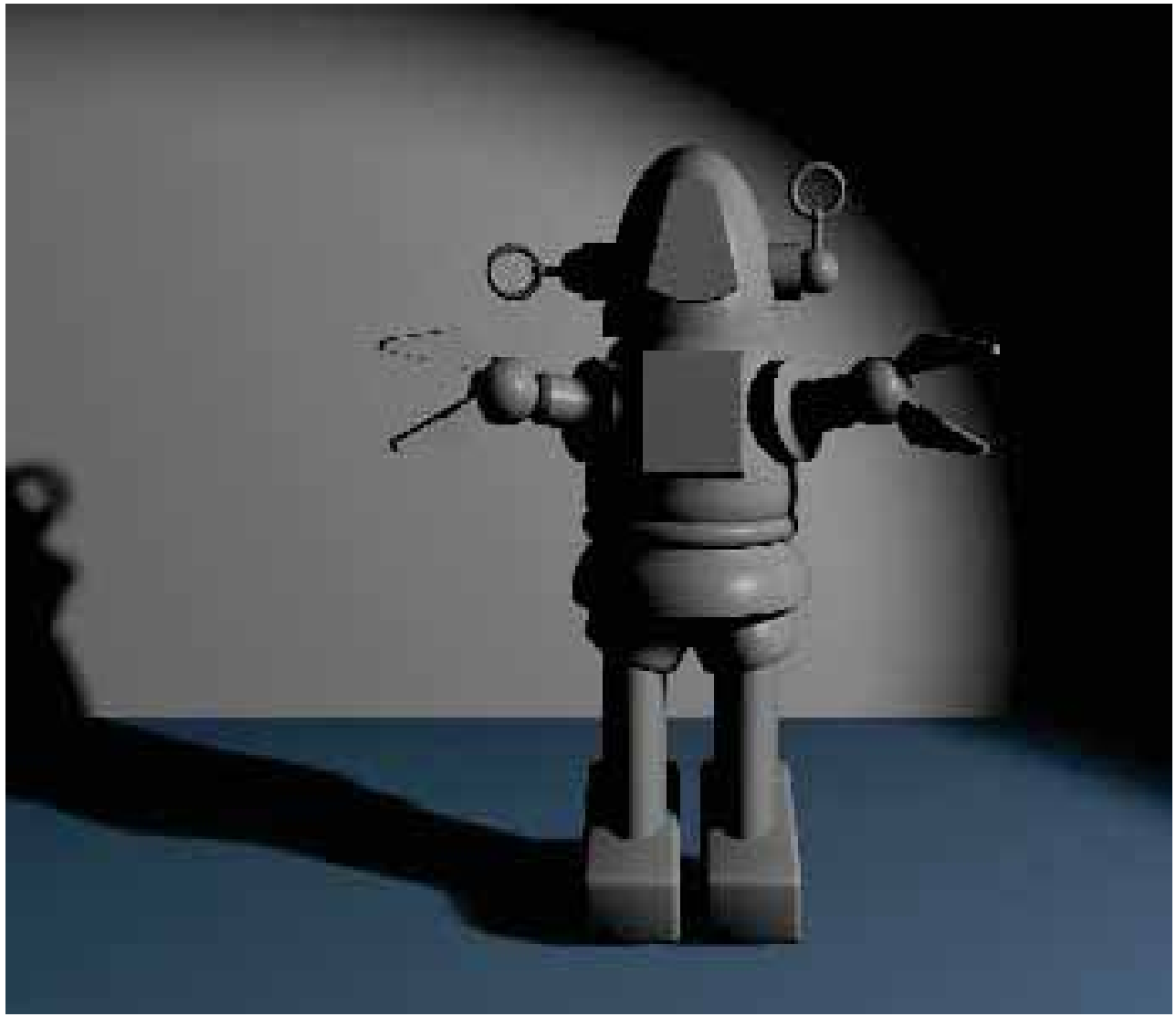
3dsMax Skills

Click and activate Select And Manipulate. As you move the cursor over the light cone in the viewports, the hotspot and falloff circles will temporarily turn red. When the circle is red, you can adjust the size of the spotlight falloff, hot spot, or both. The larger the gap between the two circle representations, the softer the transition between the shadow and light will appear in the render.



3dsMax Skills

This image shows the robot render with the falloff between the light and shadow increased. The transition is much wider and softer than the original.



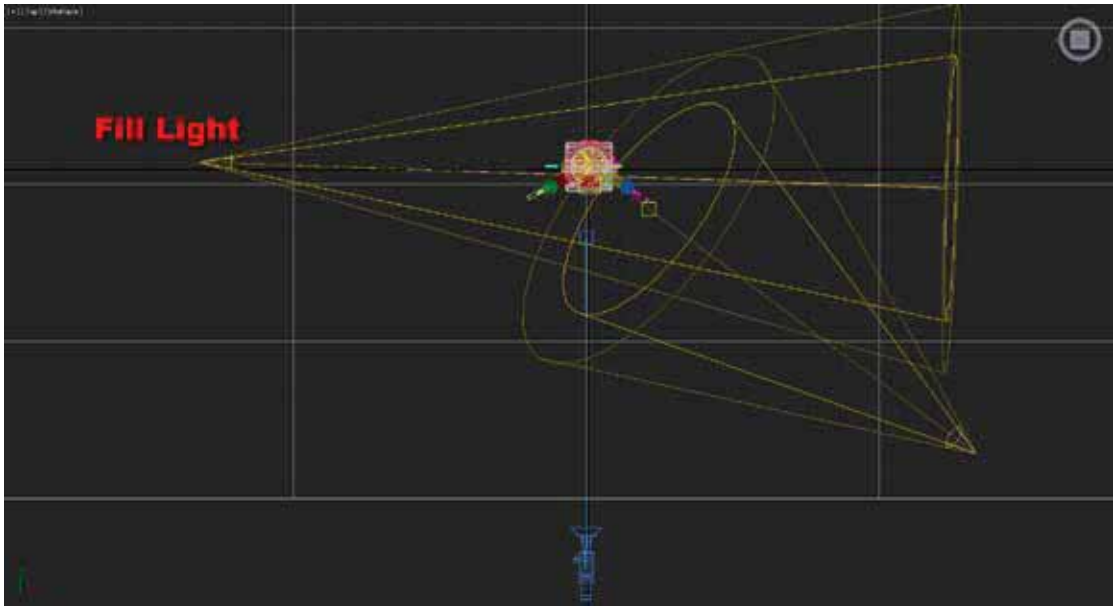
3dsMax Skills

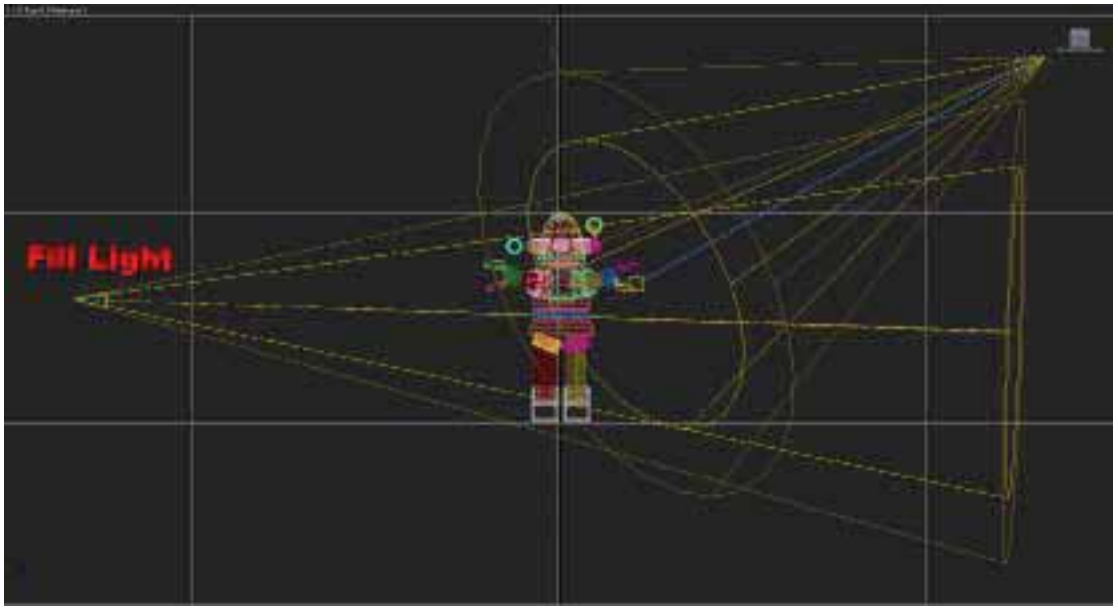
Now let's get back to adding lights to our scene.

The Fill Light

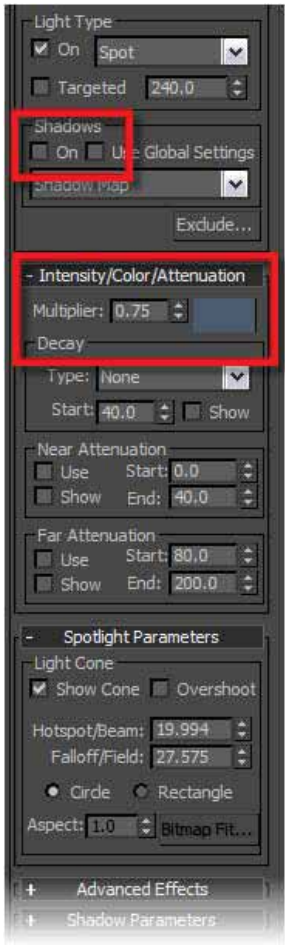
We will now add a fill light to the robot scene. Remember that the goal of the fill light is to lighten the very opaque, dark, and dense shadows created by the key light.

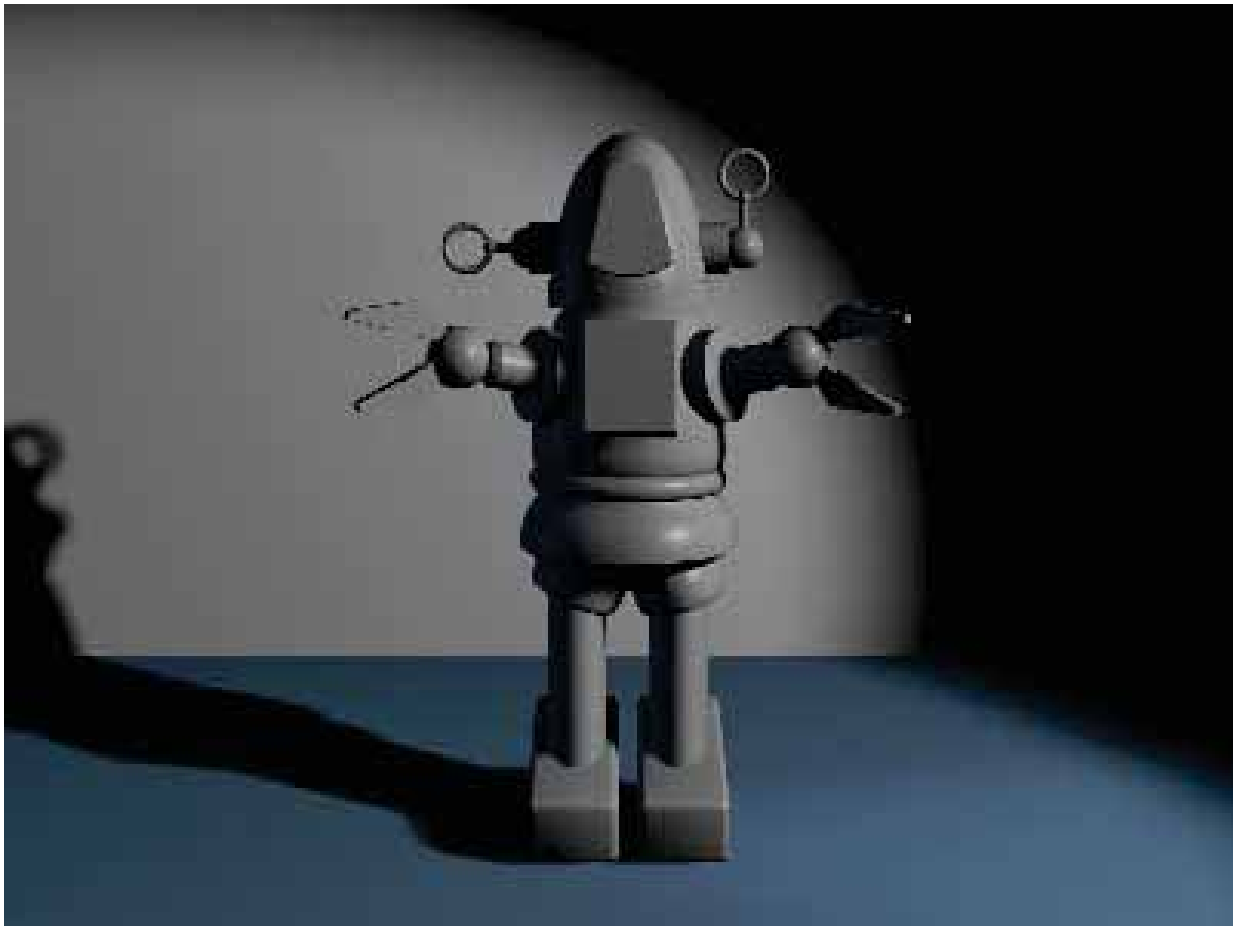
- Add either a Target Spotlight or a Free Spotlight to the scene placed on the opposite side of the key light at about half the height of the robot object.
- Drag the target or point the light at the robot.
- Adjust the falloff of the light to your liking. There is no right or wrong setting.



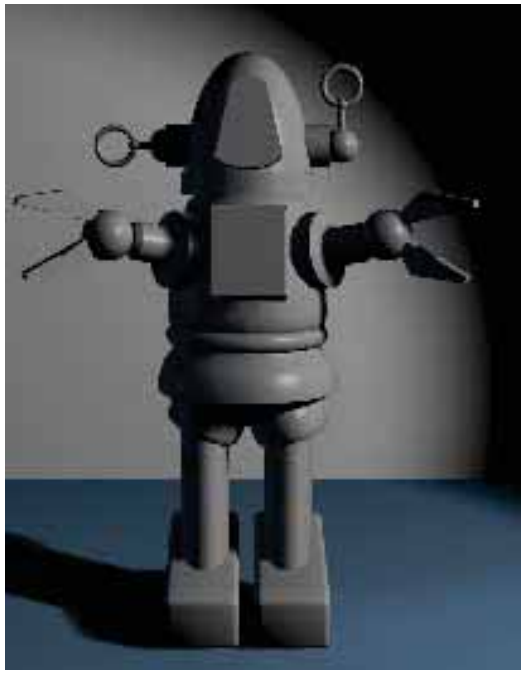


- Leave the Shadows box unchecked in the General Parameters rollout.
- In the Intensity/Color/Attenuation rollout, set the Multiplier value to a setting between .5 and .75
- Click the Color preview to open the color picker, and using the Dropper tool, select the bluish color from the floor plane. Lighten the color if it is in the darker range of values.
- Render the robot. The shadows are lighter and there is some of the ground color in the fill light simulating light reflecting from the ground into the robot object.





Finally, we will add a rim light to further separate the robot from the background.

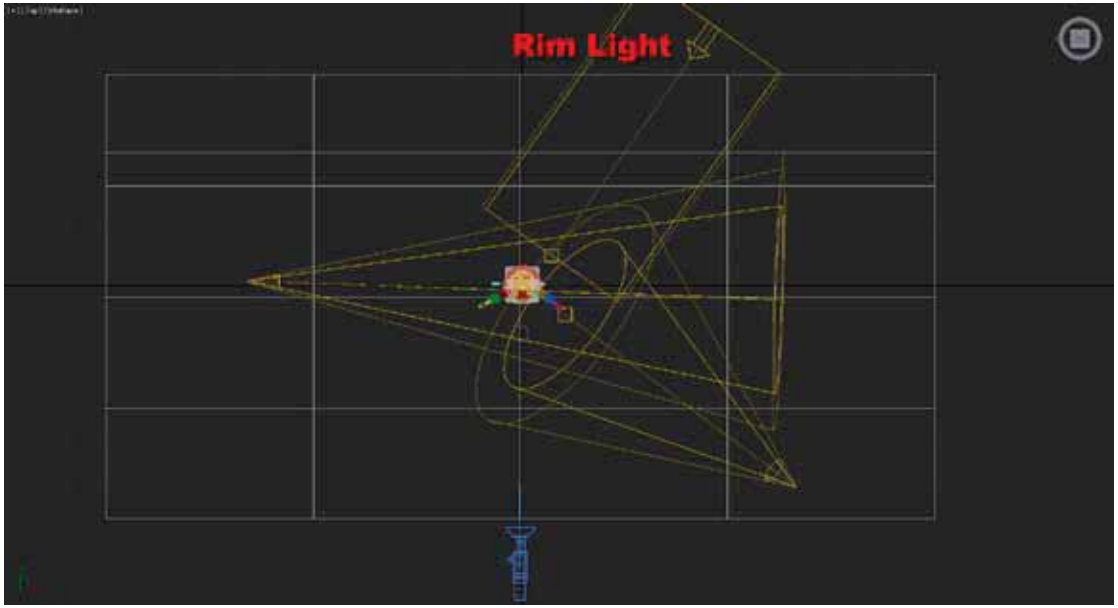


The Rim Light

The rim light is used to separate the object from the background. It can be placed on either side of the object. As the artist, you will need to decide which side would light most effectively. In this particular scene, we will place the rim light behind the robot on the same side as the key light. In this particular instance, this is done because the values of the light side of the robot are very similar to the values on the background plane.

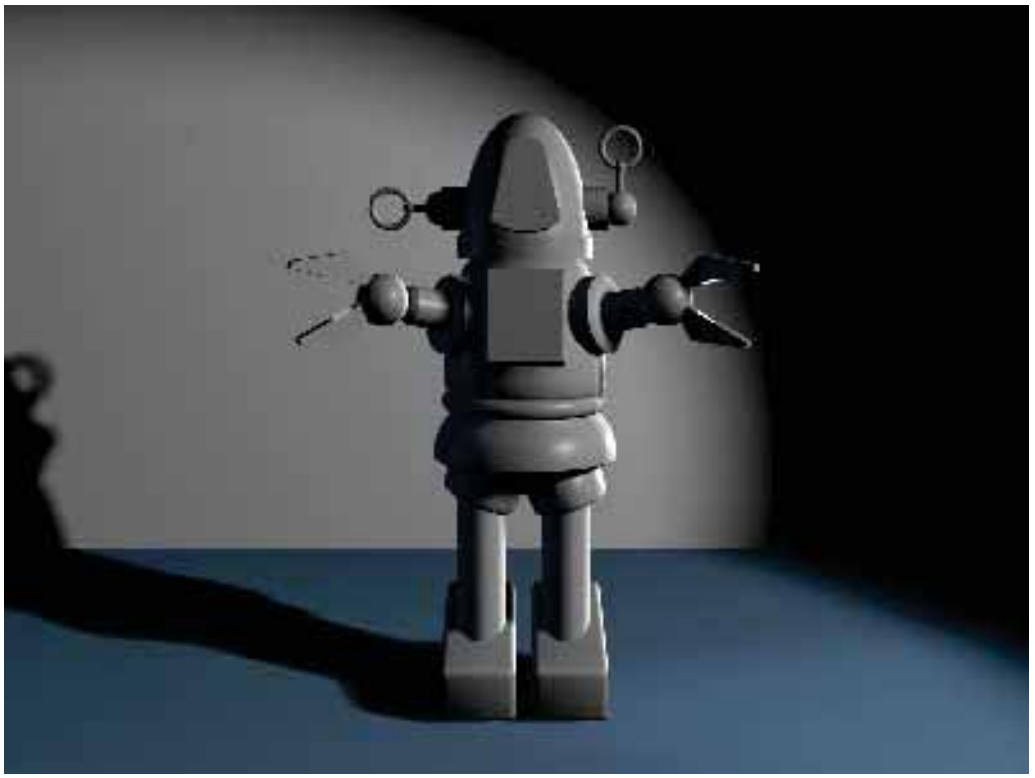
To place the rim light, do the following:

- Add either a Target Direct or a Free Direct light to the scene. We use the direct light because it has parallel rays and can be places such that it does not light the ground plane. Place it on the same side as the key light at about half the height of the target object, slightly behind the robot, and so the rays of the light are moving parallel to the floor surface. It does not matter if it is positioned behind the rear plane. The light will shine through that object.
- Turn off shadows if they are on.
- Drag the target or point the light at the robot.
- Adjust the falloff so there is very little since we do not need a smooth and gradual transition between the light and shadow.



3dsMax Skills

- This time increase the multiplier value to 2 and change the color or the light back to white. This will give a very intense light that will serve as a rim light quite adequately.
- Render the robot.

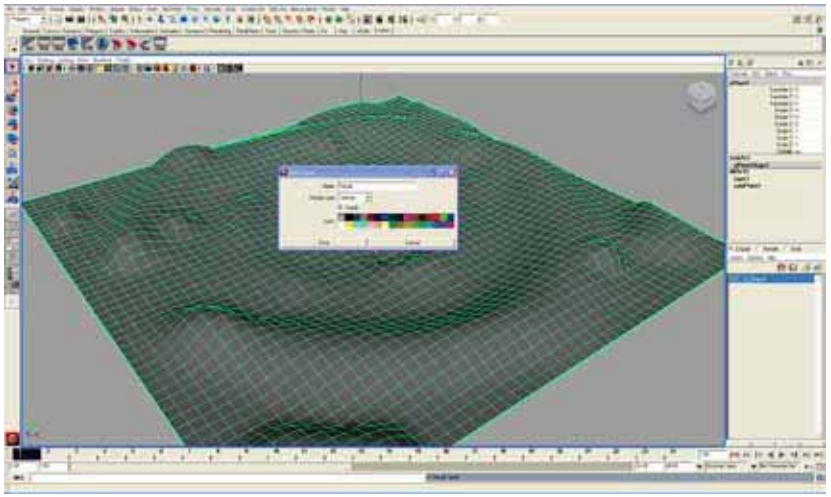


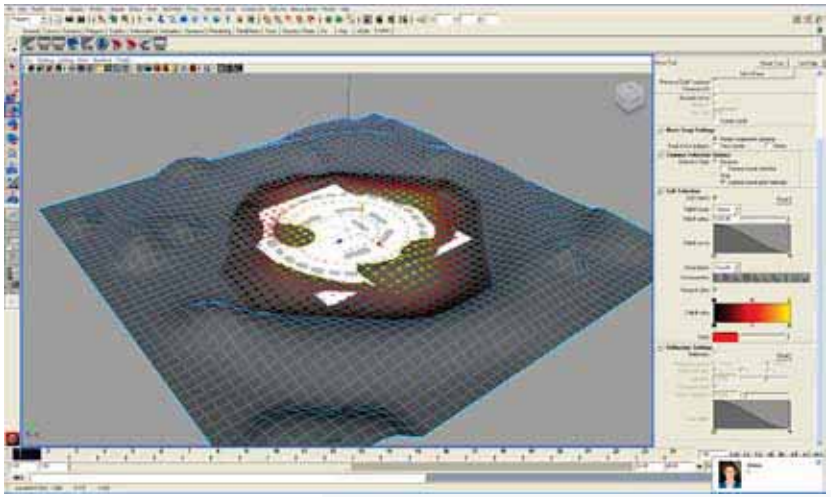
As you can see, the added contrast between the robot and the background nicely separates the two and makes the object more the focal point.

Workbook

Interface/Menus

Autodesk® Maya®





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Maya Interface

1 - Setting a Project
When you start up Maya, it is best practice to set up a project file. This will allow you to always save work to a specific directory.

2 - Primitives
In Maya you create primitive 3D geometry as a starting block to modeling detailed 3D objects

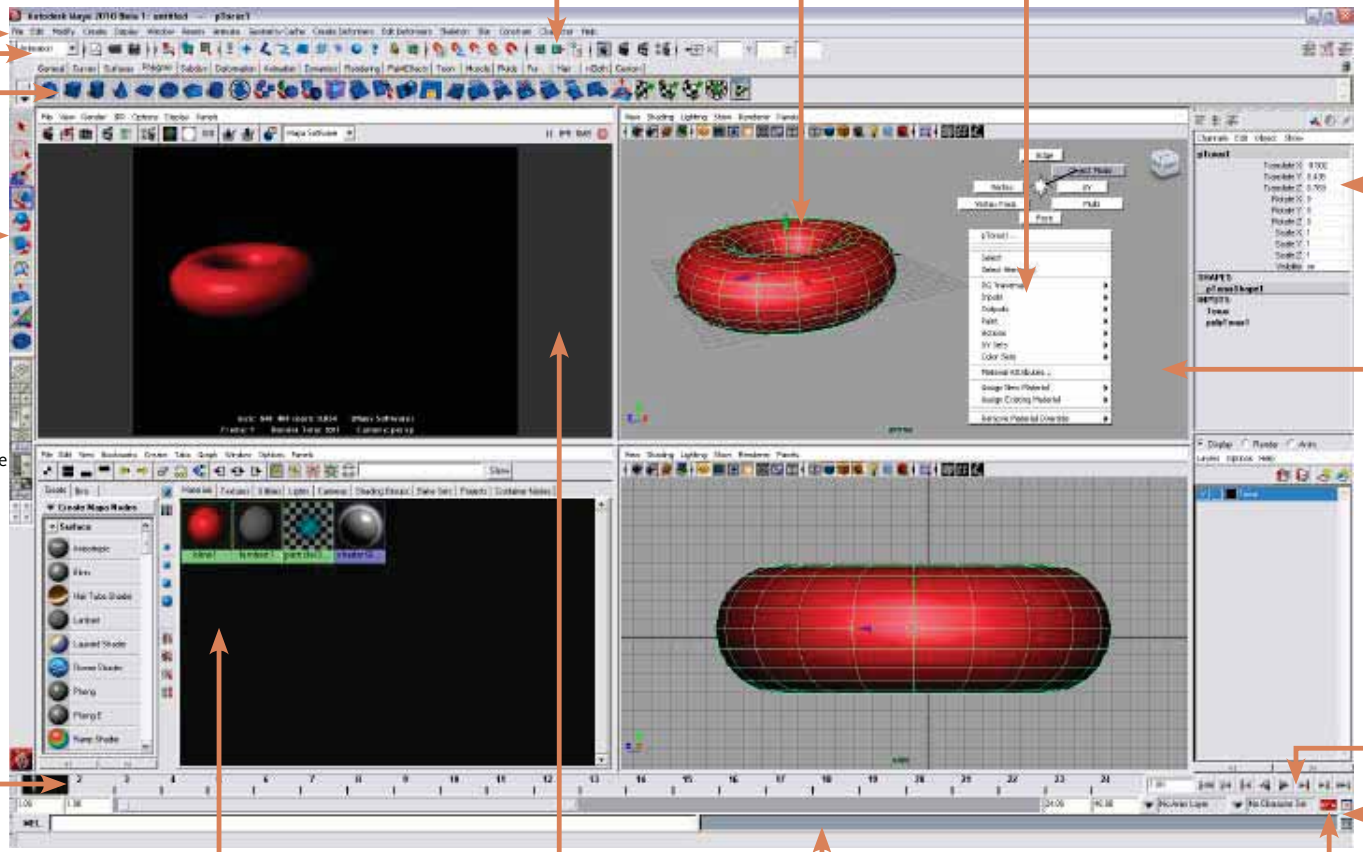
3 - Marking Menus
Marking Menus allow you quick access to editing your mesh objects. You can select different components to allow you to start modeling.

4 - Channel Box
The channel box gives you quick and easy access to the Transform, Rotate and Scale channels of an object

Status Bar

Menu Sets

Shelf



5 - Tool Box
The ToolBox holds all the Transform, Scale and Rotate tools, as well as other tools used for selecting objects.

6 - Viewports
Using the viewport Tools, you can Tumble, Pan and Zoom the Perspective Viewport

Playback Controls

Time Slider

Feedback Editor

7 - Hypershade
The Hypershade is where you will create all your materials for your scene objects. Its clean layout makes it easy to use.

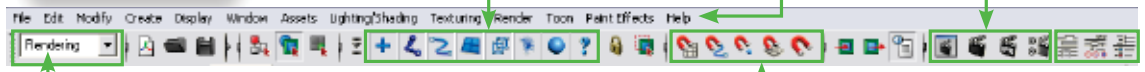
8 - Rendering
When you render, Maya converts a 3D Scene into a 2D Image.

9 - Auto Key
Auto Key allows you to automatically key objects as you scrub through the timeline making transform, Rotate and Scale changes. Any change you make a key will be created

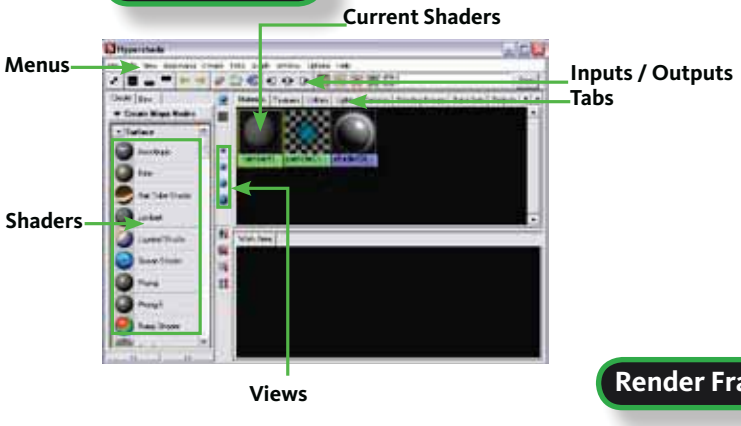
10 - Animation Settings
Animation Settings allow you to take control over all aspects of your animation setup, from Frame Rate to Number of Frames.

Maya Menus

Status Bar

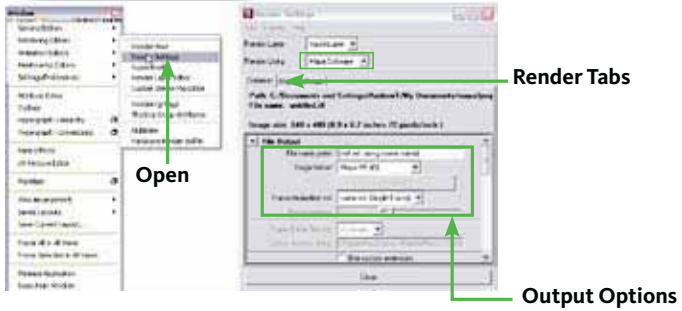


Hypershade

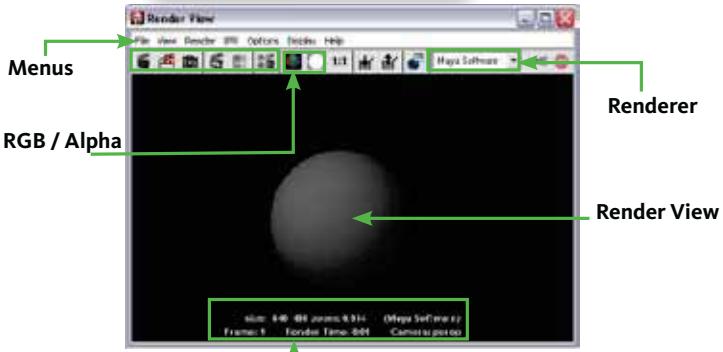


Shelves

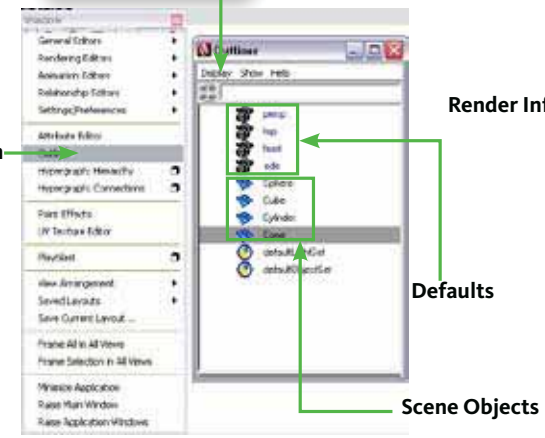
Render Settings



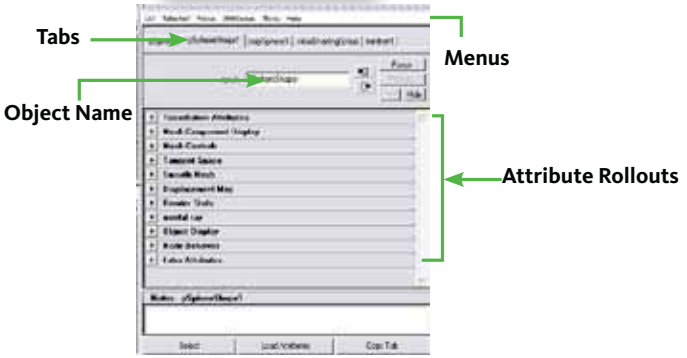
Render Frame Window



Outliner



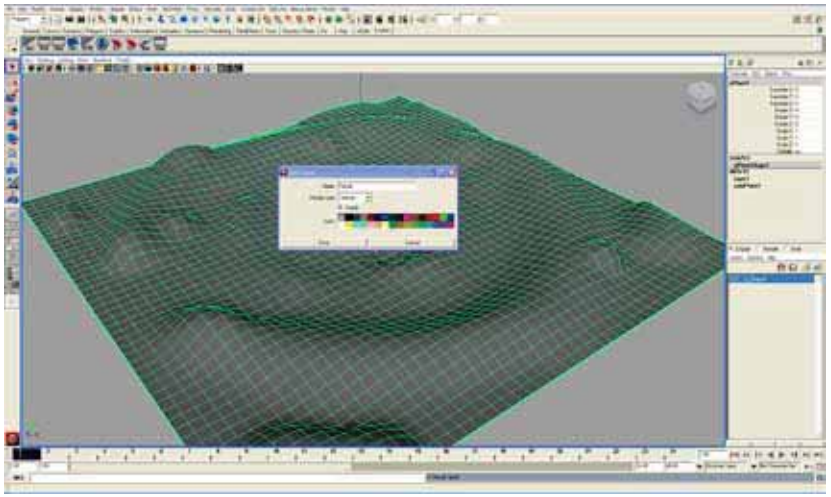
Attribute Editor

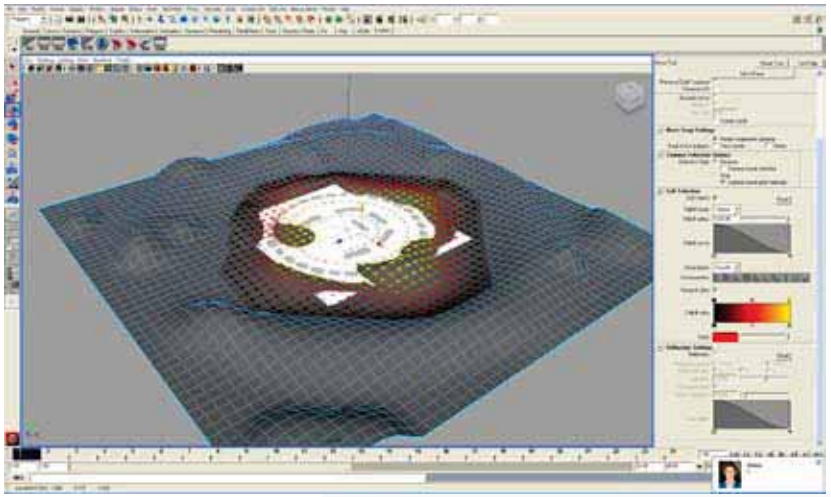


Workbook

Getting Started Tutorials

Autodesk® Maya®





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Maya Setting Up a Project

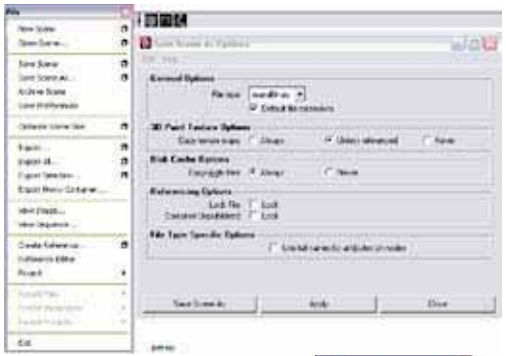
1

File Management is crucial to the success of any 3D project. By setting a project folder, you are always making sure that files get saved to specific and relevant directories. For example when you set up a project all scene files you save are saved to the Scenes Folder, any materials you save are saved to the Materials Folder etc. First got to File›Project›New.

2

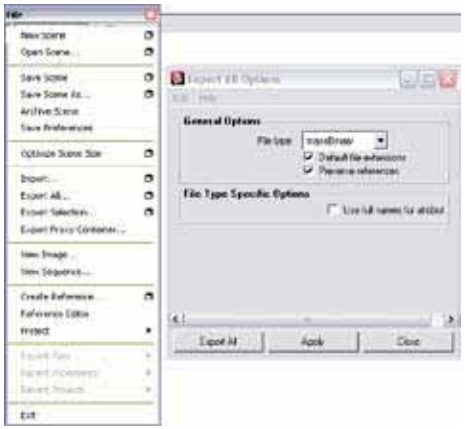
When you Click on New under Project, The Set Project Dialog will appear. This simply allows you to name the relevant folders you will require for your project. You will just click Use Defaults then click Accept. The Browse For Folder Dialog will appear. Here you will select the directory to which all project files will be saved.

3



The Open file dialog, navigates you directly to the Scenes Folder, in the project Folder you set up earlier. Notice that all your files are laid out in an organized manner. Any files you save, Export, Render are all saved to their relevant Folders making it really easy for you to manage your project and ensure that data doesn't get lost.

4



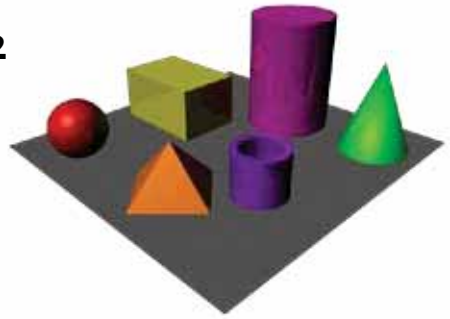
If you go to File›Import, you will notice that an Import Folder was created in your project directory. It is best to save any data from another application that you wish to import in this folder. Maya will always navigate to the import Folder when you click Import. Notice what happens if you go to File›Export you will notice that you will be taken to the project folder again. All major folders that are required are set up for you in an easy to manage way.

Maya Primitives & Editable Polygons

1

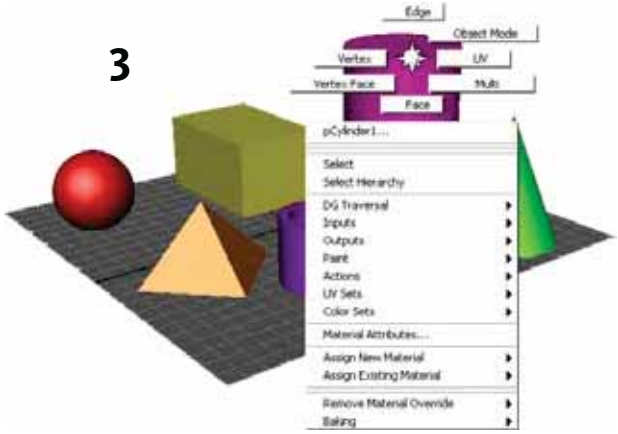
In Maya you generally create new primitive objects using the Shelf, or the Create menu. Primitive objects are used to block out your model. You then go into the different sub-object modes to model the primitive into shape.

2



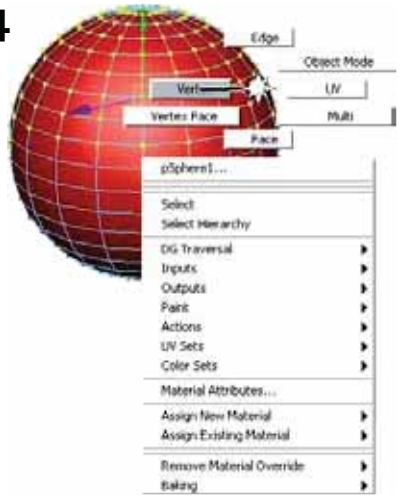
Primitive objects consist of Boxes, Spheres, Cones, Planes, Pyramids and Cylinders. They are easy to create, generally with a 2 click mouse operation.

3



Once you have created a primitive object as your starting block you can immediately work with it as an Editable Poly by right-clicking over the object and bringing up the marking menu. You can start using some of the Sub-Object modeling tools to develop and refine your model.

4



An Editable Poly has 7 Sub-Object levels, Vertex, Face, Multi, UV, Object Mode. Each of these levels allows you access to different elements of the Polygon.

5

Deformers can also be applied to objects in the Animation Menu›Create Deformers›Nonlinear Deformers. When a deformer is added you have the ability to Bend, Squash and Twist the shape.

Maya Creating Materials & Textures

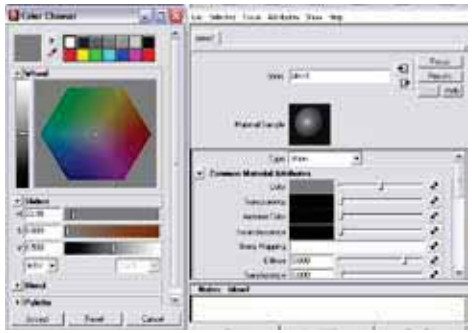
TUTORIALS

1

The Hypershade is an easy to use dialog. This is where all your scene materials and textures will be created. The Hypershade allows you to manage individual scene materials in their own individual material slots. You can create Procedural Materials. These are materials created parametrically within Maya. You have different types of shaders available that act as a starting point for creating a particular look for a material. Examples of shader types are Blinn and Anisotropic. You can also create Bitmap Materials. These use either parametric image maps or external image files.

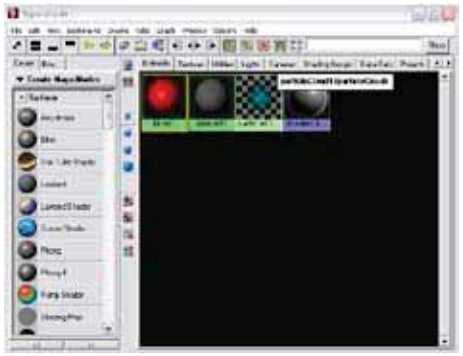
2

First you will create a simple Procedural Material. To do this click on Blinn to create a new Shader. Double click the new shader and in the attribute editor you will Change the color to Red.



In the Attribute Editor, double click the Diffuse color swatch to bring up the Color Chooser Select a light red using the Sliders.

3

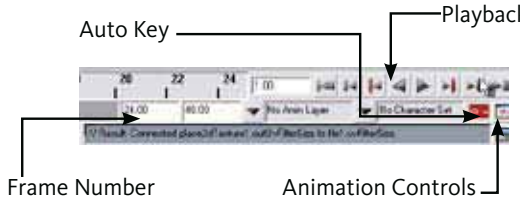


In the scene, create a Sphere and with it selected go into the Hypershade, Right Click over the Material Slot and from the Marking Menu, select Assign InitialShadingGroup To Selection

4

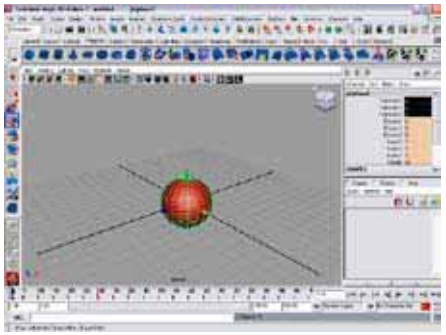
Now you will create a material with a texture on it. Create a new Blinn Material, double click it, and in the Attribute Editor Click the Map Button next to the Diffuse Slot. Select Checker from the Create render Node Dialog. Apply the shader to the object and press 6 on the Keyboard to view the texture in the viewport.

Maya Animation



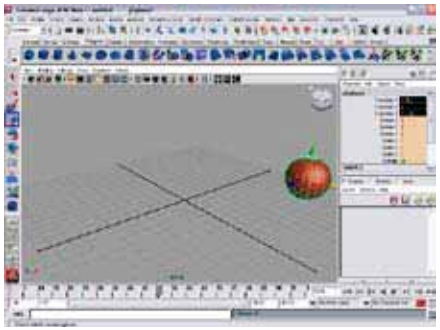
The Animation and Playback controls allow you to play your animation in real-time in the Maya viewports. Auto Key, allows you to set an initial key, scrub through the timeline, move your object, and the object will be automatically keyed.

1



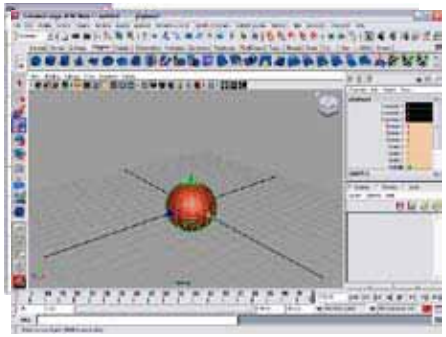
In this tutorial, you will create a simple animation of a sphere moving across the viewport. To start, go to the Polygon Shelf and click on the Sphere. Left Click in the viewport and drag out a Sphere. Go to the Toolbar and select the Move Tool. Select the Sphere. You are now ready to start animating.

2



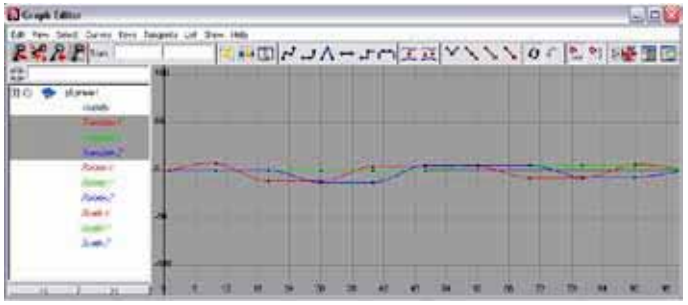
Go to the bottom right of the interface and hit the Auto Key button. Move the Sphere on Frame 1, then press S to set a key, this creates a key at frame 1. Now go to Frame 10 and then move the Sphere to a new position. Notice that a new key frame is created. Move the Time Slider to Frame 20 and move the Sphere, another new key frame is created.

3



As you move the Time Slider across the Time Line and move the Sphere you will see new keys are created. Set new Keys at Frames 30, 40, 50 etc until you reach 100. When you are done be sure to turn off Auto Key.

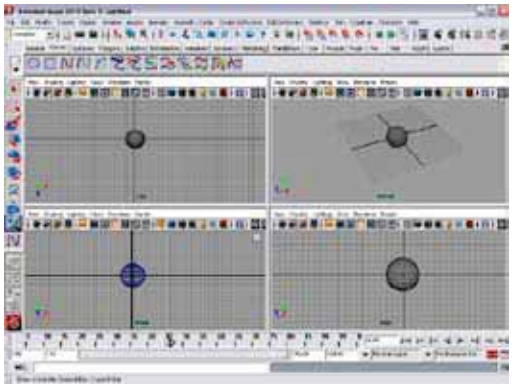
4



Once you have animated your Sphere, Go to Window›Animation Editors›Graph Editor - Curve Editor. With your object selected you will see the animation curves that were created. You can refine your animation using these curves.

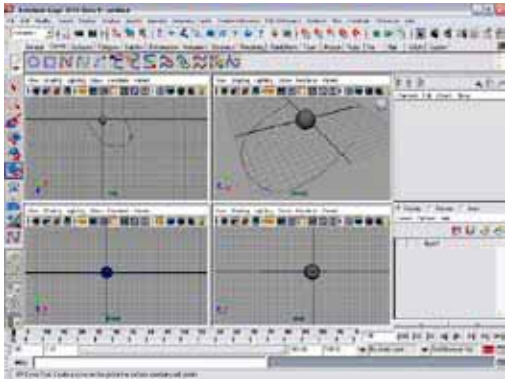
Maya Animating a Camera Along a Path

1



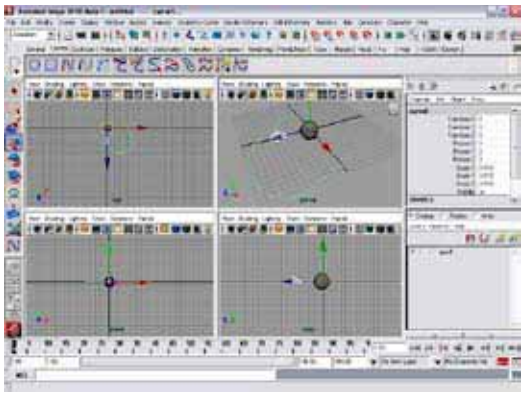
In this tutorial, you will animate a camera along a path. This is a great way of creating camera walkthroughs. You can attach either a Free Camera or a Target Camera to a path. First go to Polygon Shelf>Sphere. Drag out a Sphere in the perspective viewport. The next step will be to create a Path and a Camera in the scene.

2



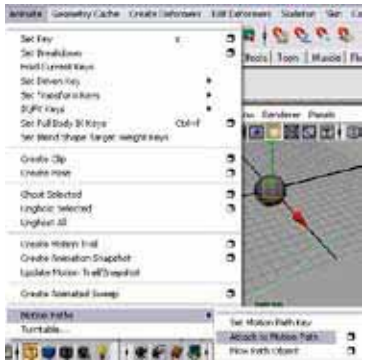
Go to Curves Shelf>EP Curve Tool, and create a curve in the top view around the Sphere. In the next step you will create a camera

3



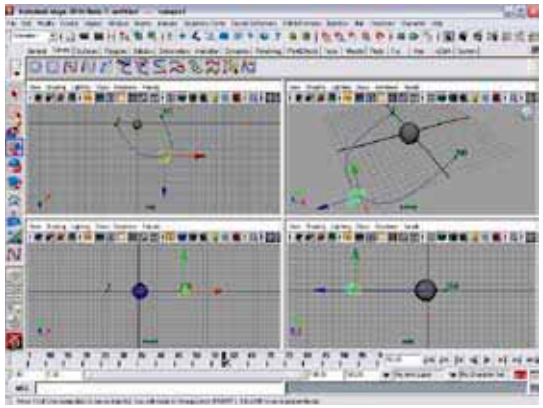
To create the Camera, go to Create Menu>Cameras>Camera. Place your Camera over the path. In the next step, you will attach the camera to the path. You will do this using a Motion Path Controller.

4



To create the Motion Path Controller, first select the Camera, then select the Path. Go to Animate>Motion Paths>Attach to Motion Path. This will attach the camera to the path.

5

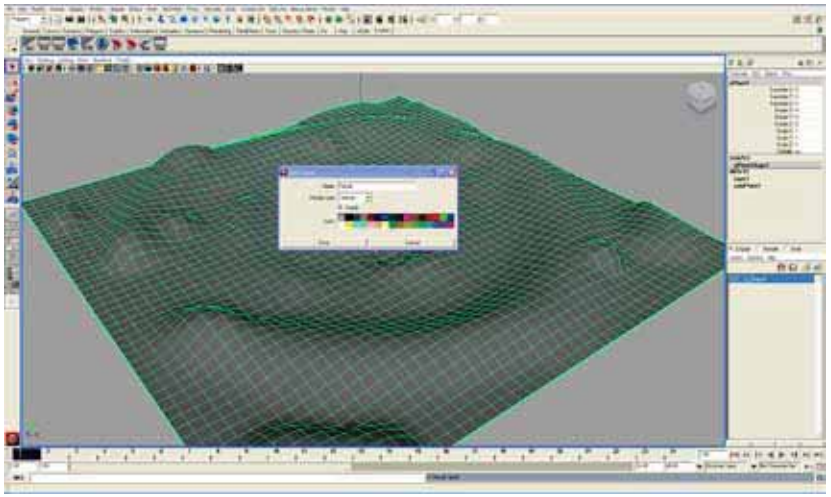


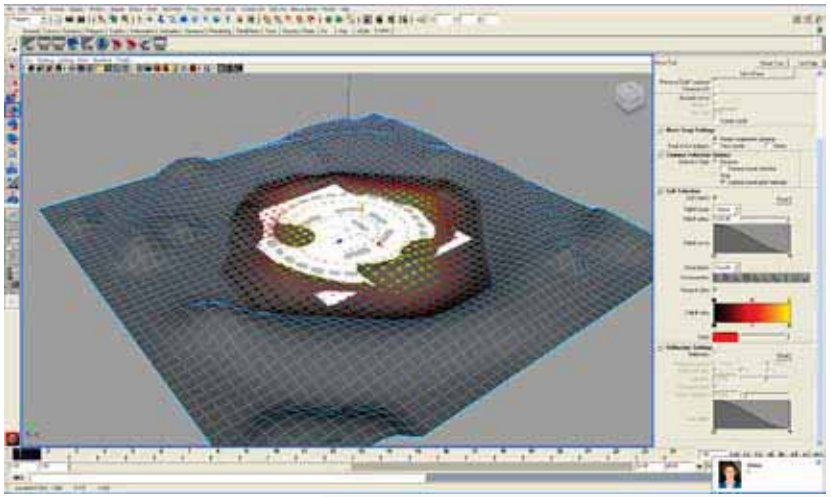
You will notice the camera jumps to the beginning of the path. Also key frames are created at the beginning and end frames. If you scrub through the time line you will see the camera sweep along the path

Workbook

Learning

Autodesk® Maya®





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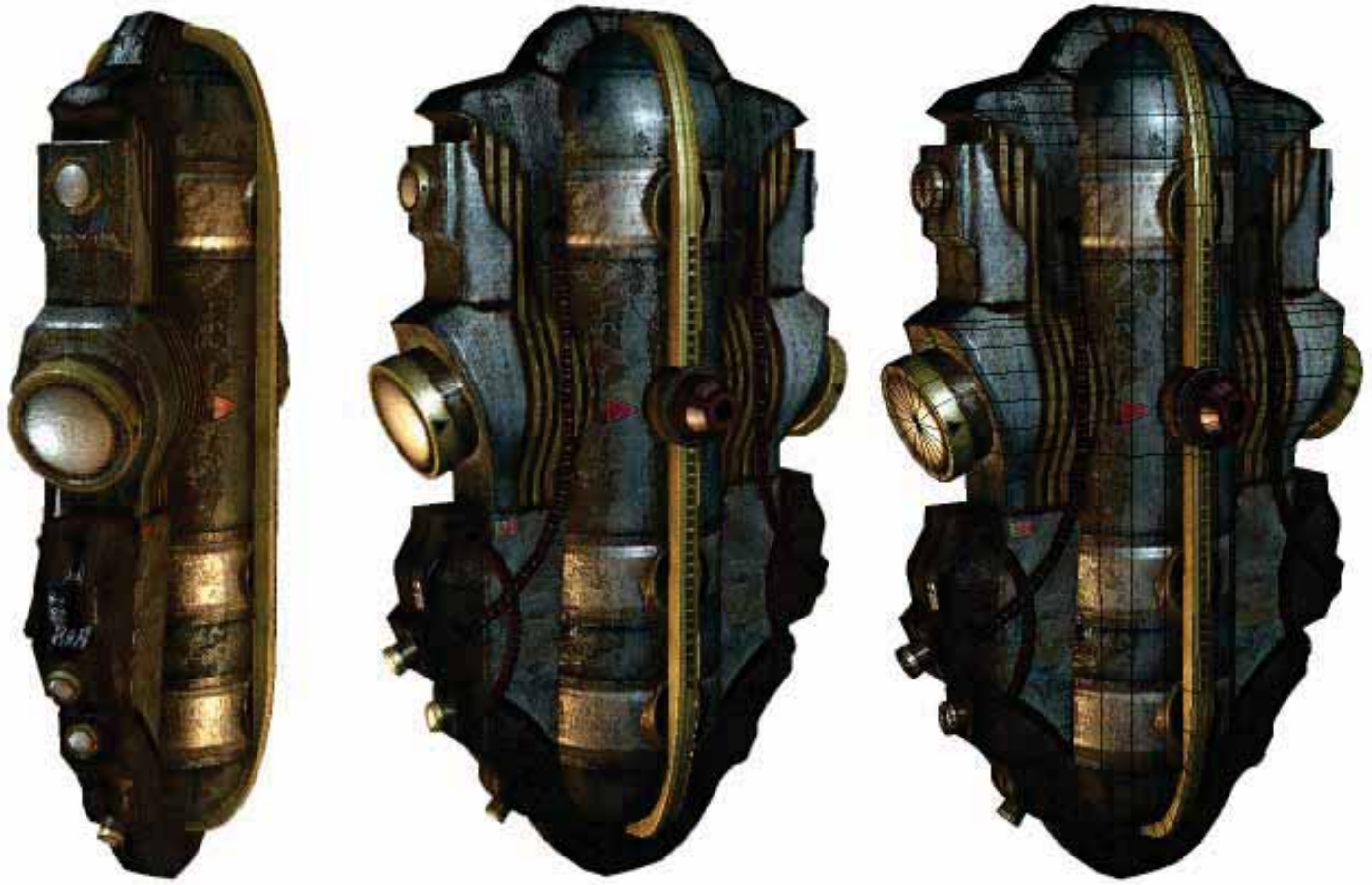
Getting Started with Maya

This is a "Getting Started" introduction for Maya basics, you will want to become familiar with all of tools in this section and if you need more information refer to the help Menu in Maya.



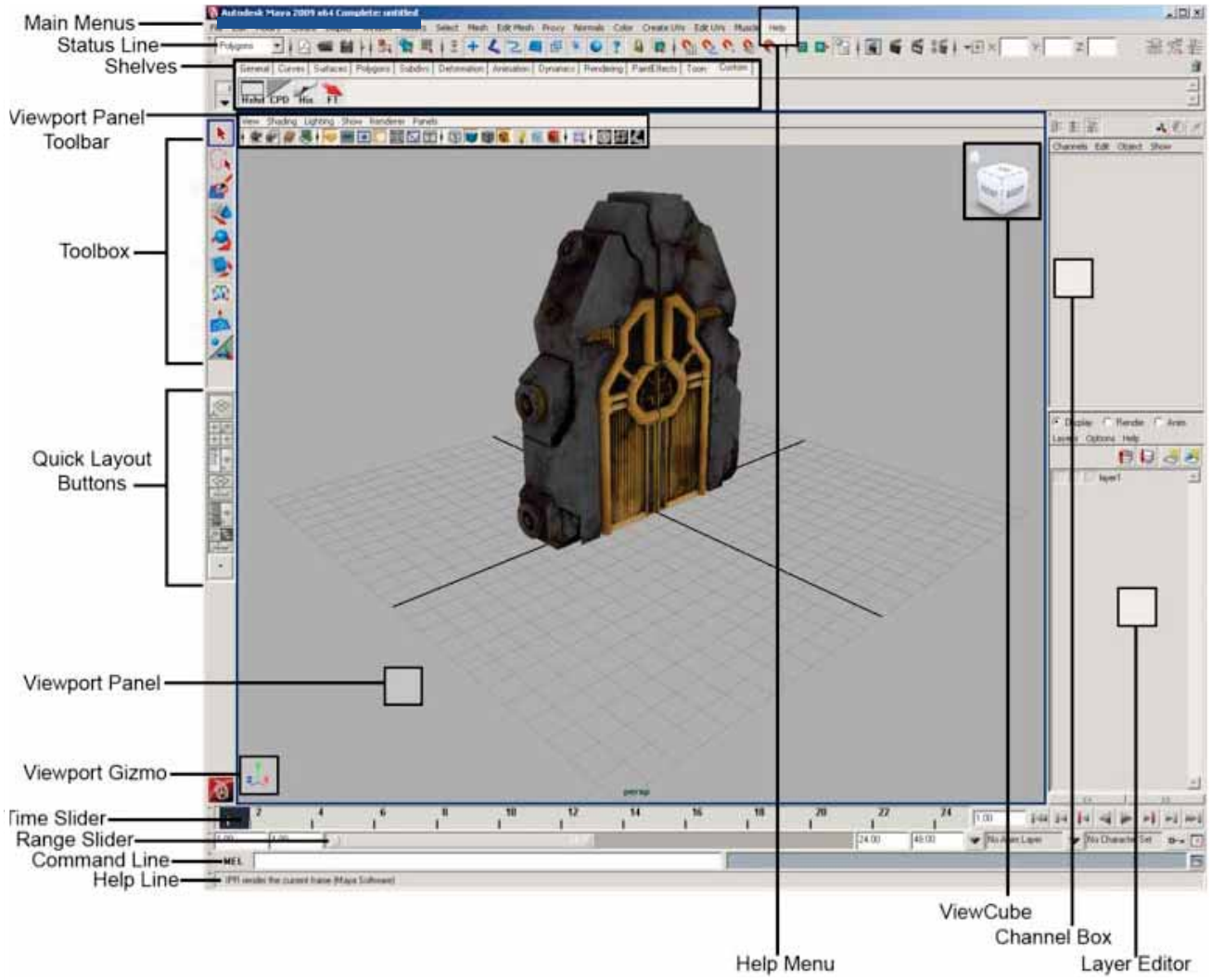
Maya Getting Started

Main Menus
The Maya user Interface

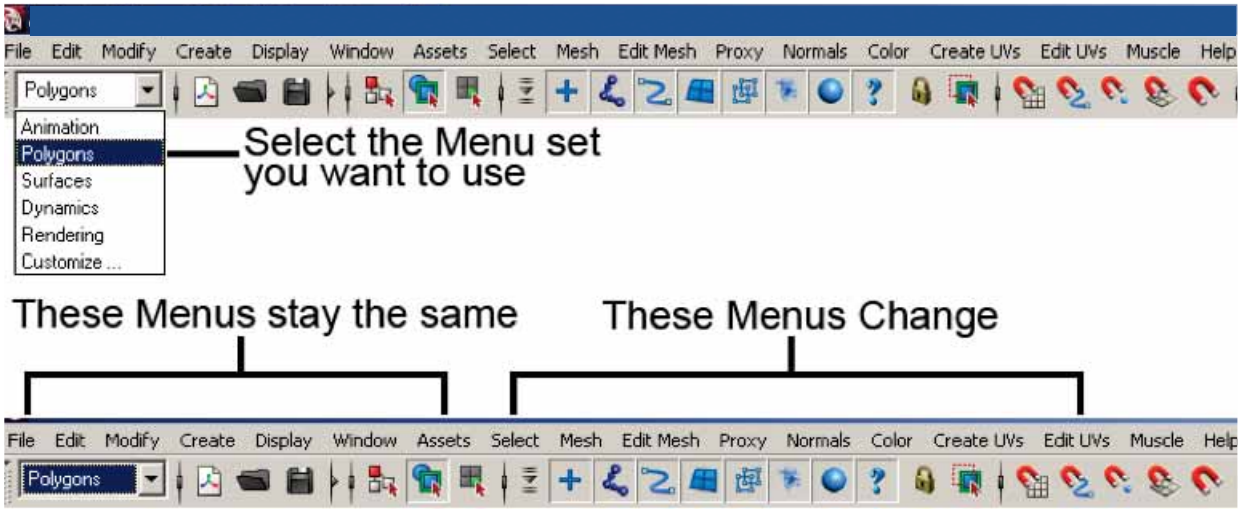
We are going to cover the most commonly used menus, commands and hotkeys. The Maya User Interface is shown here in its default configuration, and can be customized to fit your workflow. There are many menus in this interface, some for modeling and some for animation. They are grouped into different shelves, so that you can open them individually. Maya is a very big program and you will not need to memorize everything in this layout. Just explore as much as possible and try to get a sense of the overall interface and as you learn more you will begin to see how the tools all work together.

The **Main Menus** are located at the very top of the Maya Interface. It is the top bar that starts with **File** and ends with **Help**. The main Toolbar also has other menus that are always visible, such as **Edit**, **Modify, Create, Display, Window and Assets**. These Menus will always stay visible.

The **Status Line Toolbar** is the top toolbar. This Toolbar has several category settings that you can choose from, such as Animation or Polygons for instance. When you switch between the categories, the top right section of the tool bar will change with new categories specific tools.



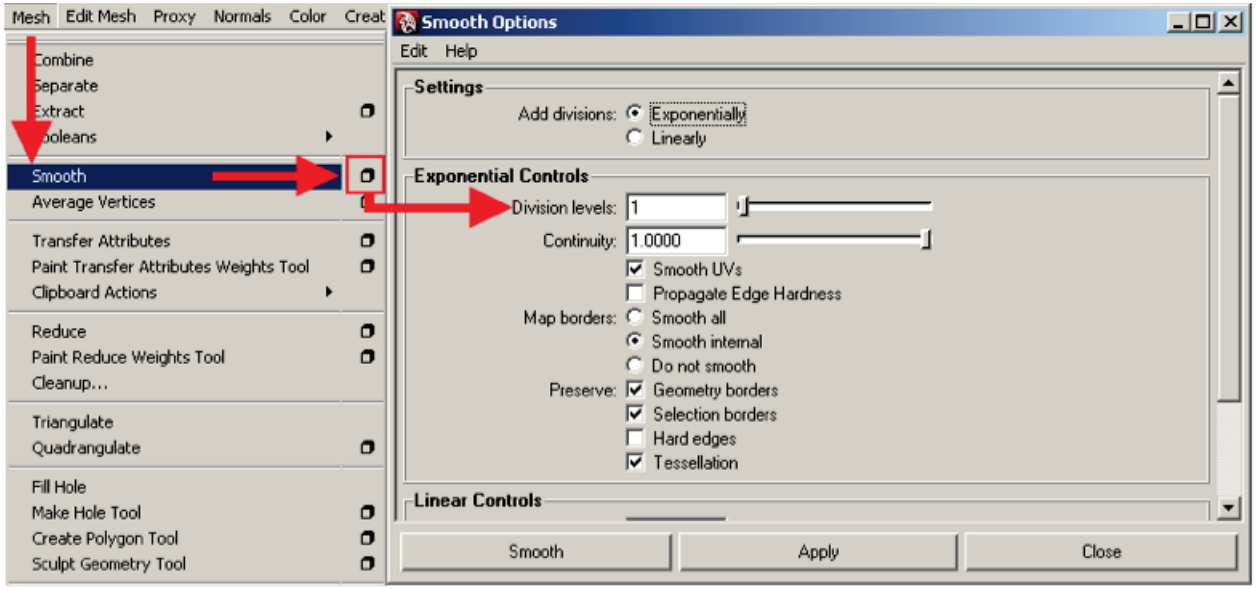
It also contains another set of icons below that are status line icon commands.



All of the commands can be accessed in the drop down menus by default, pictured here is the **Mesh** menu.

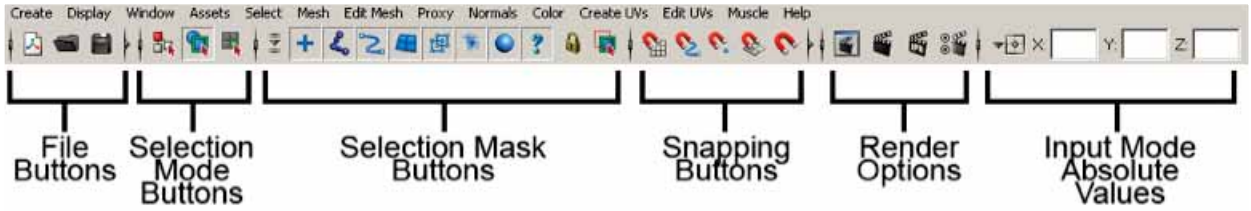
This is the main area for the commands you will probably use most often. On the end of each command menu there is a black square Options Box, this contains additional Options which can be setup before the command is executed.

Inside the **Smooth Options** box there are sliders and check boxes that can be adjusted.



Maya Getting Started

Status Line Icon Commands are a set of icons that help with selecting groups and common settings.



- **File Buttons** are used to create and save scenes.
- **Selection Mode Buttons** let you select between object hierarchy.
- **Selection Mask Buttons** let you make specific object component types selectable or un-selectable.
- **Snapping Buttons,** toggles snapping objects to grid, points, and curves.
- **Render Options Buttons**, are used to open the render window, settings, and to perform an IPR render.
- **Input Mode**, allows you to input absolute values for the selected transform of an object.

You can also use the option box to rename multiple selected objects.

The **Shelves** toolbar holds creation items and tools, each categorized in tabs.

The Polygons tab is selected in the image below. There are icons to create a polygon spheres and cubes, also on this toolbar there are other commonly used objects and features.

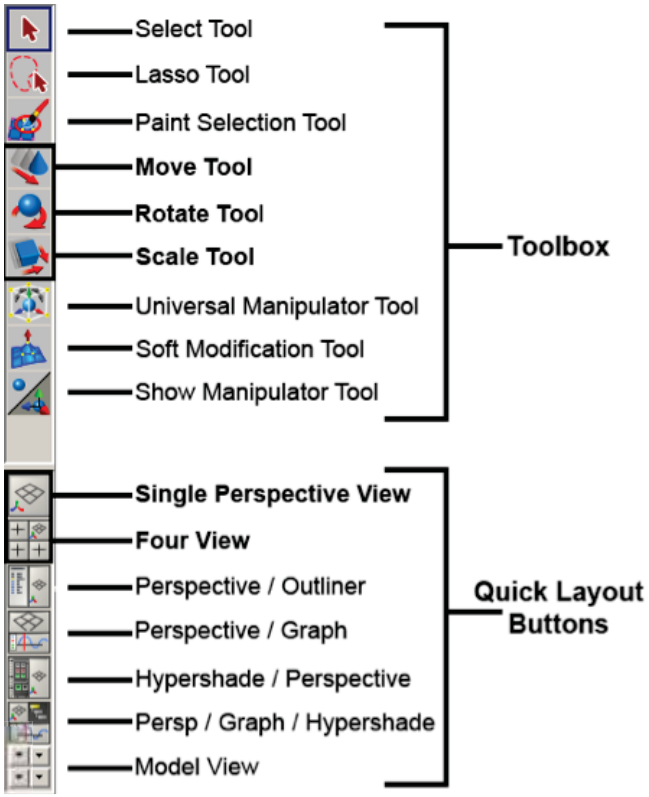
You can add icons to the **Custom Shelf** tab, by pressing **Alt + Left Mouse Button**, while selecting a command.

The **Toolbox** is located on the left side of the user interface and contains useful object transform tools.

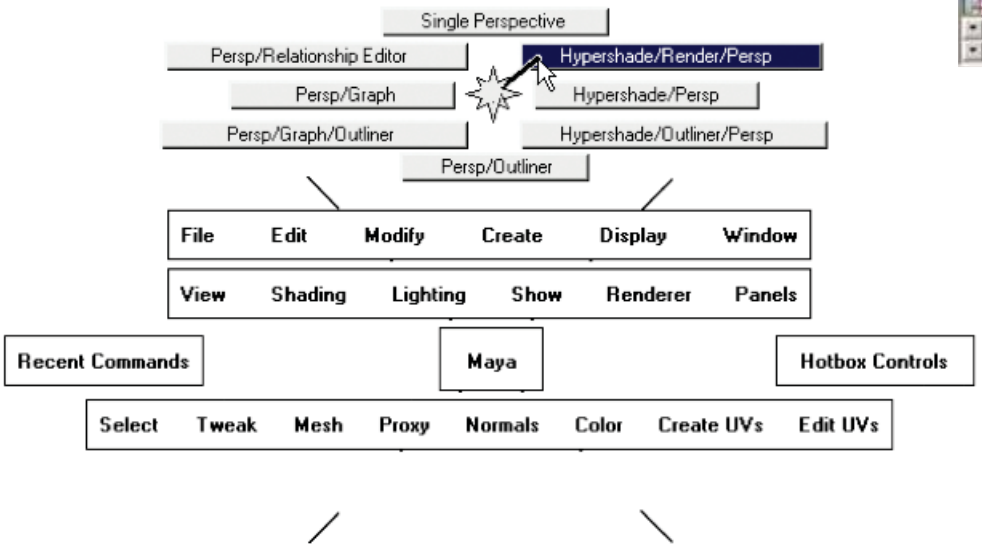
The select tool is used when you want to select an object, or to get out of a transform mode. Below that are the **Move, Rotate** and **Scale** Icons. These are used to manipulate any object or component, such as polygons or edges.

Maya Getting Started

The **Quick Layout Buttons** are used to change the viewport configuration. Sometimes you want to have a view of the Hypershade and just a perspective window. This depends on your own preferences or workflow and there is an icon to change this view quickly. You can also change back and forth from **Four View** and **Single View** by using the icons, or using the **Spacebar** hotkey.



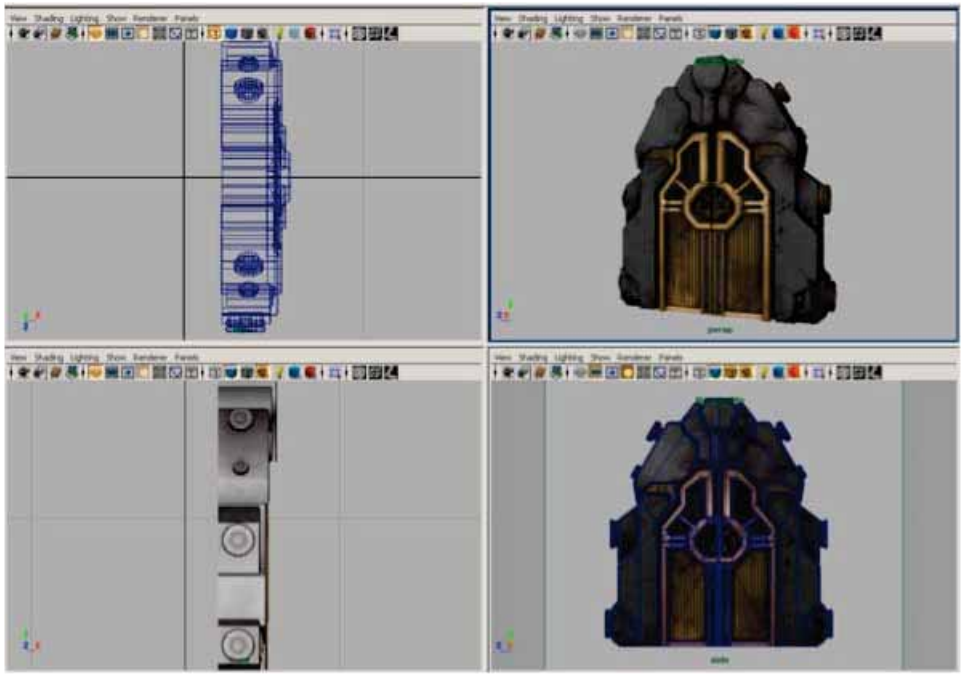
The **Hotbox Shortcut Menu** can be accessed by holding **Spacebar** in any Panel viewport window. Once the menu is visible, you just **Left Mouse Click** to the desired command, another menu will also pop up with a square options. This menu is commonly used for advanced menu navigation, but even new users can access this powerful tool.



Viewport Panel

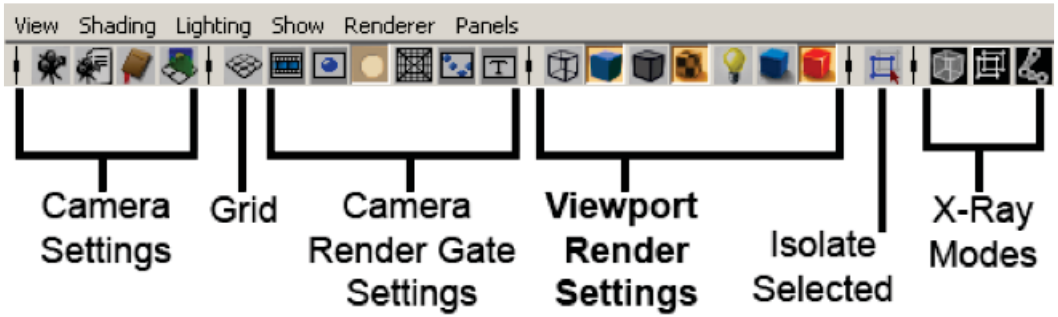
The **Viewport Panel** is the main navigation window where you will be working. This is like the desktop on your monitor. Everything you design will be represented in these areas.

The Orthographic panel viewports support up to four simultaneous views, by default it is set to Top, Perspective, Front and Side.



The **Viewport Panel Toolbar** is located inside each viewport panel. This is commonly used to change the current viewport render settings. It has icons to toggle between different lighting and camera options. There is a drop down menu right above this panel with additional functions, think of these as options boxes. They contain various options to customize everything that is visible in each viewport.

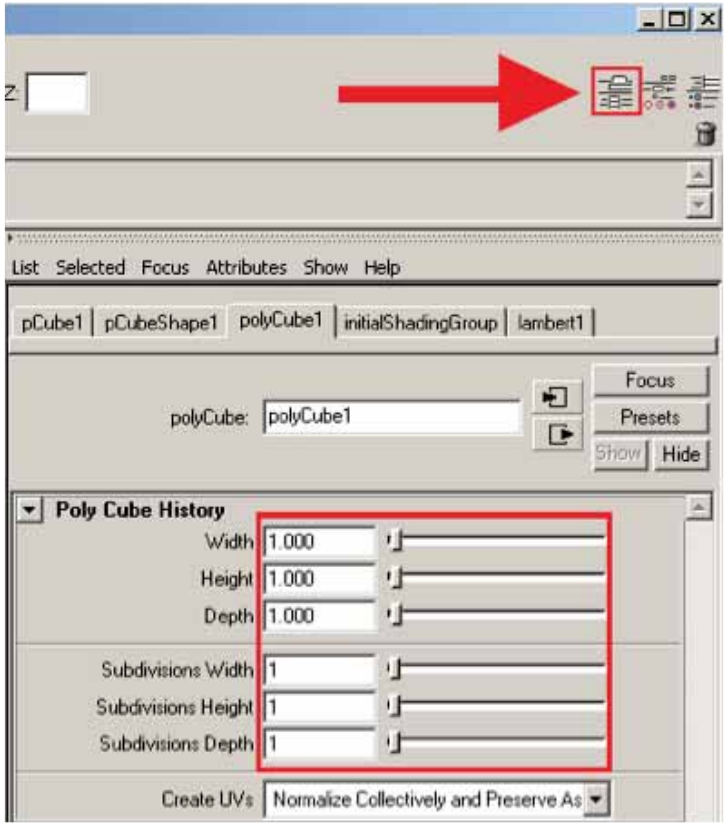
Every viewport can have custom settings.



Panel Viewport Camera Navigation

You can move the camera around an object when it is selected. To do this just select an object and hold **Alt key + mouse button** you can maneuver the camera, around, sideways, and zoom. These same key commands are also used for navigation inside the Hypershade and UV Texture Editor. However the rotate function is disabled because you will be dealing with 2D space.

- Holding Alt + Left mouse button and dragging will rotate around the object in the viewport.
- Holding Alt + Middle mouse button and dragging will move the camera with the model in the viewport.
- Holding Alt + Right mouse button and dragging will zoom the camera in and out from the model in the viewport.



The Attribute Editor is on the top right section and gives you full graphical controls for adjusting objects. It is located above the Channel Box Menu. This is a great way to set the exact parameters of your primitive objects, such as a cube. When you want to set values for things this is also done here.
All you have to do is move the slider to the right or left, or input a numerical value to the box.

Maya Getting Started

The **View Cube** is located in the top corner of the selected viewport. Clicking on a particular face, corner or edge of the cube automatically adjusts the camera's view so it matches that face. The viewing camera animates in real-time during the transition between views so you can see how the orientation of the camera changes in relation to the 3D scene. There are 26 standard views available. You can turn off the View Cube and edit options for the View Cube by selecting **Window > Settings/Preferences > Preferences**, and selecting the View Cube category.

3D Space is the ability to see and manipulate an object in all three coordinate spaces. In computer based 3D we use the Coordinate System to model our objects.

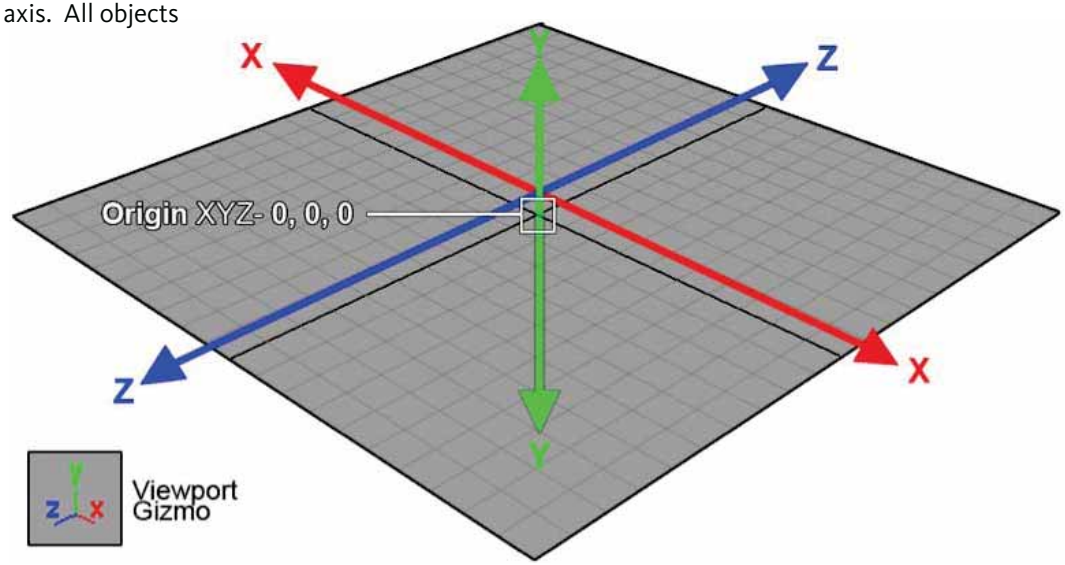
XYZ Coordinate System

In Maya, 3D space is measured using the **XYZ Coordinate System**, it is defined by three axis; the X-axis, the Y-axis and the Z-axis. If you imagine looking into a movie screen, the width would be the X-axis, the height would be the Y-axis and the depth would be the Z-axis. In Maya, these axis are presented with X and Z on the ground, represented as the grid, and Y as the height.

You can find any point in a 3D world by defining a coordinate for each of the axes. To help you visualize the three axes, each is given a corresponding RGB color. **X is Red, Y is Green, Z is Blue**.

Maya Getting Started

The Viewport Gizmo is located in the lower left corner of the viewport. It will tell you which direction is up, depending on the camera. The **Origin** is the center point of the world; it is located at **o, o, o,** of the XYZ axis. All objects and transforms are measured from this location.

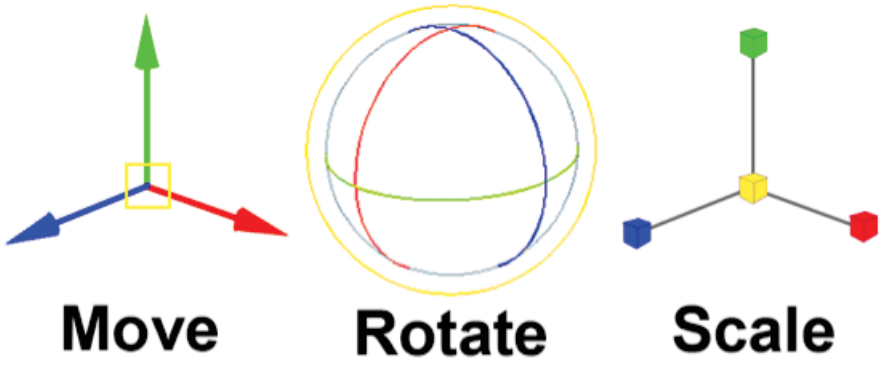


Viewport Manipulator Gizmos are visual handles that allow for transformation of an object, by either move, rotate or scale. The yellow square allows for movement on all axis at once.

Move an object by pressing hotkey W to bring up the gizmo handles. Using the Left mouse button and dragging on the colored arrows will move it on the desired axis.

Rotate an object by pressing hotkey R to bring up the orbital gizmo handles. Using the Left mouse button and dragging on the colored arrows will rotate it on the desired axis.

Scale an object by pressing hotkey E to bring up the gizmo handles. Using the Left mouse button and dragging on the colored arrows will scale it on the desired axis.

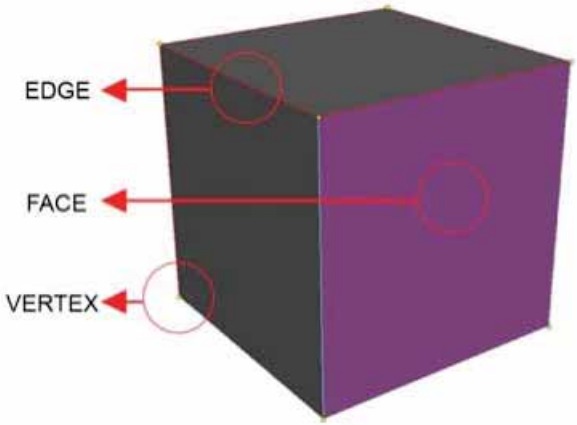


Undo Command is Ctrl + Z. This will allow you to go back previous steps.

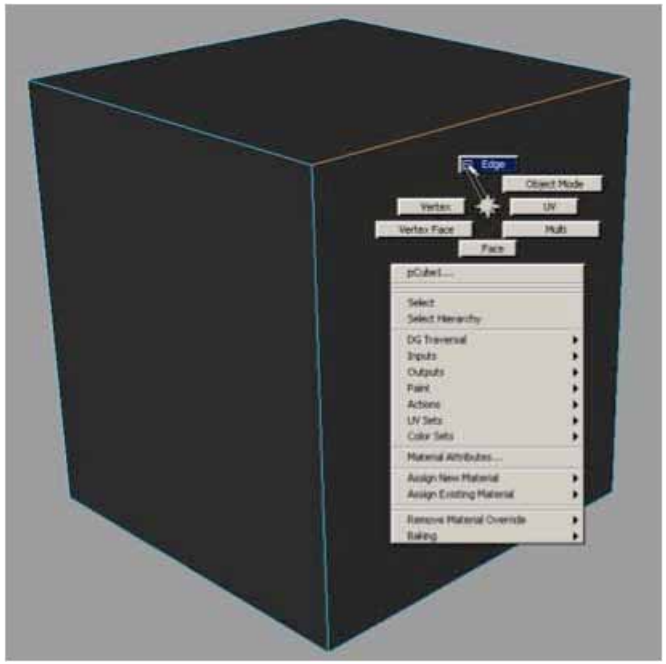
Polygon Components

Polygon Components are Edges, Faces, Vertex, and Polygons. They can be accessed by **Holding Right Mouse Button** while you have an object selected. This will bring up a options box that will allow you to select from the various object components, such as Edges, Faces, or Vertex.

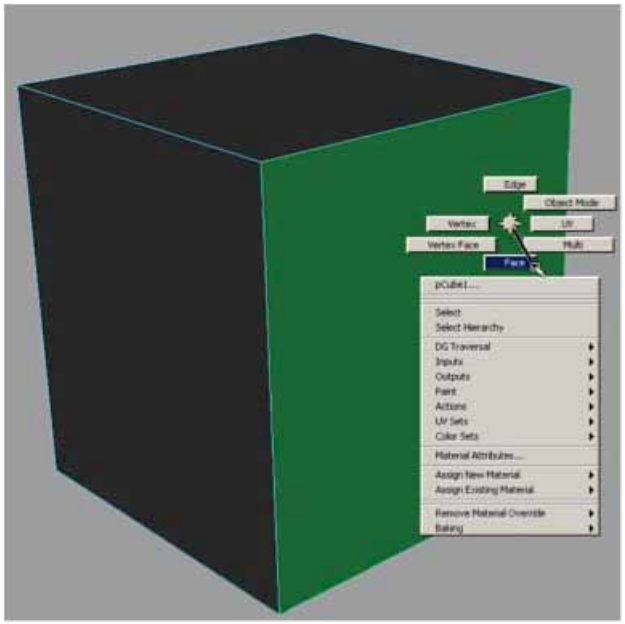
The **Multi Component** will allow you to select more than one component at the same time while using the **Shift Key** during selecting. Once you have your selection you can manipulate each of these components using your transform tools.



Polygon Components, Edge, Face and Vertex.

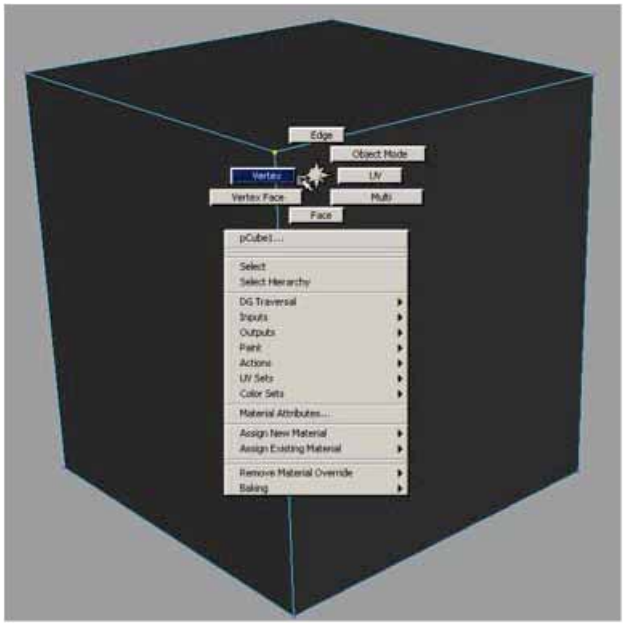


Edges Component Selection



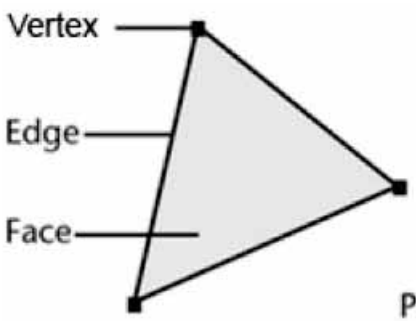
Faces Component Selection

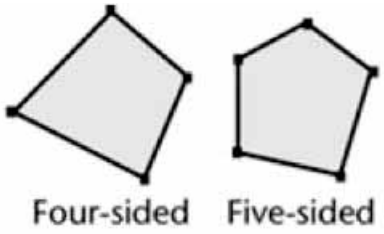
Maya Getting Started

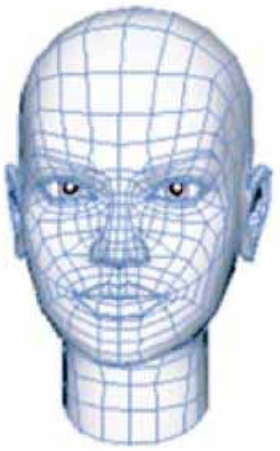


Vertex Component Selection

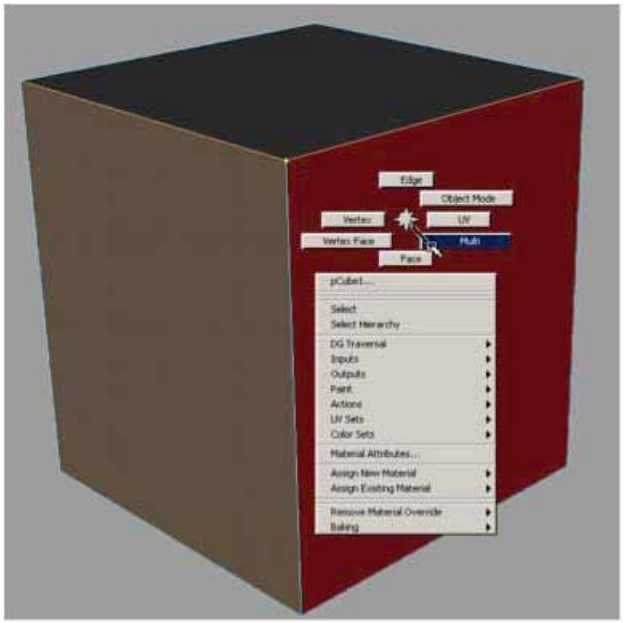
A polygon is any 3 or more-sided 2D object and when it's composed with more polygons, it can create a 3D object.







Polygonal models are composed of many separate polygons combined into a polygon mesh.



Multi Component Selction

Maya Hypershade

The **Hypershade Toolbar** is where you will create a material and shading network.

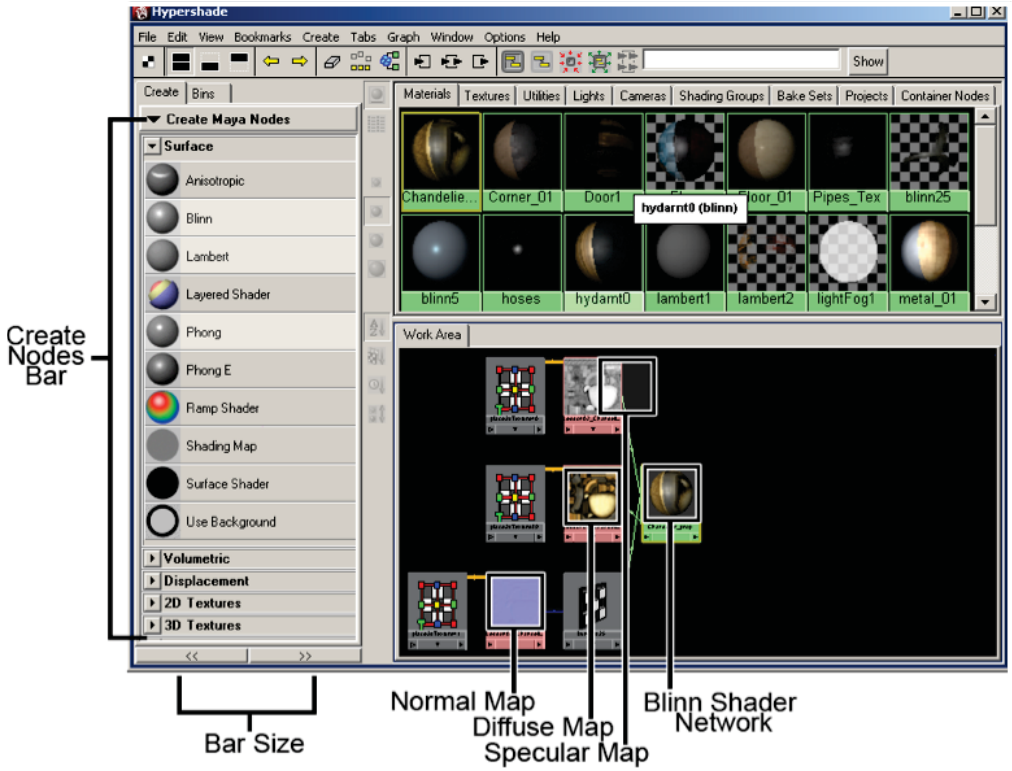
Window > Rendering Editors > Hypershade.

A material type is also referred to as a shading model or shading network. The shading model determines how the surface simulates a natural reaction to light. Some of the most common materials are Blinn, Phong and Lambert. They are located in the **Create Nodes Bar**. You can also create Maya, Mental Ray and other nodes here.

Maya Getting Started

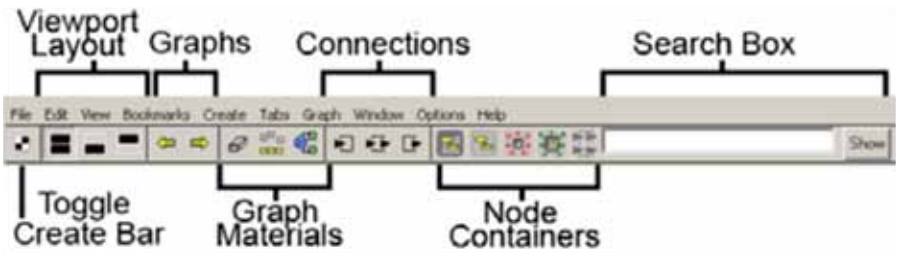
The Hypershade Viewport area contains the **Materials Tab**, pictured below. The **Work Area** is where all the shader connections can be made using a visual drag and drop method. This is done by using the middle mouse button to drag from a material to a surface property. Pictured is a **Blinn Shader Network**.

It has connections made for a Diffuse, Specular and Normal Map. The **Bar Size** buttons make the tab larger or smaller.



At the top is the **Hypershade Main Toolbar**. It contains some key commands for navigating the Hypershade.

- **Viewport Layout** will change the work area between a top and bottom configuration.
- **Graph Materials** buttons will show the shading network of a selected material when selected.
- The **Connections** buttons will show you all input and output connections to a node.



Think of **Node Containers** as folders for Materials, Lights or Shading Groups. They help you keep organized. The **Search Box** is used to separate materials with a certain prefix or to find a specific texture.

UV Texture Editor

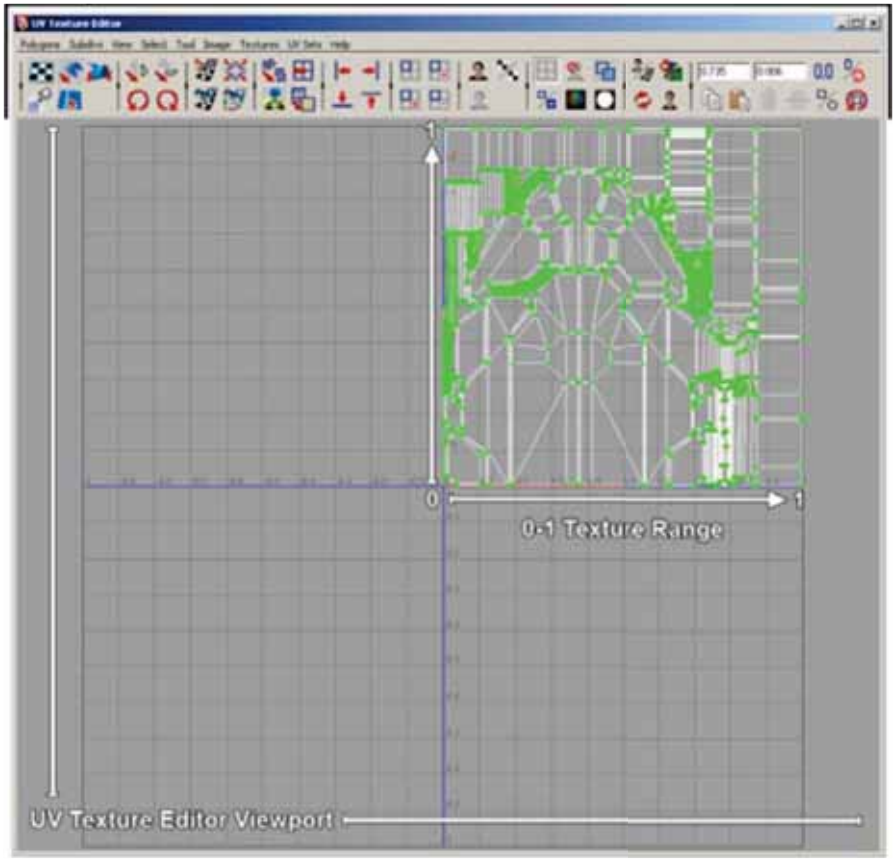
The **UV Texture Editor** is where we do our UV Texture mapping.

A **UV** is a point that matches up with a **Vertex** on the surface of a 3D model.

To open the UV Texture Editor, **Window > UV Texture Editor**. You have the **UV Texture Editor Toolbar** that contains all of the UV layout commands.

The UV **Texture Editor Viewport** is similar to the 3D viewport, expect it only works on X and Y axis. It is essentially a 2D representation of the 3D models surfaces. The top right quadrant is referred to as the **0-1 Texture Range**. All of the UV's should end up in there for most cases. However there are tiling methods that allow for placement outside of the 0-1 Texture Range.

UV's are marked as green points. UV's can be edited by **holding Right Mouse Button and selecting UV**.

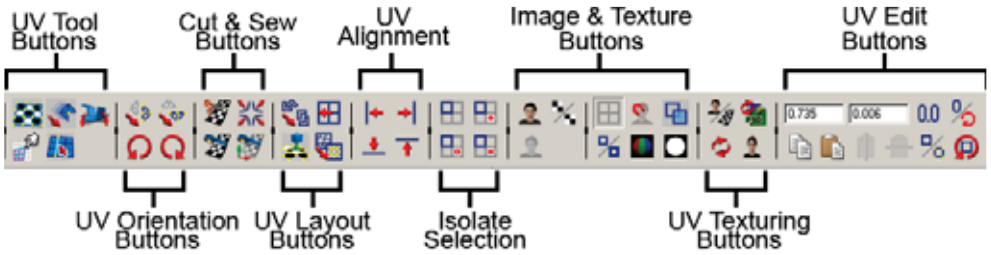


UV Texture Editor Toolbar

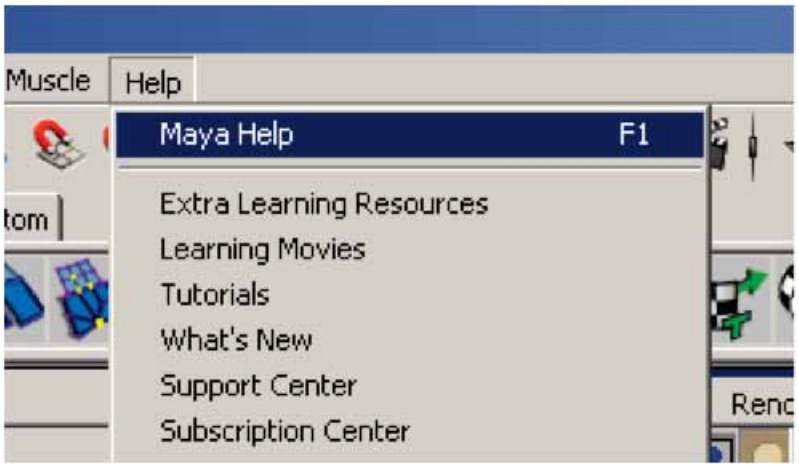
Maya Getting Started

The **UV Texture Editor Toolbar** is similar to the other menus in Maya. You can **Right Mouse Click** on the Icon to open the options box for that tool. There is also a drop down menu on the top with every command, and a black options box.

Below we have a row of icons that are shortcuts to the most used layout commands.



- The **UV Tool Buttons** will allow you to manipulate and layout UV's.
- The **UV Orientation Buttons** let you flip UV's and rotate by 45 degrees.
- The **Cut and Sew Buttons** allow you to cut and sew UV shells. A shell is a bunch of attached UV's.
- The **UV Layout Buttons** will layout UV's in a cleaner more optimized way.
- The **UV Alignment Buttons** will align the selected UV's to the minimum or maximum U or V value. It is a good tool to make UV's flush to the left, right, top or bottom edges.
- The **Isolate Selection Buttons** allow you to work on a subset or shell of UV's while hiding the rest.
- The **Image & Texture Buttons** allow you to control the display of images and textures in the UV Texture editor Viewport.
- The **UV Texturing Buttons** are used for texture baking and changing the viewport image ratio.
- The **UV Edit Buttons** are used to show the location of UV's and allows you to copy & paste UV's.



Maya Help can be accessed on the Main menu or by pressing hotkey F1 and is a very useful resource guide. Refer back to it if you want to learn more about the tools and commands we have covered.

Simple Mass Modeling

Overview

This exercise covers the creation and editing of simple primitives and how they can be moved, rotated, scaled, duplicated, and assembled to gain a greater understanding of architectural form and space. You will also look at various concepts of pattern, scale, and proportion and explore additive and subtractive forms. Universal design themes will also be covered, including the creation of centralized, linear, radial, clustered and grid forms; space; and planes and plutonic forms.

In this lesson you will learn the following:

- How to set up a scene with preferences
- How to create building blocks from simple primitives
- How to move, rotate and scale objects
- How to split and cut polygons
- How to extrude surfaces
- How to chamfered vertices and bevel edges
- How to assemble forms
- How to assemble space

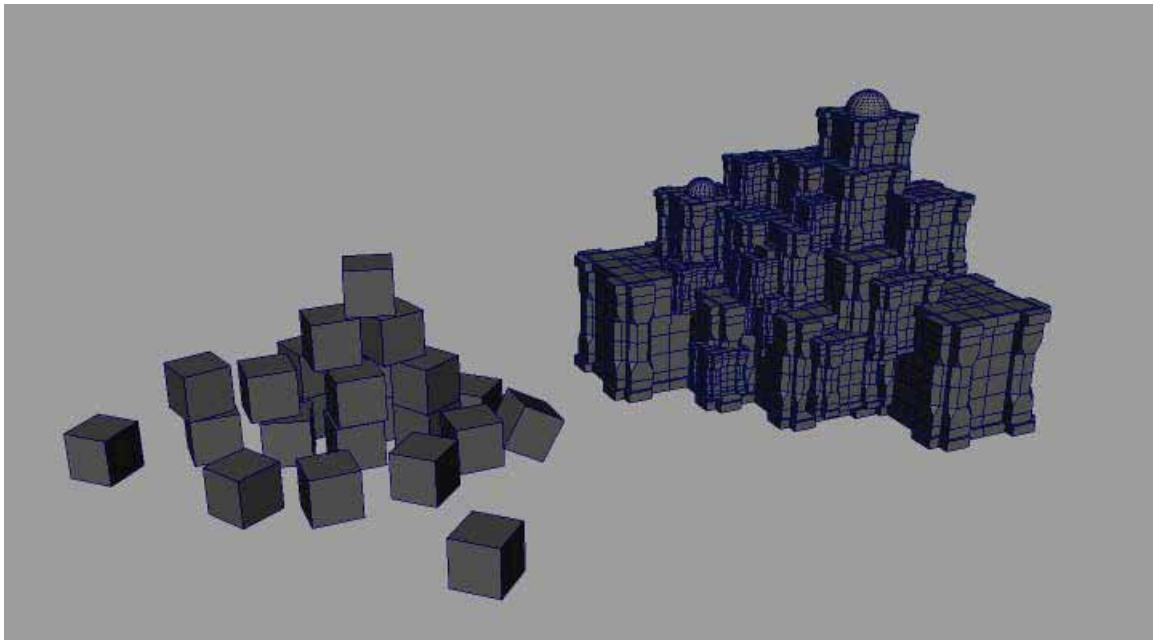
Getting Started

1. Set preferences

Before you create your polygon architecture, you will need to change some of the default settings to a more suitable environment for this type of work.

- Select **Window > Settings/Preferences > Preferences**.
  The Autodesk® Maya® software user preferences window appears.
- In the Preferences window choose **Categories > Polygons**
- In the Polygon Display settings, set the following:
  - **Border Edges: On**
  - **Edge Width: 4**

This displays border edges more prominently on polygon meshes and helps to identify the edge conditions of any open geometry.

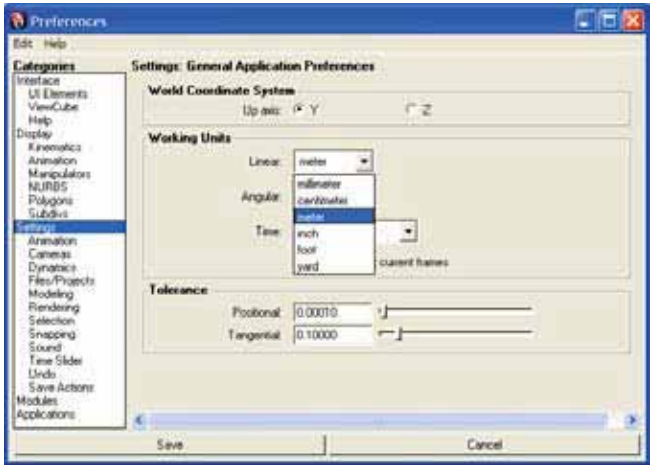


Toy Blocks Are the Basis of Form and Space

- In **Preferences** window, choose **Categories > Selection**
- In the **Polygon Selection** settings, set the following:
  - **Select faces with: Whole face**

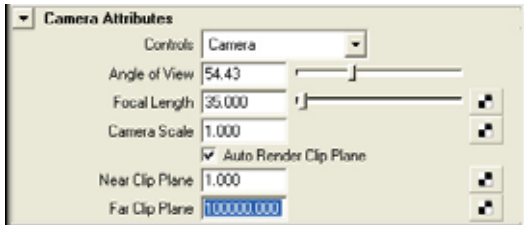
The Whole face setting lets you select polygon faces by clicking on any part of the face rather than on a center dot as with the center setting.

- In **Preferences** window, choose *Categories > Settings*
- In the **Working Units dialog box**, select the **Linear** drop down-menu **choose meter**



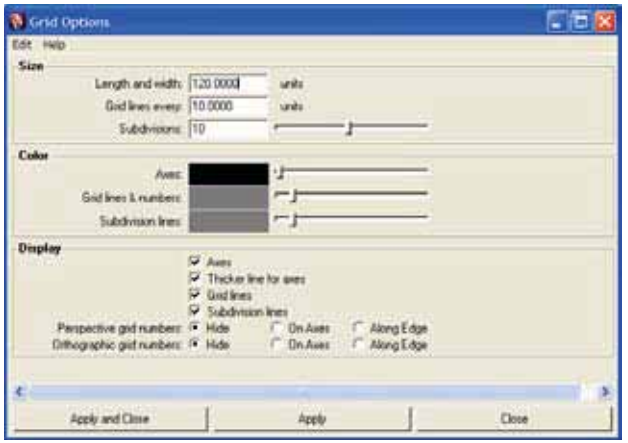
Preferences Dialog Box

- Click the **Save** button to close the settings window
- Open the Outliner and select each camera one at a time: top, side, front, and perspective then change the **Near Clip Plane** to **1** and the **Far Clip Plane** to **100000** for each of them. This will ensure the scene is visible at long and short distances



Camera Attributes

- Select **Create > Polygon Primitives** and turn off the **Interactive Creation** option for primitives
- Select **Display > Grid** and in the **Grid Options** dialog box change the grid size for **length and width** to **120** with the **Gridlines** and **Subdivisions** at **10**



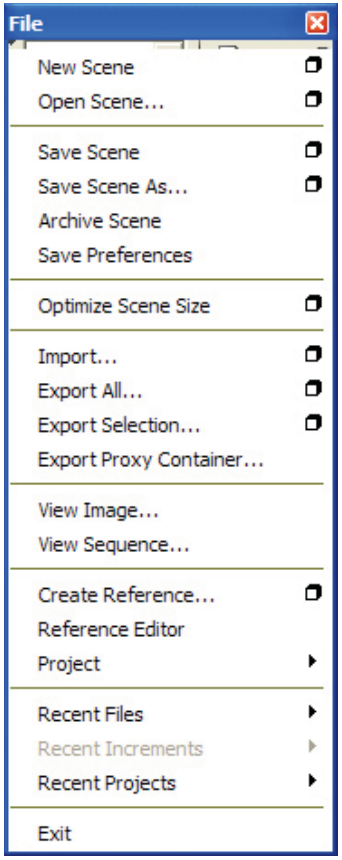
Grid Options Dialog Box

Creating the Building Blocks

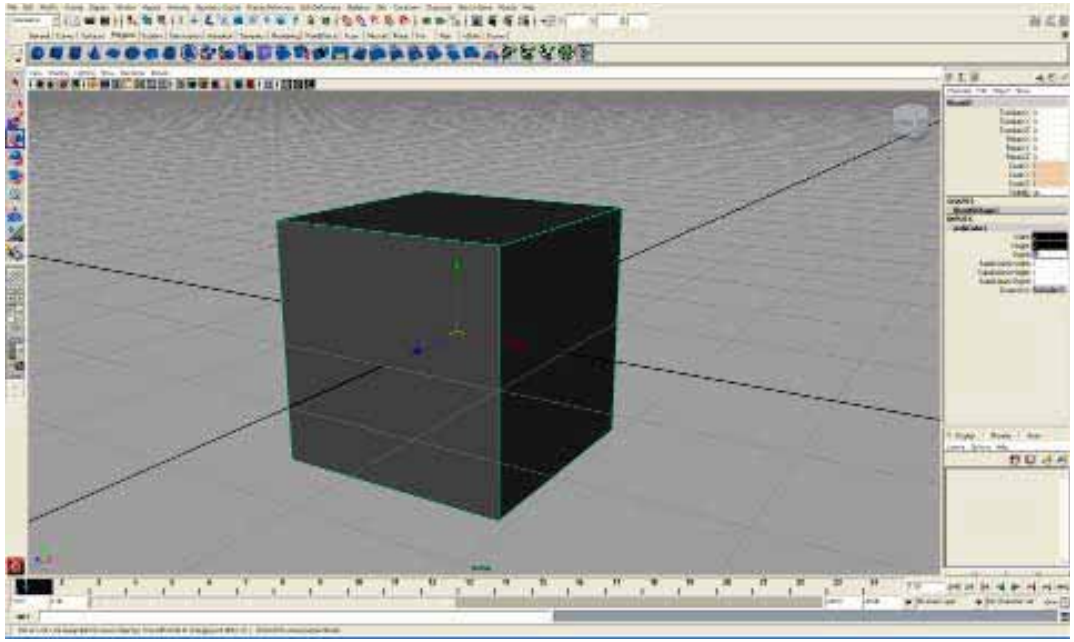
Once your workspace is ready, create a new scene and name it.

1. Create a file

- Select **File > Save Scene As...**
- Name the file *Architecture01_Form_Space_Mine*



File Save Menu



2. Create cube primitive as the building block form

- Ensure you are working in the perspective view
- Select **Create > Polygon Primitives > Cube**
- In the **Channels** dialog box to the right, select the input node **polyCube1** and highlight all three fields by holding down the **Ctrl** key and change the width, height, and depth to 2
- In the **Channels** dialog box rename the mesh *Block01*

3. Adjust pivot for easy movement within the scene

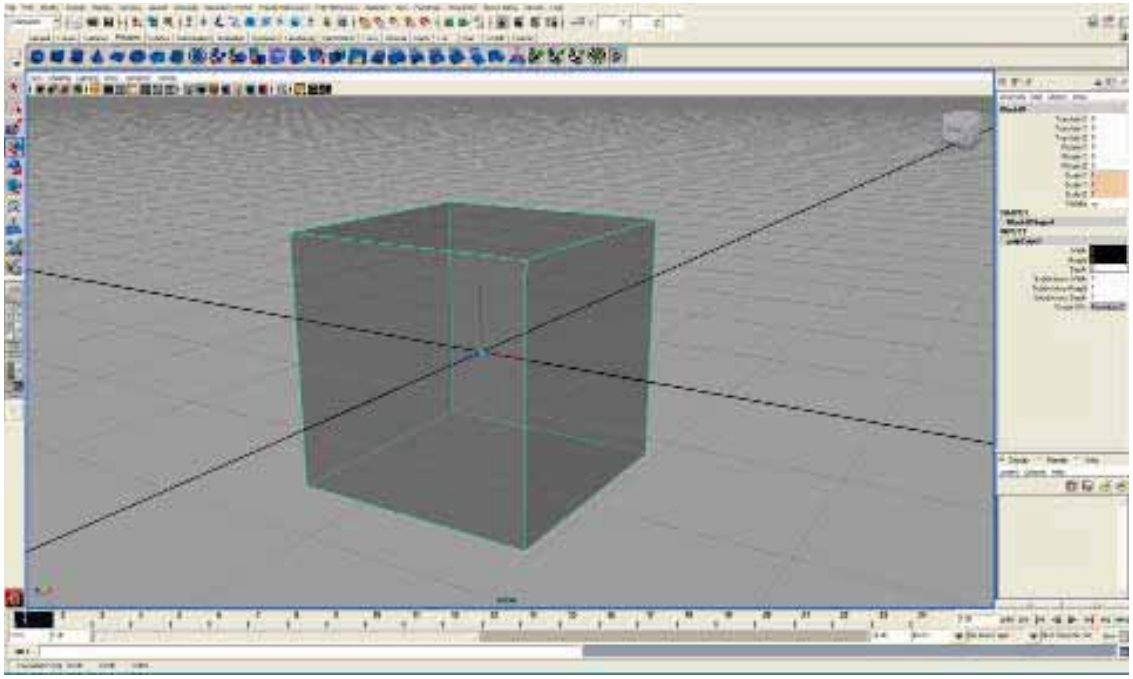
It is always a good practice to position the pivot of an object at the center of its base. By default the pivot of most primitives exist at the center of the volume but having it at the center of the base can be very handy when snapping an object or scaling it.

- Select the new building block *Block01*
- Select the **move tool** (hotkey: W) to enter move mode *(this will allow you to see the pivot) (Using the + or – hotkey will scale the manipulator larger or smaller)*
- In the **viewport menu** Select **Shading > X-Ray**
  See how the pivot sits at the center of the block. This makes it difficult to move precisely on a grid.

- Enter Edit mode for the pivot point by pressing the Insert key

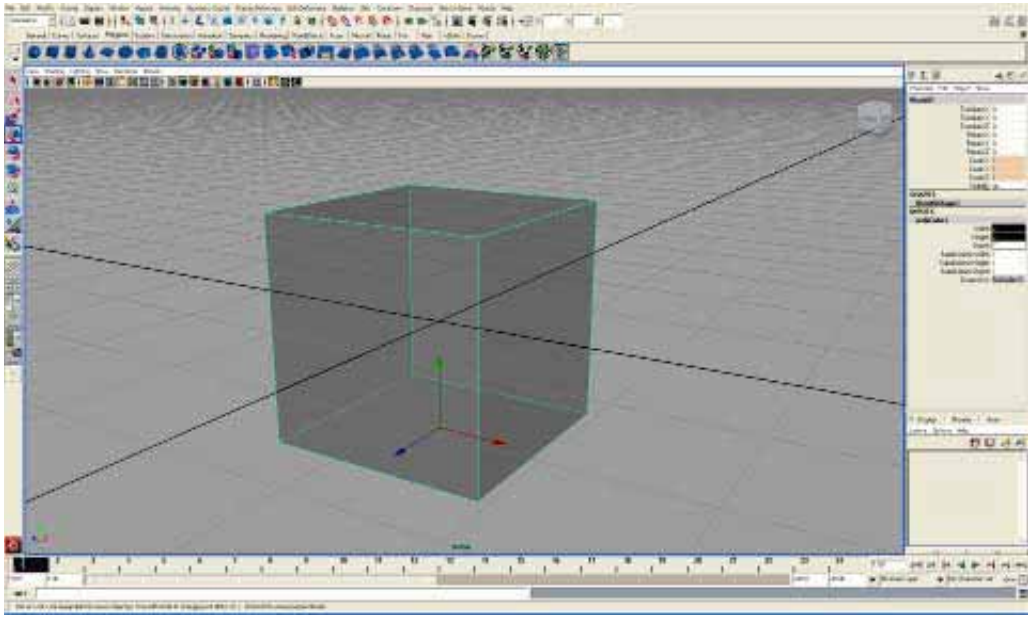
Tip:

Notice how the manipulator loses its arrows.



X-Ray Mode and Pivot Adjust Mode On

- Snap the pivot to the base of the cube by holding down the **V key** (Snap to Points mode) and click dragging the pivot along the Y-Axis to one of the bottom corners of the cube; this should place the pivot directly at the center spot underneath the cube
- Exit Edit mode for the pivot point by pressing the **Insert key** again



Pivot Moved to Center of Base

- Now move the cube onto the grid by holding down the **X key** (Snap to Grids mode) and click dragging the mesh over the origin of the grid
- Save the scene

Now the block is better suited for architectural placement, scaling, and rotation within the scene. Placing the pivot at the center and base of the mesh helps when positioning forms upon a surface and is an excellent practice when creating architectural form.

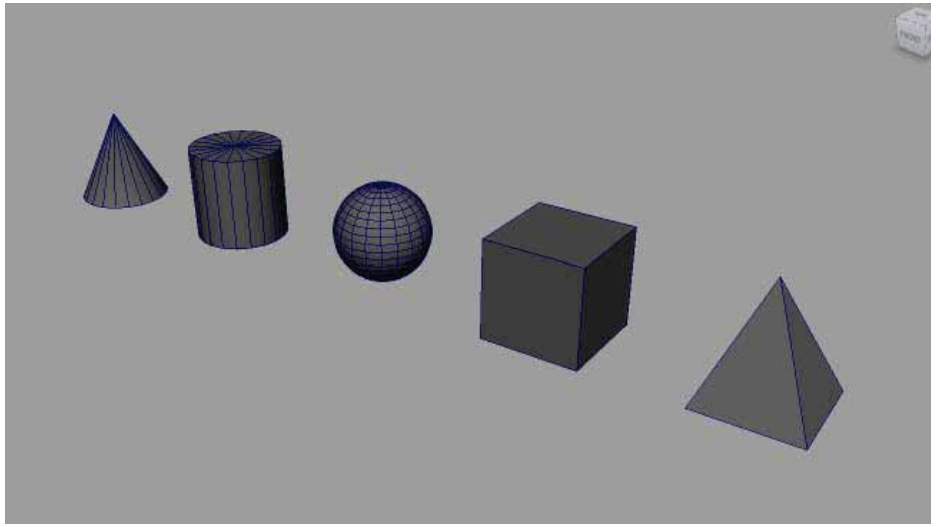
4. Create the rest of the primitives

Create the rest of the plutonic forms but using a sphere, cylinder, cone, and pyramid. Make a few duplicates of the cube and make a flat square platform, a post, and a beam. Keep them relatively similar in size.

- Select **Create › Polygon Primitives › Sphere**
- Select **Create › Polygon Primitives › Cylinder**
- Select **Create › Polygon Primitives › Cone**

Tip:

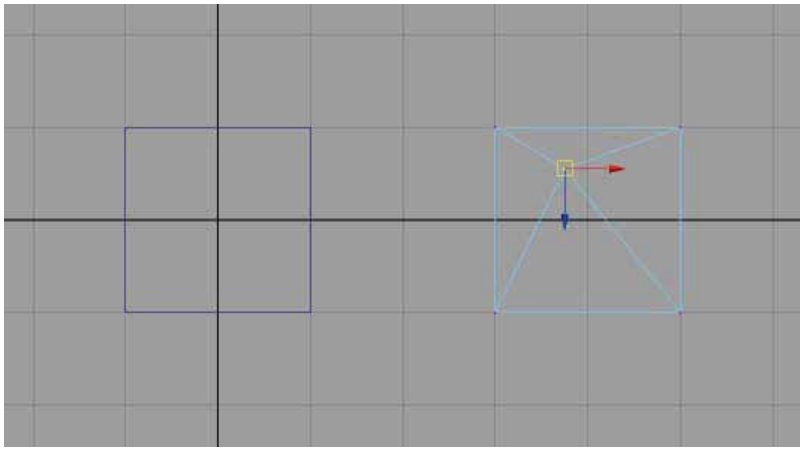
Holding down the **V Key** will let you snap to any vertex in the scene and is extremely helpful when moving objects or adjusting the pivot of an object or group.



The Plutonic Forms

For the pyramid, duplicate the form and simply collapse the top surface.

- Select Block01 then select **Edit > Duplicate**
- Select top face then select **Edit Mesh > Collapse**
- In the top viewport select the vertex that is off-center, and snap it to the grid by holding down the **X key** (Snap to Grids mode) and click dragging it to the center of the mesh



Pyramid tip adjustment

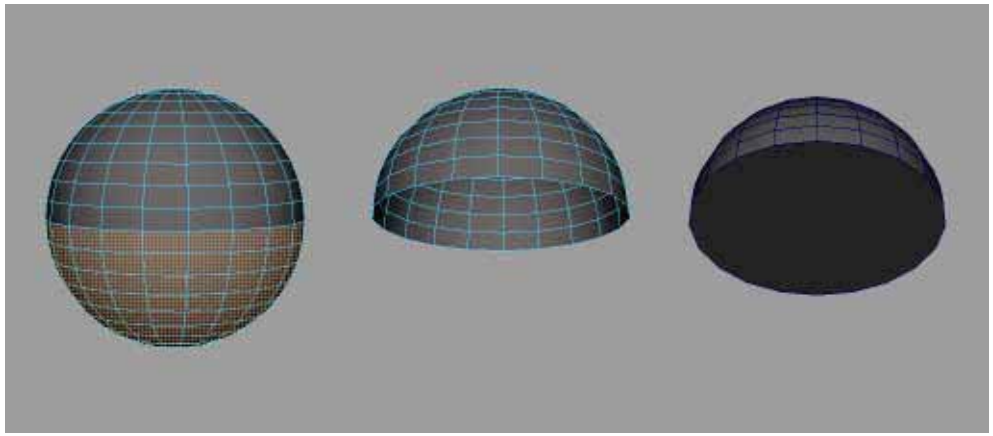
Creating the Additive and Subtractive Forms

Use new—or copies of—the sphere, cylinder, cone, and pyramid.

1. Create Subtractive Forms by Deleting Faces

For the sphere, you will simply delete faces and fill in the missing surface.

- Select **Create > Polygon Primitives > Sphere**
- Select the faces of the lower half of the sphere and delete them
- Select **Mesh > Fill Hole** to close the new dome



Sphere Subtractive Form

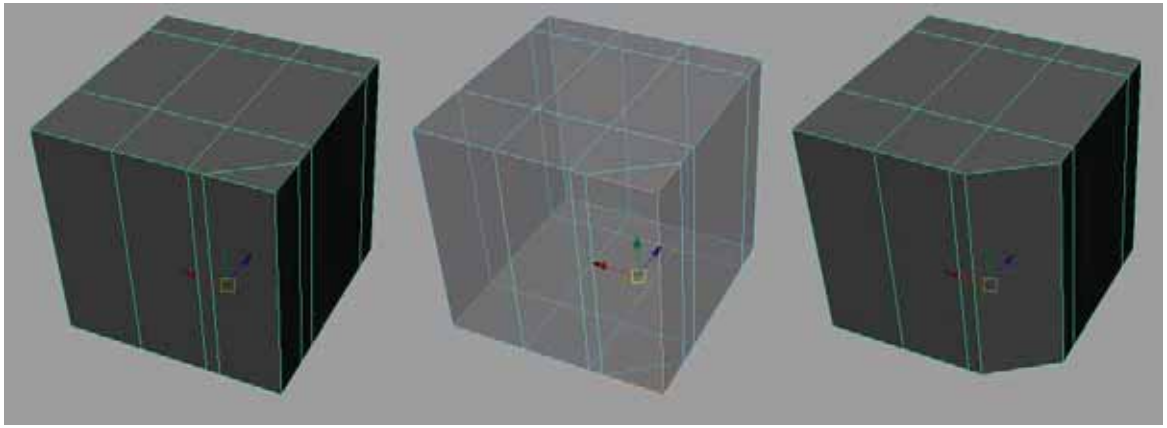
Tip:

You can use the Ctrl+D hotkey to duplicate the selected geometry without going into the menu each time.

2. Create subtractive forms by deleting edges and vertices

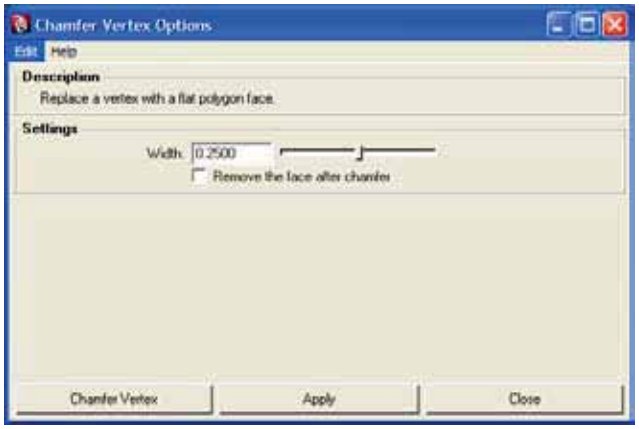
For the cube, you will cut the faces of the object and delete the edges along with the vertices.

- Using the cube in the scene, **select Edit > Duplicate** and create a copy to modify
- Select the new cube and select **Edit Mesh > Cut Faces Tool**
- Subdivide the cube a few times in the top viewport holding down the Shift key to constrain the action in the x and z axis



Cube Subtractive Form

- Subdivide the cube in the top viewport at an angle at one of the corners
- Select the edges of the corner
- Select **Edit Mesh > Delete Edger / Vertex** and the entire corner edge will be removed without leaving stay vertices



Chamfer Dialog Box

3. Create subtractive forms by chamfering

Chamfering vertices is another method to create subtractive forms. Using the cube, you will bevel edges and chamfer vertices of the object to create new forms

- Using the cube in the scene select **Edit > Duplicate** and create a copy to modify
- Select the top four vertices and select **Edit Mesh > Chamfer Vertex Tool Box** and set the width to **0.25**. Be sure to leave the Remove Face After Chamfer box unchecked and press **Apply**
- If the edges of the newly formed object looks awkward, it may be that they are soft; to harden them, select **Normals > Harden Edge**

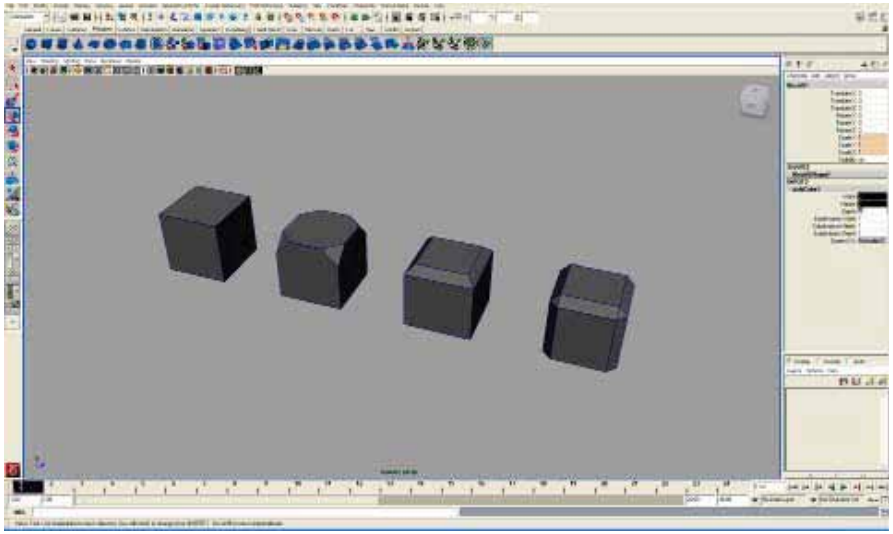
Tip:

You can use the G hotkey after each operation to use the tool over and over again.

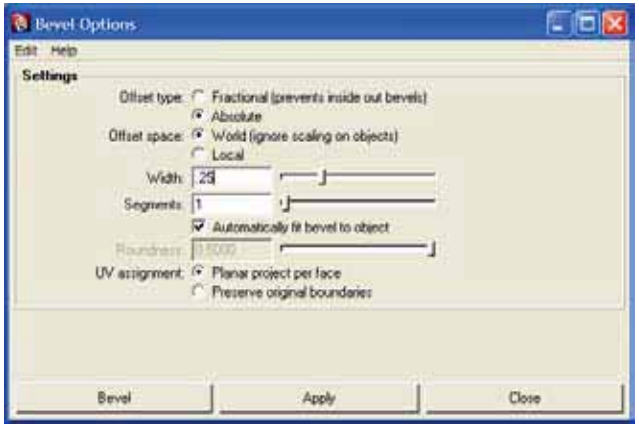
4. Create subtractive forms by beveling

Beveling edges is yet another method to create subtractive forms. Using the cube, you will bevel edges and chamfer vertices of the object to create new forms.

- Using a cube in the scene select **Edit > Duplicate** and create a copy to modify
- Select the top four edges and the side edges and select **Edit Mesh > Bevel Tool Box**
- Set the **Offset type** to **Absolute** and **Offset Space** to **World** with the width at **0.25** and then press **Apply**



Cubes with Chamfered Vertices and Beveled Edges

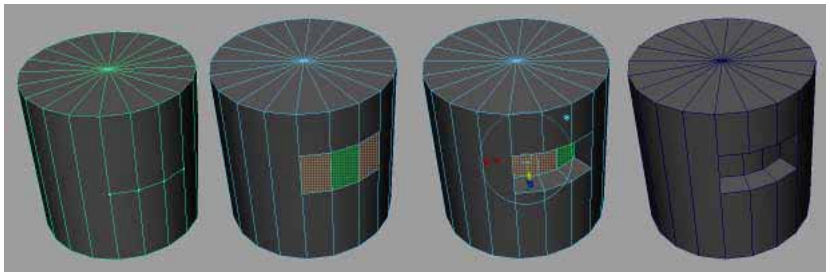


Bevel Dialog Box

5. Create subtractive forms by splitting polygons and extruding

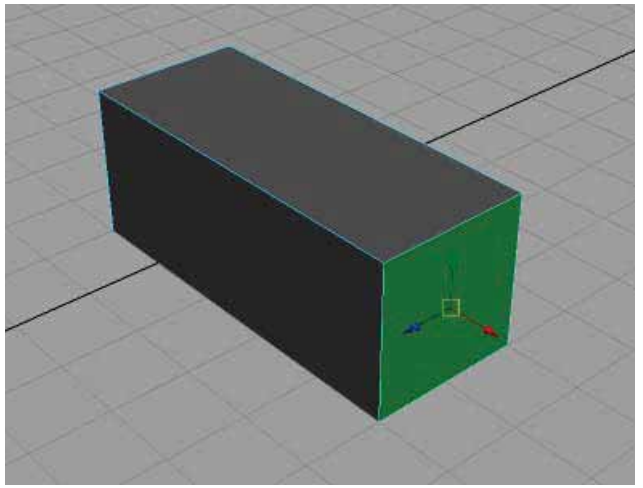
Scaling or extruding parts inward of a pure form is yet another method to create subtractive forms. Using the cylinder, you will subdivide the object and extrude parts inwardly to create new forms.

- Duplicate a cylinder in the scene using the **Control + D Hotkey**
- Select the cylinder and then **Edit Mesh > Split Polygon Tool**
- Set the **snapping tolerance** to **100**
- Split the cylinder along the side faces twice to create additional faces
- Select **Edit Mesh > Extrude** and push the faces inward



Cube with Chamfered Vertices and Beveled Edges

> **Tip:**
>
> Continue to create subtractive forms by moving or extruding faces inward to the pure form. You can also use other methods, such as **Control + Right Click** on an Edge and select **Edge Ring Utilities > To Edge Ring and Split** to subdivide objects more quickly.



Using the Grid to Snap Movement of Faces

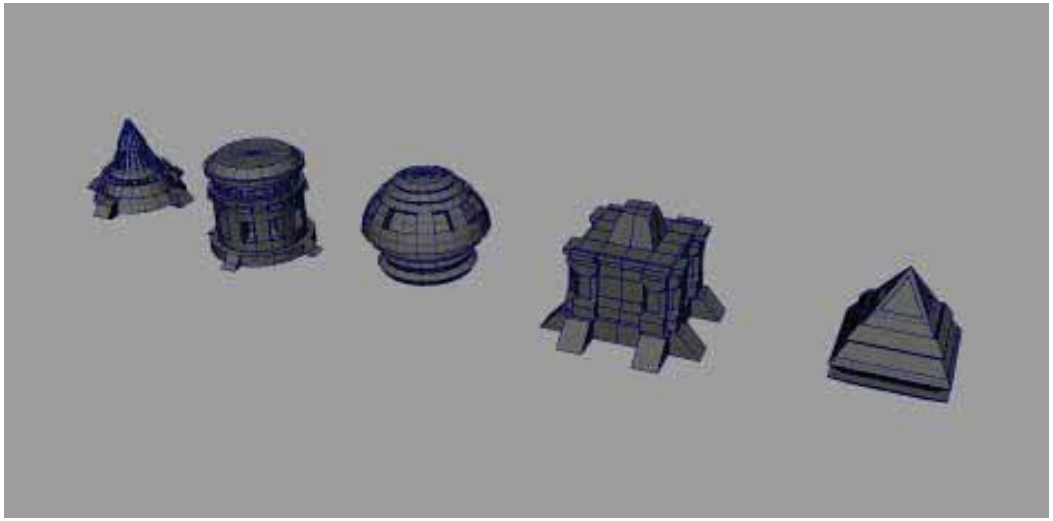
6. Create additive forms by combining objects

Additive forms are much easier as they simply require extruding faces outward from the form or combining various simple forms into a more substantial form.

- Duplicate a cube in the scene using the **Control + D** Hotkey
- Select a face and move it in the scene while holding down the **X** Key; you will find that you can scale cubes while keeping them of the grid. This makes it very easy to create forms and align them.
- Subdivide the cube using the various methods, and extrude single or groups of faces to create an additive form
- Duplicate some of the cubes and other primitives in the scene, and scale some of them to different sizes vertically and horizontally
- If you decide to use more than one object to achieve this, you should assemble them together and select **Mesh > Combine** to create a new additive form

Assembling the Building Blocks

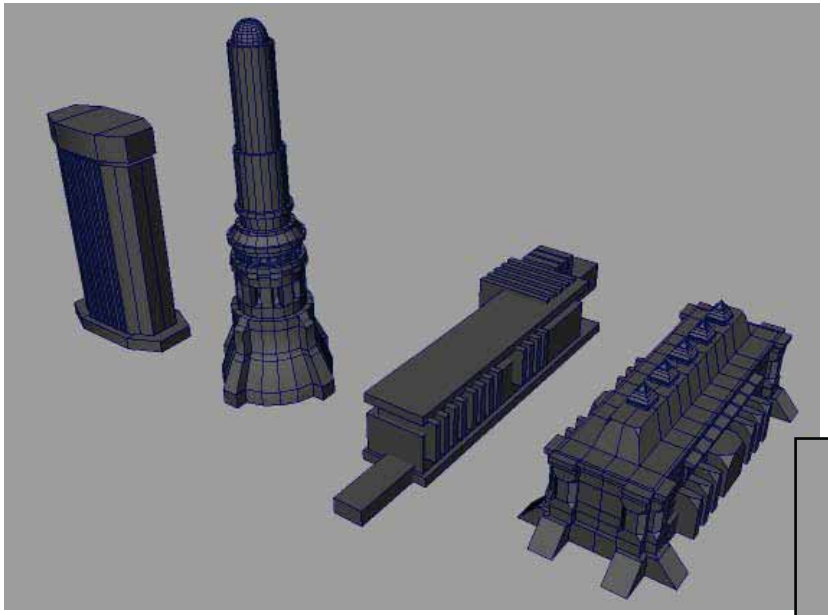
Through simple Tools and Methods like Scale, Duplicate, Move, Polygon Face Cut, Split Polygon, and Combine you can really get a lot of curious forms. Select Face and Edge Loops or Rings to extrude or split to offer you more and more choices while you try to create the following fundamental architectural forms:



Centralized Forms

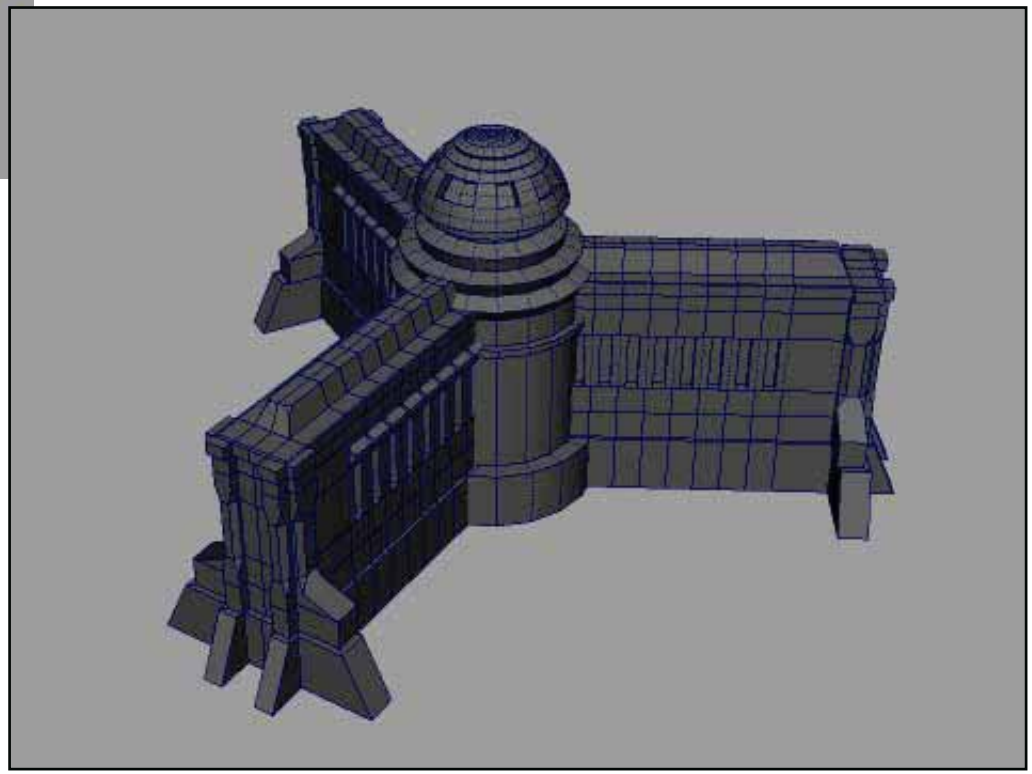
1. Create centralized forms

2. Create linear forms



Linear Forms

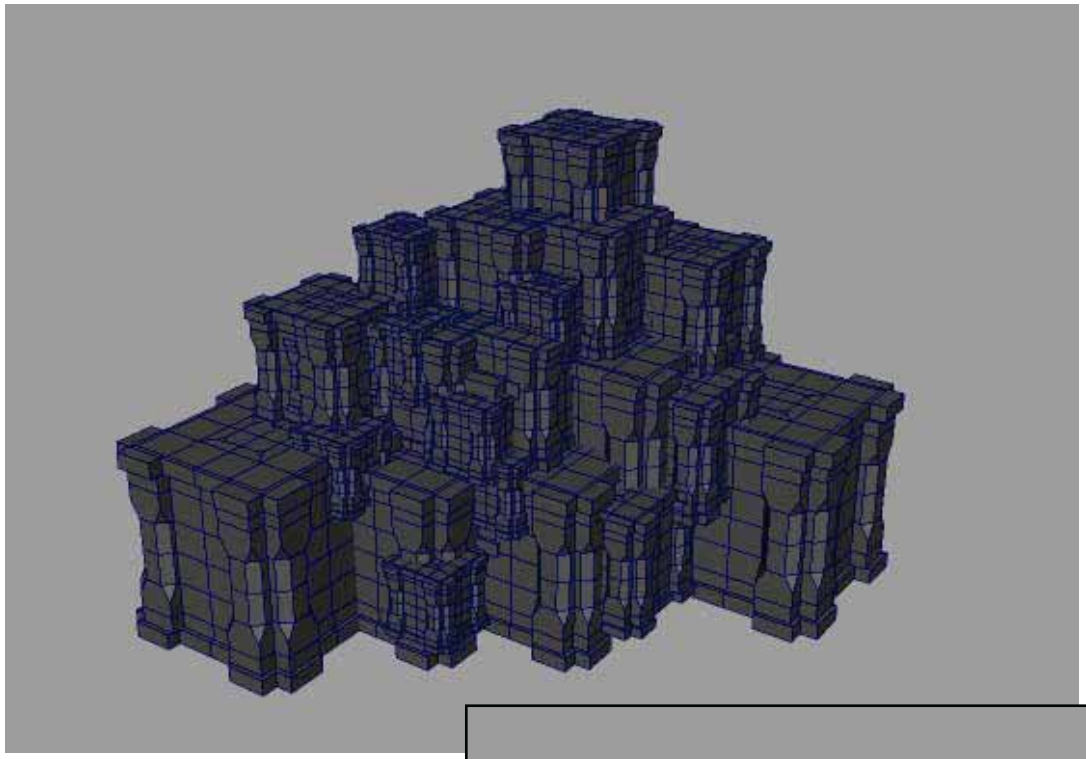
3. Create radial forms



Radial Form

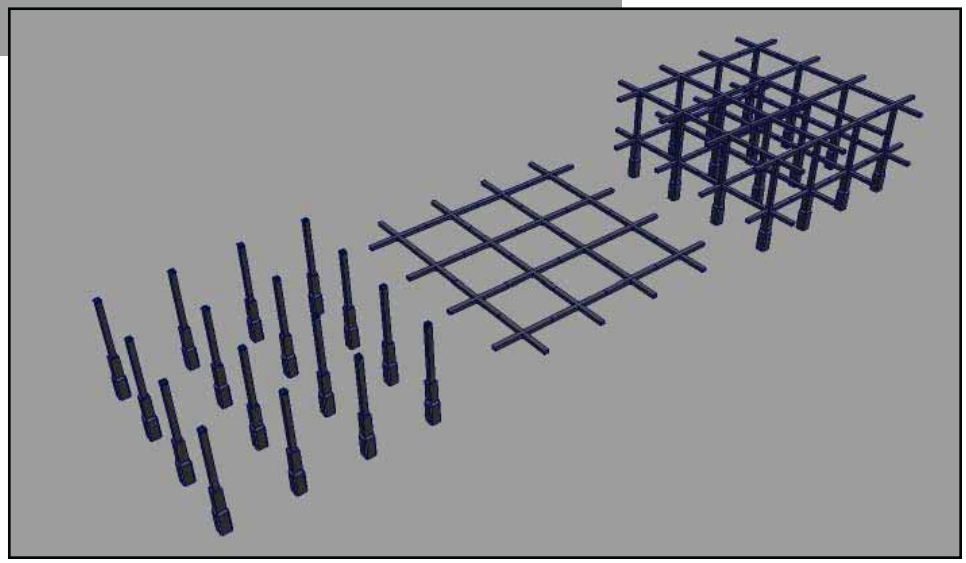
Maya Form & Space

4. **Create cluster forms**



Clustered Form

5. **Create grid forms**



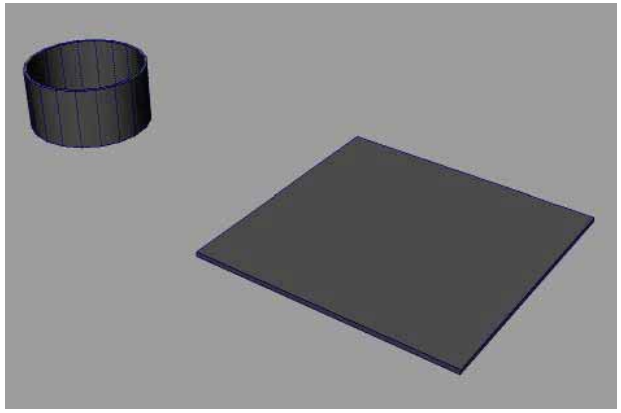
Grid Form

Defining Space

Defining space simply involves the use of a plane or repeating elements to create ideas of closure. Columns work well when spaced evenly in enclosing a space.

1. **Create a plane and pipe**

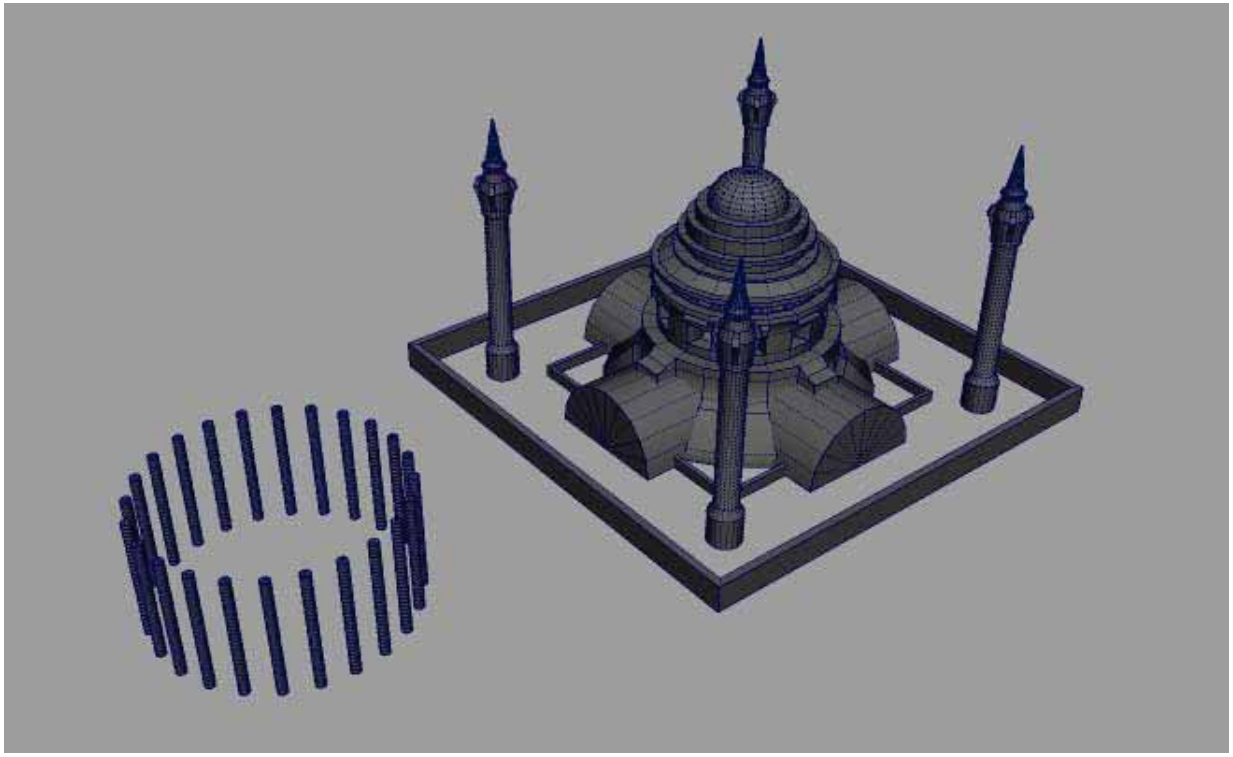
   - Select **Create > Polygon Primitives > Plane**
   - Input length and width of **4**
   - Extrude the plane by 0.05 to create a ground surface with a bit of thickness
   - Duplicate the plane and rotate it so that it becomes a wall
   - Select **Create > Polygon Primitives > Pipe**
   - Input a thickness of 0.05



Pipe and Plane

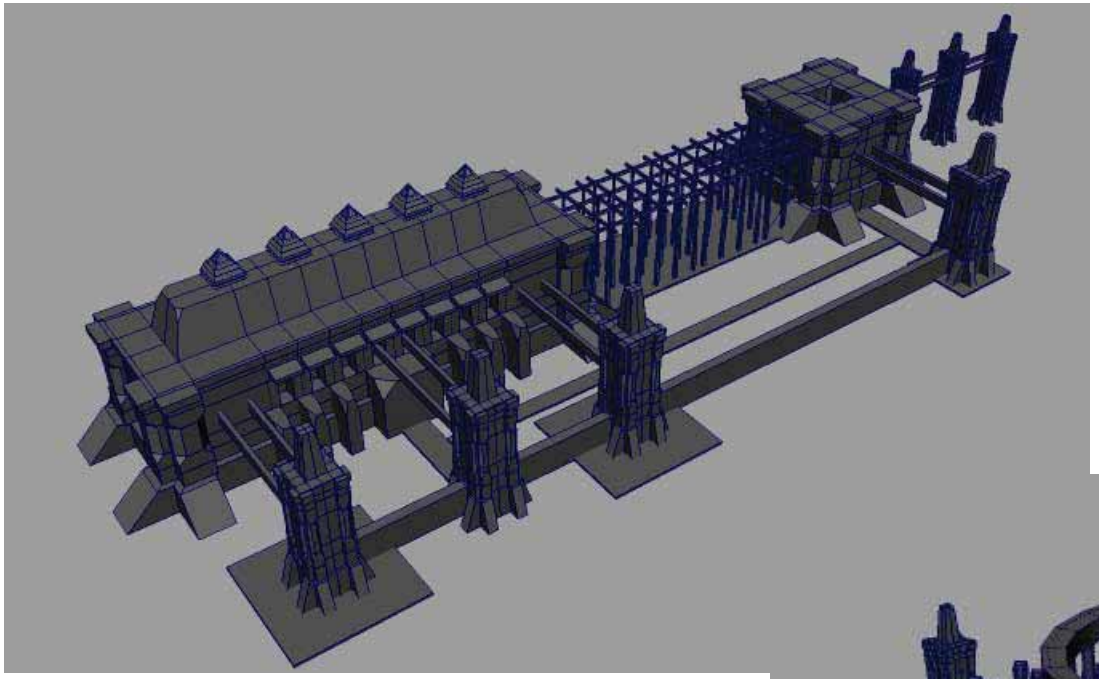
Spatial themes can easily be explored now by assembling various walls, ceiling, or floors to create the following fundamental architectural spaces:

2. **Create centralized space**



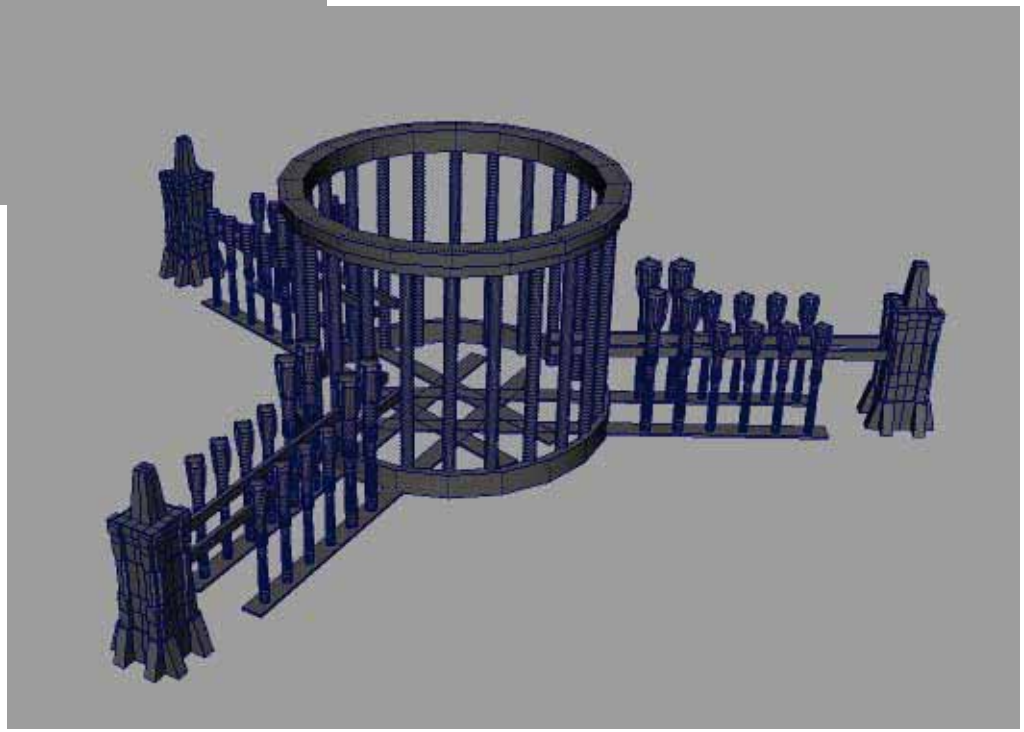
Centralized Space

3. **Create linear space**



Linear Space

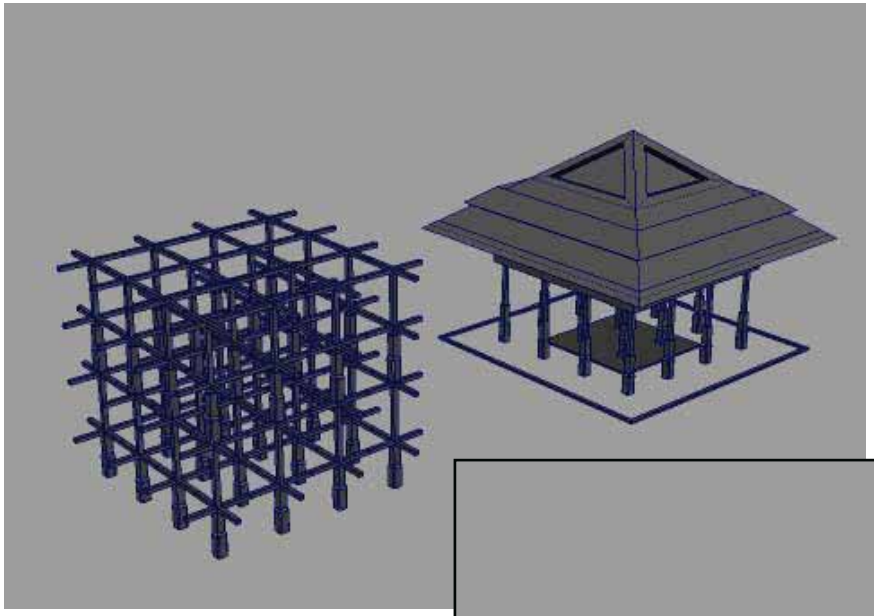
4. **Create radial space**



Radial Space

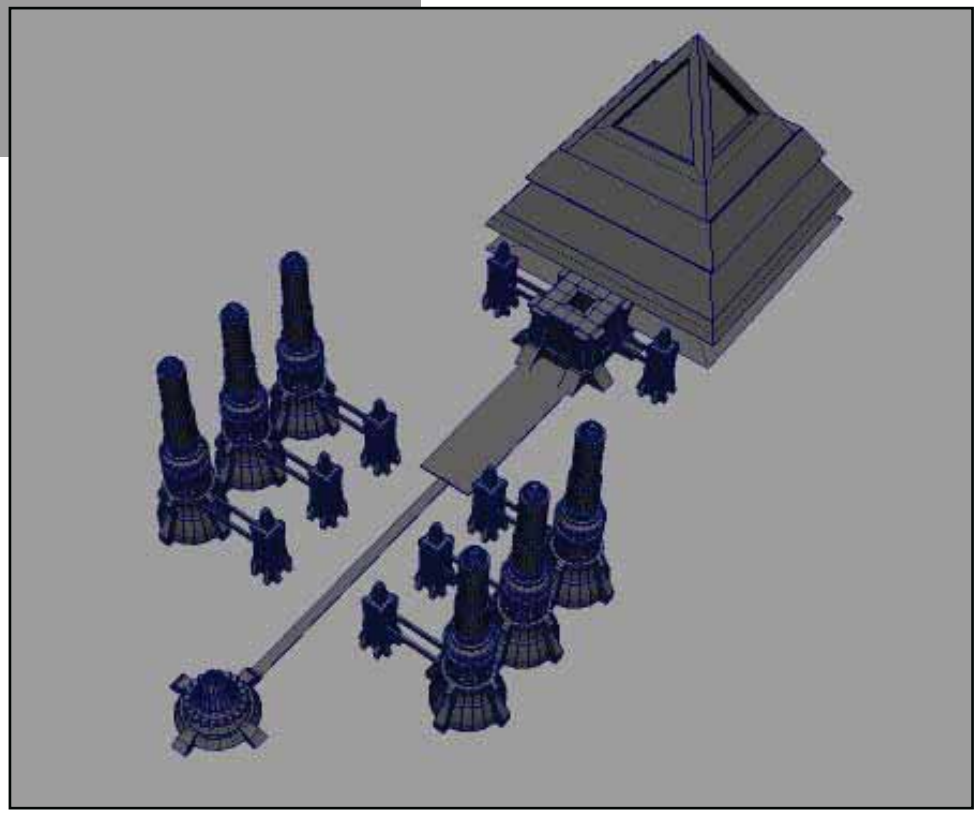
Maya Form & Space

5. Create grid space



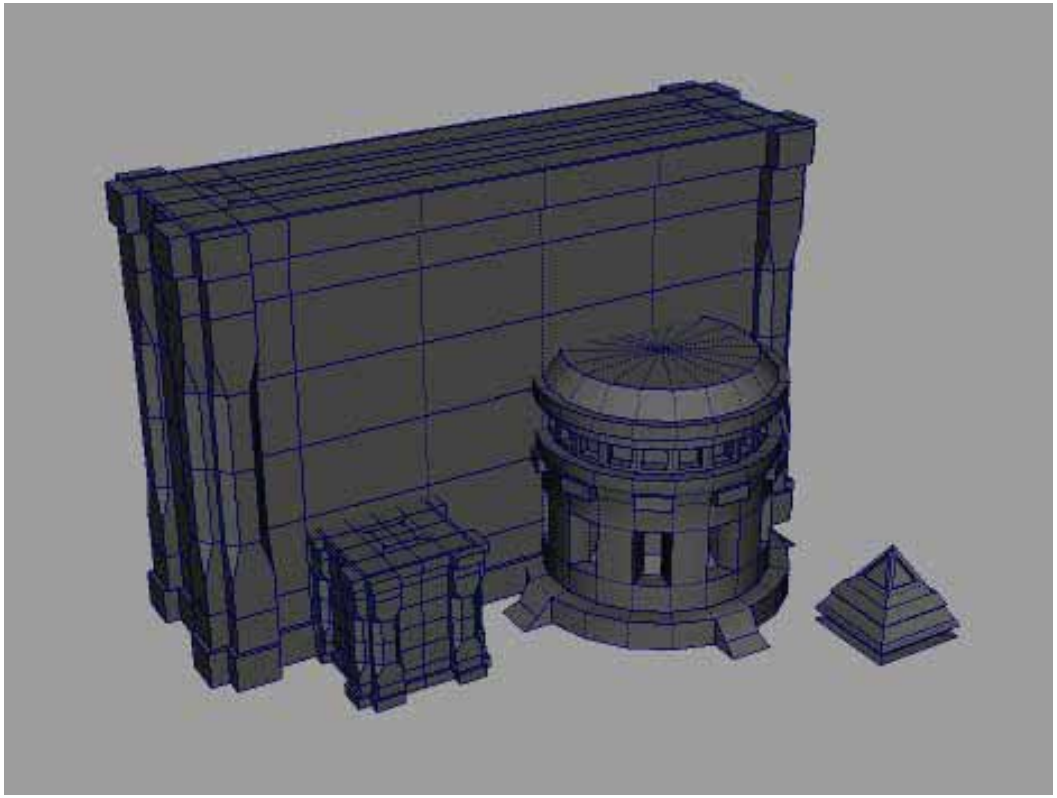
Grid Space

You can create symmetry through spacing and mirroring elements or explore ideas about axis by setting up a linear space that ends at a structure. You can even make a datum.



Axis Through Symmetry

Maya Form & Space



Datum

Concepts Explored

- Pattern, Scale and Proportion
- Subtractive and Additive forms
- Architectural themes of Form
- Architectural themes of Space
- Orders of Space and Form

This exercise provided you with the essential tools and procedures to create form and space. It is easy to see that by practicing these techniques you will be able to create almost any type of architecture. Remember that selecting rings and loops of edges and faces is a powerful method that allows you to subdivide an object quickly before you extrude. Master this skill and you will be able to mass modeling quickly.

The fundamental forms and space will be invaluable when considering types or styles of architecture. Using the additional files provided with this exercise will help you to continue thinking about how these architectural themes have been used throughout historical form and space.

Historical.ma provided for further exploration of architectural form and space.

Playing Outside—Stonehenge

Being told to go play outside is a frequent occurrence growing up. Anywhere from a backyard sandbox or schoolyard field to a dense nearby forest or sandy beach, children have found a place to build forts or sand castles. This desire to dwell in the landscape is a universal theme that started centuries ago and grew from the simplest meeting under a tree or baptism by a lake. Site is the foundation of ritual, and choosing the best location or altering it to suit an architect's needs is often a very important part of establishing a sense of place.

Overview

This lesson covers the creation of Stonehenge. It will involve the editing of a plane that will eventually become the site for this prehistoric example of space and ritual. This exercise will teach you how to model a basic terrain and model simple organic forms.

In this lesson you will learn the following:

- How to set up a scene with preferences
- How to use a 2D plane as a reference to construct and assemble a site
- How to edit geometry with Smooth Selection
- How to use the Sculpt Geometry Tool
- How to create polygons
- How to work with polygon modeling techniques
- How to smooth polygon meshes
- Explore architectural themes of site

Stonehenge

Getting Started

1. Set preferences

Before you create your polygon architecture, you will need to change some of the default settings to a more suitable environment for this type of work.

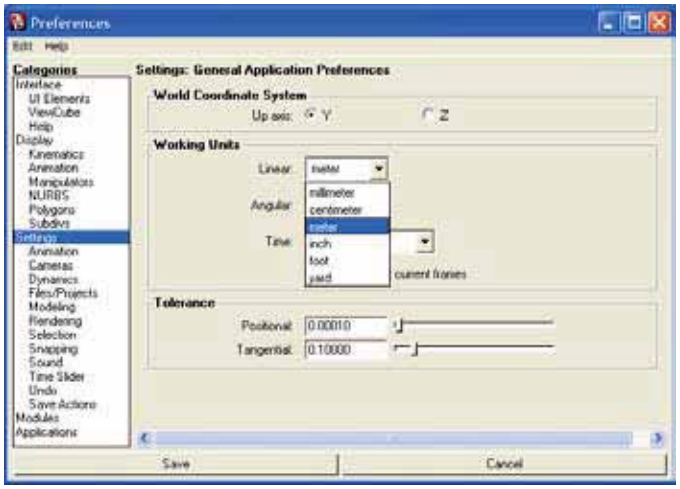
- Select **Window › Settings/Preferences › Preferences**
  The Autodesk® Maya® software user preferences window appears.
- In the Preferences window choose Categories › Polygons
- In the Polygon Display settings, set the following:
  - Border Edges: On
  - Edge Width: 4

  This displays border edges more prominently on polygon meshes and helps to identify the edge conditions of any open geometry.

- In **Preferences** window, choose **Categories > Selection**
- In the Polygon Selection settings, set the following:
  - Select faces with: Whole face

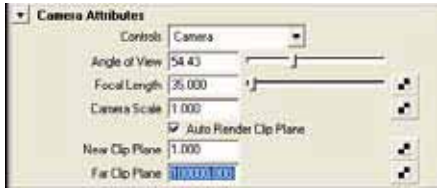
The Whole face setting lets you select polygon faces by clicking on any part of the face rather than on a center dot as with the center setting.

- In **Preferences** window, choose **Categories > Settings**
- In the **Working Units** dialog box, in the Linear drop-down menu choose **meter**



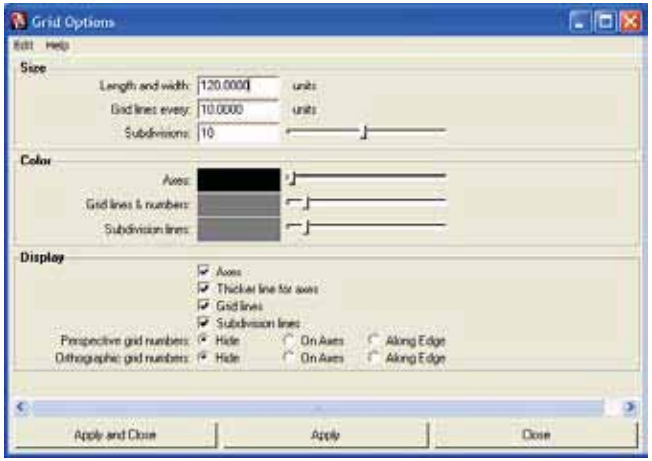
Preferences Dialog Box

- Click the **Save** button to close the settings window
- Open the Outliner and select each camera one at a time: *top, side, front, and perspective*, then change the **Near Clip Plane** to **1** and the **Far Clip Plane** to **100000** for each of them. This will ensure the scene is visible at long and short distances



Camera Attributes

- Select **Create > Polygon Primitives** and turn off the **Interactive Creation** option for primitives
- Select **Display > Grid** and in the **Grid Options** dialog box change the grid size for **length and width** to **120** with the **Gridlines** and **Subdivisions** at **10**



Grid Options Box

Creating the Site with the Use of a Projection Plane

You can use various viewports to display drawings, sketches, or photographs to help visualize your models in Maya; much like an architect creates their designs from the plan, section, and elevation views of a blueprint.

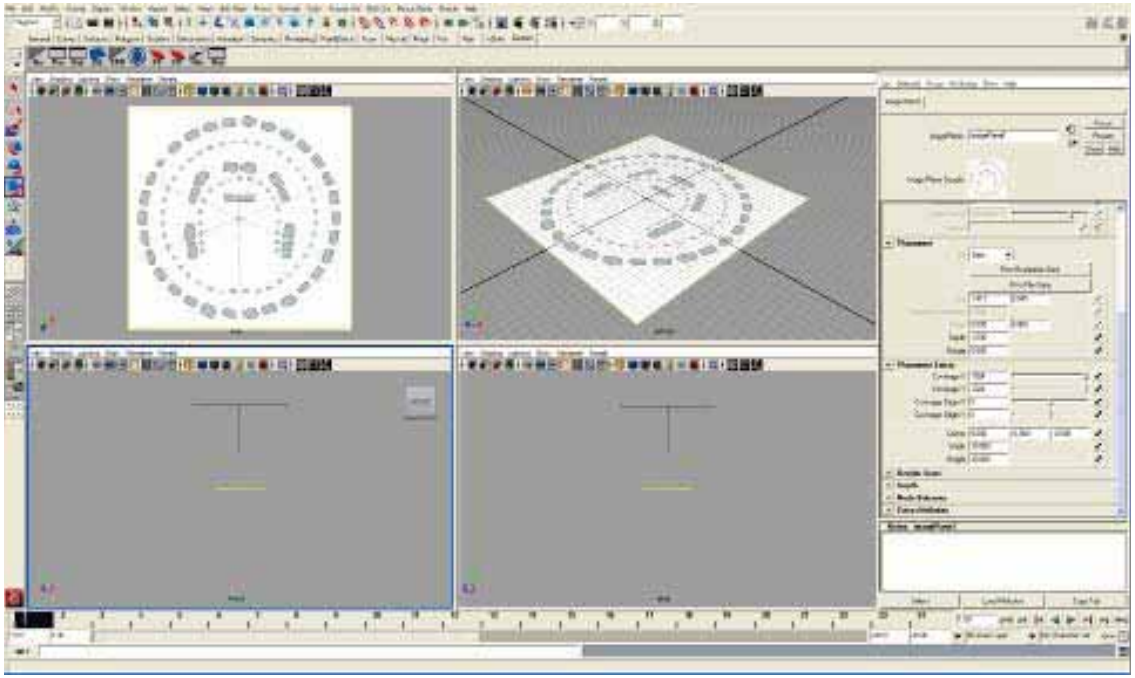
1. Create a file

- Select **File > Save Scene As**...
- Name the file *Architecture02_Site_Ritual_Mine*

2. Create a projection plane

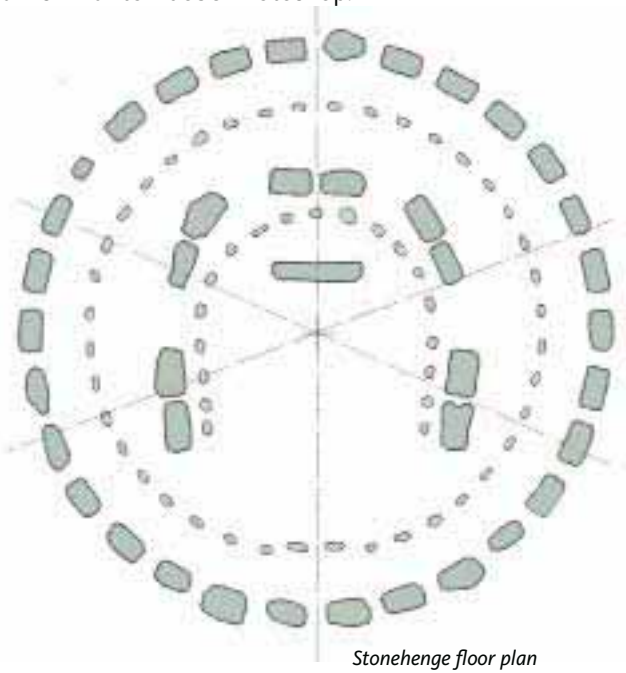
You can import 2D images into any orthographic camera view as *image planes*. An *image plane* is a 2D object (plane) that places an image file in the scene view.

You can move the image plane, change its transparency, or turn it off.



Projection Plane

For this exercise you need to load an image similar to this, you can create this by hand or in a program similar to Adobe Photoshop.



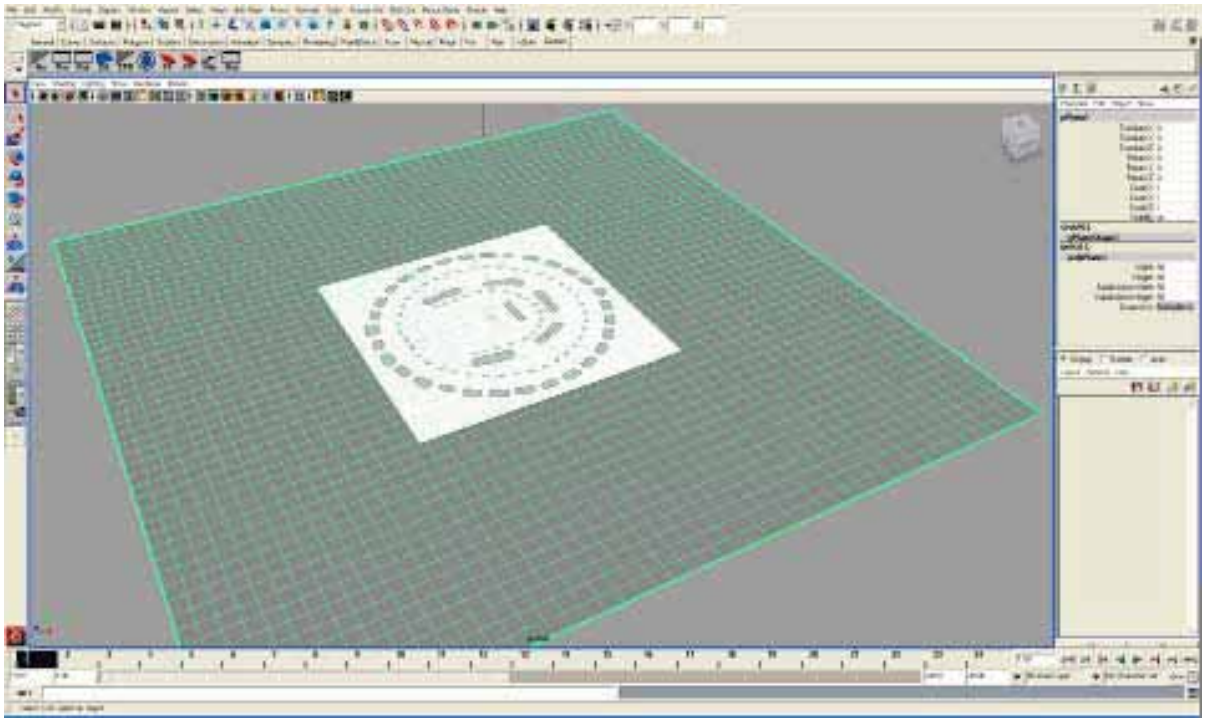
Stonehenge floor plan

- Ensure you are working in the top view.
- In the top view panel select **View > Image Pane > Import Image**
- Select your image file
- The image should now appear in the Top Viewport

3. Adjust the size and transparency of the image plane

- In the top view panel menu, select **View > Image Pane > Image Plane Attributes** to display the Attribute Editor on the right
- Scroll down to find and expand the **Placement Extras** tab and set both the width and height to 30 to scale the image plane to be the proper size for something like Stonehenge
- Under the **Inputs Image Plane Attributes** set the Alpha Gain attribute to a value of 0.25 to make the image partially transparent for easy working

Inputs Image Plane Attributes



The Plane

Creating the Terrain

The basis for Salisbury Plain where Stonehenge is found will be a simple plane. The sculpting of that terrain will reveal the organic features of the site.

1. Create a plane

- Select **Create > Polygon Primitives > Plane**
- Set the height and width to 50 and the subdivisions both at 50

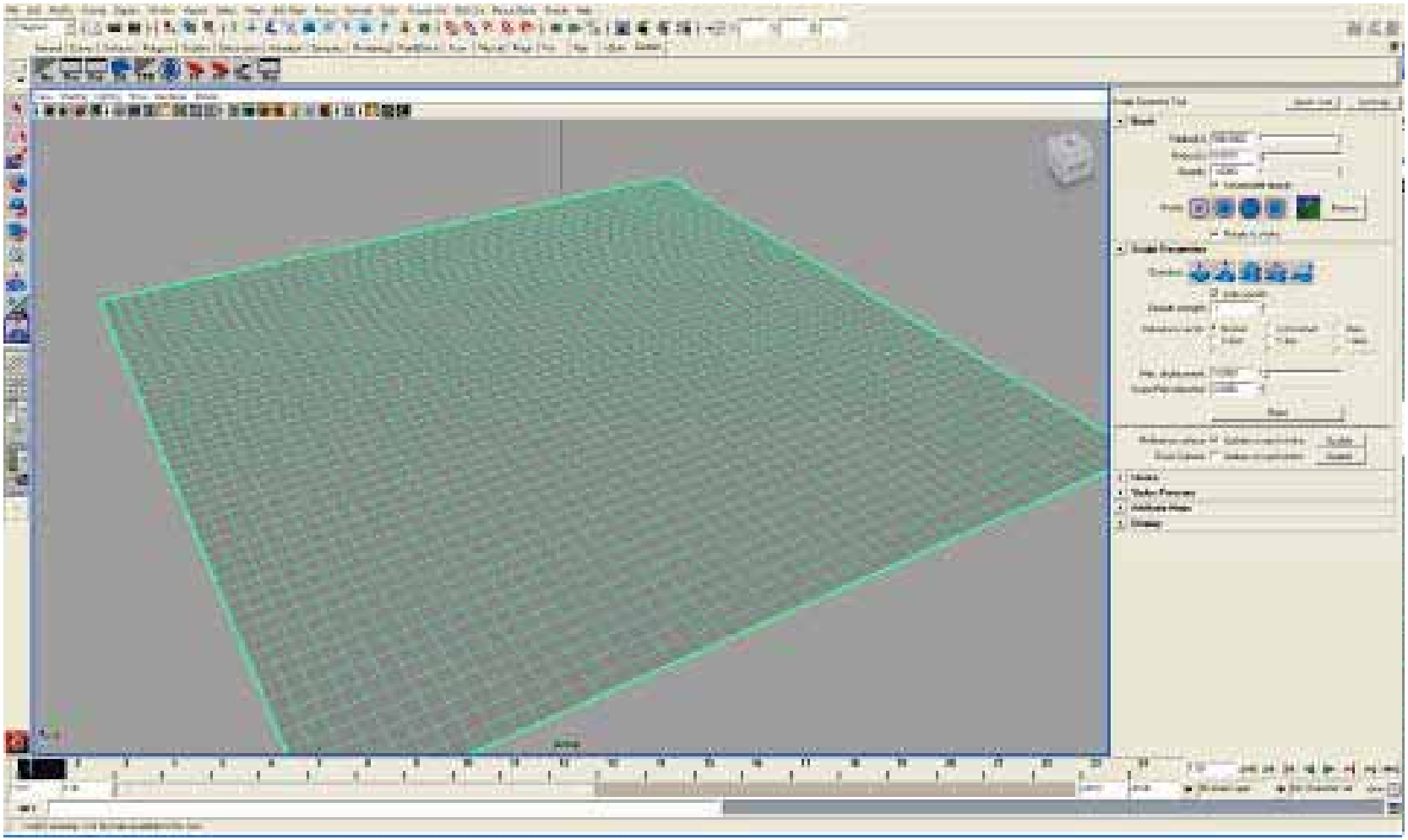
Tip:

To hide the image plane in the perspective viewport access it through **View > Image Pane > Image Plane Attribute**s and switch the **Display** to **Looking Through Camera.**

Maya Project

2. Sculpt the terrain

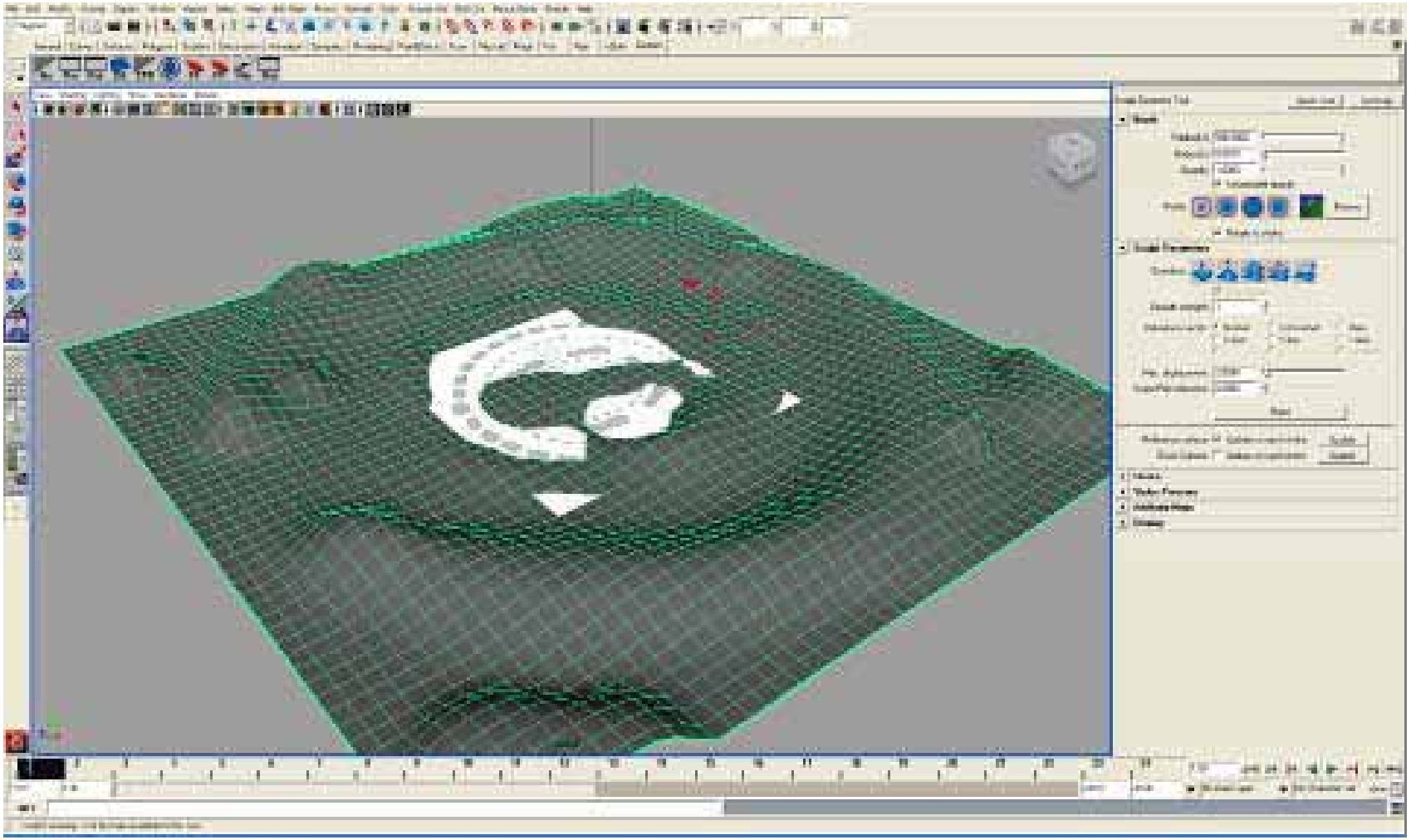
- Select the plane
- Select **Mesh > Sculpt Geometry Tool**
- Click the **Tool Setting** on the far right of the **Status Bar**
- Under the **Sculpt Parameters** select **Operations > Up Icon**
- Set the Max displacement to 5.0



Sculpt Geometry Tool

Maya Project

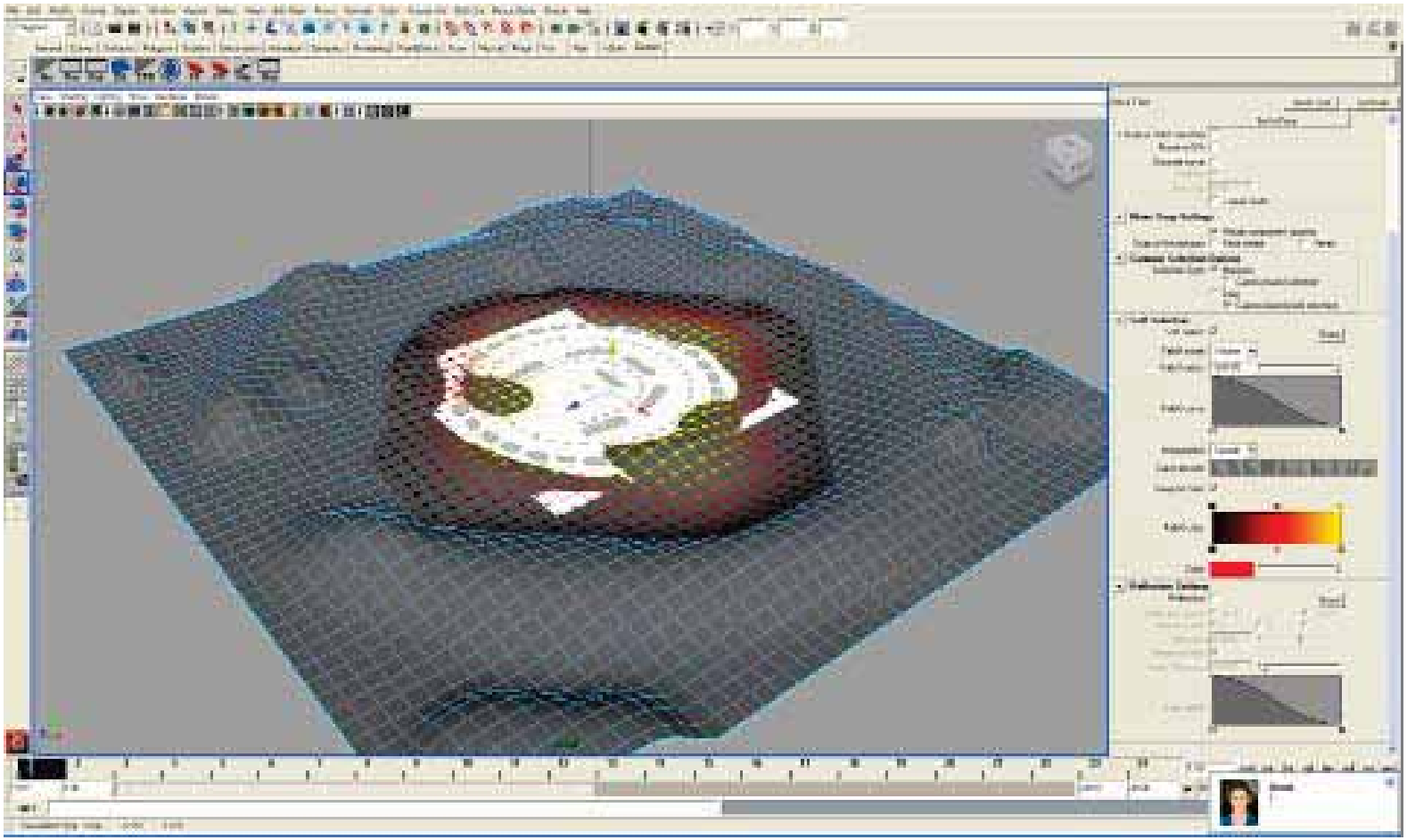
- Holding down the **B** key adjust the size of the brush with which you will be sculpting.
- Begin to pull up the terrain geometry to form a general site of concentric circle patterns.
- By adjusting the smoothing and trying out some of the other buttons you should be able to create a convincing terrain.
- Use different brushes sizes, and relax to get a convincing undulating field.



Sculpted Terrain

3. Adjust the grade of the terrain

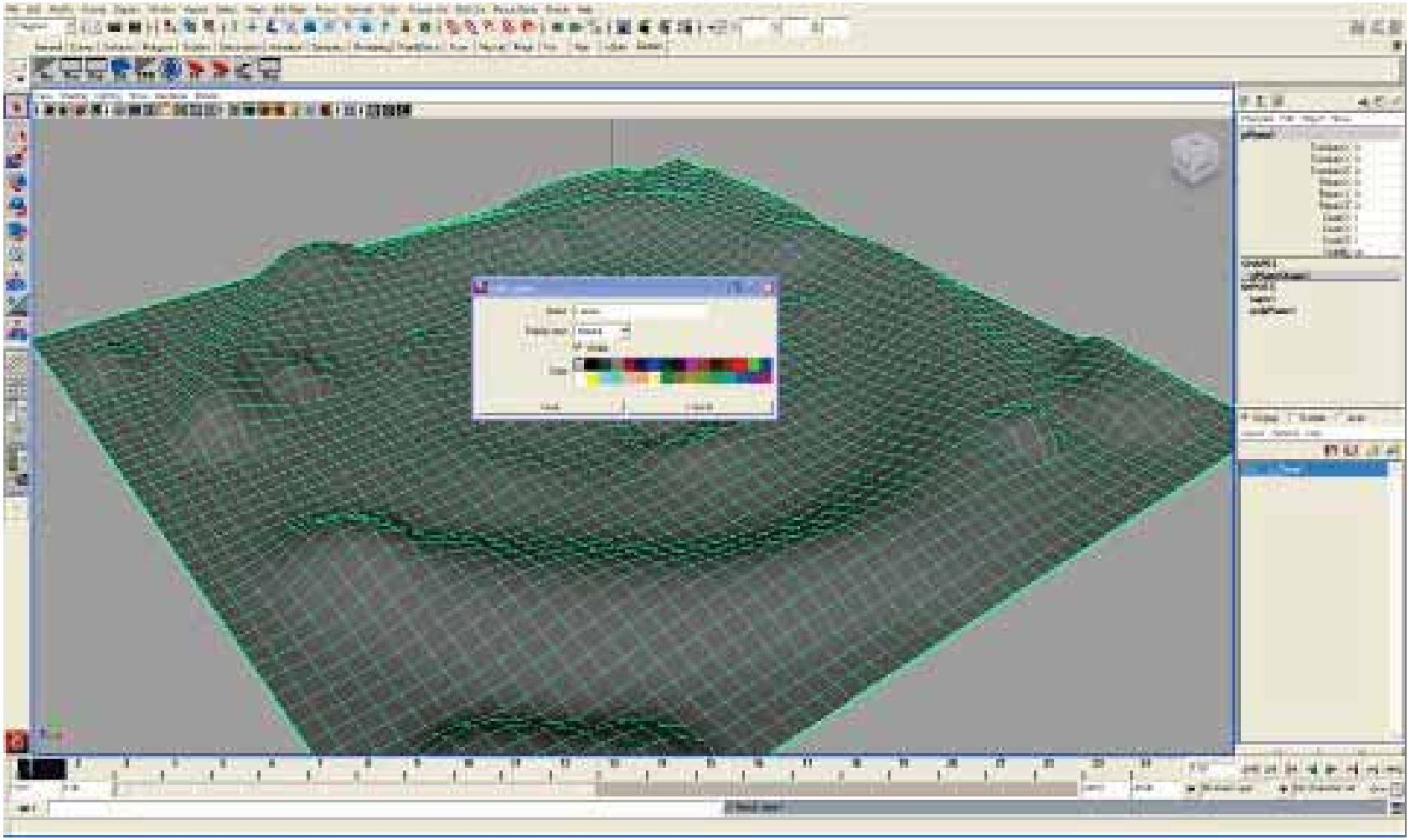
- Go to the Select mode and access the Tool Settings from the far right of Status Line and under the **Soft Selection** tab turn on **Soft Select**
- Go to the Vertex mode and select a group of vertices at the center
- Hold down the B key just as you did before and adjust the size of the field you are selecting, and you should notice the color gradient of what will be influenced by the soft selection you have made



Soft Adjustment to Terrain

4. Create a new layer and assign the terrain

- Access the **Channels** dialog box by clicking on the icon in the top-right corner of the Status Line
- Select the terrain you have just made and click the **Create a New Layer and Assign Selected Objects** button on the far right of the layer area
- Double-click on the newly formed layer, and give it a name such as *Terrain*

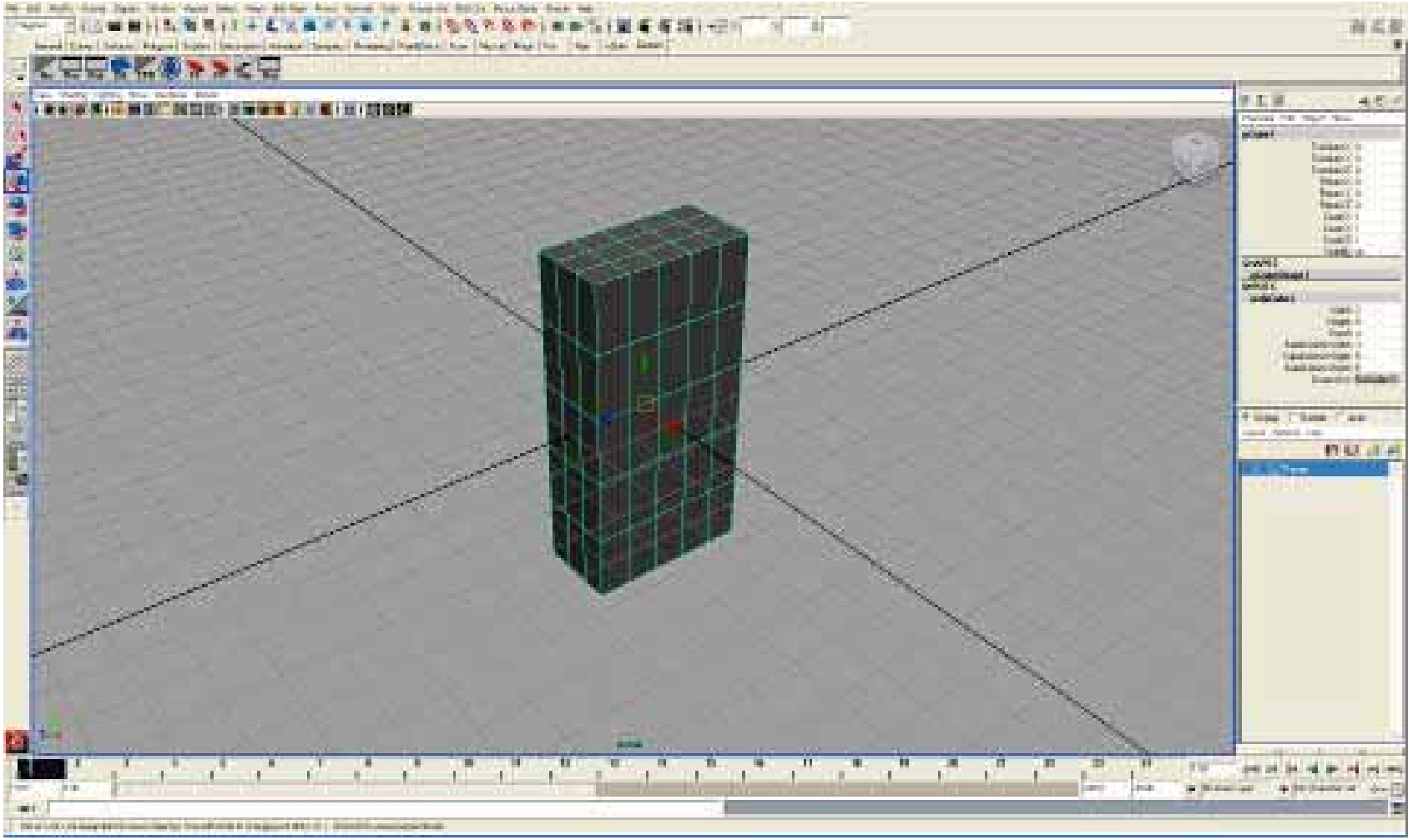


Assign Terrain to Layer

Creating the Monolithic Stones

Stonehenge would not be much without stones, so you will be creating a few monolithic stones to add to the scene.

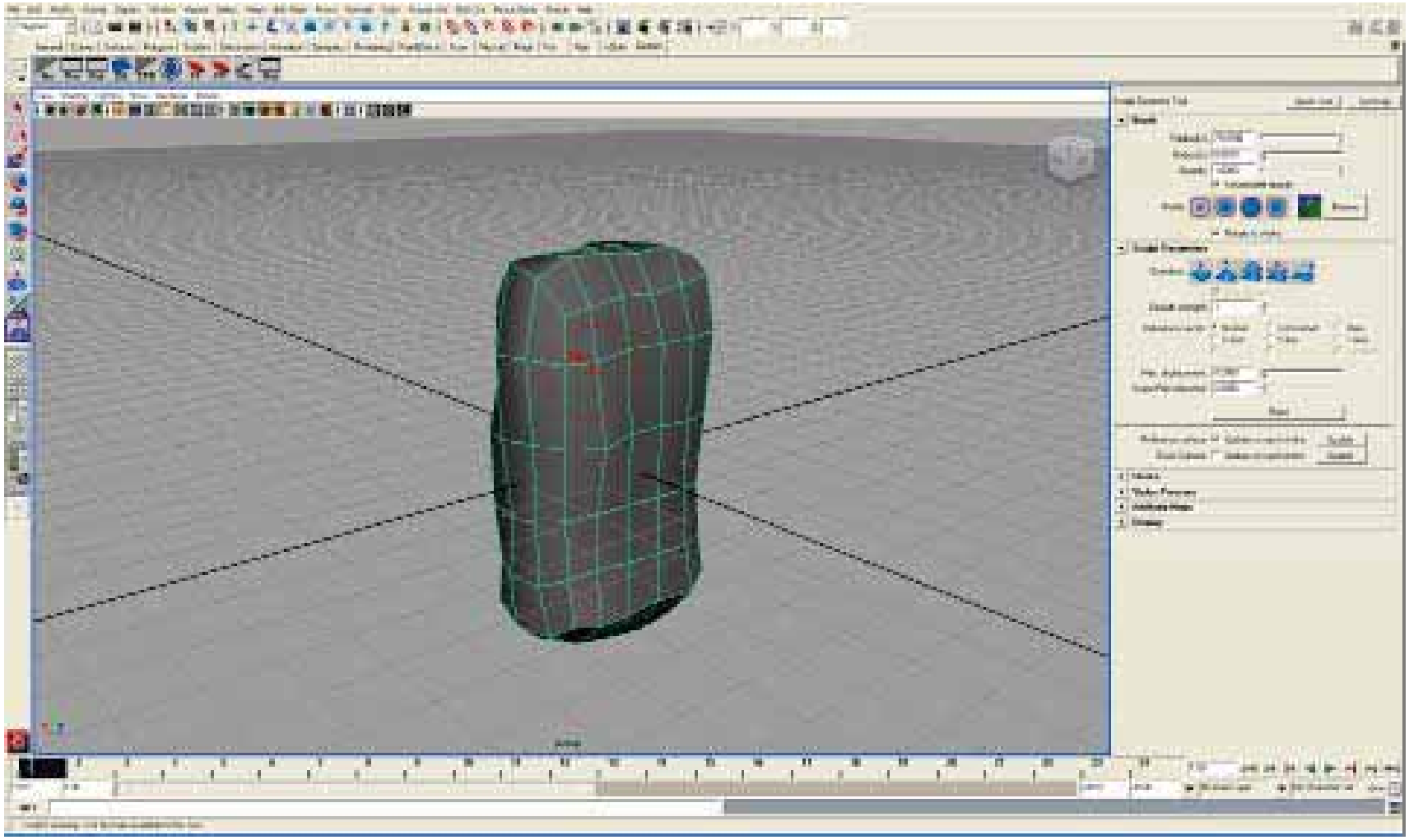
1. **Create a cube**
   - Select **Create > Polygon Primitives > Cube**
   - Set the width to 2, the height to 8, and the depth to 4
   - Set both the Subdivisions to Subdivisions width 3, Subdivisions height 5, and Subdivisions depth 5



Create Basis Form for Stone Slab

2. Sculpt the stone

- Select the plane
- Go to **Mesh > Sculpt Geometry Tool**
- Click the **Tool Setting** on the far right of the **Status Bar**
- Under the **Sculpt Parameters** choose **Operations > Up Icon**
- Set the **Max. displacement** to 0.5
- Holding down the **B** key adjust the size of the brush with which you will be sculpting
- Begin to pull up the surface geometry to form an interesting stone slab
- By adjusting the smoothing and trying out some of the other buttons you should be able to create a convincing eroded stone form
- Use different brushes sizes and relax to get a smooth feel to the mesh



Sculpt Geometry Tool for Stone

3. **Sculpt the altar and lintels**

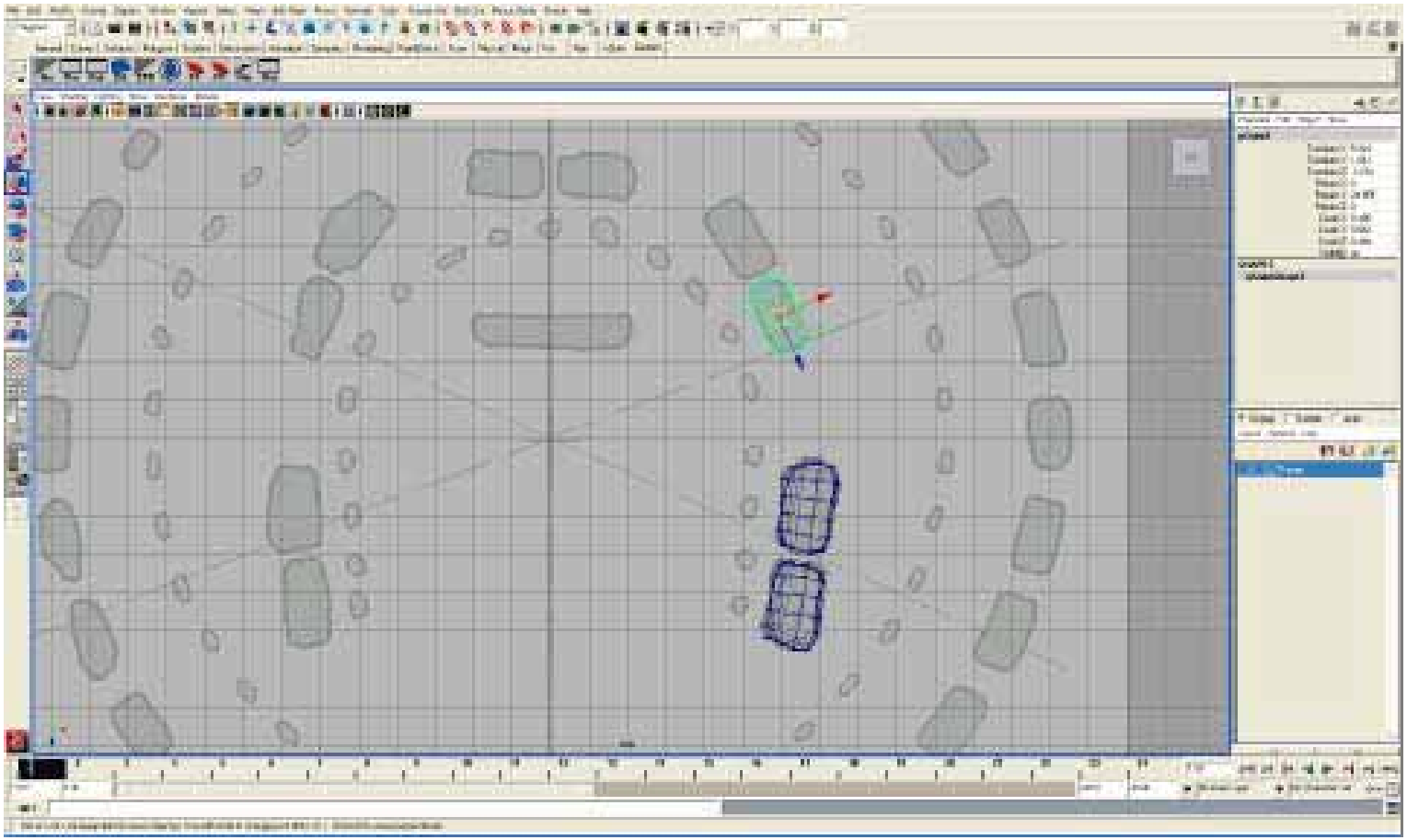
   - Continue sculpting the alter and lintels for this mysterious architecture using some of the techniques you learned in earlier lessons, such as splitting polygons and extrude, if you would like.
   - Use duplicates of the stone already in the scene or practice creating new ones.

Assembling Stonehenge

Now that you have Salisbury Plain hidden away you can begin placing your objects around the site like the ancient did but with much more ease.

1. **Assemble the stones**

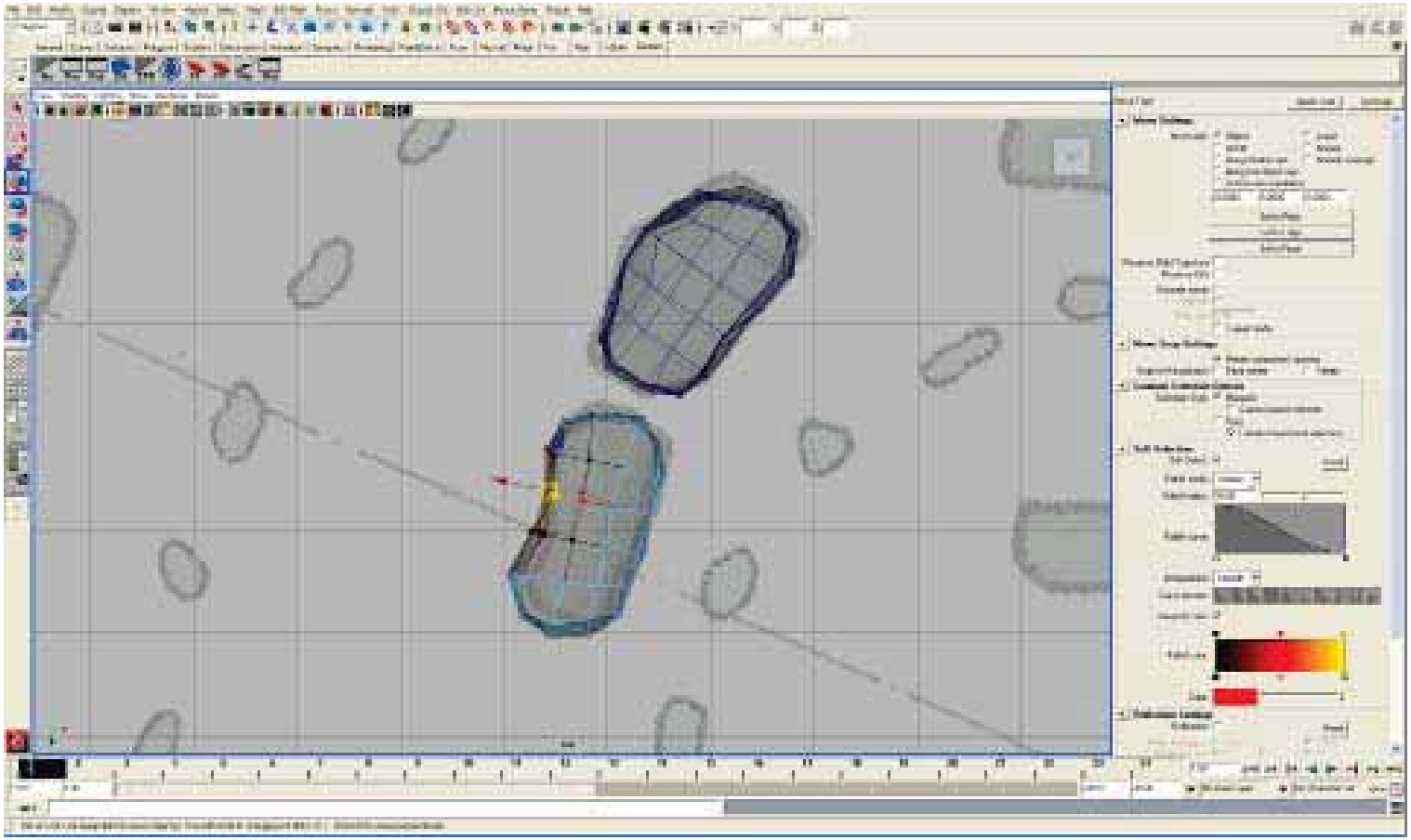
   - In the top viewport is the easiest way to move, scale, rotate, and position your new forms.
   - Use the image plane as a reference to where the stones should be placed.



Assemble the Geometry Using the Image Plane as Reference

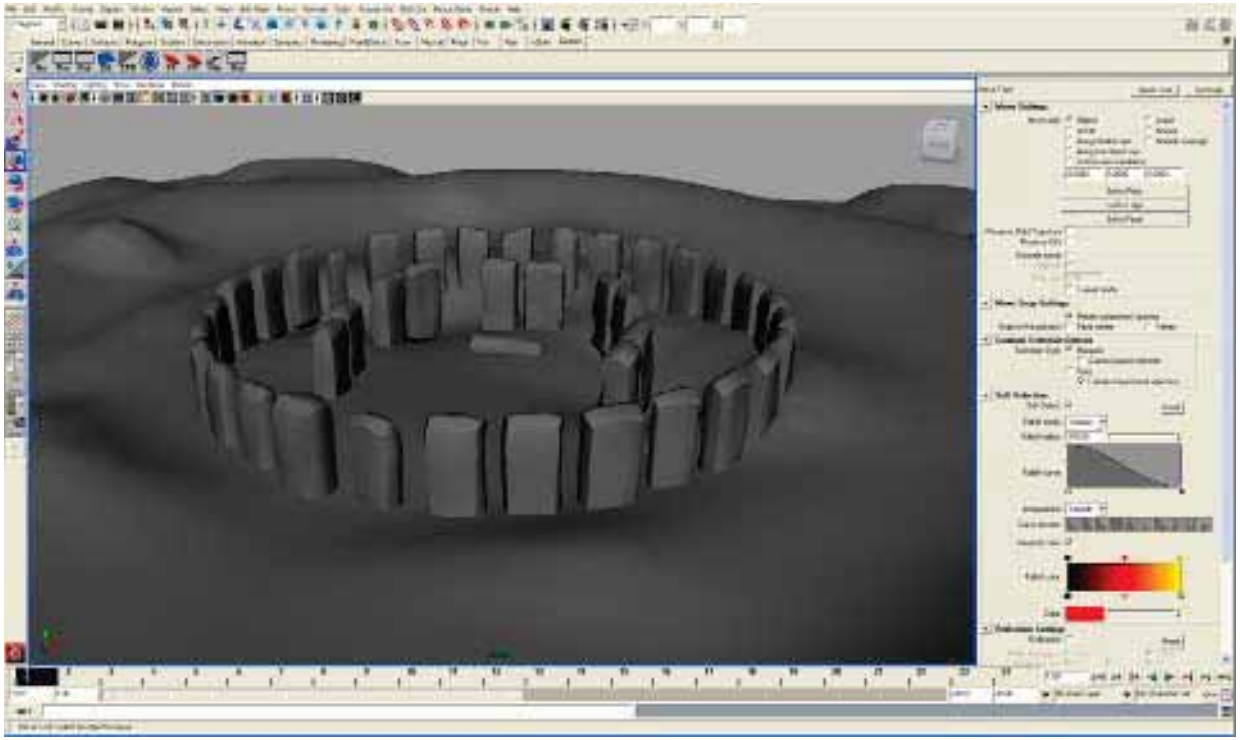
2. Adjust the stones

- Using the soft selection at a lower falloff radius in vertex mode will allow you to gently massage the forms to each be unique and fitting to the plan visible in the image plane
- Continue to follow the plan and position the rest of the stone
- Add the lintels and scale them to be appropriate
- Duplicate and Scale some of the stone to be smaller stones to match the plan
- Save your scene



Adjust the Forms Using the Image Plane as Reference

Maya Project



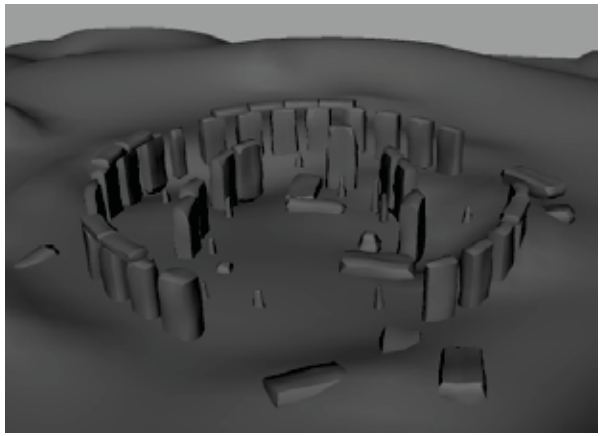
Top Viewport Showing Image Plane and Placement of Stones

After the Exercise

Understanding the ideas behind establishing a site will help you when approaching any architectural problem. Now that Stonehenge is set up, continue to assemble the structure and consider researching this particular ritualistic architecture and try to reassemble the pieces to how it presently stands with broken stones and buried eroded elements. You could also raise the mound high and situate the stone up high or dig a hole and position them around the edge to see how site can vary with the same architectural elements at your disposal.

Concepts Explored

- Creating Terrain
- Staging primitive ritual
- Ceremony in the landscape
- Architectural themes of Site and Place



Stonehenge after many years

Finished Model

Workbook

SkillsUSA™ CHAMPIONSHIPS

2010

3D Visualization & Animation Competition

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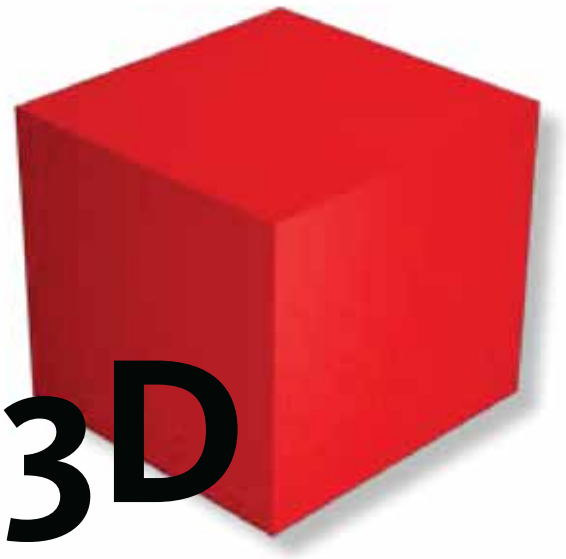

Workbook

2010

SkillsUSA™ CHAMPIONSHIPS

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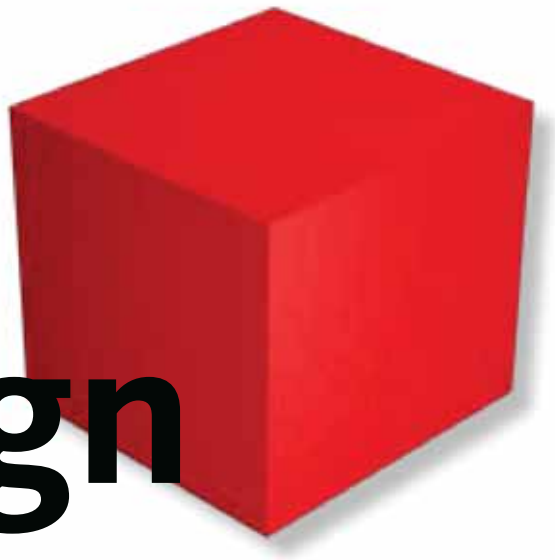

Design

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The Elements and Principles of Design

The elements of design are the foundation to all visual imagery including traditional painting, illustration, architecture, graphic design and 3D art.

Think of elements as ingredients such as flour, baking soda, water or vinegar.

Principles are the wisdom of how to combine these ingredients, or elements. If you want a mild combination, mix water and flour. If you want an exciting combination, mix baking soda and vinegar.

It's the same with the elements and principles of design. Lines are elements. Everyone uses lines when they draw a picture. But an artist may draw a group of people using wobbly or energetic lines to give the picture a repetitive pattern. That's the principle of rhythm. The artist may also use stiff lines to make one person stand out of that group. That's the principle of contrast.

A comic book works the same way, but over a series of pages. Let's look at another element: the point. In a picture, a point may be just a dot. In a comic book panel, it may be "the most important point" in the panel, like a light on a control panel. On a comic book page, it may be a series of panels that make "points" to tell the story. For example, one panel shows a red light to make the point that the character is in danger; the next panel shows her face to make the point that she isn't afraid, and so on.

But not every point needs a panel. One panel may show a key entering a car's ignition. The next may show the character arriving at a destination. We don't need to show her putting the car into gear, using the blinker, or adjusting the radio – only enough to make the point that she drove there. That's the principle of economy.

Knowing the elements and applying the principles can help you direct an animated story. If you consistently place the camera at medium distance (the element of space), you've applied the principle of unity: "one-ness" of camera placement. If you think it's better to simply return to that position every few shots, you create rhythm. If that always-the-same position gets boring, a final close-up on a character's face creates emphasis. It also creates contrast. We pay attention because it's different from what we're used to. It also creates balance. We had a big dose of medium shots, and we "balanced it out" with a close-up shot.

The following are additional examples of how using design principles can help you tell stories:

With color, you can give a story unity and economy by choosing a limited palette.

You can create emphasis and contrast by using a dull palette to set the stage for a sudden bright color to pop out.

You can create balance by using cool colors, like blue and green, for scenes that feel calm; and warm colors, like reds and oranges, for scenes that feel as if “the heat is on”.

With lines, you can design your shots with horizontal and diagonal angles until your character stands strong. Then you can introduce vertical lines, which give us contrast and balance.

With texture, you can emphasize smooth surfaces until “the going gets rough” in your story. Then you can introduce rough surfaces for contrast. Be careful, though. if those surfaces look like they don’t belong in this story, you my lose unity.

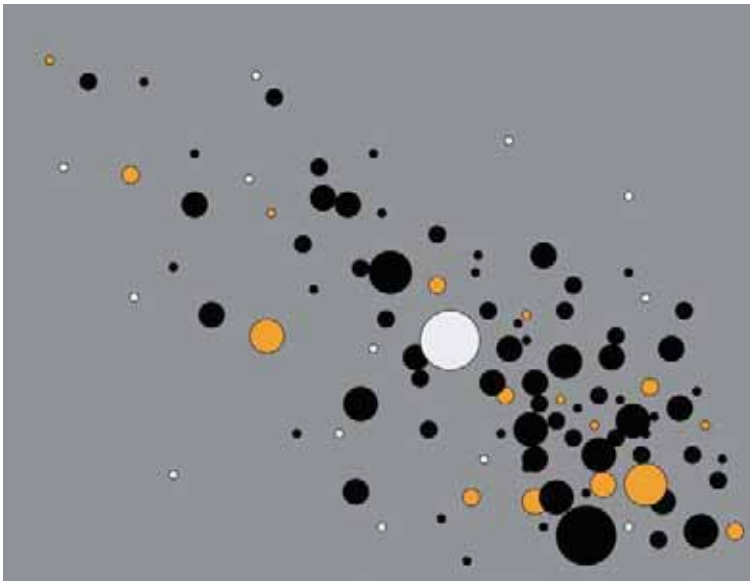
If you’ve ever wondered how great artists, animators and filmmakers make their decisions, here’s the answer: they follow their instincts. They feel as if the picture or story “ought” to be this way. They feel that a close-up shot reveals the character’s feelings better than a distant shot, or that a distant shot shows the character’s predicament better than a close-up. These decisions may be based on instinct, but sometimes our instincts get muddled, or they need guidance. The principles of design remind us that good decisions have common qualities. They are the short list of wisdom that help us make good choices.

Below are the elements of design we will be exploring. Remember they are the ingredients.

- Point
- Line
- Shape
- Form
- Space
- Value
- Texture
- Color

Point

A point is the most basic of design elements and can be defined as the smallest area of visual attraction in a composition. Point is just that, it is a point or mark. But, a single point can also be used to create a focal point and attract a viewer's attention to a specific area, emphasizing the story. A point can define a location in space, and it can create an illusion if there are multiple lines. When there are several points near each other, the human mind starts to create a visual connection. If there are very many, more complex shapes can be seen and we can even begin to assign mass and a sense of weight to the grouping of points.



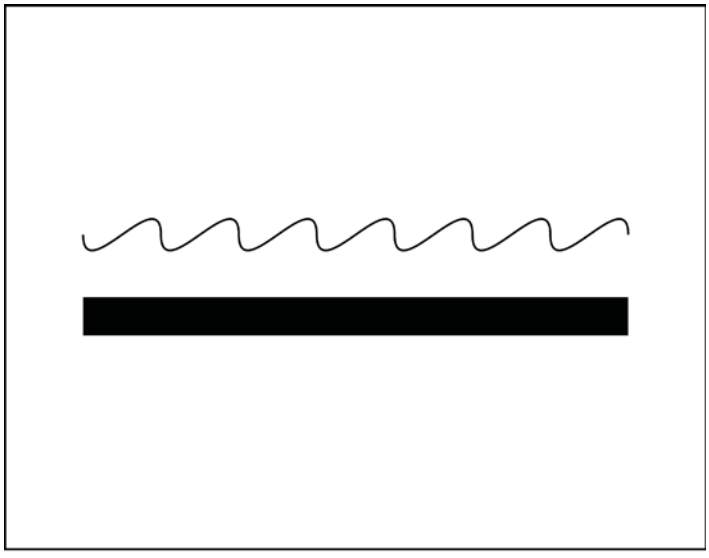
Line

Line could be considered one of the most powerful elements of design. Line is used to define a shape, describe a contour, or be implied by the outside edge of a form. With line, you are able to create and describe much of what we understand about 2D and 3D space. A simple line can describe a horizon in a landscape, a road disappearing into the distance, or even something as complicated as an expressive quality such as energy or mood.

Characteristic of Line are:

Width or Weight

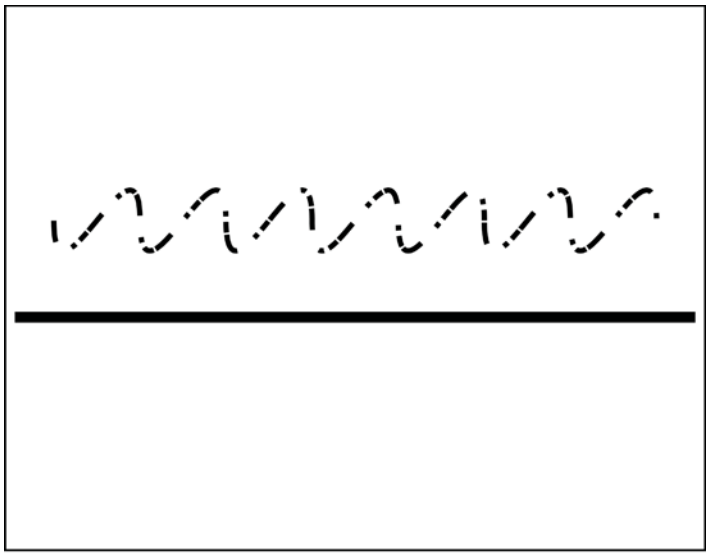
Heavy lines can be used to indicate a feeling of power or of a close proximity while light lines can indicate delicacy or distance.



Width or Weight

Length

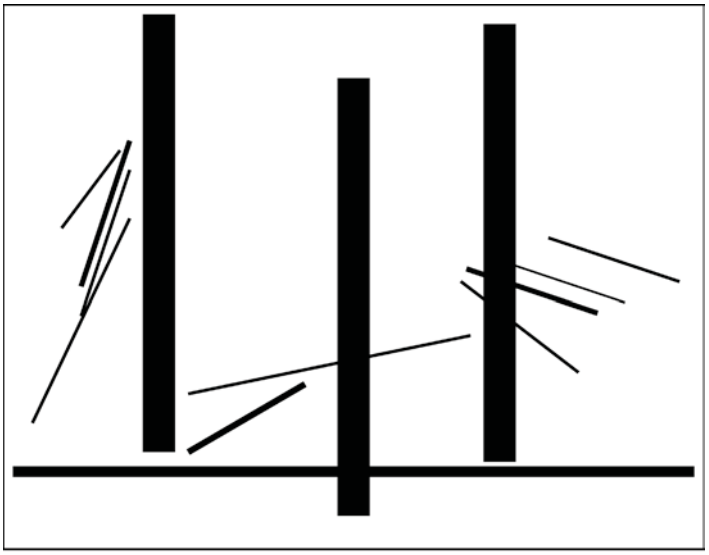
Long lines can give a feeling of continuity, while short, broken lines have a nervous tempo or pattern to them.



Length

Direction

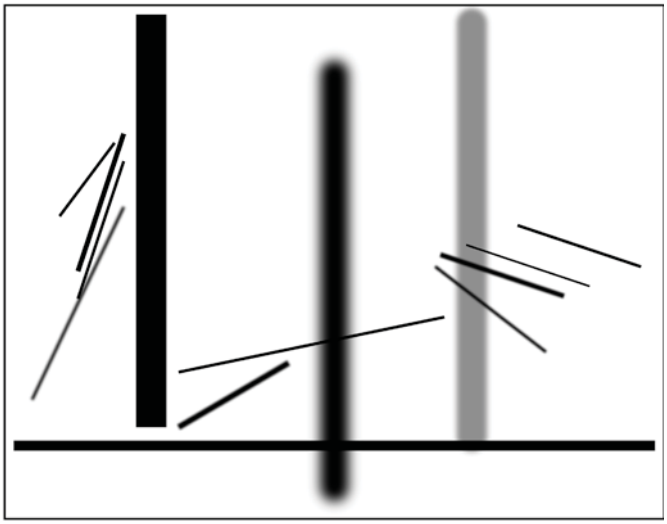
Horizontal lines suggest stability and project calmness and peacefulness. Vertical lines depict power and height, and diagonal lines can have the feeling of action, movement, or instability.



Direction

Focus

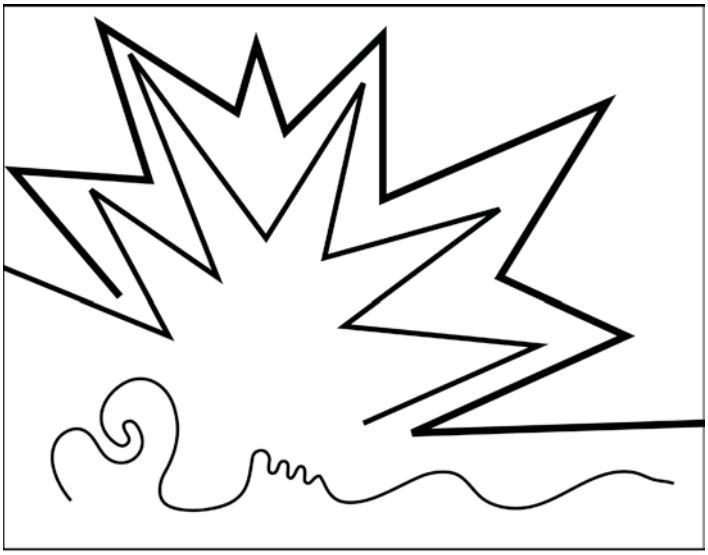
Sharp lines give the appearance of clarity and decisiveness, while blurry or fuzzy lines give the feeling of softness, gentleness, or a dreamlike quality.



Focus

Feeling

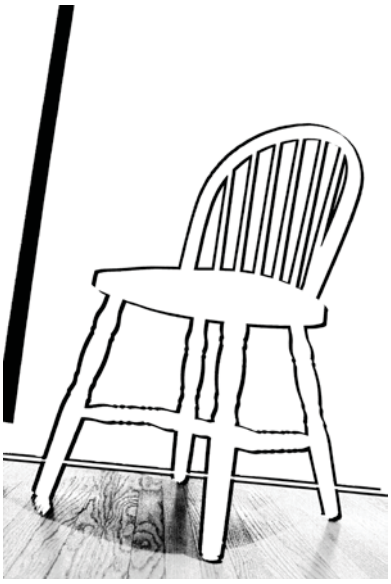
Sharp, jagged lines can express speed, anger, aggression, or nervousness while graceful, smooth, or meandering lines can suggest slowness, elegance and romance.



Feeling

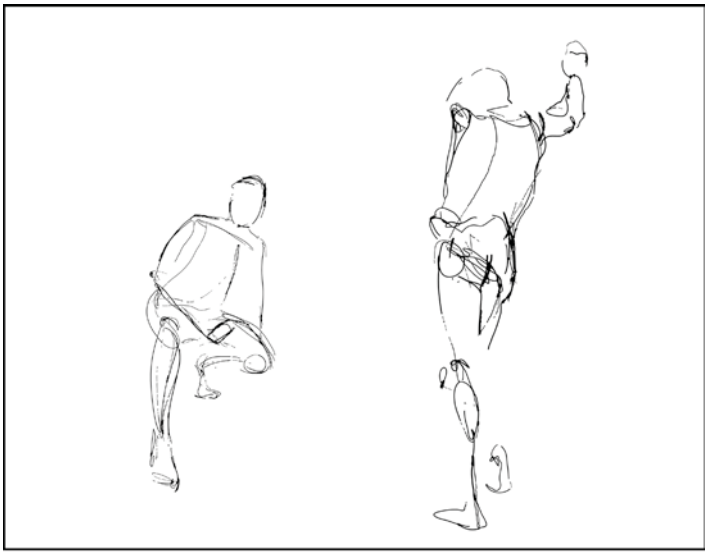
Contour

Contour lines describe the shape of an object and the interior detail – basically any edge – be it the edge of a shadow or the edge of plane.



Gesture Lines

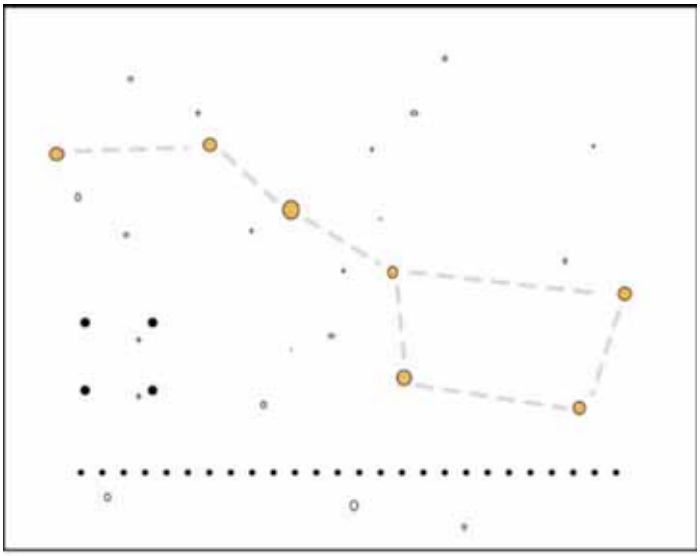
A Gesture line catches the movement or "essence" of an active figure or scene.



Gesture

Implied Line

When points or objects are in close proximity, implied lines are created. An implied line is also created by the point of view (POV) of an object or character.

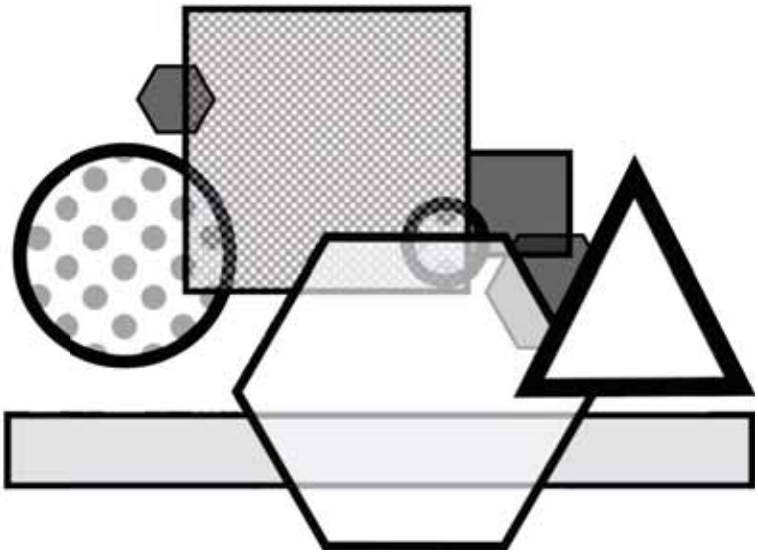


Implied Line

Shape

When a line encloses a space, it creates a shape. Shape is two-dimensional only, meaning that it has height and width, but no depth. Depth of a shape can be implied, but it is not real; therefore it is illusionistic.

Shapes can be broken down into the following categories:

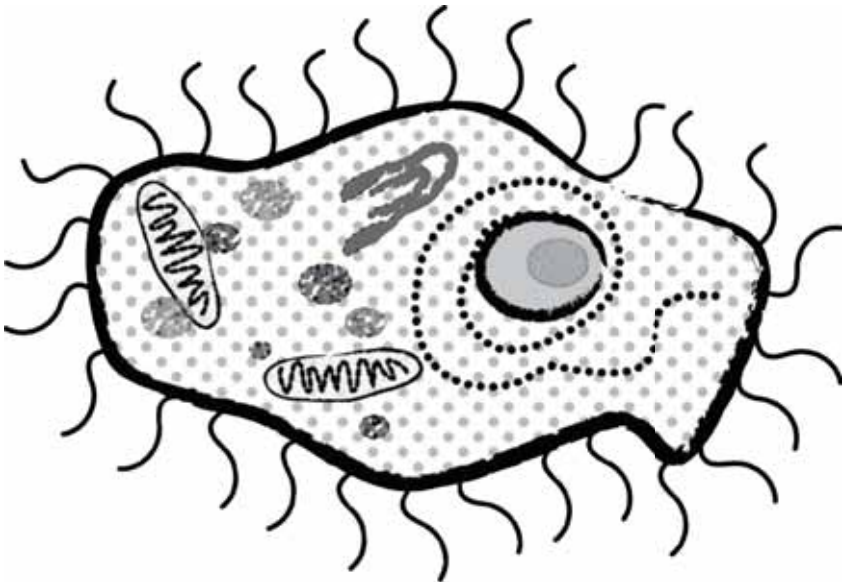


Geometric Shapes

Circles, squares, rectangles and triangles are the most familiar to us. We see them in nature and in the manmade realm, ranging from crystals and snowflakes to architecture and machine parts. Rectilinear shapes fall into this category as well, since they are angular or straight.

Organic Shapes

Organic shapes are often found in the natural world. Trees, rocks, and cells are all examples of organic shapes as are all animal and human forms. But we can also see them in the manufactured world in anything that is free-flowing or irregular, such as drapery, overstuffed furniture and many stained-glass windows. Curvilinear shapes refer to the use of curved, rounded forms.



Positive Shape

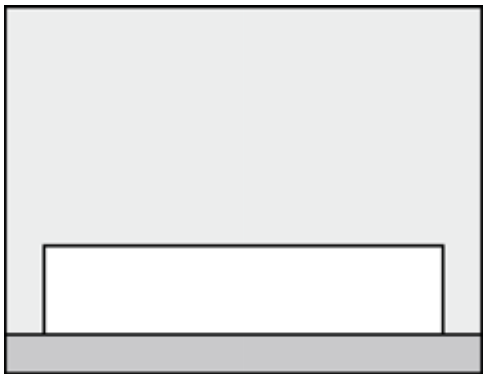
A positive shape is the object within a picture plane, such as a chair.

Negative Shape

A negative shape is the space around and in between (the openings within) the positive shape.

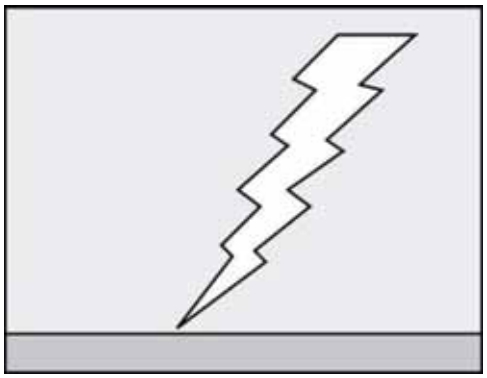
Static Shape

A static shape appears stable and unmoving, such as a mountain or a simple block.



Dynamic Shape

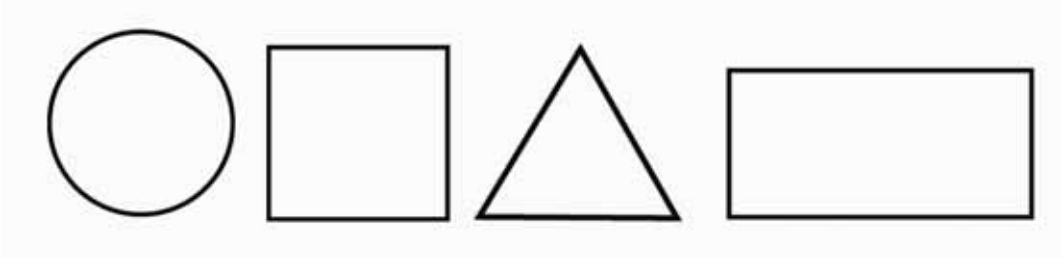
A dynamic shape appears to be moving and is active, such as the cloud formations around the mountain or a lightning bolt.



Form

Form is the three-dimensionality of a shape. Shape is only two-dimensional, lacking depth; form is three-dimensional, having depth. Form can exist in real space, and it can exist in virtual space. With a form, you move around in it and, in the case of a building, walk into it. To imply form of a shape in 2D space, you can use shading or perspective drawing. By creating a light source for a circle and casting a gradation shadow, you can turn a flat circle into an illusionistic sphere. By using vanishing points, you can create the illusion of a flat square becoming a 3-diminsional cube. Any shape can be made into a form by adding depth.

Shape

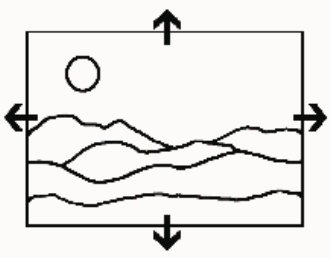


Form

Space

Space is the expanse or area in which all objects and events take place. Space has three-dimensions; width, length, and depth. Space can also be considered to have a fourth dimension of time. With an environment you are able to walk through and explore the space. With an object, you are able to walk around the object, look above it and under it. In the case of architecture, there is exterior space, and there is interior space.

Two-dimensional space



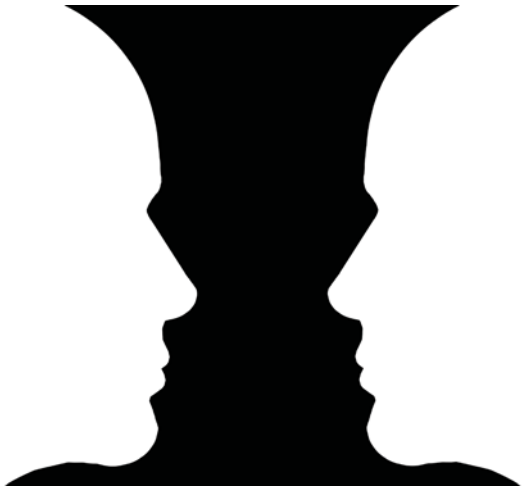
Types of space:

Positive Space

Positive space is like a positive shape, in that it refers to the shape of the object in space.

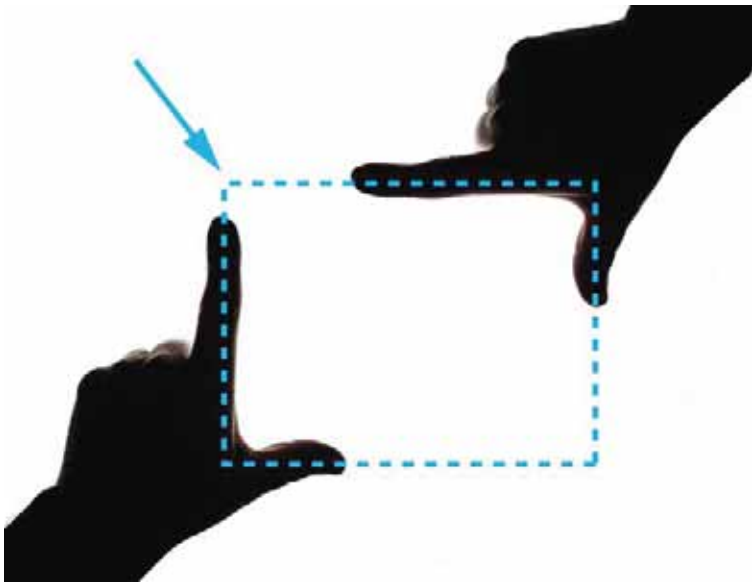
Negative Space

Negative Space is the space around the object. Negative space, as seen here in the space around the vase above, can also have a recognizable shape. Playing with these two spaces can create interesting results.



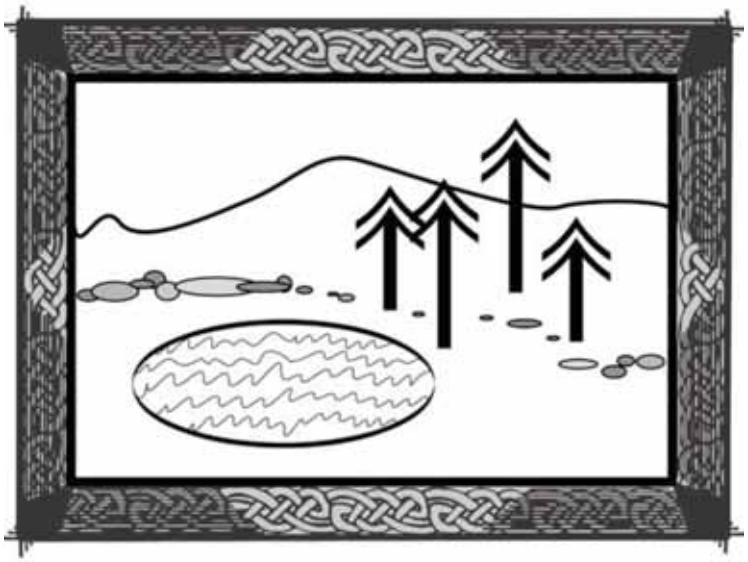
Picture Plane

The picture plane is the flat constraints of your composition; a space having width and height, but no depth.



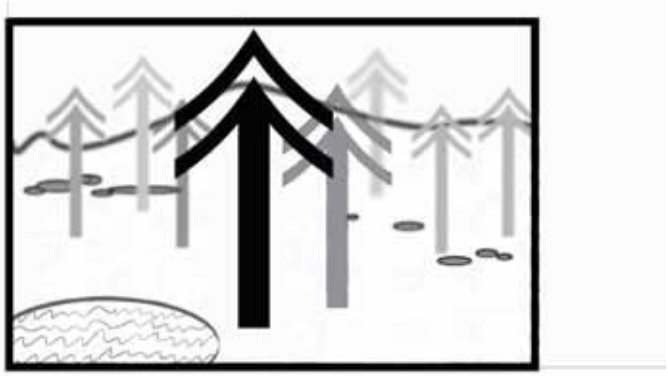
Composition

Composition is the arrangement of your design elements within the picture plane.



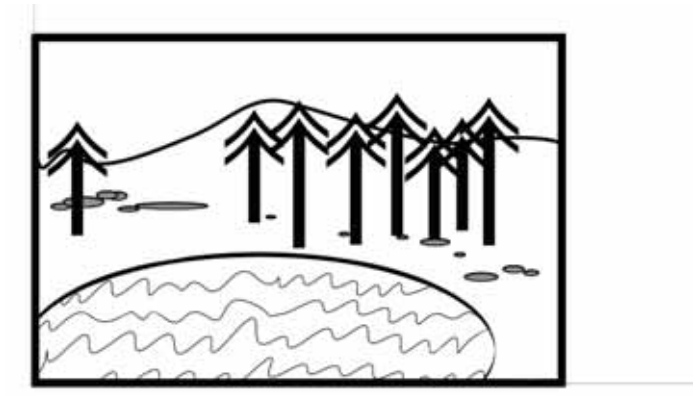
Focal Point

The focal point is the area of your composition that you want to have priority over the rest of the composition. The focal point has a dominant presence. In other words, it has hierarchy over the other elements.



Proximity

Proximity is the space in between shapes or forms. Proximity can create tension or balance by the positioning of the shapes or forms in relationship to each other.



Value

Value is a range of lightness and darkness within a composition or within a shape or form. Value ranges from pure light to complete darkness, with all of the scale ranges in between.

Elements of Value:

Tint

Tint is the white added to a color or value. By adding white to a green, you tint the green to a white. By adding white to a medium grey, you change the medium grey to a lighter tint of grey.

Shade

Shade is the opposite of tint. By adding black to a color or value, you change its shade. A night sky would be a dark shade of blue. Black added to a medium grey would be a dark shade of grey.

Contrast

Contrast is the difference between values. The larger the difference between values, the higher the contrast will be. The closer the values, the lower the contrast will be.

Gradation

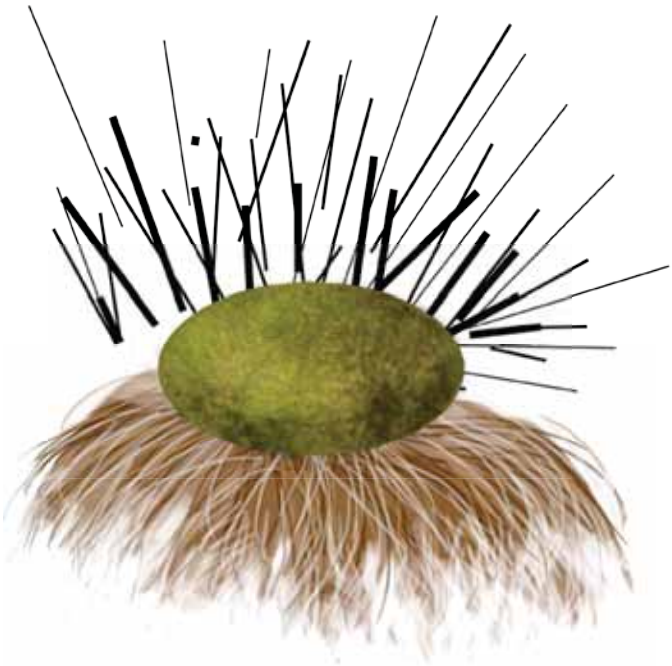
Gradation is the change in value ranges over a composition or an object.

Scale

Scale is the range of pure light/white to pure dark/black of any color.

Texture

Texture is the surface quality of an object. Texture can be rough and prickly, like the surface of a cactus, or it can be soft like the fur on a cat. It can be woven like a basket, or it can be smooth like glass. Texture can be real – something you can touch and feel on an object. It can also be implied by the use of pattern and value, as in a drawing/painting of an object's surface or skin.



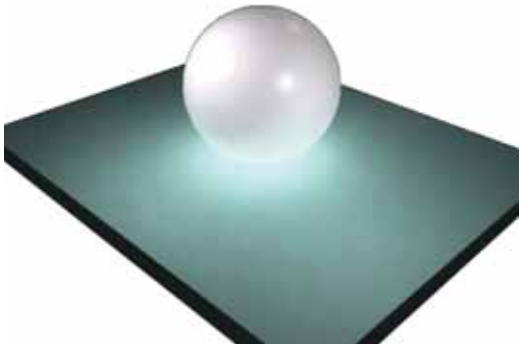
Color

Color is the most complex of all the elements. It has a physical presence and creates a psychological response in the viewer. Did you know that color comes from light? Did you ever examine the colors coming from a rainbow? You can see how it was formed if you understand the principles of a prism. With the rainbow, the small drops of water in the atmosphere refract the light into the separate color spectrums. While a rainbow is refracted light, the color of an object is determined by reflected light. What color we see is determined by which light waves or color spectrums are absorbed and which color spectrums are reflected back and picked up by the human eye. In pure black, all color is absorbed, and in pure white, all color is reflected back.

Besides the color being reflected, the luminosity (light intensity) of the color is affected as well. When light hits an object, the color is either reflected back **specularly**, **scattered**, or it is **absorbed**. More often than not, it is a combination of the three.

Specularity

Specularity is reflection that has a high sheen or mirror-like quality to it. The light reflection has a focused quality to it.

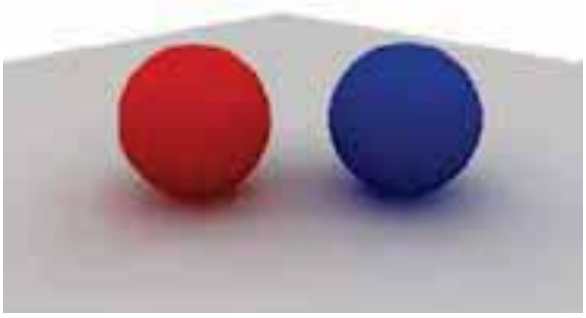


Scattered

Scattered refers to reflection that is usually uniform in nature due to the light leaving the object in an unfocused radial path.

Absorbed

When light is absorbed, the reflective quality of the color is low and therefore has a soft matt surface. A non-glare monitor screen is a good example of this quality.



Now that you have learned about the elements of design here are some exercises to work on.

The Principles of Design

The principles of design are the ways in which we organize the elements of design to create a cohesive composition.

The principles of design we will be exploring are:

- Balance
- Emphasis
- Economy and Continuation
- Rhythm
- Unity
- Proportion
- Contrast

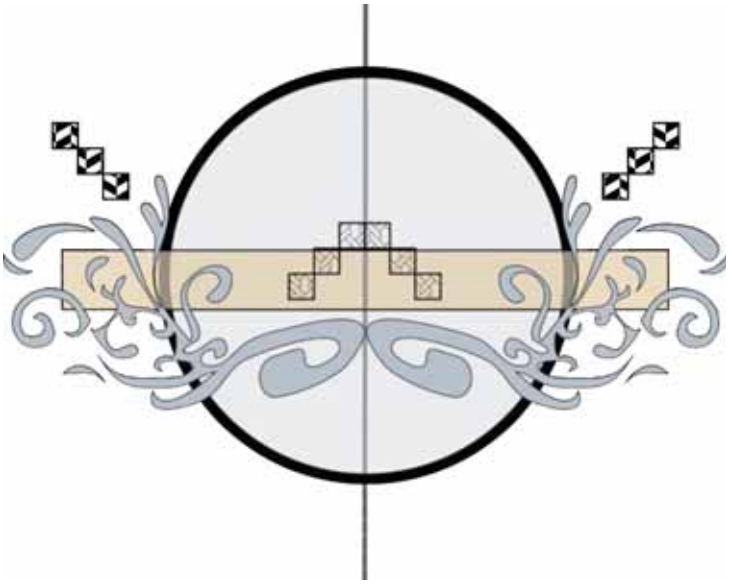
Balance

Balance is the visual arrangement of elements or objects in a composition that creates a sense of equilibrium. Balance can be symmetrical, asymmetrical, or radial.

Symmetrical

Symmetrical balance means both sides of an imaginary line are the same. Symmetrical balance is another term for symmetry. A composition has symmetry elements are repeated in a mirror-like fashion, usually on a vertical axis. This mirror-like symmetry is also known as bilateral symmetry.

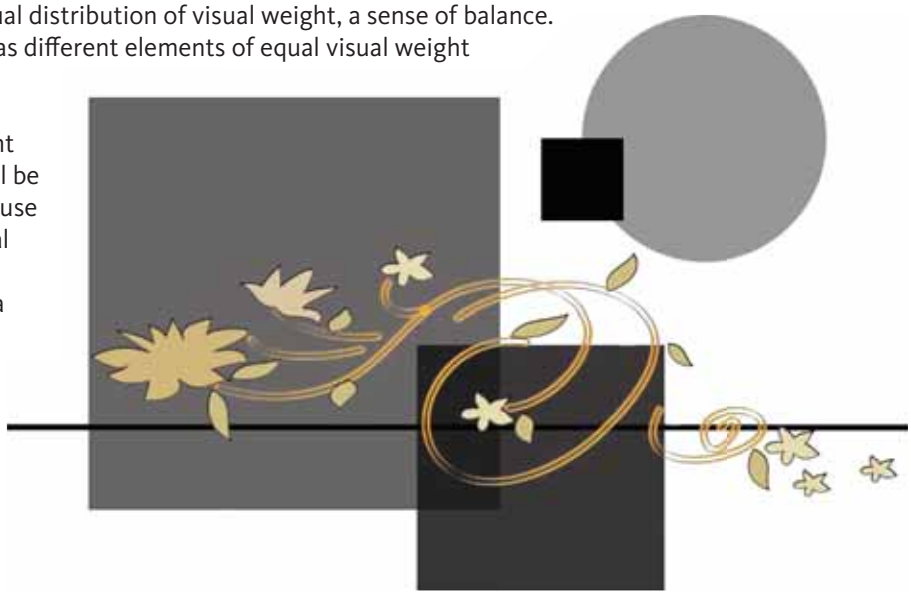
Symmetry appeals to our innate sense of balance. We see symmetry in our bodies, as well as throughout out natural and man-made environment. We observe symmetry on a daily basis in the world around us. For this reason, it can be a valuable tool in design as it can evoke a feeling of predictability and stability in the viewer.



Asymmetrical

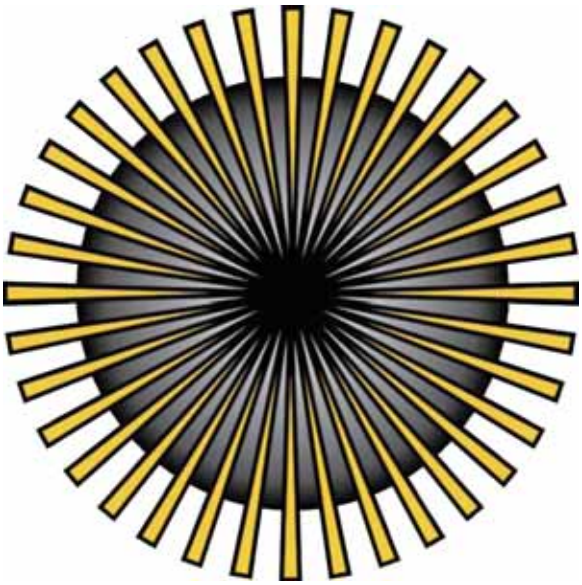
Asymmetrical balance means each side of an imaginary line is different yet equal. Asymmetrical balance, or informal balance, refers to the creation of visual balance through the use of contrasting elements. These elements may include different sizes, shapes, values or colors yet still provide, through the equal distribution of visual weight, a sense of balance. This sense of balance is created when a design has different elements of equal visual weight distributed on either side of a central axis.

Large, dark shapes always "feel" heavier than light shapes. The lower portion of a picture format will be viewed as nearer to the ground and heavier because of our innate sense of gravity. An element's visual weight will also vary according to size, texture, complexity of shape, contrast and placement in a design format.



Radial

Radial balance, or radial symmetry, is when elements emanate from or are arranged around a common central point. Radial symmetry often incorporates the use of diagonal elements that extend from a focal point. Flowers and other natural forms often exhibit this kind of balance. Radial symmetry is used in many circular designs. The attention is drawn to the center by the elements and principles used in the design.

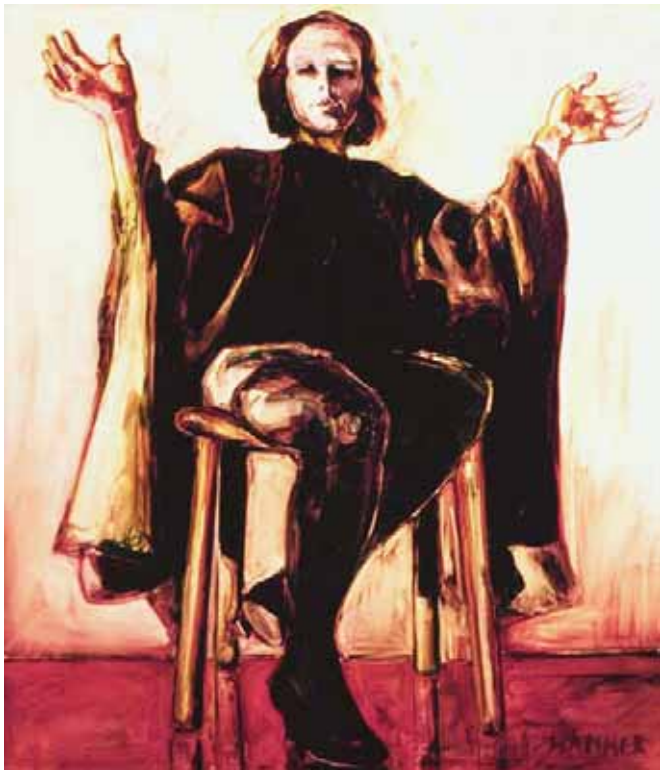


Emphasis

Emphasis creates a focal point or points in a design. It can serve as a marker to show what in a composition has hierarchy or importance. Levels of emphasis can work as road signs to guide the viewer through the multiple levels of a composition. You can create emphasis by making something dominant or by creating a focal point.

Dominance

An object or element has dominance when it has priority over surrounding objects either through the use of color, size, position, or proximity.



Focal Point

A focal point in a composition can be created by light and dark (contrast), line movement (either implied or real), the level of saturation of colors, and by the use of dominance as described above.

Economy

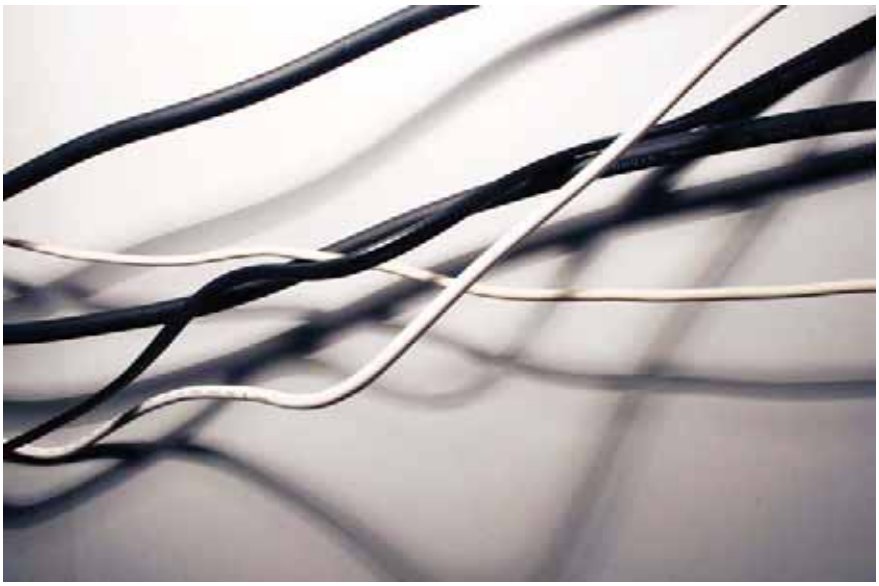
Economy is a principle of design which emphasizes the simplification of elements to express a message. Only the elements required to express the idea are used. The use of too many elements or contrasts in a design may distract viewers from the message, or cause them to disengage completely from the viewing experience. To understand economy in design, think about and remember the phrases “less is more,” and “in simplicity there is beauty.”

Continuation

Continuation refers to the "lining up" of visual elements in a design. When elements are placed in a continuous fashion, the viewer's eye will transition from one element to the next with a feeling of unity. Continuation can also be created by tangible lines that you can see, such as on the edges of a tall building shooting up into the sky, and from implied lines, such as the direction a person in a composition may be looking. The viewer's eye naturally follows both to the natural conclusion.

Rhythm

Rhythm refers to the repetition of shapes or elements in a design. Rhythm also refers to the movement of the viewer's eye through a design. Often, the repetition of shapes can serve as a tool to create this visual pathway. This repetition may be random or planned, forming a pattern. It can also create a sense of tempo, or time, in the composition.

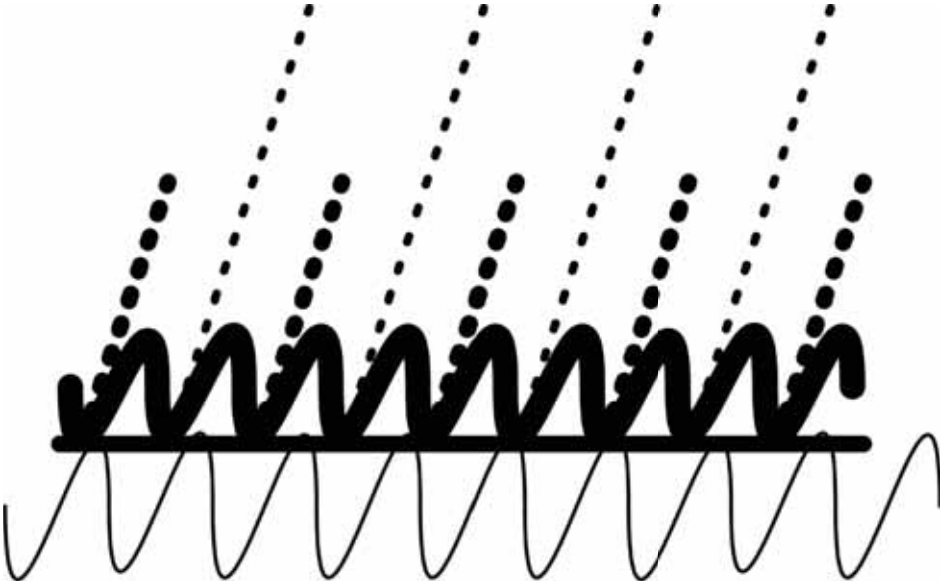


Repetition

There are different types of repetition.

- **Regular**

  Regular or systematic repetition is created when the elements and intervals between the elements have a consistency with very little change.

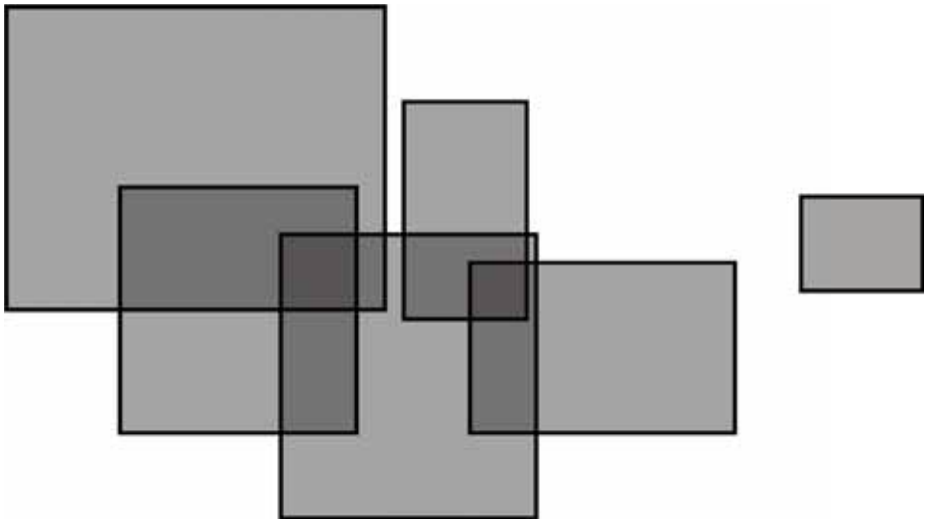


- **Flowing**

  Flowing rhythm is more organic and can have more variation in the elements used to create the composition, much like a winding natural stone walkway or waves of meandering wire.

- **Progressive**

A progressive rhythm sets up anticipation of continuation. This is done by the progression of sequential elements, like the scene layouts in a comic book or buildings in a city skyline.

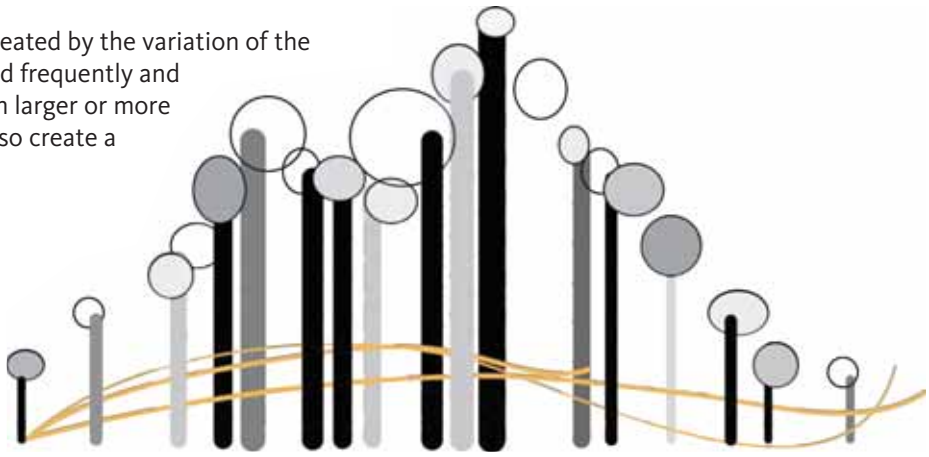


Pattern

Pattern is created by elements being repeated in a predictable fashion. The repeating element or elements work together to create an overall pattern.

Tempo

The tempo of the rhythm in a composition is created by the variation of the repetition of elements. Small elements repeated frequently and close together create a faster visual tempo than larger or more fluid elements spaced further apart. This can also create a sense of time in the composition.

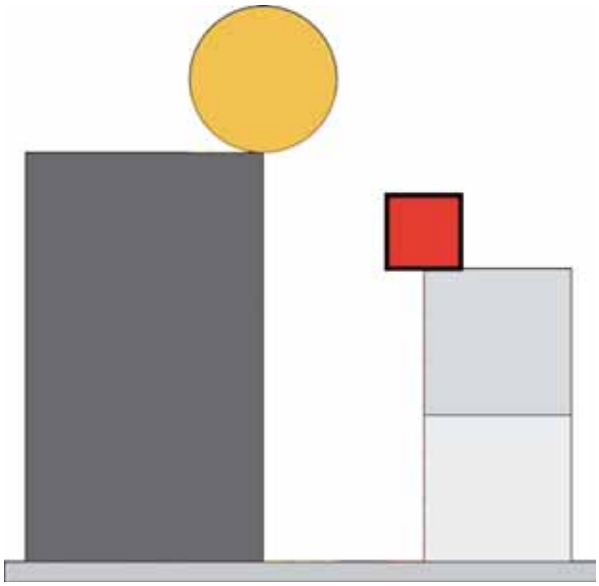


Unity

Unity refers to visual harmony and agreement among the elements in a design. When the parts work together to create a whole, you have unity. This is also called Gestalt. Gestalt is complex. Simply put, it means that the whole is greater than the sum of the parts meaning that we as viewers of a composition, get greater pleasure from the whole composition than by examining the individual elements used to create the composition. To achieve Gestalt, or unity, we can utilize the concepts of repetition, proximity and continuation.

Proximity

Proximity can create unity or tension depending on how much emphasis is given to each element and how close the elements are placed to one another. A sphere near the top edge of a cube creates tension through the sense that the sphere could drop, whereas another cube placed squarely on top of the cube creates a sense of unity or stability.



Proportion

Proportion is the relationship of elements in comparison with each other, or with aspects of a single element or object. Proportion can create a sense of unity or of unease. If we view a house with a door much out of scale with the rest of the house, we have a sense that something is not right. The same goes for a man with arms too long for his body. Proportion can also govern the amount of an element we use to create balance, such as how many organic shapes we might use in conjunction with how many geometric shapes. Proportion works well with balance and with unity.

Contrast

Contrast is used to create emphasis through the use of contrasting elements. Elements with strong contrast stand in opposition to one another: light against dark, large against small, round against square, smooth against rough, etc. In color, this might mean warm colors against cool colors, or light colors against dark ones.

There will often be many kinds of contrast within one design. Too little contrast will cause a design to be uninteresting; too much contrast can cause it to be confusing.

Contrast is a part of our everyday world. From the shape of a building against the sky, a boat against an ever-changing backdrop of sea and sky, or a statue in a garden, the mix of man-made and natural contrasts is all around us.

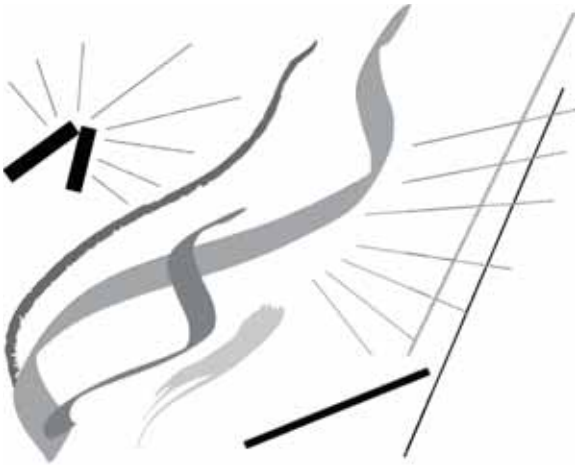
Examples of contrasts used in design might be:

- Large to small
- Light to dark
- Curved to straight
- Old to new
- Geometric to organic
- Smooth to rough
- Warm to cool
- Many to few
- Deep to shallow

Types of contrast

Line Contrast

The use of different types of lines can create a strong contrast. Thick, bold lines have a bold effect, but when contrasted with delicate lines, the entire atmosphere of a design can change. The bold lines may appear closer and the smaller, more delicate lines appearing further away. An emotional context can be established for strength versus weakness, leader versus follower, etc.



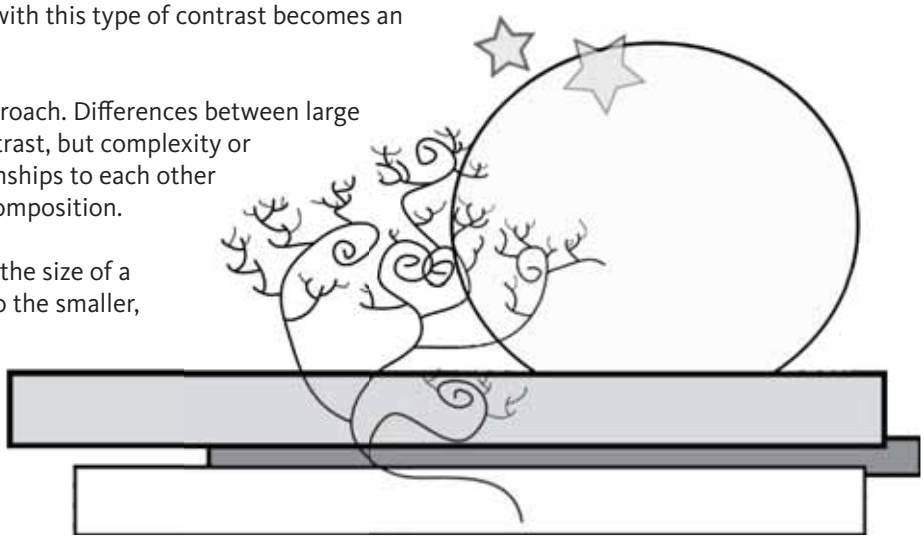
Line contrast can also create pattern and texture. Think of the hard flowing line that might make up the horns of a goat (pattern), and the short softer lines that can represent the fur of the goat (texture).

Shape and Form Contrast

Similar shapes of different sizes offer many opportunities for contrast. A larger shape may seem to advance visually, or it might appear more stationery because of its stronger visual weight. A smaller shape, because of its lesser visual weight, may seem to have the freedom to move around at will. Working with this type of contrast becomes an exercise in space and balance.

Completely different shapes offer another approach. Differences between large and small shapes can provide one form of contrast, but complexity or simplicity of different shapes and their relationships to each other plays a large part in the overall contrast of a composition.

A small, but complex organic shape can offset the size of a larger, simpler one. The eye will be attracted to the smaller, organic shape because of its complexity.
Angled or sharp edges can be very dramatic when tempered with curved or softer shapes. This type of contrast adds visual interest to a design.



Color Contrast

Color allows for very bold, or very subtle contrast, and an infinite number of steps in between. Colors can be contrasted with warm against cool, light against dark, bright against muted, etc.

Value Contrast

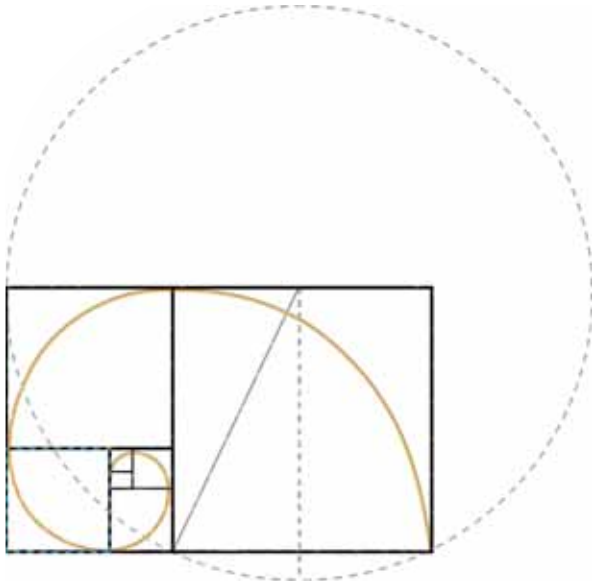
The effects of dark and light offer an infinite number of dramatic possibilities. They can set mood, create emphasis, establish a pattern, as well as give a sense of excitement, dimension, space, or environment.

Composition

Focal Point

An area of interest is called a focal point. As an artist, you can create and manipulate this area of interest. A focal point can also be thought of as a visual starting point within an image or space.

When designing a composition and placing a focal point, the artist is creating areas of emphasis within the picture area. The Golden Section is one method that artists throughout history have used to create these divisions of space in a harmonious manner. The “golden section” is a system of proportion, devised by the Ancient Greeks, based on mathematical relationships found in nature. This system of proportion relies on the use of a ratio, which defines the relation of one part to another. This is also used to create a relationship to the whole composition through a mathematical formula. The “golden section” is also known as the “golden ratio”.



Contrasts of value, shape and color are all simple and effective ways to engage the viewer. These differences and contrasts attract attention and can be used to make images more engaging.

The area of greatest contrast may also be the area of greatest interest in a design. This area of interest is called a focal point. The artist is both the creator and manipulator of this area of interest.

There are many ways to create this area of visual interest but one of the simplest is through value contrast. To review, value contrast refers to the relationship between areas of light and dark. Areas of similar value within an image are can be described as low-value contrast and areas with more extreme, pronounced value contrast can be referred to as having high-value contrast.

To create a focal point using shape:

- Use complex shape(s).
- Direct the viewer using compositional or perspective lines.
- Isolate the area of interest.
- Interrupt a pattern.

To create a focal point using value:

- Place highest value contrast in area of emphasis.
- Create a focal point in a high key design with dark values.
- Create a focal point in a low key design with light values.
- Create emphasis with size difference.

To create a focal point using color:

- Place an intense, saturated color in a design of muted colors to create emphasis.
- Place muted colors in a saturated design to create an area of interest.
- Introduce another color in a monochromatic scheme to create a focal point.

Color Theory

Controlling color can be difficult. But, it can be one of the most effective ways to control or affect a composition. The best approach with color is to think about a color scheme before applying color to shape or form. Joseph Ittens, the famous color theorist, said, "He who first draws lines and then adds color will never succeed in producing a clear, intense color effect." Color is an essential part of any composition and needs to be determined in the early stages of any work to be the most effective.

Color is tricky, in that it is constantly changing and is always being influenced by the colors surrounding it. It is almost impossible to see a color by itself without it interacting with its surroundings. In virtual space and on a 2D plane, color can behave quite differently than in the real world. In the real world, distant objects in the background appear to blend together and appear less saturated due to atmosphere. This can be replicated in virtual space, as well as on a 2D surface if you understand how to manipulate color.

The Color Wheel

Many people find choosing colors that work together an intimidating and confusing process. The following are some of the basic principles about how the color wheel works and schemes for using color. The following guidelines will help you learn how to use a very limited palette, yet give the impression of using many colors. The basic color wheel is made of twelve colors:

- Yellow
- Yellow-green
- Green
- Blue-green
- Blue
- Blue-violet
- Violet
- Red-violet
- Red
- Red-orange
- Orange
- Yellow-orange

All colors can be changed by changing the tint or shade. Tint is changed by adding white, and shade is changed by adding black. The following colors examples will include not only hue (the color) but the hue with tint (white) and the hue with shade (black).

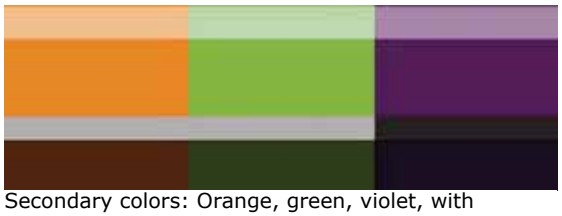
Primary Colors

Primary colors are used to create all other colors. When Primary colors are used together in a design, there is a strong color contrast because of their lack of similarity. Each color has a separate, independent identity.

Primary colors: Red, yellow, blue, with desaturation, tints and shades

Secondary Colors

Secondary colors are the product of mixing two primary colors together. They are positioned midway between the primary colors from which they are mixed. Secondary colors, when used together, have less color contrast than primary colors. For example, green and violet are secondary colors which both contain the primary color blue. The influence of the color blue creates a commonality between them. A softer color contrast is the result.



Secondary colors: Orange, green, violet, with desaturation, tints and shades

Tertiary Colors

Tertiary colors are made by mixing a primary with a secondary color. They are positioned between the primary and secondary colors from which they are mixed.

Tertiary colors: Yellow-orange, red-orange, red-violet, blue-violet, blue-green, yellow-green, with desaturation, tints and shades

Temperature

The color wheel can be divided into areas of color temperature, known as warm and cool.

Cool Colors

Cool colors are any colors that contain or are related by the color blue. Colors such as green, blue and violet are dominant cool colors. Cool colors are calming and appear to recede into space when placed next to warm colors.

Cool colors from the color wheel

Warm Colors

Warm colors are any colors that contain or are related by orange. Yellow, orange and red are dominant warm colors. Warm colors are aggressive. When used with cool colors, they appear to move forward into the foreground.

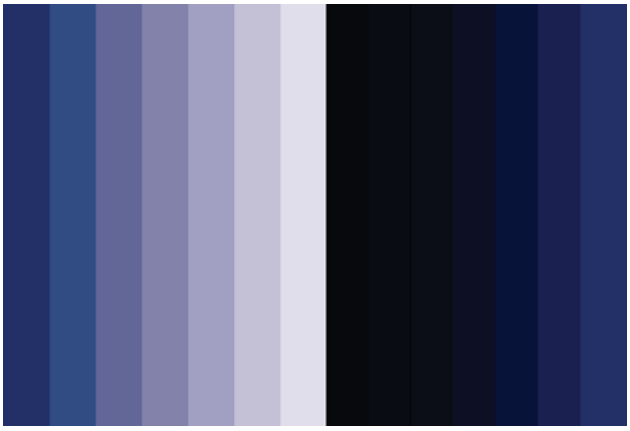
Warm colors from the color wheel

Working with Color as a Beginner

Many artists who are just beginning to work with color find choosing colors that function well together an intimidating process. The biggest mistake artists make in the beginning is trying to use too broad of a color palette. Learning to work with a limited palette in an effective way can actually give the impression of using many colors. Let's look at a few of the basic color schemes and consider some of the basic ways to begin using color.

Monochromatic

Monochromatic is the simplest of the color schemes. It uses only a single hue along with tints, shades, and tones. Adding a neutral and varying the values of that single color can help create interest and add contrast. A monochromatic color scheme explores the tints and shades of a single color. You will notice that the pure hue is brighter and more vivid than the hue mixed with either white or black. The color in its fully-saturated state attracts the eye more powerfully than the tints and shades around it. The tints and shades are not as intense in hue saturation and become desaturated. Adding white, black, or any other color to a pure color will desaturate it.



Monochromatic color scheme, blue with black and white added

Analogous

An analogous color scheme uses two or more hues lying next to each other on the color wheel. This is an elegant scheme to use and often seen in nature. An analogous color scheme is harmonious because the colors used share common color characteristics.

For example, red-orange, orange, and yellow-orange are all mixed from varying amounts of red and yellow. Analogous color schemes can be very effective and like monochromatic, in a 3D environment or on a flat 2D picture plane, can create color consistency.

Analogous color scheme with example of value changes

Complementary

A simple complementary scheme begins with two colors that are opposite of one another on the color wheel. These colors intensify each other's appearance, so the end result tends to be stimulating, and can even give the visual illusion of vibration

Toning down the saturation of complementary hues (with tint/shade/saturation) and raising or lowering their value beyond the level of maximum saturation lessens the visual contrast between them.

Complementary color scheme

Triadic

This is a broader range of contrasts that draws on three colors equidistant from each other on a color wheel. (This happens if you draw an equilateral triangle within the color wheel). An example would be the three primary hues. If you turn the triangle a bit, you would have red-orange, yellow-green, and blue-violet. When any two colors from a triadic color scheme are mixed together, they will create interesting semi-neutrals.

Triadic color scheme

These colors are called semi-neutrals because they are not true neutrals. A true neutral, or mute, is the product of a color mixed with its complement.

Split Complementary

A split complementary is any one hue plus the two hues located on either side of its complement. This can be a broad color scheme and easy to use in a number of interesting ways.

Split complementary color scheme

Hue, Value, and Intensity

Every color has three properties: hue, value and intensity.

Hue

Hue is the quality we identify by a color name such as “red” or “purple.” It corresponds to the distinctive wave-length of a color. To change the hue of a color, we must mix another color with it. If a little green is mixed with blue, the resulting change from blue to greenish blue is a change in hue.

Change of hue

Value

Value is how light or dark a color appears. Referring to the relation of a color to white or black, value indicates where on the value range of pure dark to pure light a hue resides. Think of it this way: a light blue sky has a high value; a dark night sky has a low value. A change in value is higher or lower in value than the normal spectrum of the hue.

To change the value of a color, we need to mix it with something lighter or darker. By mixing black or white with a color, we change the value without changing the hue. This is how you desaturate a color.

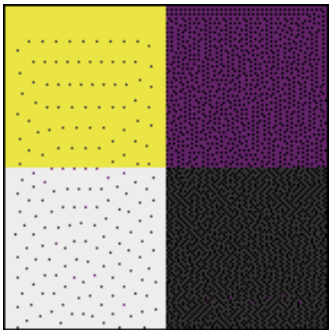
Intensity

Intensity refers to how bright or dull a color appears. It is also called saturation or chromaticity.

Basically, intensity is how much of the hue is identifiable. Grays are achromatic, meaning no hue or color is identifiable. Therefore, grays are low in intensity. A primary red, on the other hand, would be completely saturated and therefore extremely intense and high in chromaticity. Hues reach their full intensity at different values. Yellow would reach its full intensity higher on a scale of grays than red or blue.

Color wheel with value and intensity

Different colors have different values. For example, if you compare the value of yellow to the value of violet, yellow is much lighter in value than violet.



Color and value comparison

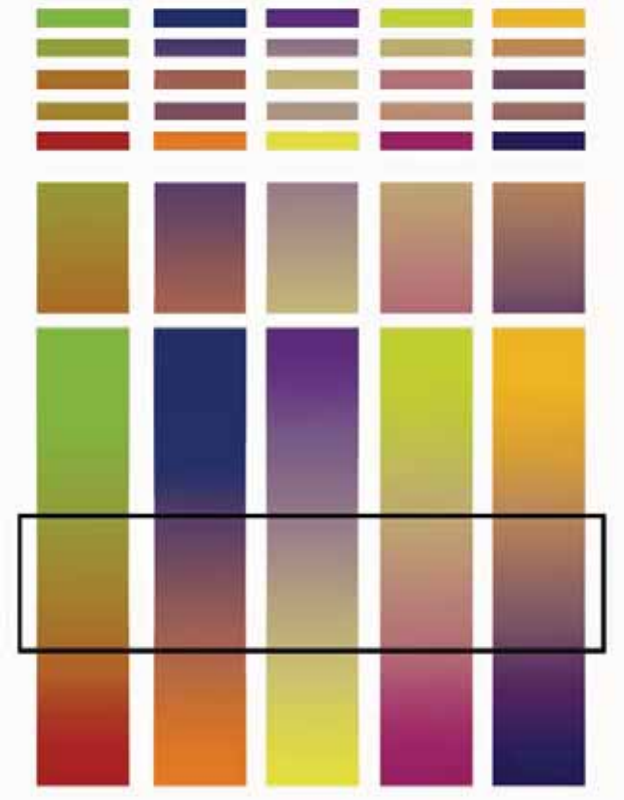
One way to imagine the value of a color is to imagine it as a black and white photograph.

Color wheel with corresponding gray scale swatches for value

Neutrals

Neutrals are hues that have had their complements added to them. Adding a color's complement to desaturate it is referred to as muting the color. This creates a neutral hue. Mixing any two highly contrasting colors is an easy way to make the colors harmonize. The two hues mixed begin to share the same influences in the process.

This process is one to stay in if you want your work to appear harmonious. It is also one way to ensure a pleasing color scheme. When you can work primarily in the neutral range, you can use the more saturated and contrasting colors to create your focal points or relief to the predominate color range.



Palette of neutral colors that have had their complements mixed

Color and Storytelling

Color theory may not be magic, but it does bring us to the hidden emotional power of color.

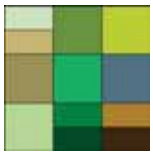
When it's a drab day and you watch a movie that takes place in a sunny resort, you may feel as if you've been in the sunshine. What we see affects our feelings, but how? If you put your hand on a picture of warm colors, then on a picture of cool colors, you can't tell the difference. But somehow your eyes tell you that one is warm and the other cool. That's because color has "associative power." Warm colors like yellow and orange and red are associated with the sun and fire and embers. Cool colors like green and blue and violet remind us more of leaves and pools and nighttime. There are exceptions – some fire is blue, and the petals of a rose may be just as cool as the leaves – but we still feel as if red is warmer and blue is cooler, even if it's not literally true.

Artists use this. Storytellers use it. They choose colors based on how the colors "feel." They may use bright colors to make a block look like a piece of candy, or a poisonous frog. They may color a track to appear like vines or limbs or blood vessels or trails of light. They may color a tense conversation scene with a palette like an erupting volcano. They may color a love scene, even if it takes place indoors during the winter, with a palette like a spring garden. This is how we use color creatively – not by choosing literal colors, but by choosing colors that express feeling. Or to put it another way: we don't paint with acrylics or oils or RGB coordinates, but with fire and ice and blood and earth.

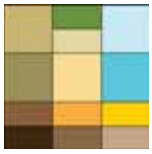
Now, put your imagination to work. How would this scene look if it were colored like an ice-cream parlor?

A blast furnace?

A jungle?



A farm?

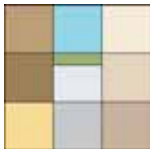


A dungeon?

A junkyard?

A fiesta?

A desert?



What "season" should it feel like? Autumn colors may give a story a somber tone, whereas summer colors may feel more cheerful. If you think this scene should feel a certain way, come up with your own ideas for color associations. It will help you to make creative choices for your palette, and add emotion to the scene.

As you learn to model, texture and animate in 3D, think about how the elements and principles of design, color theory and composition apply to your scene.

- Are your objects interesting shapes?
- Are the scale and proportion working?
- Are there areas where your eyes can rest?
- Are there focal points to draw the viewer to?
- Are you using color to tell your story?

Working in 3D allows you to view your objects in orthographic and perspective views. You are able to create objects and render them from different camera angles. Design, color and composition are important factors and a larger challenge to control in a 3D space. As you start to lay out your project, think about what the story is you want to tell and how you can apply the theories you have learned to create a clear message for the final viewer of your project.

Workbook

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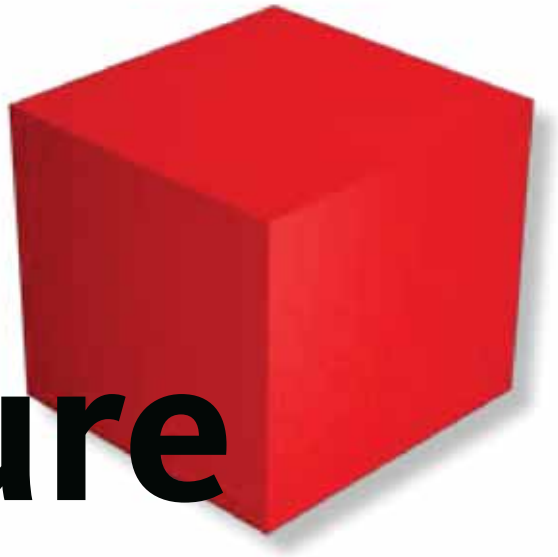

Texture

Workbook

Texture

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Texture Principles

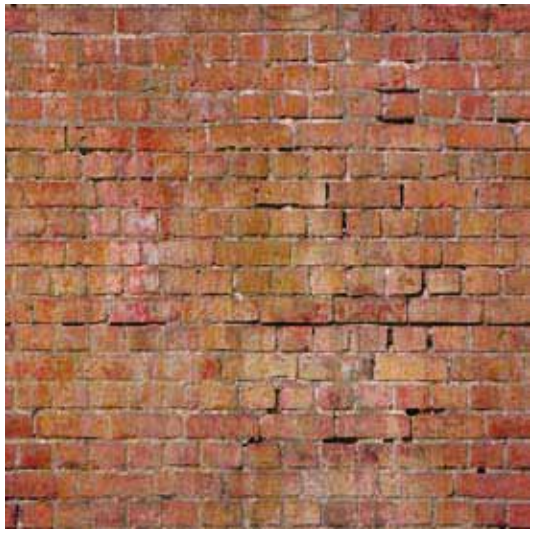
In this lesson, you learn the process of creating a texture from photographic references, and how they apply to video games and film. The texture tells the story of the untextured grey model. Textures add life to the entire environment, and give way to new ideas. Many art styles are combined when creating professional textures. Hand painted textures are created with a stylus much like a painter's brush. A great deal of time is required to get high quality results. Devising a system of texture creation can speed up production time. The process is easy to understand, but it may take some practice to get the textures just right.

Tileable and Custom

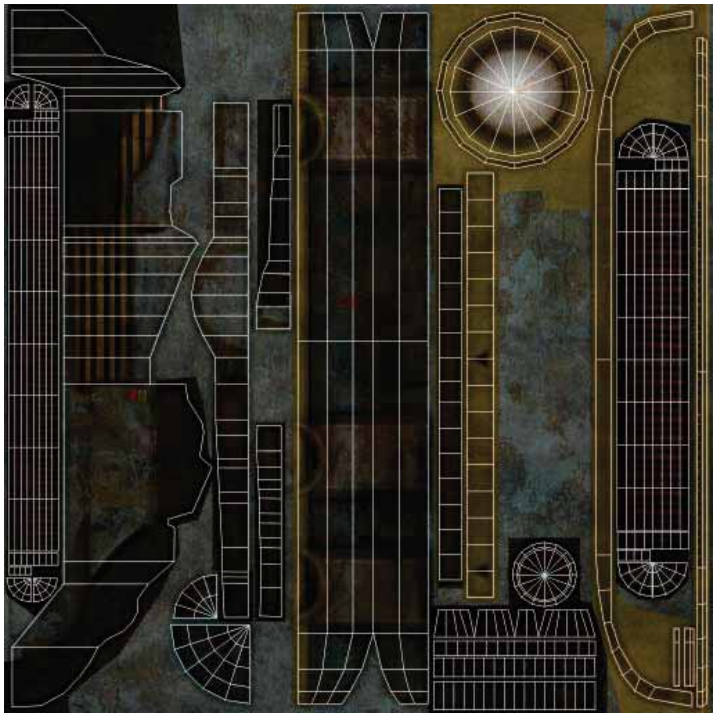
A texture map is a 32 bit RGB color file created in Adobe Photoshop or another 2D painting program. Textures are used in video games, film, TV, and advertising. Most 3D models have a texture on them, like a colored skin that shows color, specular, and fine details. Procedural textures require a mathematical algorithm to be generated. These are used mainly in film and TV production.

A tileable texture is a 2D image that is applied to a polygonal object or BSP level geometry. You create the textures from a digital photograph or a hand painted image. Tileable textures are designed to have seams in a specific area, or no seams at all. Having no seams enables a texture to be repeated over a large area. Custom textures are unique to a specific model or area. A custom texture has unique UV space and a fixed resolution. It is possible to reuse portions of a custom texture to save space and time. One way to reuse a portion of texture is to mirror from the right side of an object to the left side.

Pictured are a tiled brick texture and a custom metal prop texture.



Tileable brick texture



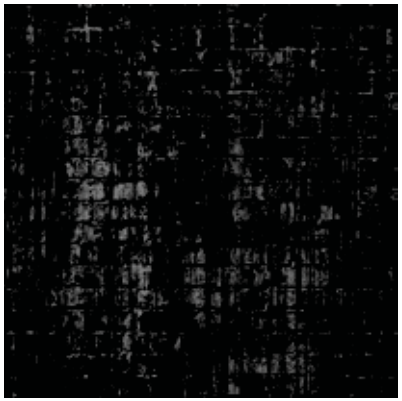
Custom prop texture

Texture Principles

The images display a brick texture mapped on primitive objects. The brick texture is tiled once, and can be made to tile in all directions. This is a Phong shader, and it has a diffuse, specular, and normal map.

Diffuse Map

Specular Map



Cosine Map

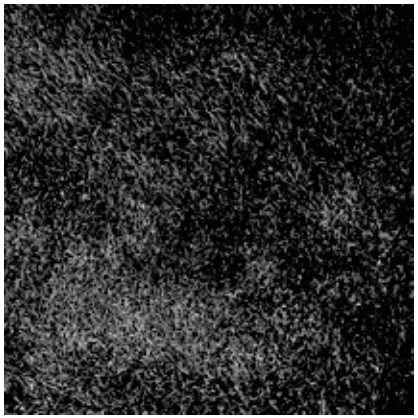
Normal Map

Texture Principles

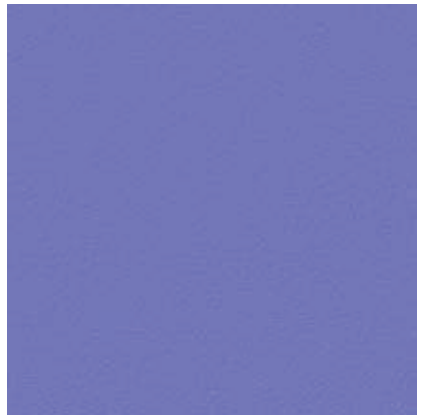
Pictured is an organic grass texture. This is a Phong shader and it has a diffuse, specular, and normal map.

Diffuse Map

Specular Map



Cosine Map

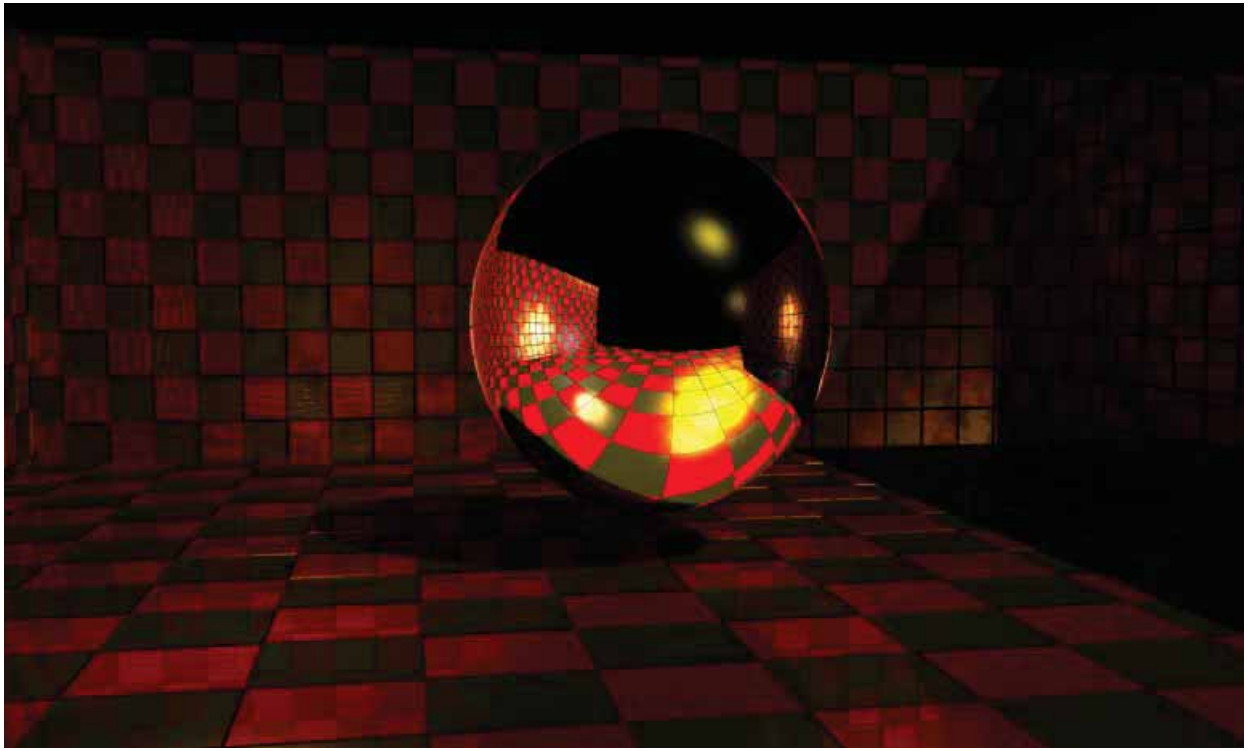


Normal Map

Texture Principles

You create procedural textures using a nod- based system in the material editor of the 3D software package or game engine. These textures are mathematically based, and can be infinitely tiled.

The image is a chrome shader on a sphere, in an environment with checkers on the walls and floor. Notice the yellow lights in the scene are reflected on the chrome ball. There is a directional light facing downward to the lower left, and two point lights.



Texture Principles

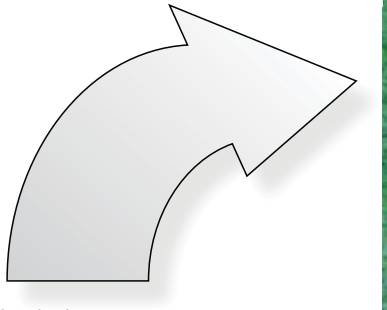
The process for creating a tiled texture that may be used vertically and horizontally is done in Photoshop. Once you have a good photograph, use the offset filter to display the seams in the middle of the texture. The goal is to paint out the hard edges. Using the Clone tool, the seams are hand painted so they are not visible. The same process is done for concrete and wood textures. It is more difficult to paint out the seams in organic textures, and may take time to perfect. Brick can be made seamless by using single or groups of bricks to cover the seams.

The images are of a grass texture, the offset texture, and the texture with seams painted out.

Original grass texture

Grass texture using offset filter

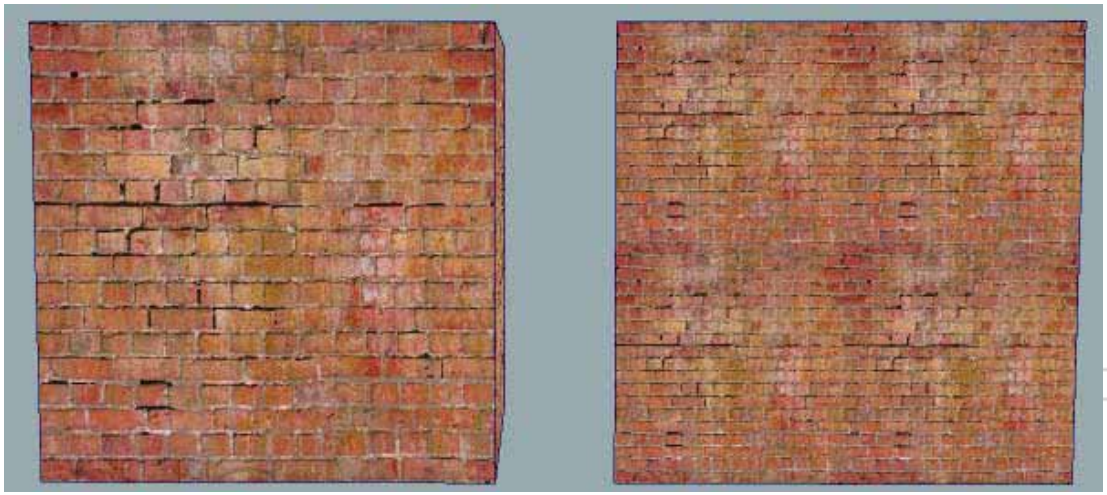
Grass texture with painted seams



Pictured is the seamless grass texture tiled twice in both directions.

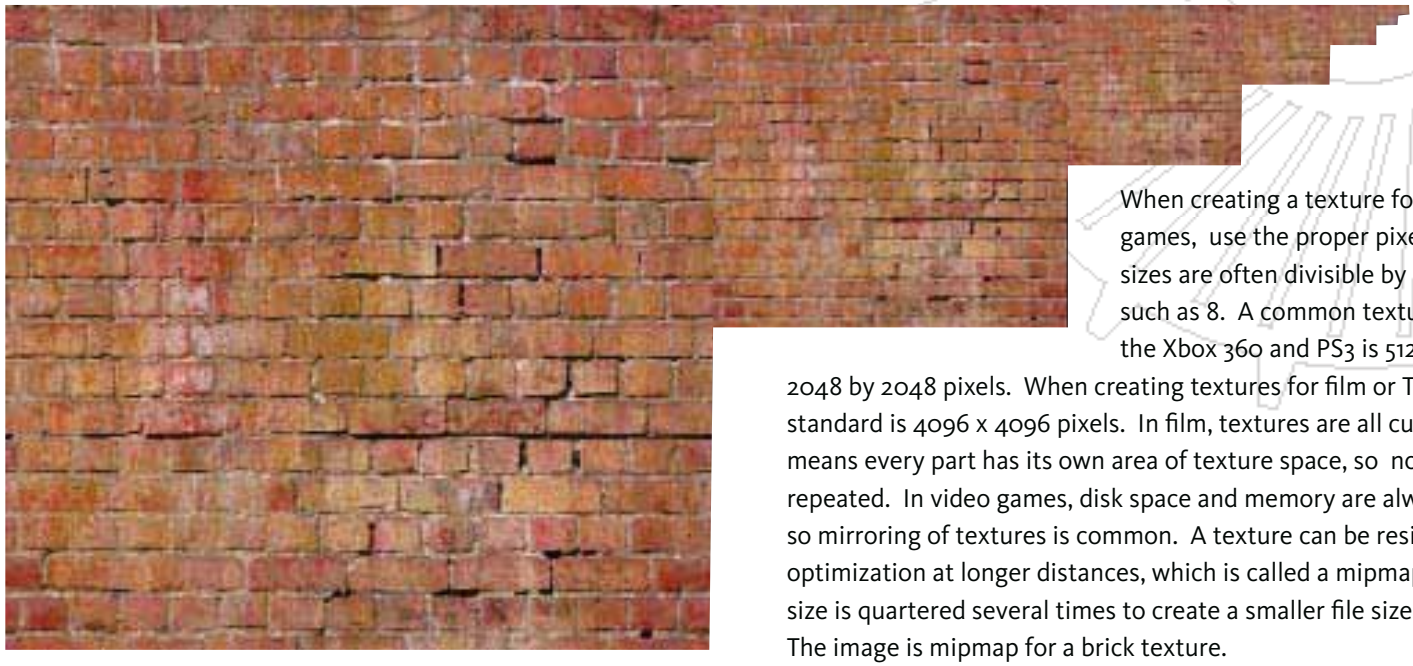
Texture Principles

The images are the brick texture on a cube, one is tiled once, and the other is tiled twice.



UV's tiled once

UV's tiled twice



When creating a texture for film or video games, use the proper pixel size. Texture sizes are often divisible by an even number such as 8. A common texture size for the Xbox 360 and PS3 is 512 by 512, up to 2048 by 2048 pixels. When creating textures for film or TV, the current standard is 4096 x 4096 pixels. In film, textures are all custom. This means every part has its own area of texture space, so nothing looks repeated. In video games, disk space and memory are always a concern, so mirroring of textures is common. A texture can be resized for game optimization at longer distances, which is called a mipmap. The texture size is quartered several times to create a smaller file size.
The image is mipmap for a brick texture.

Texture Principles

You create a mipmap using a plug-in for Adobe Photoshop, with the Nvidia Normal Maps and DDS filter. The Nvidia Normal Map and DDS filter create normal maps, and may also export specific settings to the DDS format. The DDS format is a compression tool for exporting smaller versions of the same texture. Creating a mipmap is usually done on the programming side, and is automatically swapped when the player gets farther away from an object. The physical resolution or polygon count is optimized in video games called a Level of Detail model. A LOD model is created at half the resolution for viewing at long distances. In film, there is no need for this since it is all rendered out for non real time viewing.

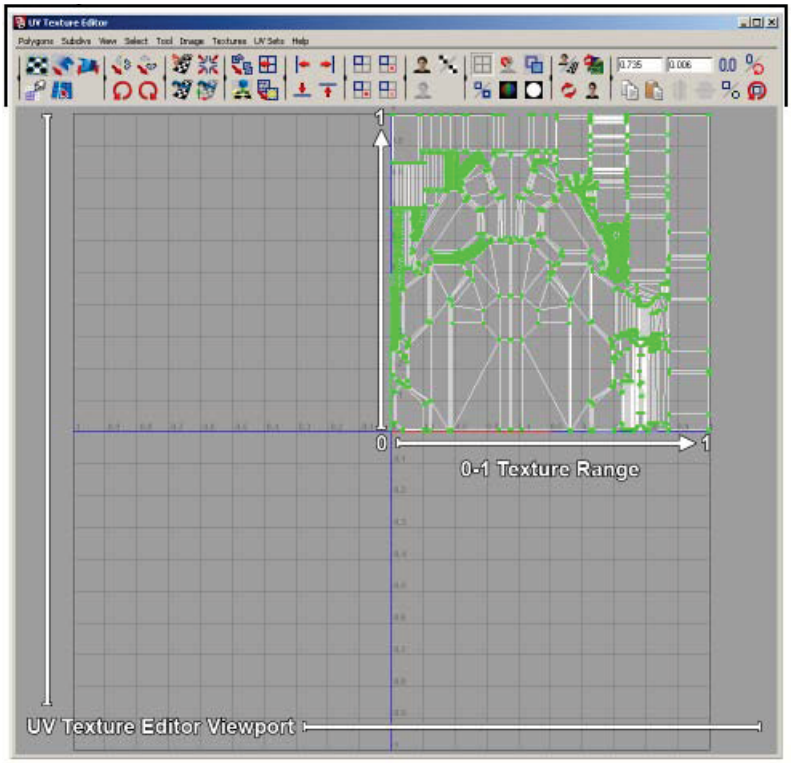
The image is mipmap for a prop texture.

Texture Principles

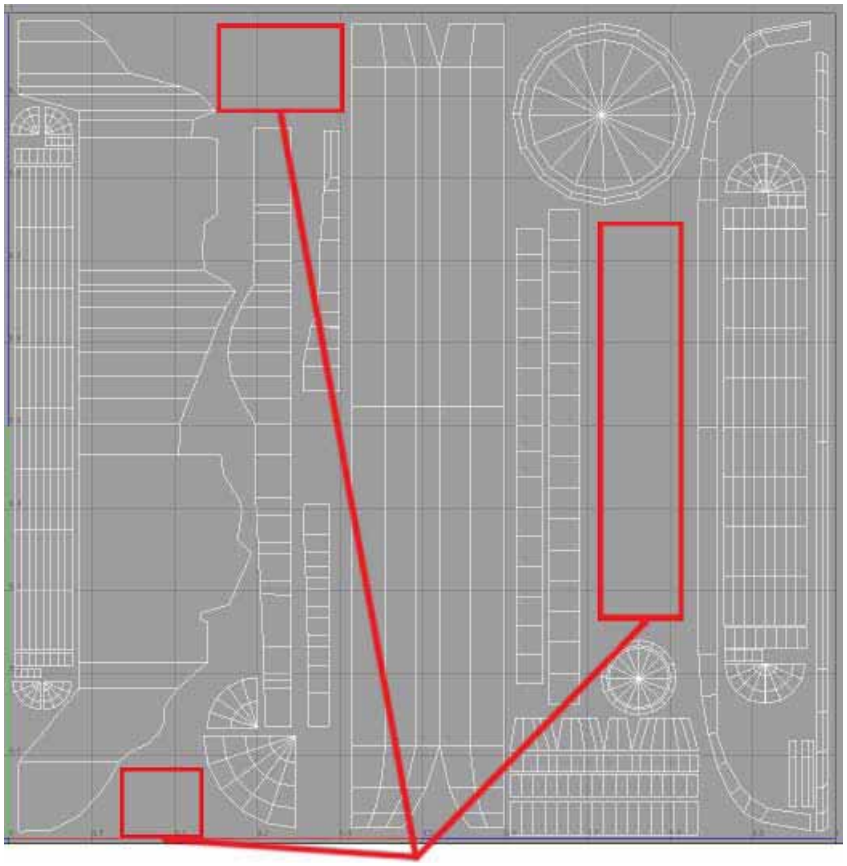
UV Placement

A model has a set of UVs on each polygon edge, similar to a vertex for texturing. A tileable texture usually starts on the 0 to 1 Texture Range, and can be scaled to the desired resolution based on the geometry size. It is okay to go outside of the 0 to 1 UV space when creating a tileable texture in a 3D package. In a human head model, the geometry is laid out so that there is no UVs overlapping. In some cases, there may be overlapped UVs when the geometry is mirrored or reused.

The image is the Autodesk Maya UV Texture Editor and 0 to 1 texture range.



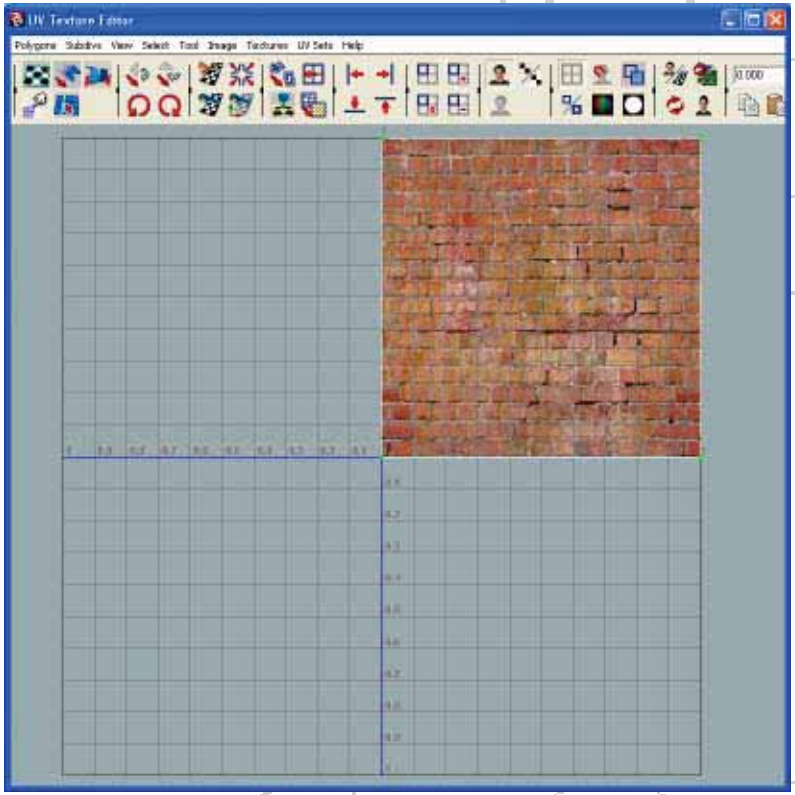
Pictured is a prop with correct UV placement, although there is some wasted UV space. Use stickers and detail variations to fill empty space.



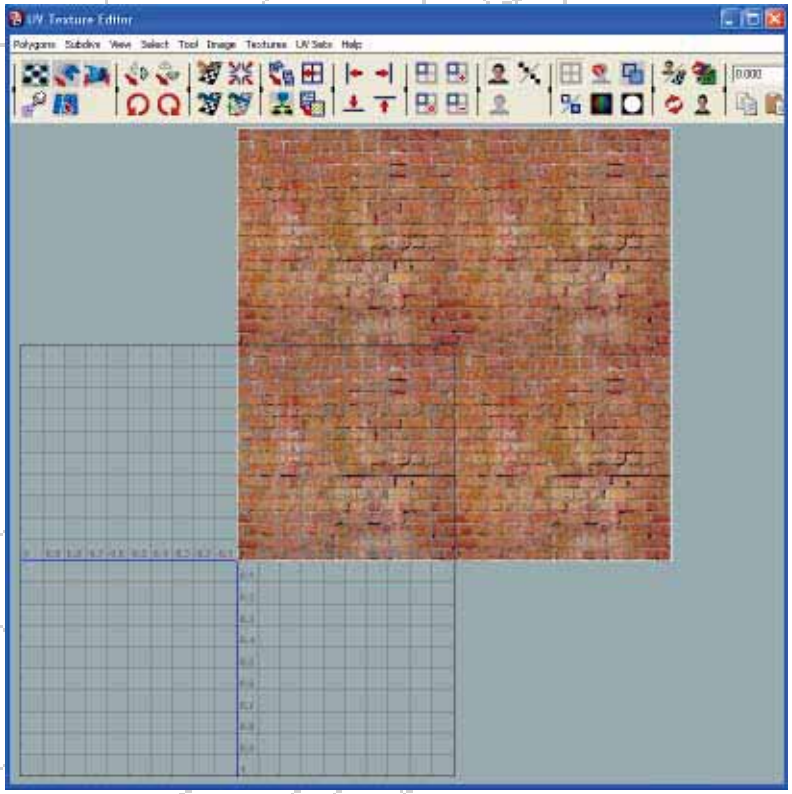
Try and fill the empty space with extra details and variations

Texture Principles

The image displays a UV Layout with UVs in the 0 to 1 space.



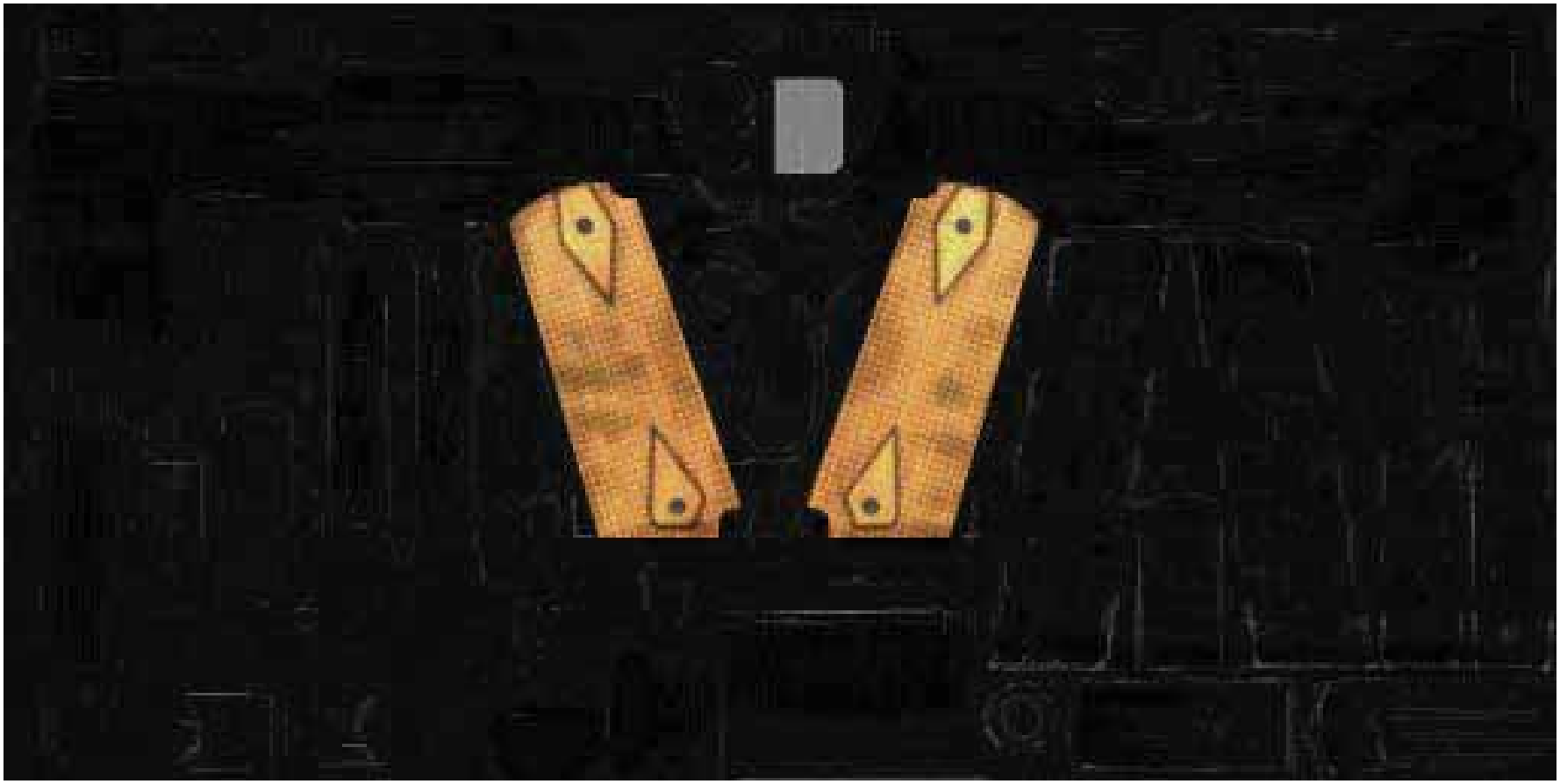
The image displays the UV layout with tiled UVs twice.



Texture Principles

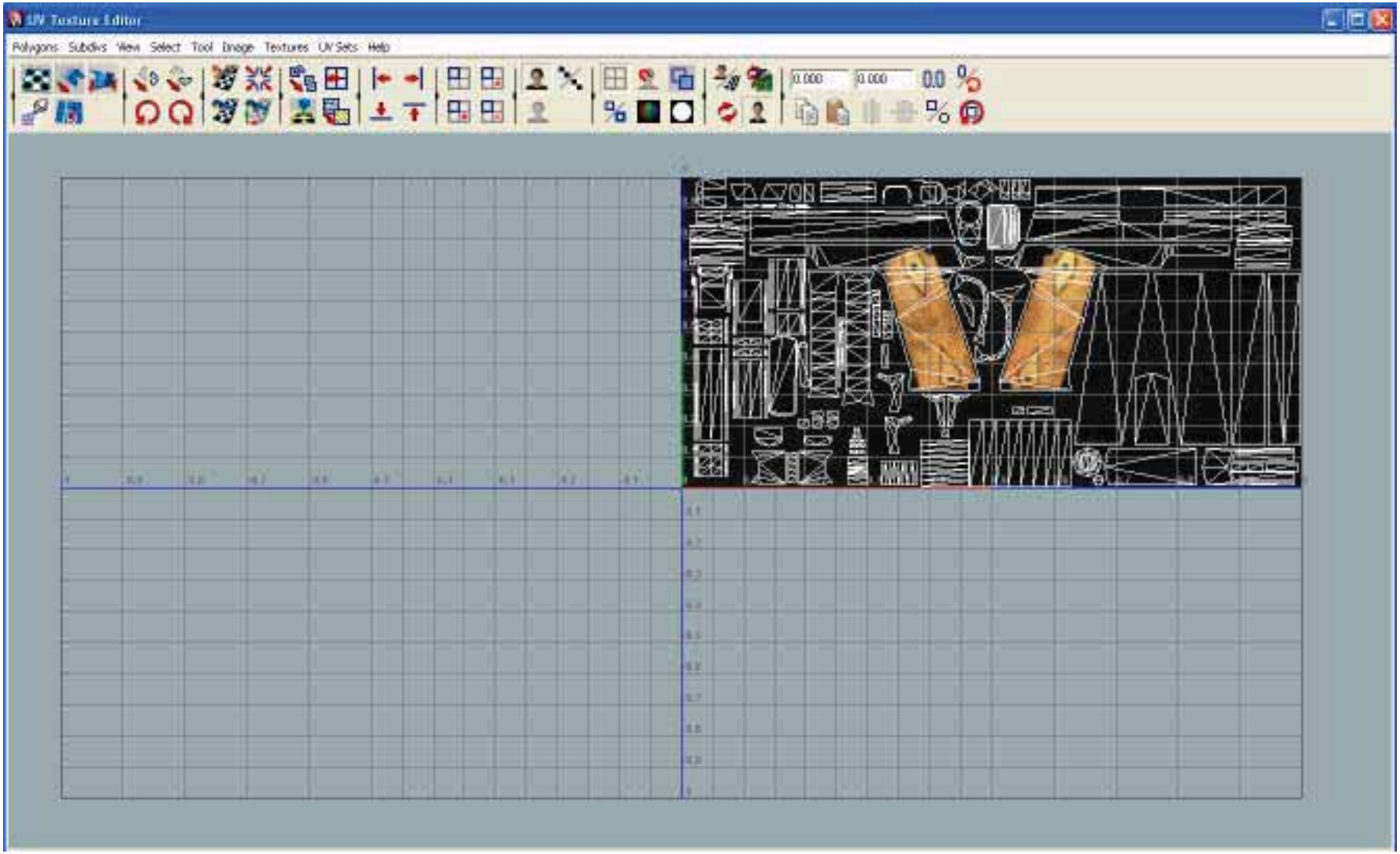
A square texture occupies the 0 to 1 UV space, such as 512 by 512. A rectangular-shaped texture, such as 1024 x 512, also occupies the 0 to 1 space. However, it must be scaled left to right to fit. When the texture is applied, it will show up in the Texture Editor and on the model as looking correct. This is a good way to save space using the 2:1 ration textures. When creating UV layouts, think about ideal placement for optimal resolution and reuse. It might seem extreme, but the tighter the UVs, the higher the quality of the textures.

The texture displayed fits in the 0 to 1 space and is 1024 x 2048 pixels.



Texture Principles

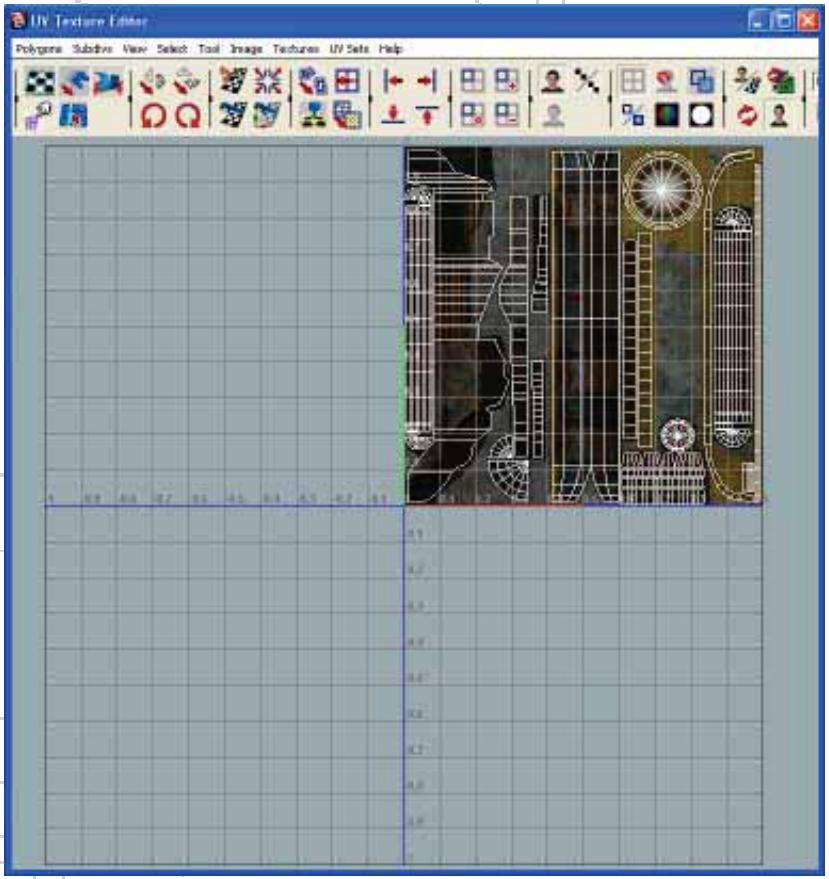
This image is the UV layout of the handgun.



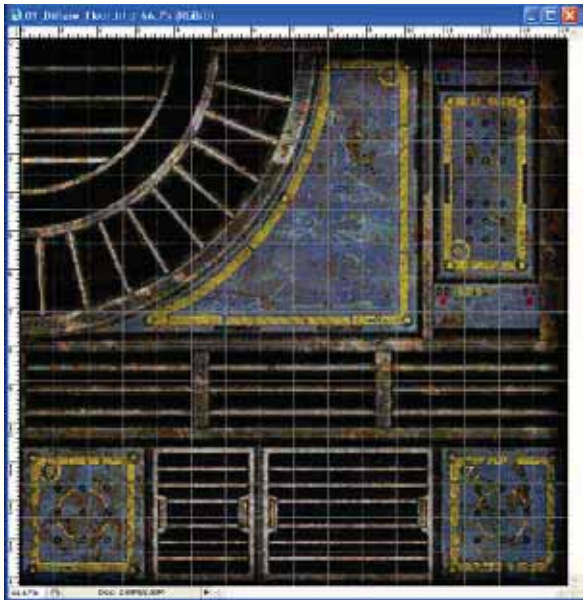
Texture Principles

The texture displayed fits in the 0 to 1 space and is 1024 x 1024 pixels.

This image is the UV layout of the prop.



Texture Principles



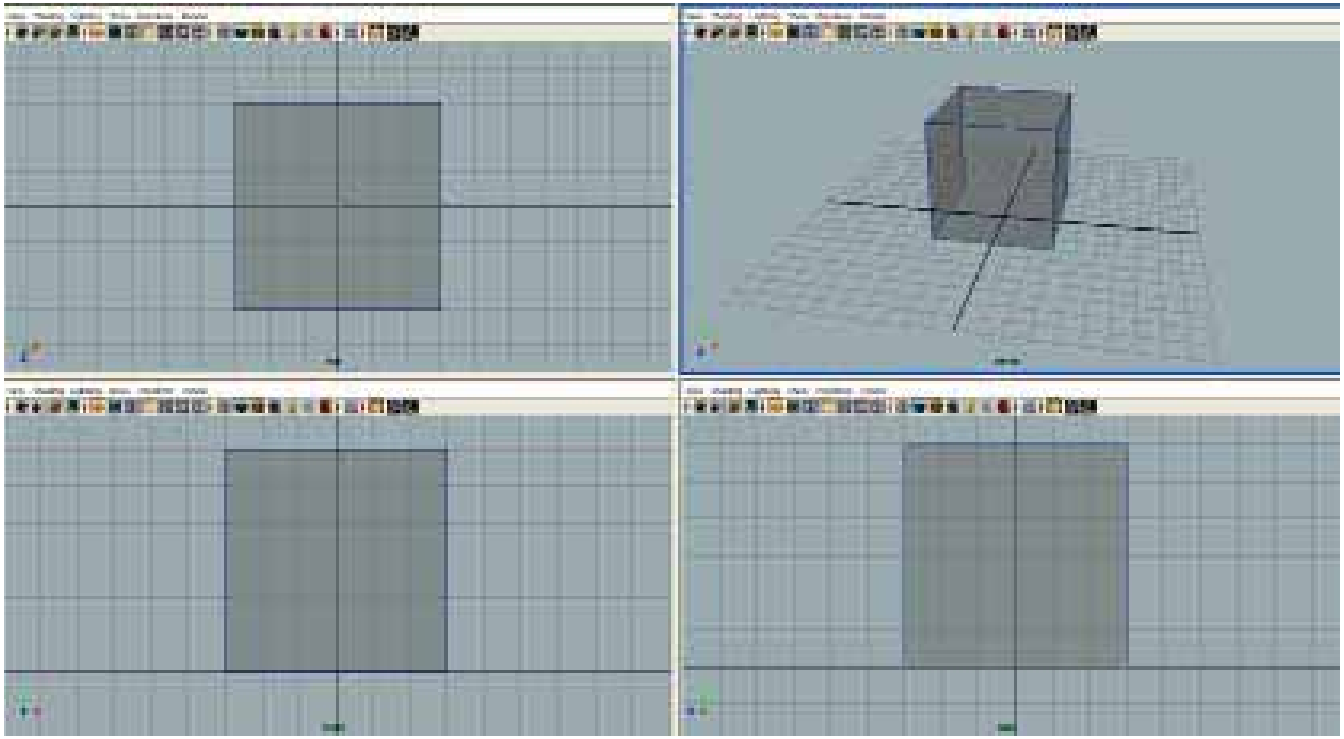
The Grid

The grid refers to the coordinate system that a game engine, Photoshop, and 3D software use to align geometry and textures. The game engine is based on powers of 2. The grid is used in every 3D software package, but may have different settings. It is applicable in creating assets for film and TV. Setting up proper grid units in the 3D software and Photoshop enables you to take full advantage of reusing textures. The artist creates trim pieces that can be taken from a tileable texture and reused throughout the level. Texture sets that are the same style may be built on the grid, and will line up with the game engine or 3D geometry.

The image is a photo of a grid setup in Adobe Photoshop with a grid overlay and rulers.

In older generation video games, the textures were made to lie precisely on the grid. Today, video games have enough storage to have custom texture maps on many surfaces. When creating environment artwork, use the 3D grid. The grid enables modular pieces to be snapped to one another. Many video games also take advantage of the 3D package unit setup, which usually matches the video game engine units. You adjust the grid for the scale and dimensions of the object being created. It is important to build the geometry clean, so there are few intersecting pieces of geometry.

Pictured here is a cube snapped to the grid in Autodesk® Maya® software.



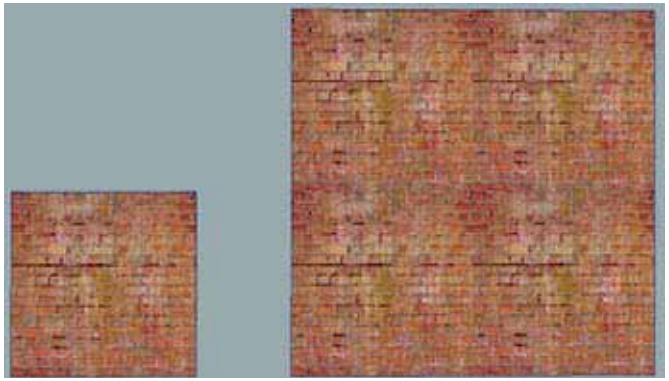
Texture Principles

Texel Density

Texel density is the pixel resolution on the relative size of the object. The pixel resolution keeps a relative balance between the textures in a scene. It is best to keep a close relationship of resolution on the environment and characters. You make adjustments if visual flaws are apparent. Some game engines automatically use a predefined texel density, such as 4 pixels per inch. The game engine automatically repeats the texture to fit the size of the level geometry. In film, the resolution is set manually by the artist in the UV editor. There are resolution standards for games and films that export directly from a 3D package.

Texel density is the amount of pixels used per inch of geometry. A 512 by 512 pixel texture covers 7 1/2 feet of space, or 90 inches. A 1024 by 1024 pixel texture covers 15 feet of space, or 180 inches. The desired texel density of 5.6 pixels per inch is calculated this way for most surfaces. When creating smaller table top sized props, use a higher texel density of 8.5 pixels per inch. This means that a 512 by 512 should cover 5 feet, or 60 inches. A vehicle or portion using a 512 by 512 texture equates to 10 feet or 120 inches, with a texel density of 4.2 pixels per inch. The wheels use the 90 inch formula of 5.6 pixels per inch.

The image is a 7 1/2 foot and 15 foot wall using a 512 by 512 texture.



Brick wall that is 7 1/2 feet tall using a 512 x 512 texture

Brick wall that is 15 feet tall using a 512 x 512 texture

In Maya, enter 90 in the Projection Height and Width. It displays the amount of UV space to use. Autodesk® 3ds Max® and XSI also have settings that enable a fixed texture resolution. If your object only takes up one quarter of the 0 to 1 space when a 90 inch projection is used, then the model will only require a 256 by 256 texture. This ratio of size to pixels may be changed when more resolution is needed. There is no exact texel resolution for film or games. It is usually set by a technical director and may vary.

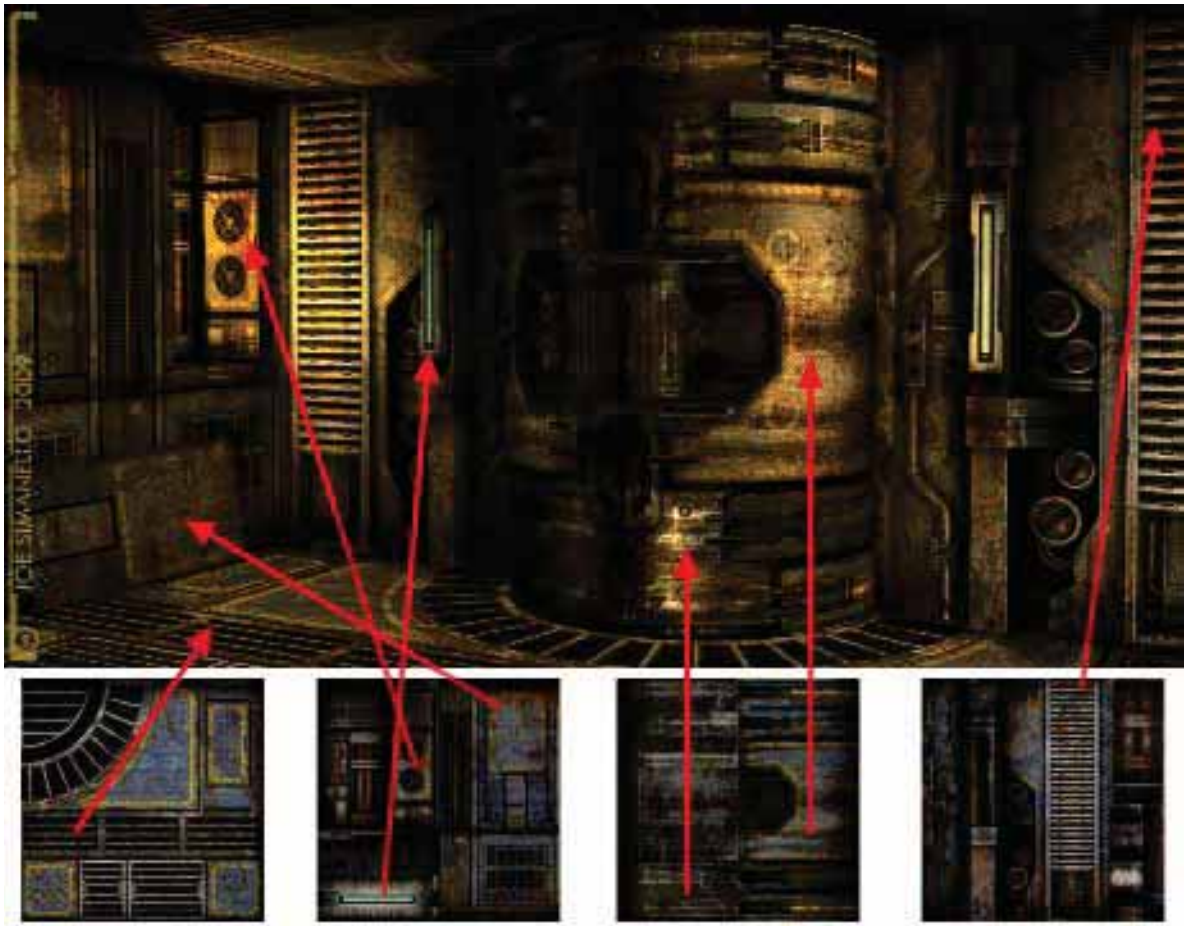
The image is an 8 foot prop using a 1024 by 1024 texture.

Texture Construction

Common Usages

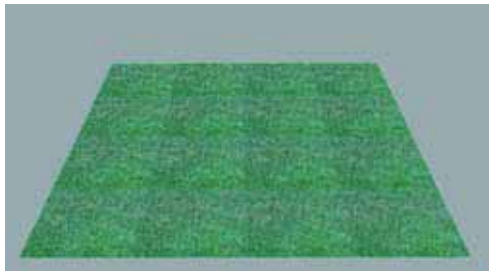
There are many hard surface and organic types of textures with multiple uses. When creating a texture for film or games, never assume that it has one purpose. An artist applies a wall texture on the floor or ceiling. It is good to create textures for use on multiple types of architecture. You use hard surfaces such as concrete, metal, and wood on almost every type of surface.

In the image, the textures point to their location on the model.



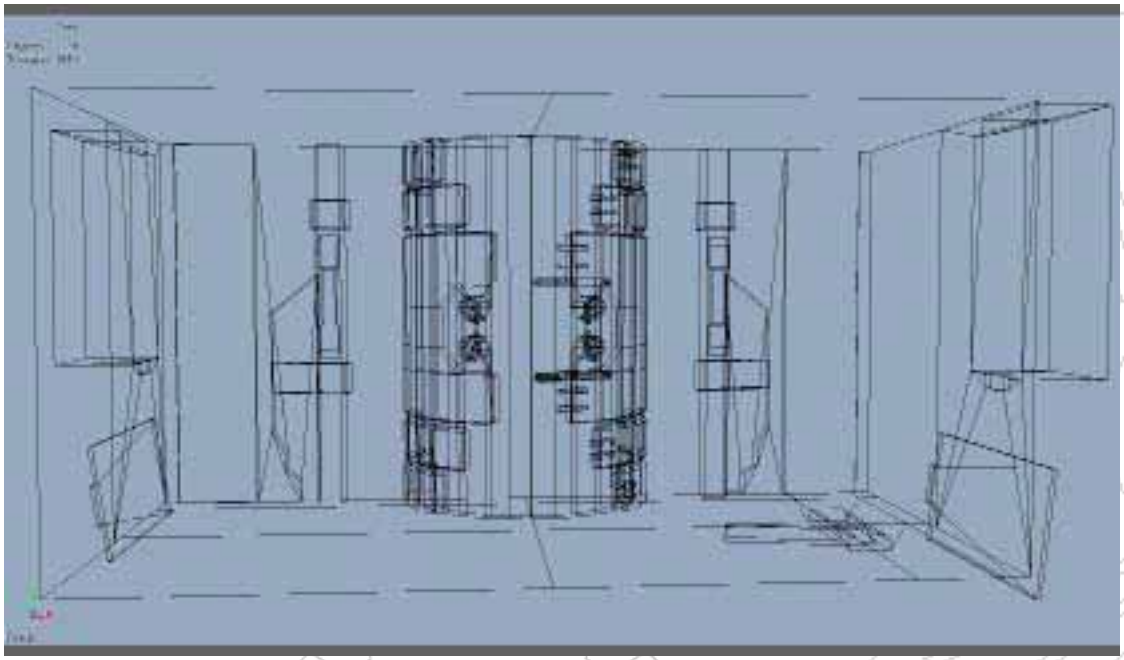
Do not build surfaces such as grass and dirt on the grid unless they have incorporated trim pieces. Organic textures are commonly used on ground surfaces. Architectural pieces such as floors, walls, ceilings, and trim are similarly made. These pieces are grouped in texture sets. Create doors, windows, and detail pieces to accent the environment.

The image is a tiled grass texture applied to a polygon plane.

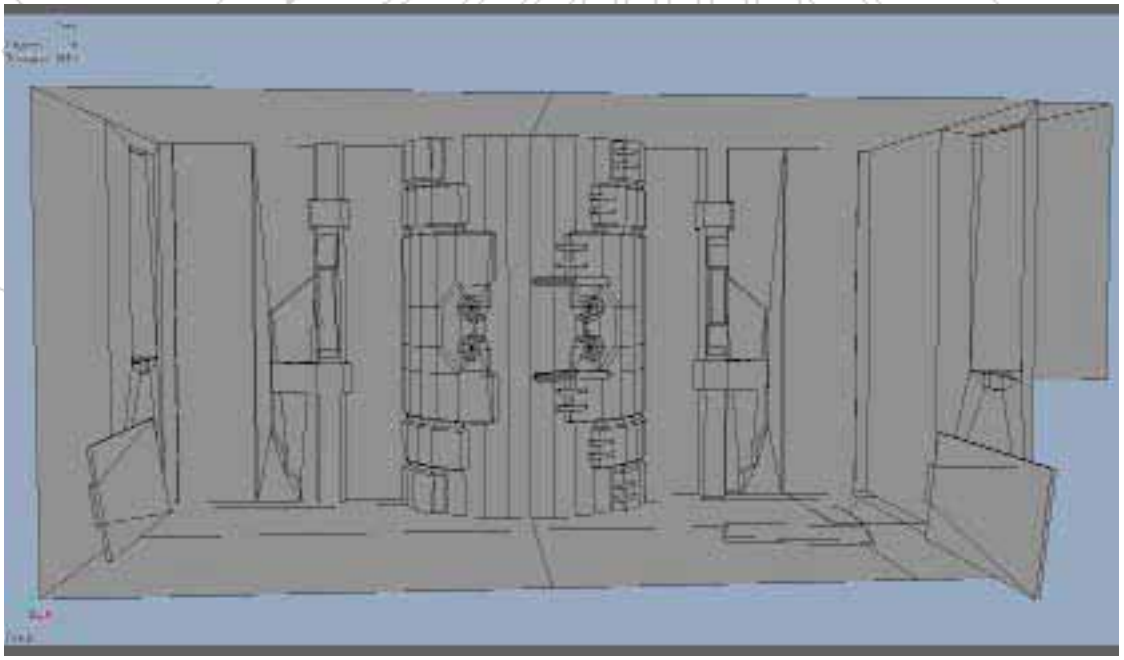


The polygons are best to texture if the geometry is flush, without overlapping areas. Without lights, the wireframe and shaded views display the geometry lines and hard edges. If the model is built in quads, the video game converts it to triangles. This is done to optimize performance of the render engine. When rendering for film, keep the geometry in quads.

Texture Construction

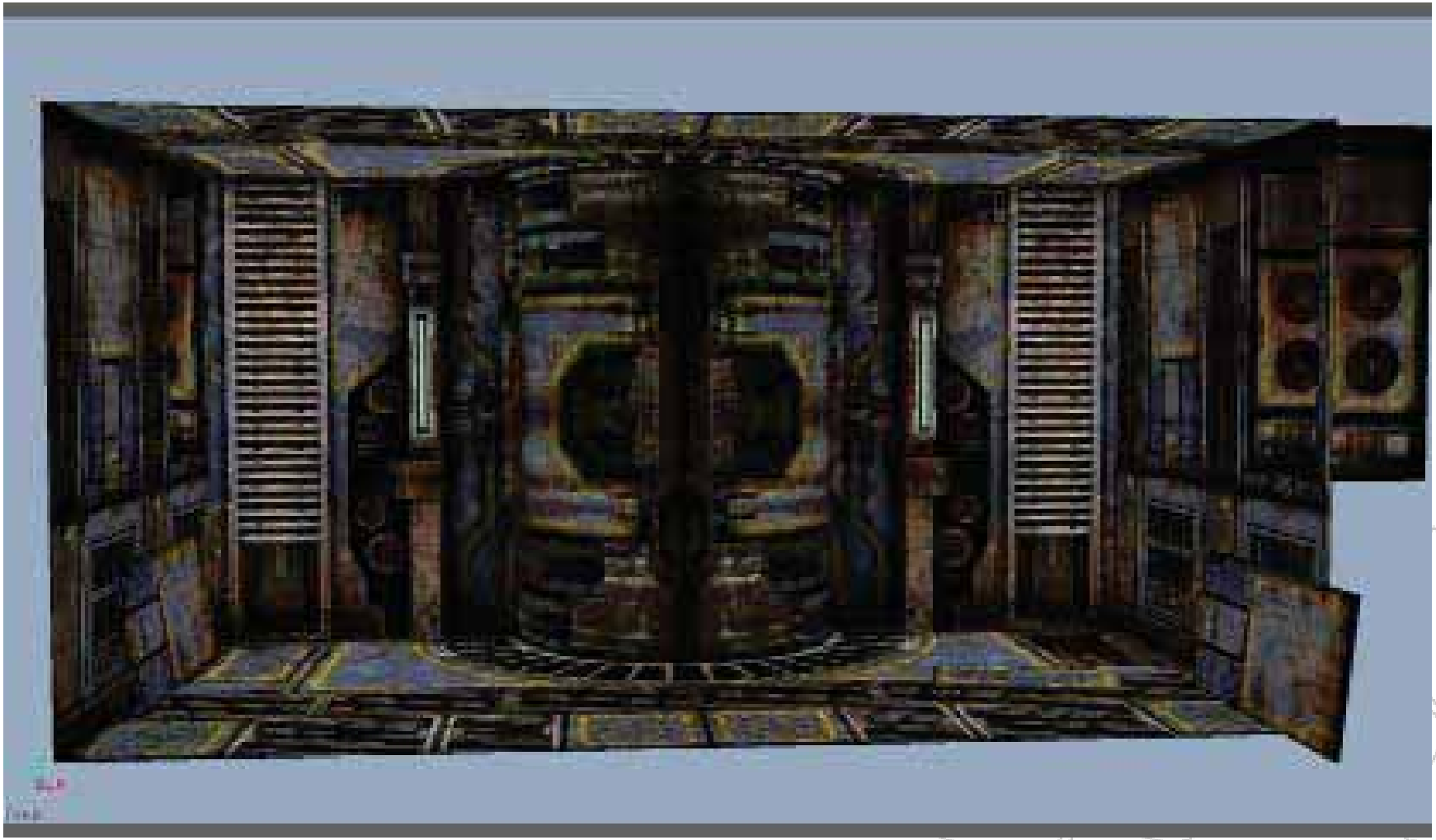


Pictured are the Bio Chamber scene in wireframe and shaded wireframe.



Texture Construction

The image is the Bio Chamber scene with textures applied.

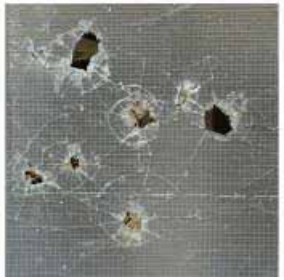


Texture Construction

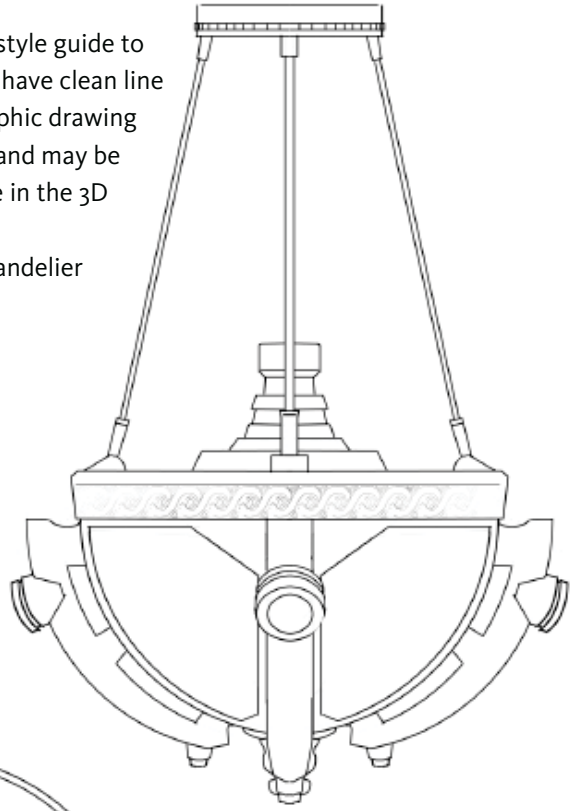
Reference Images

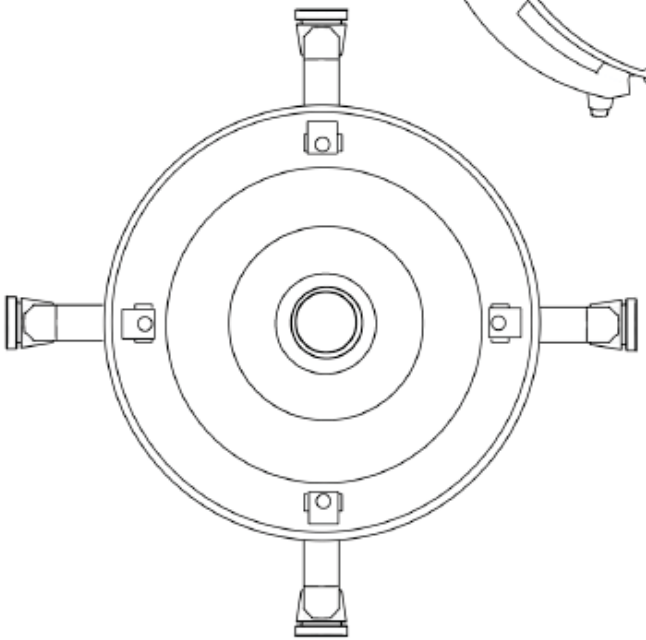
You use reference images as visual guides to create the details of the texture. It is difficult to create details from memory. When designing a texture, use photographs or references. Apply the reference photos directly on the texture and blend into the surrounding elements. Using realistic textures creates a good sense of urban reality. Many films and video games are themed to an urban style.

The images are references of a cargo container, concrete cracks, broken glass, and rust.



Concept art is often used as a style guide to create 3D models. It is best to have clean line art to work from. An orthographic drawing is made by the concept artist, and may be modeled from as a visual guide in the 3D viewports.
The image is a drawing of a chandelier prop.

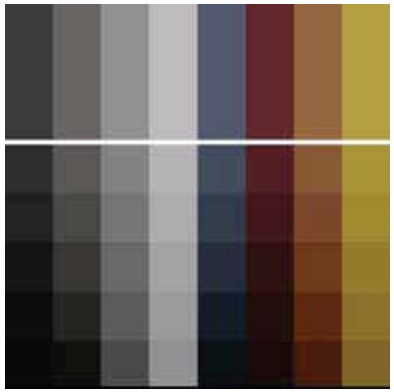




Texture Construction

It is a good idea to use a color scheme when building a texture set. Try different color schemes before settling on a specific one. Complimentary colors often work well. Use low saturation pantone colors to create a color scheme. Sometimes, one color needs the slightest adjustment, either in the hue or saturation, to make it perfect. Using a color scheme ensures that textures maintain visual consistency. The colors of a palletized color scheme were placed in vertical strips, and gradients of grey were overlaid horizontally to create different hues.

Pictured is the color scheme used for the Bio Chamber.

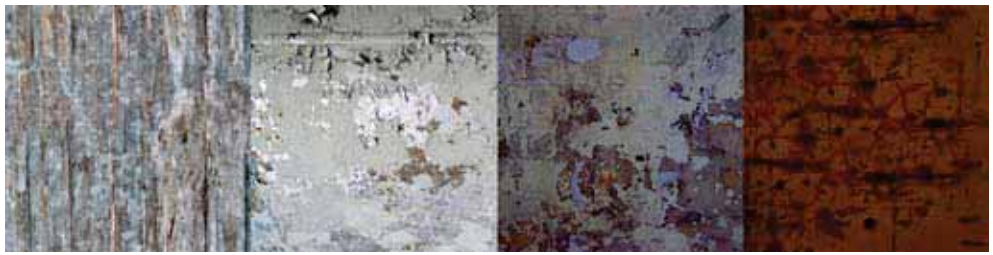


The image is an example of a palletized color scheme.

Base Textures and Detail Templates

It may take a production artist several hours to create a single texture. To save time, create a base set of Photoshop layers to use for a texture set. You use these layers as a starting point, and then add the details needed to build the final texture. This system enables the textures to have a uniform look.

A metal base texture is built by taking a series of metal photographs, and setting them to Overlay Layer Style. Set the Opacity 20%. Use five to ten images to create a metal base texture. Below is an image of four side by side examples of textures used for the metal base. The same process is used for concrete, organic, and custom layout textures. Similar textures are used on organic textures, not necessarily metal photos. You use this process to create a consistent look in film and games.
The following image is four metal base texture examples

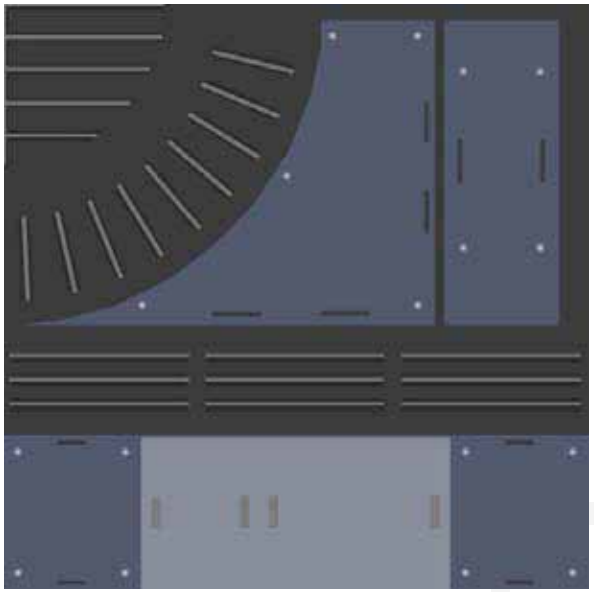


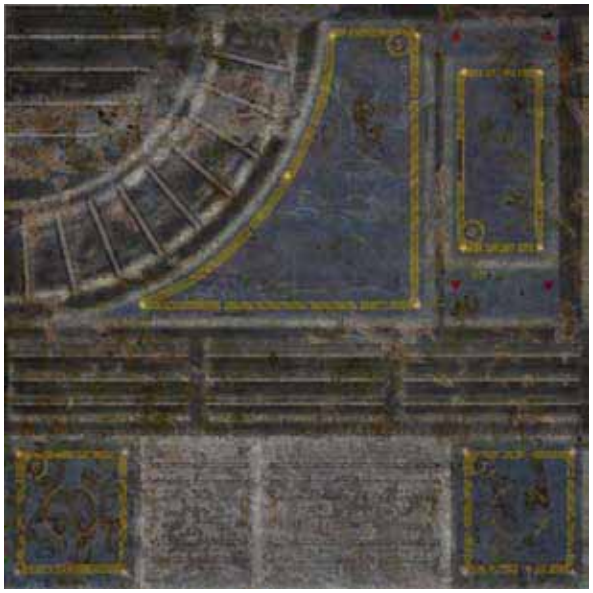
Texture Construction

Positioned under the metal base layers are localized Color Areas. This is an easy way to block in the color, and change it any time. You use the Marquee Selection tools to select areas, using the UV map as a guide. You employ the Paint Bucket tool to fill in areas with color.

The black, gray, and blue colors display areas where this process has been applied. Once the base texture is built up to a good point, it is easy to place the base metal layers into a folder and reuse to other files.

The images display the color base map and the color with metal overlays.

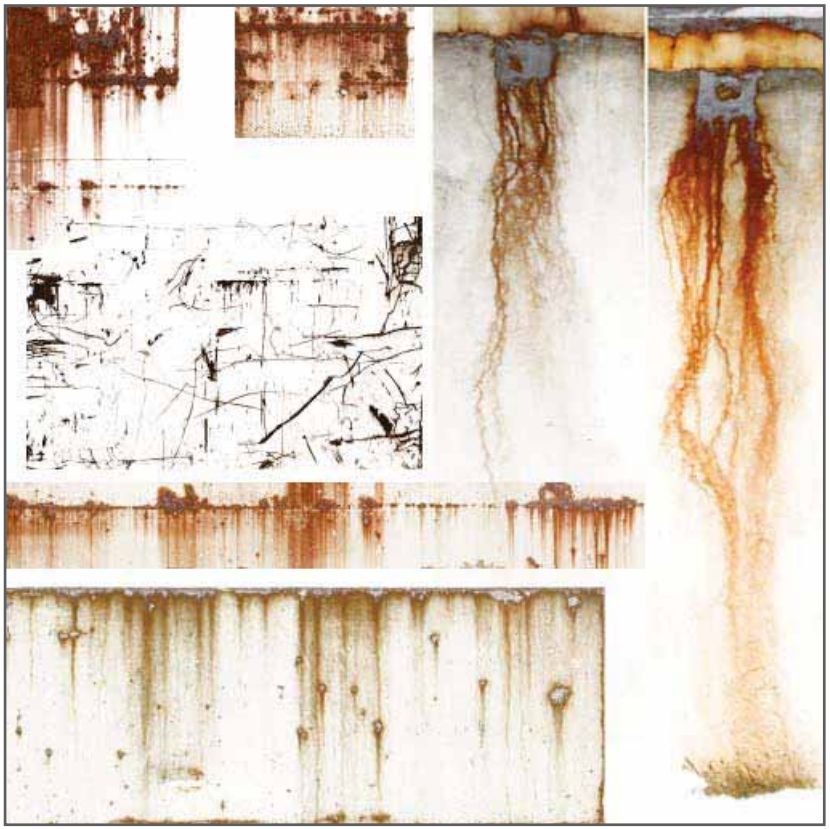




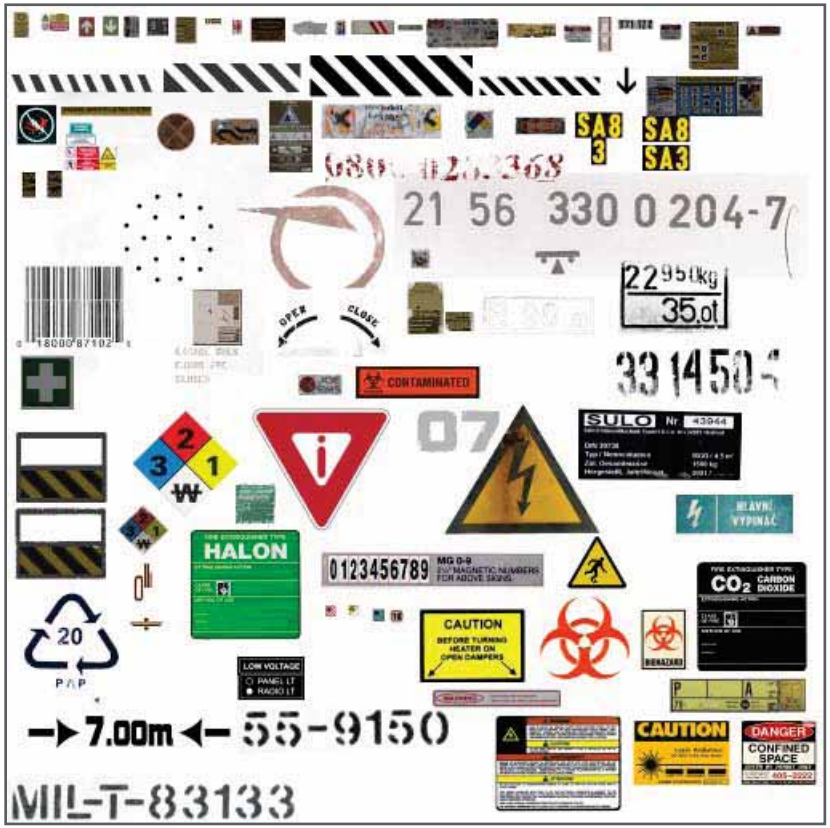
Pictured below is a common layer tab in Photoshop.

Texture Construction

Detail templates are similar to metal base layers because they are a collection of details that may be reused on many textures. For example, a rust dripping texture may take several minutes to find and extract using the Color Selection tool. You copy and paste it to the new layers, and tweak it to the desired parameters. Multiply this task by 20, and it may take several hours. The trick is to save your handpicked, cleaned up details to a new file or separate folder. When a rust texture is needed, go to the folder, pull out a layer, and flip it or erase a bit to make it look different. Create detail templates for bolts, cracks, stickers, and color variations. The image is a detail layer set of rust that may be used for overlays.



The image is a collection of stickers and logos used to detail the textures.

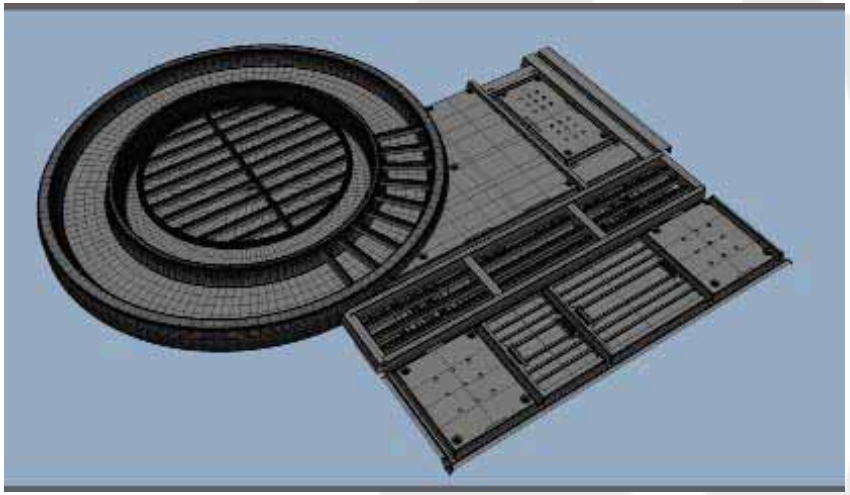


Texture Construction

High Resolution Models

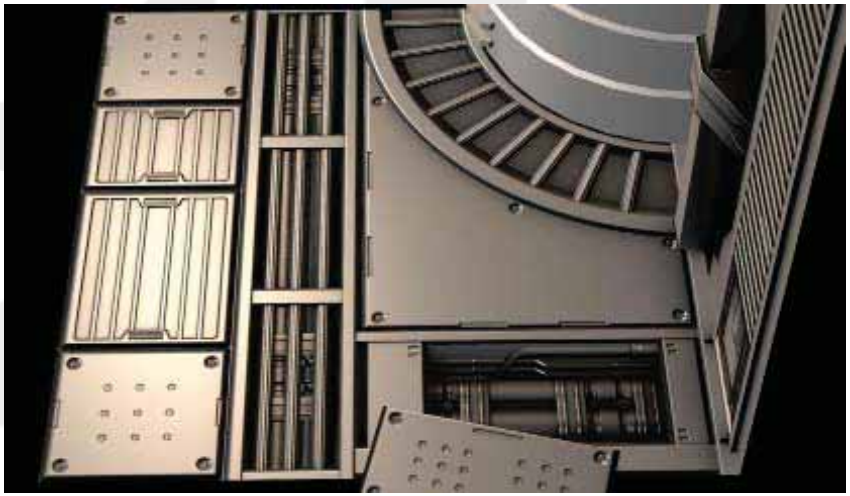
You use primitive and complex models to design a tileable or custom texture. Details do not always have to be created in 2D. You may use high resolution 3D models to design all the texture. High resolution models add great realism and depth to the texture. A 3D model enables you to bake a normal map and a matching ambient occlusion map.

The image below is a picture of a high resolution model used to create the Bio Chamber textures.



The process for constructing a normal map begins by creating a high resolution model and a low resolution model. The high resolution model is created by using polygons and a collection of detail pieces. Establishing a library of detail pieces makes it easier to design complex models. Once the high resolution model is finished, it is baked down to the low resolution model. The low resolution model may be a primitive plane or fitted to the high resolution model. Creating textures that have detail baked in will save on the polygon count and improve performance.

The image is the normal map rendered on the low resolution geometry.



Texture Maps

Pictured are renders of the Hydrant Prop created in Maya.

Textures add more realism to an environment and characters. There are many 2D painting programs that can be used to create textures, such as Adobe Photoshop and Corel Painter. Many artists use photographs and add hand-painted details to create textures. Every artist paints a different way, with a certain style or look. Sometimes you adapt to a predefined art style, so that the textures look similar. The textures in this lesson are from different models, but were all painted by the same artist. The first textures shown are from a science fiction-themed scene. The textures depicted later in this lesson are from an ammo case prop and a fantasy prop. These scenes and props were rendered using mental ray Standalone in 3D software such as Maya, 3ds Max, or Softimage (formerly Softimage|XSI) .

The image displays a render of the Bio Chamber created in XSI

Texture Maps

The images are renders of the Ammo Case created in Maya.

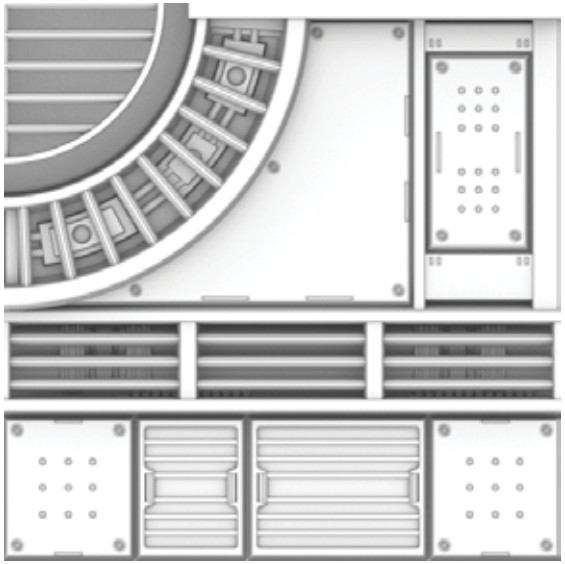
Texture Maps

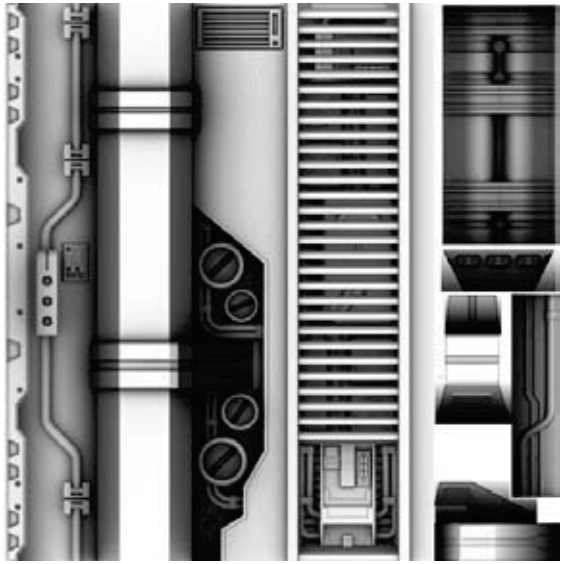
Standard Texture Maps

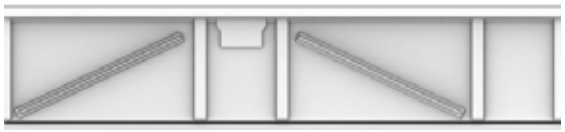
AO Maps

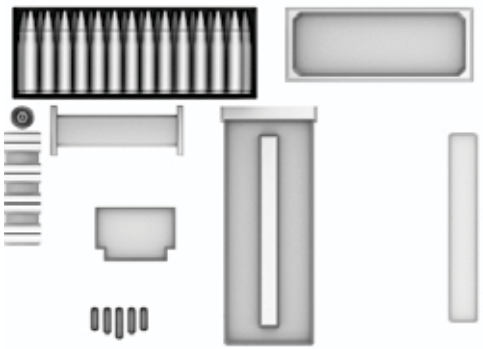
Ambient Occlusion is a shading model that adds realistic shadows to a 3D model or scene. AO maps add shadows to cracks and the underside of objects. AO maps have a soft look, and are used as an overlay on the diffuse texture. This is accomplished by setting the AO map Layer Style to Multiply in Photoshop. This is a simple way to fake global illumination, which is a method to calculate realistic lighting. It saves rendering time because the shadows are overlaid onto the diffuse texture. AO maps are created from a high resolution model and can take a long time to calculate.

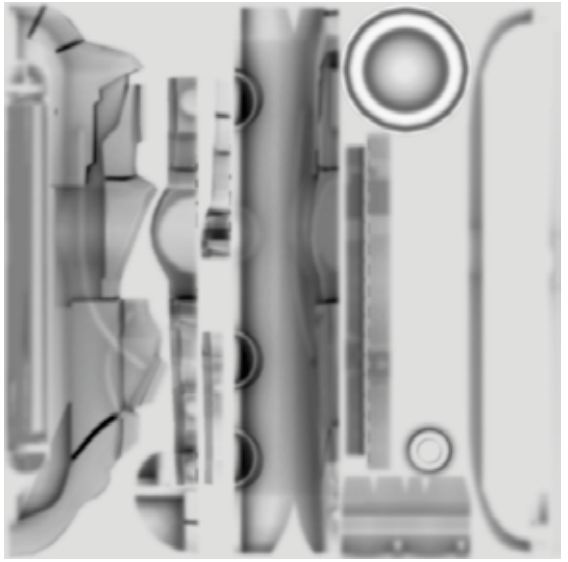
The images below are ambient occlusion maps.









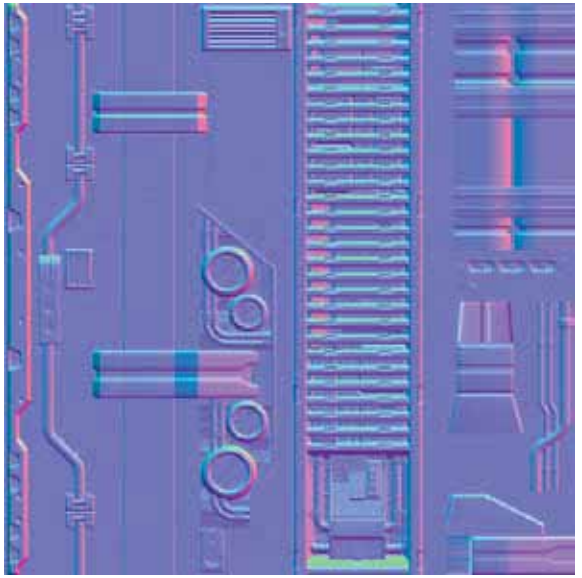


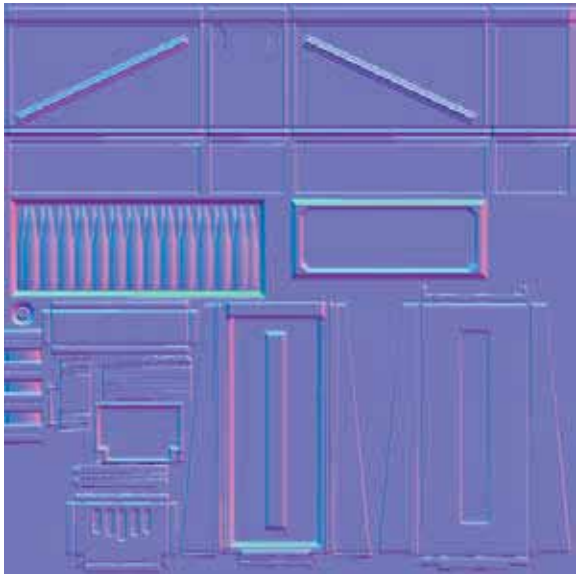
Texture Maps

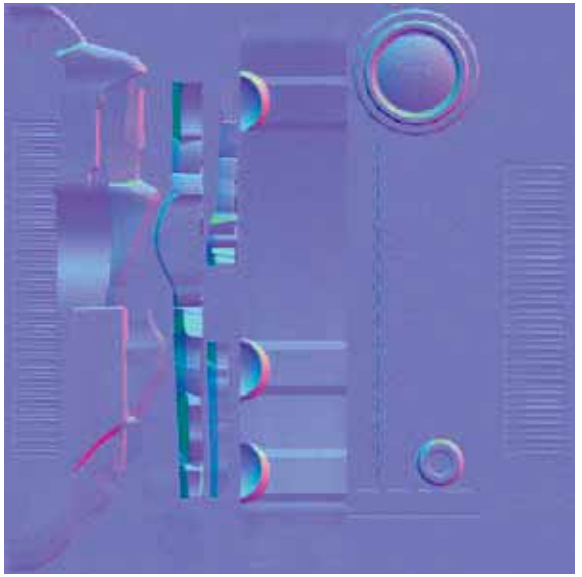
Normal Maps

A normal map is an RGB colored texture that acts as a 3D bump map. A normal map uses X, Y, Z coordinates to add detail to the surface normal of the polygon face. The normal map adds fine detail on a relatively flat surface. The normal map is seen when a light hits the polygon, shading the concave areas with shadows and the edges with highlights. A normal map bumps in any direction, but tends to degrade the effect when viewed at less than a 45 degree angle. You create normal maps in Photoshop using a grayscale image. You use the Nvidia map filter to convert a grayscale image into a RGB normal map. The common colors of a normal map are shades of blue, pink, purple, orange, and green.

Pictured are normal maps used on a floor and props.





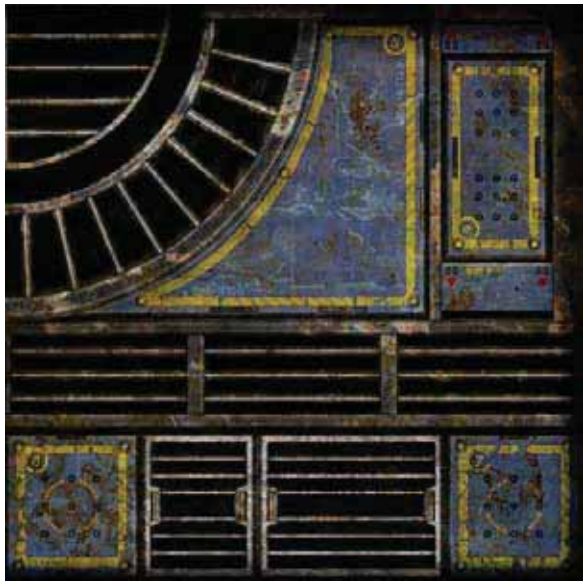


Texture Maps

Diffuse Maps

The diffuse map is an RGB color texture. This texture holds the majority of the detail and color information seen on the 3D model. In production settings, the normal map and ambient occlusion maps are created before the diffuse map. The textures should have details that line up on top of one another. It is common to go back to the normal and AO maps to add details while creating the diffuse map. When viewing a diffuse texture in a video game engine, it sometimes over saturates colors, blows out the color white, and darkens black colors. Lower the saturation, and never use pure white or black.

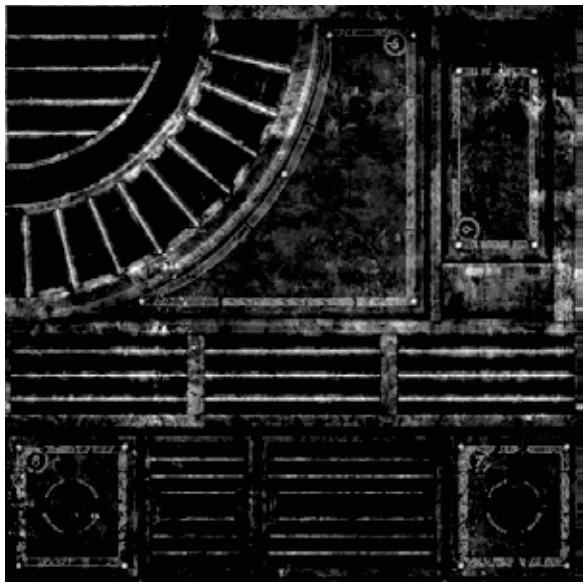
The images are diffuse color maps.

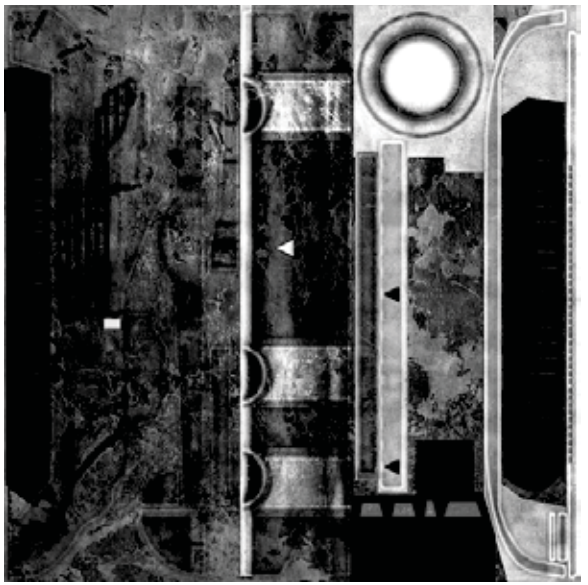


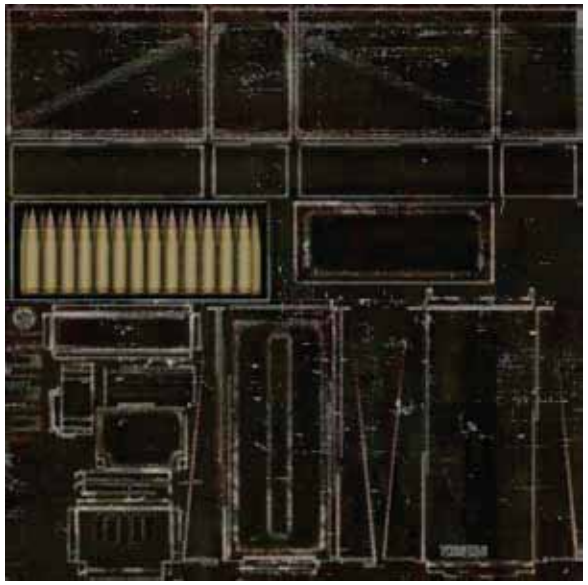
Texture Maps

Specular Maps

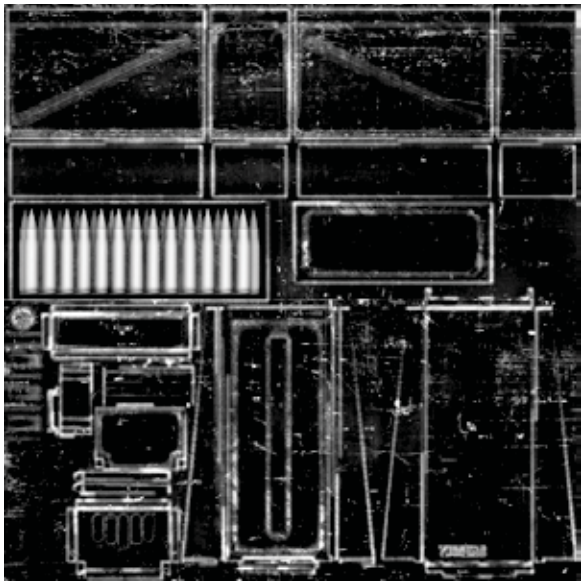
Specular textures come in two styles: grayscale maps and color maps. A grayscale specular map accents areas of the texture that are shiny and matte. White and gray areas are shinier when hit by a light. The black and dark gray areas do not reflect much light, and have a low specular value. You use color specular maps to add color when viewed at a glancing angle. To create a chrome material, add some of the same color to the specular map. The specular map adds refined detail in a texture. The final specular map is sharpened or blurred to get a worn or soft feel.
The images below are specular maps.







Color Specular Map



Grayscale Specular Map

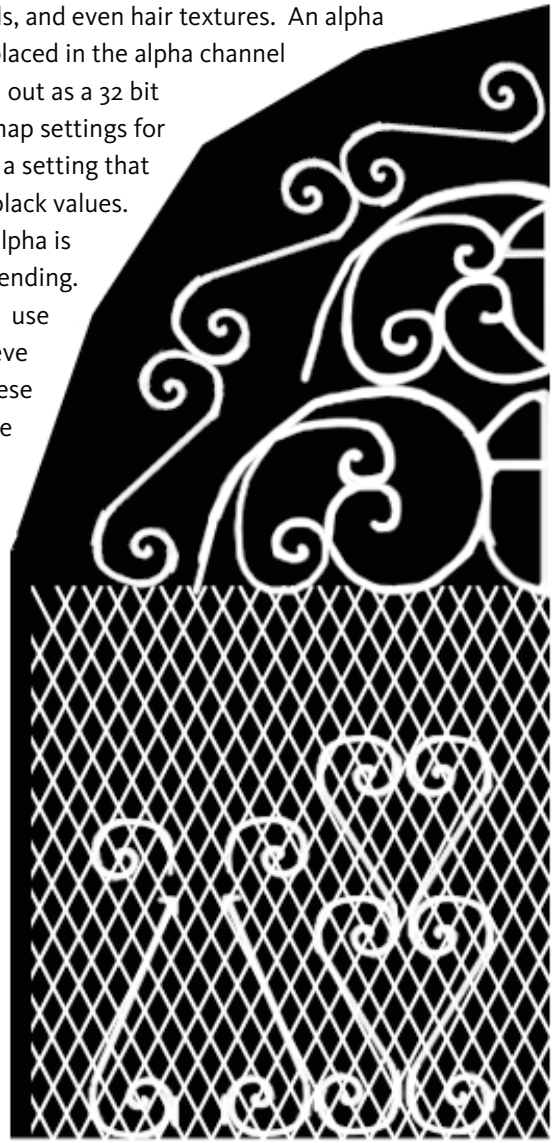
Texture Maps

Special Texture Maps

Alpha Maps

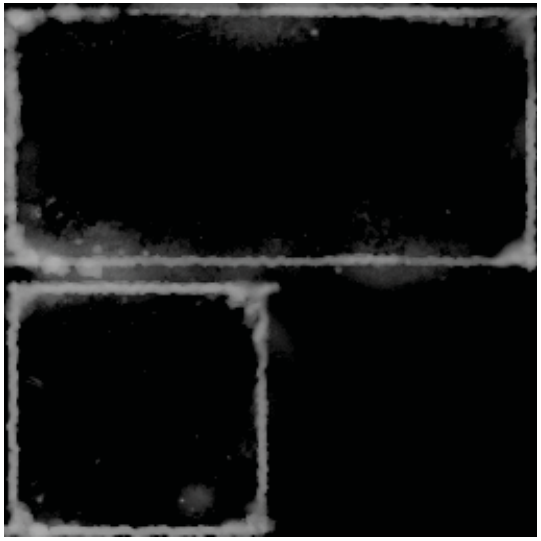
You use alpha maps for glass, decals, and even hair textures. An alpha map is a grayscale texture usually placed in the alpha channel in Photoshop. The texture is saved out as a 32 bit Targa file. There are special alpha map settings for use in a game engine. Alpha test is a setting that uses almost completely white and black values. This is less expensive because the alpha is transparent and opaque, with no blending. Alpha channels applied to windows use the full grayscale spectrum to achieve the desired transparency value. These settings are slightly more expensive in video games, when there are transparent objects rendering in front of another. In pre-render, this is not as much of a performance concern.

The images are an alpha map used with alpha test, and another used for glass.



Alpha Test

Glass Diffuse



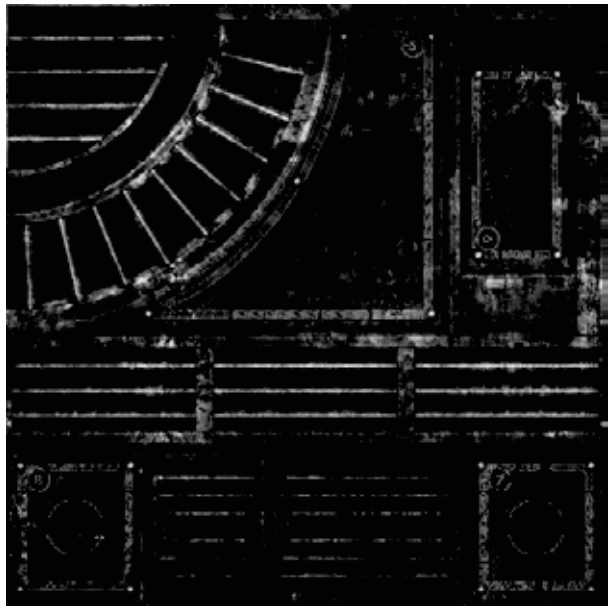
Glass Alpha

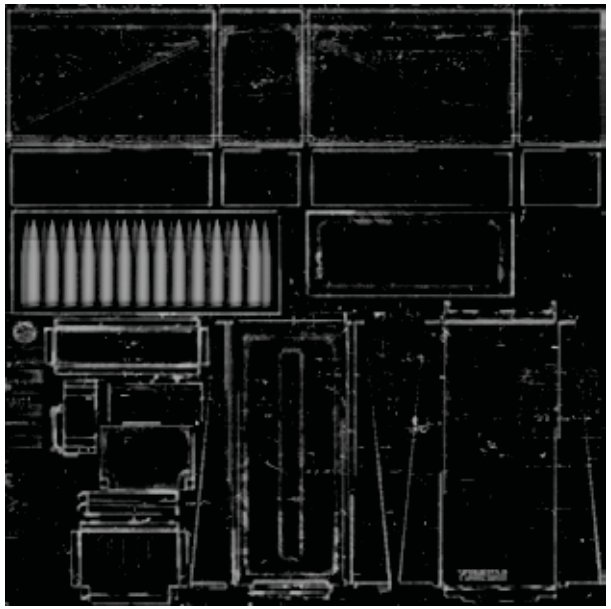
Texture Maps

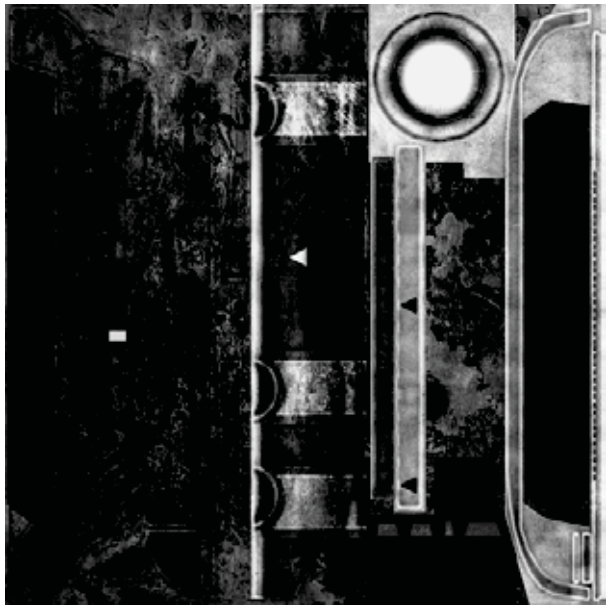
Cosine Maps

Cosine maps define the glossiness of a surface. A cosine map is a grayscale map, and may be used in combination with a color specular map. In some game engines, the glossiness level uses a reflection cube map. White areas in the cosine map pick up the reflection of the world through the cube map. When trying to get a highly reflective surface, the diffuse texture must be a darker color. Cosine maps look similar to a grayscale specular map.

The images are examples of cosine maps.





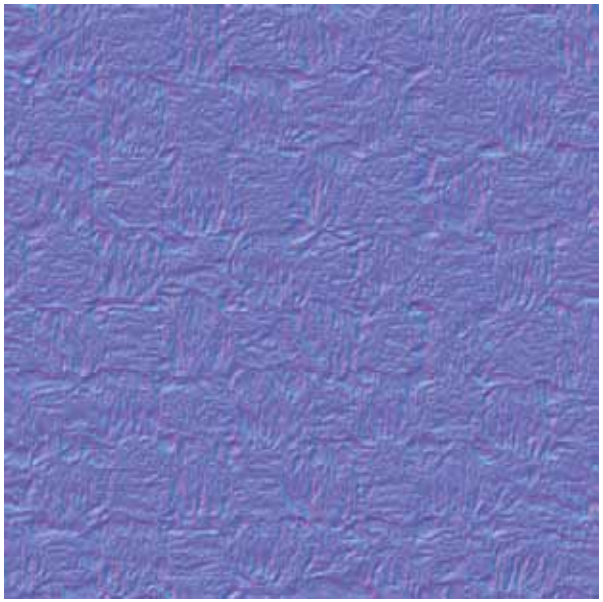


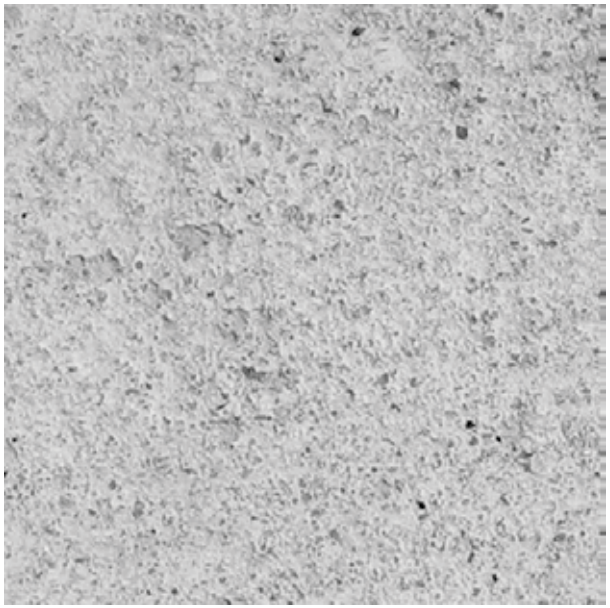
Texture Maps

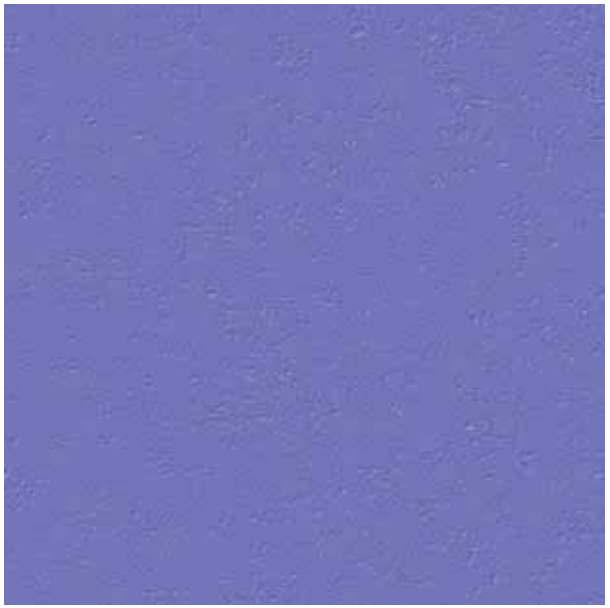
Secondary Texture Maps

Detail Normal Maps

Detail normal maps create macro details surfaces such as fabric, or large subtle variations in stone. You create a second set of UVs for adjusting the scaling and detail. Detail normal maps are usually small, about 128 by 128 pixels or less. A dual layer shader is needed with two normal map channels. The detail normal map is created from a grayscale map, using the Crazy Bump or the Nvidia normal map filter. These images are detail normal maps in grayscale and normal map.





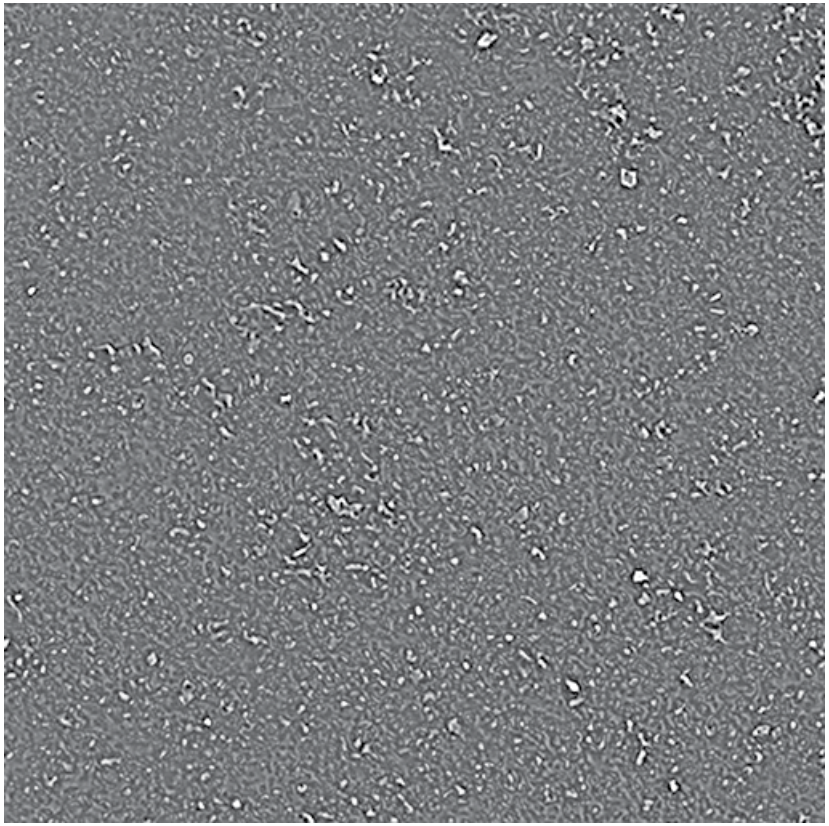


Texture Maps

Parallax Maps

Parallax maps are a form of visual displacement map. This map makes the environments surface look like it has more depth. Parallax textures are grayscale textures and are similar to normal maps in that they add depth in all directions. The more extreme the view angle, the more depth is created. Organic textures are ideal for parallax maps because they have a nonuniform layout. Custom normal mapped textures are sometimes problematic if they have very detailed edges and corners. Some 3D packages such as Softimage create a depth map, which may be used as a parallax map. There are also file converters that create a displacement or parallax map from a normal map.

The images are parallax maps for fabric and stone.



Texture Maps

BRDF Maps

The bidirectional reflectance distribution function is a four dimensional equation that defines how light is reflected on a 3D object. In video games, a 128 by 128 pixel color texture that simulates a light source is used to create lighting effects. A BRDF map is created on a solid black background, using gradients and hand painted details. Depending on the placement of the painted details, it controls the reflection properties on the model. One effect is rim lighting, which is a highlight around the edge of the model.

Diffuse BRDF

Specular BRDF

Anisotropic is a directionally dependent property that prevents the light from moving with the model when it is rotated. An anisotropic surface changes in appearance as it is rotated around its center. Cloth and velvet are examples of anisotropic materials. There are two types of BRDF maps: a diffuse and specular map. The diffuse map defines the lighting from the polygon normal of the light source. The specular map defines the lighting from polygon normal facing the camera or player. The images display diffuse and specular BRDF maps.

Glass Diffuse BRDF

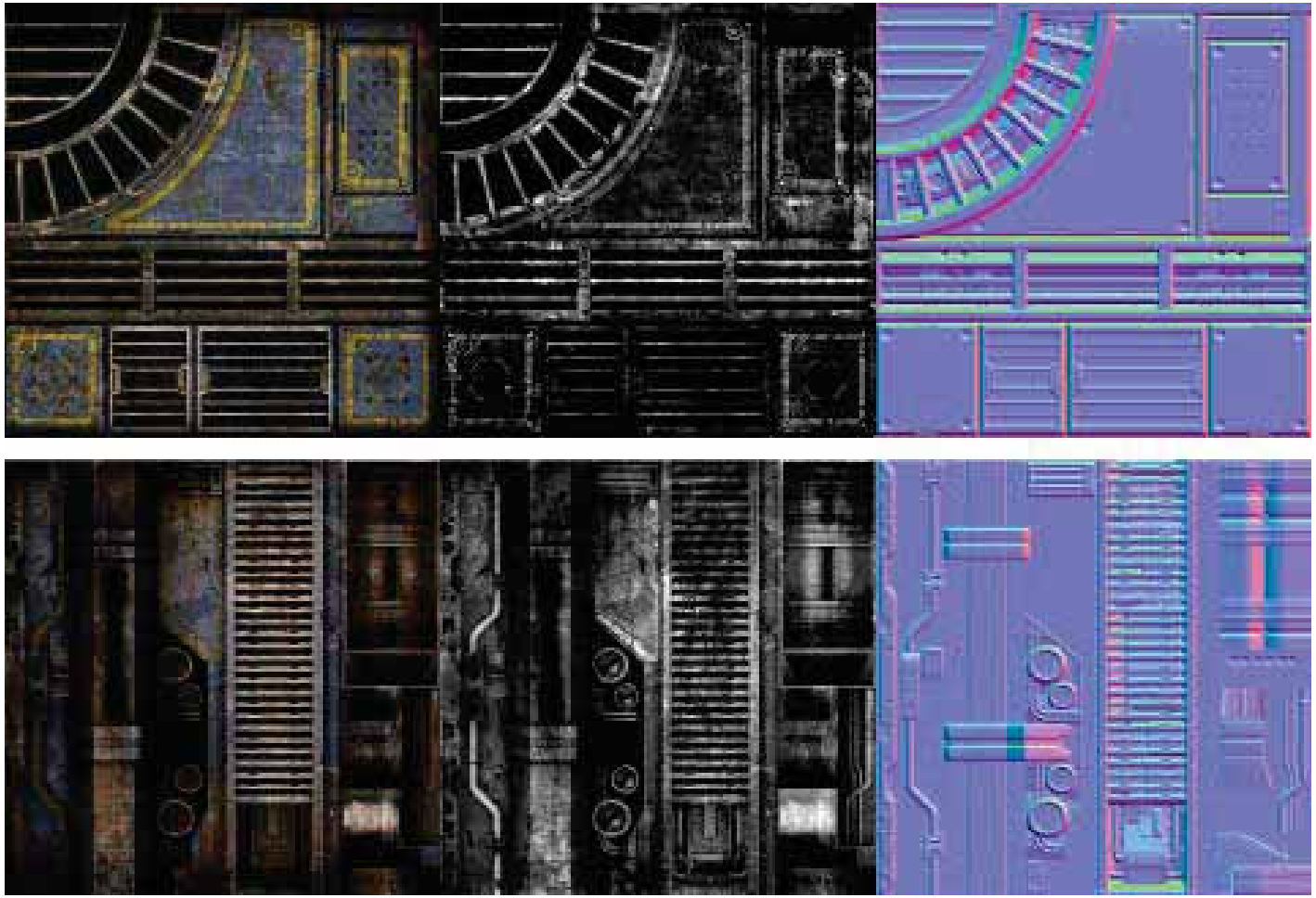
Glass Specular BRDF

Texture Maps

Final Textures

Most traditional game engines render a diffuse, normal, and specular map. The advanced game engines such as Unreal 3, Cry Engine 2, and Hammer support the maps covered above and many more. 3D software rendering supports many of these, but may have to be created and applied in different ways.

Below are final texture maps created at 1024 by 1024 pixel resolution. From left to right, they are diffuse, specular, and normal map.



Texture Realistic Wear & Polish

The application of realistic wear and tear, dirt, and grime is an art form in itself. Objects that interact with humans and the environment develop a wear pattern. The patterns may be oils from hands or machinery parts, and scratches from rubbing on another surface. When you study objects that receive heavy traffic such as furniture, you notice the corners are worn down to bare wood, and the large surfaces have scratches and dents. When objects are exposed to environmental elements such as sunlight and moisture, it causes paint to peel and cracks to form. Visit a large body of water and look at metal and wooden objects, noticing the water stains and rust formation. The bottom section of an object shows signs of decay and may turn white when minerals such as salt are deposited on the surface. Concrete shows a great deal of history, with cracks and the pot holes on street asphalt. A video game environment does not look like a clean hospital ward, but has skillfully placed areas of dirt and grime. Observe the real world process of weathering to create a convincing replica texture. Use the techniques outlined in this section, and your props and environments will look more realistic.

Pictured is a wooden table that has been outside for an extended period of time.

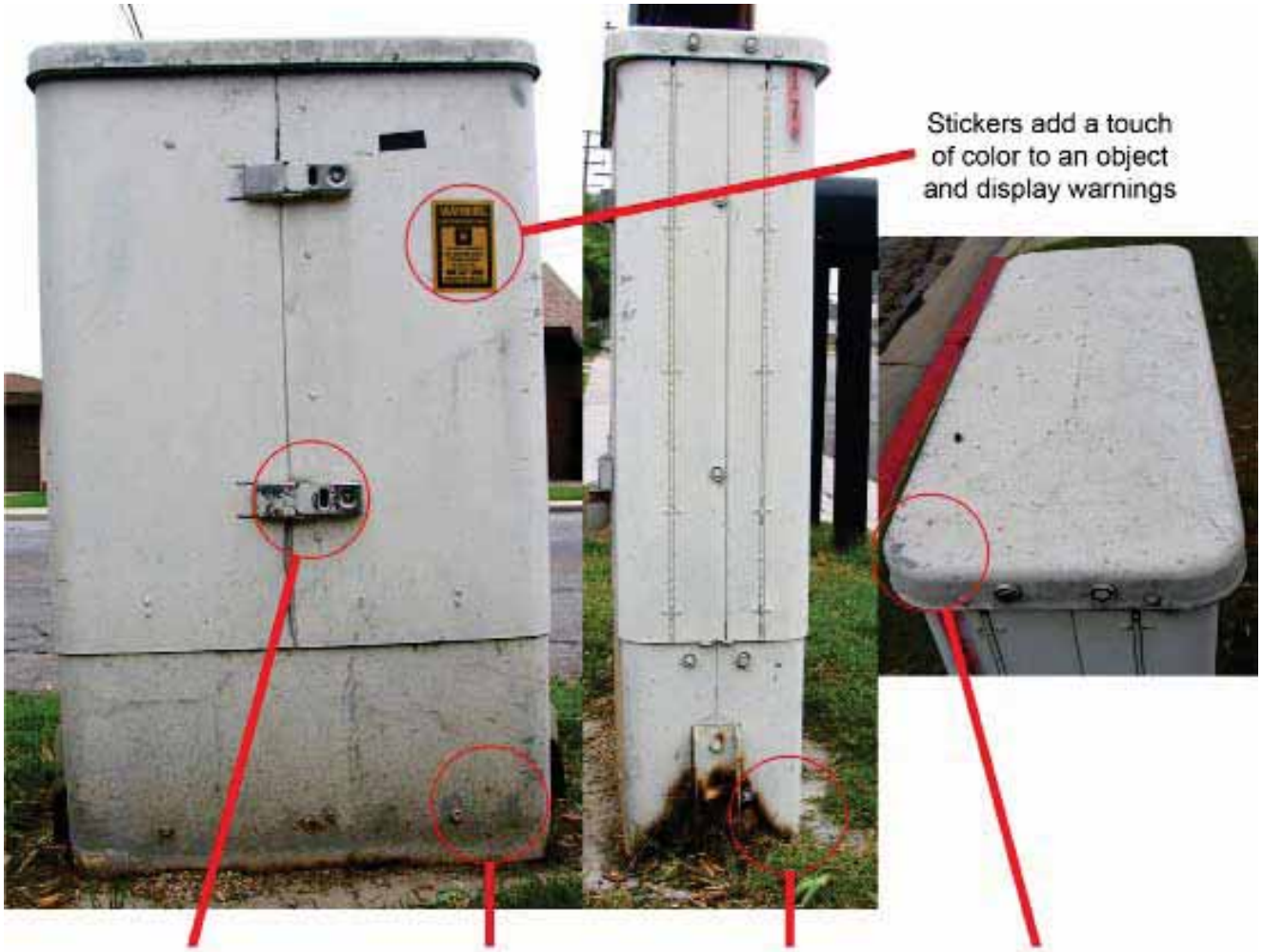
The image is the hood of a truck that has been in a hot climate near the ocean.

Texture Realistic Wear & Polish

Localized Wear

Localized wear and tear happens to specific areas of an object over time. Mother Nature is the most powerful source of structure decay. Water, wind, and sunlight on the coastline effect the surrounding environment causing constant erosion. The metal on a power box is a good source to study for signs of breakdown. On the handle area where there is frequent access with tools, the paint is stripped, exposing the bare metal. Aluminum does not rust very easily because it forms a layer of aluminum oxide, which protects the underlying metal. The sun causes paint to peel and fade over time, causing it to expand and contract. Be aware of the type of material an object is sitting on, such as dirt, concrete, or grass. Areas that have grass contain moisture in the topsoil, which disintegrates the metal over relatively short periods of time. Dirt often accumulates and sticks to the paint on lower sections of objects. The underside of lips and overhangs rust, causing streaks to form.

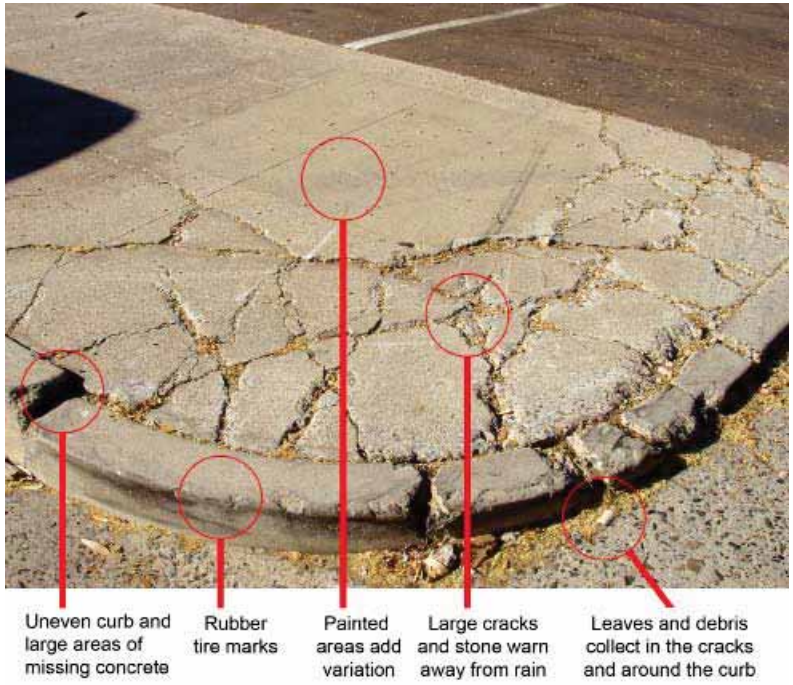
Pictured here is a diagram of a power box near the ocean.



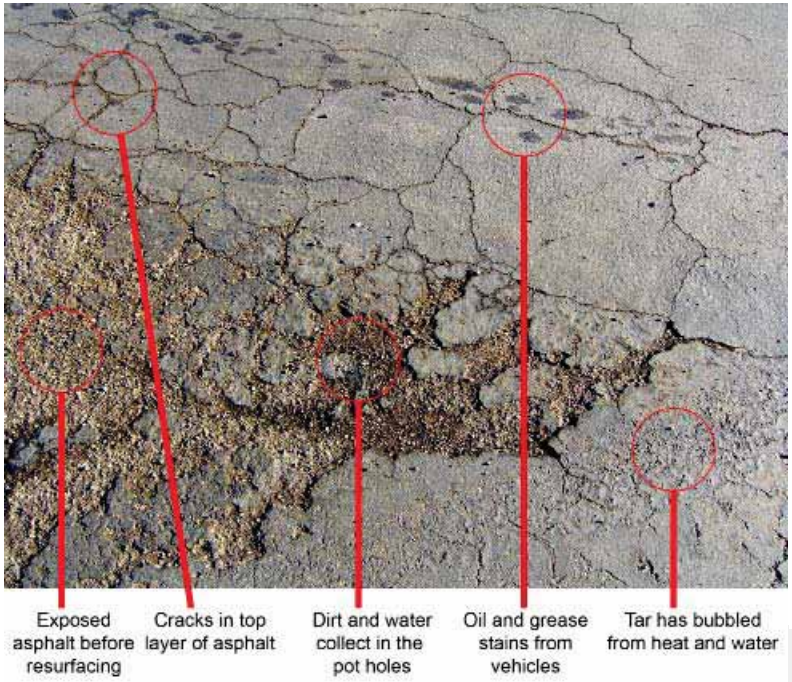
Texture Realistic Wear & Polish

Water and the movement of the underlying ground cause cracks on a stone or concrete surface. Damage occurs when vehicles drive over the surface, and heavy objects drop on them. Water and dirt erode the surface and create deep cracks and holes. When creating a texture, find good top down reference of these details. You create variation by cutting out crack details and overlaying them on top of a similar surface. Dirt layers may be overlaid onto a clean version of concrete or asphalt. The key is to use sharp details from photos and subtle dirt layers fine tuned to the desired result. The diagrams show areas of detail that may be replicated in a real texture.

The photograph below displays distress on a concrete sidewalk.



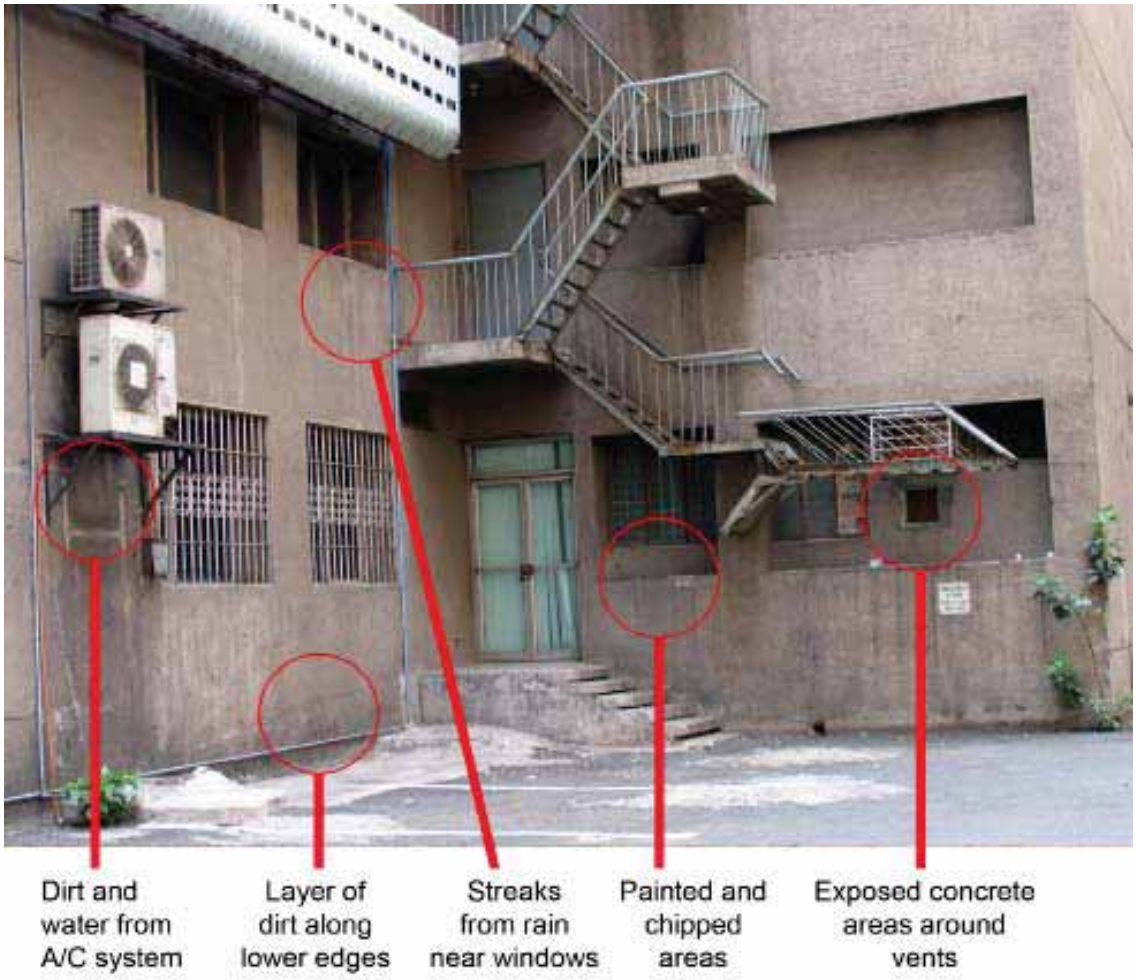
The image is a photograph of distress on an asphalt lot.



Texture Realistic Wear & Polish

Dirt and grime effects are applied in layers over the base textures. The dirt may be applied as streaks under windows and awnings. You apply grime as a treatment for a more uniform looking texture. Game engines support a second and third UV channel, and multiply the dirt layers over the base texture. Use a multilayer shader in a 3D package for use in a film. Large surfaces tend to look very tiled, even without a seam showing. Using a grim texture breaks up the repeating pattern and adds realism. Dirt gathers in the corners and along the bottom edges of the buildings, windows, and door trim. Details that are inset, such as vents, may be caulked with materials such as sealer or concrete. Polygon geometry pipes running along a building have a grime strip texture behind them to add depth. The buildings in the diagrams have not been cleaned for a long time, and have collected dirt in the corners. When it rains, the dirt runs down along a building's natural cracks or connection points.

The image displays areas where dirt collects and is washed away during rainy days.



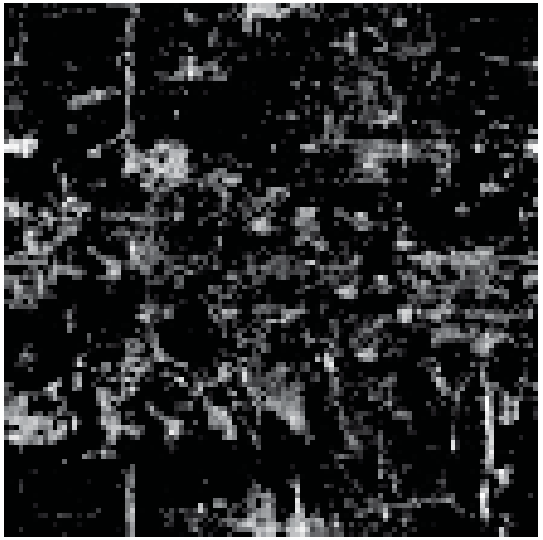
Texture Realistic Wear & Polish

Surface Overlays

A solid library of textures enables you to build a convincing texture. There some textures essential to creating the effects described in this section. The black and white grime overlay is great for a full surface effect. In Photoshop, set this layer style to overlay, or multiply and adjust the layer's opacity. The concrete wall photograph is a real world example of the desired effect. Another way to create this effect is to use a dark grime texture, and place a black and white overlay texture in the alpha channel.

Black and white grime overlay

Concrete wall photograph

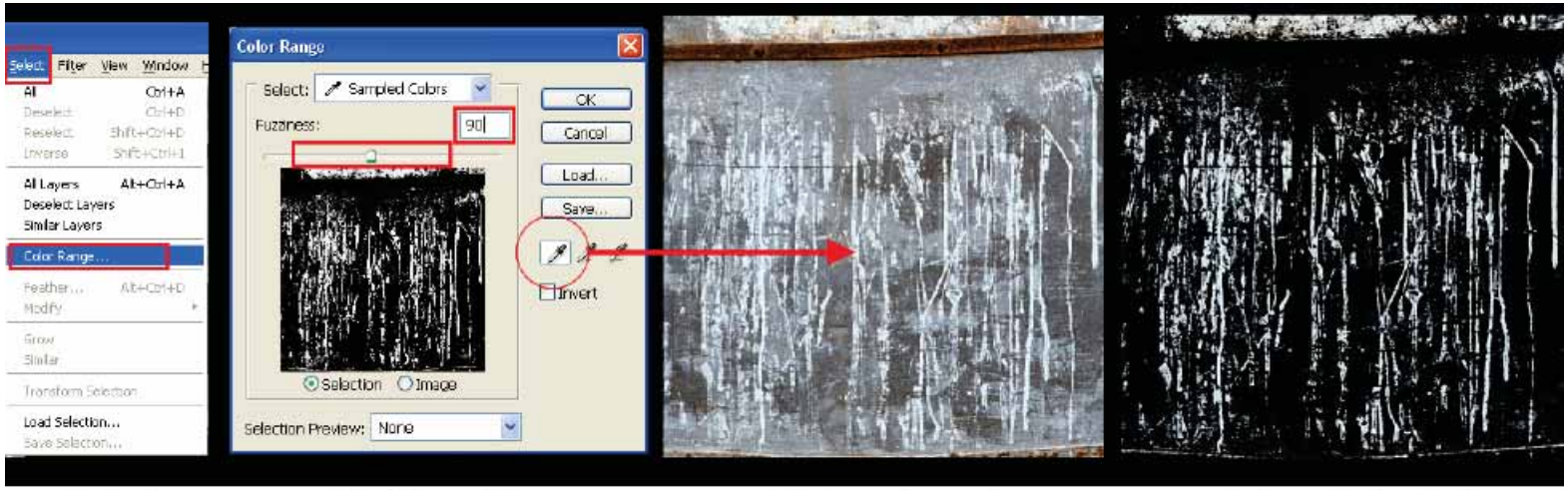


Alpha black and white grime

Dark grime texture

Texture Realistic Wear & Polish

Selecting a color range makes it easy to choose localized areas for overlays. Apply rust and colored streaks directly onto a texture, or use as an alpha texture sheet. Take a photograph with streaks on it, use the Color Selection tool in Photoshop to select out that color, and paste it into a new layer. The new grime layer may be set to overlay or multiply. Make adjustments to the hue and saturation to tint the color. Place this new grime layer on areas that need localized wear and tear.



Select Color Range | Select the white using the color picker | Photograph used for color selection | Color selection that is overlayed, and colored

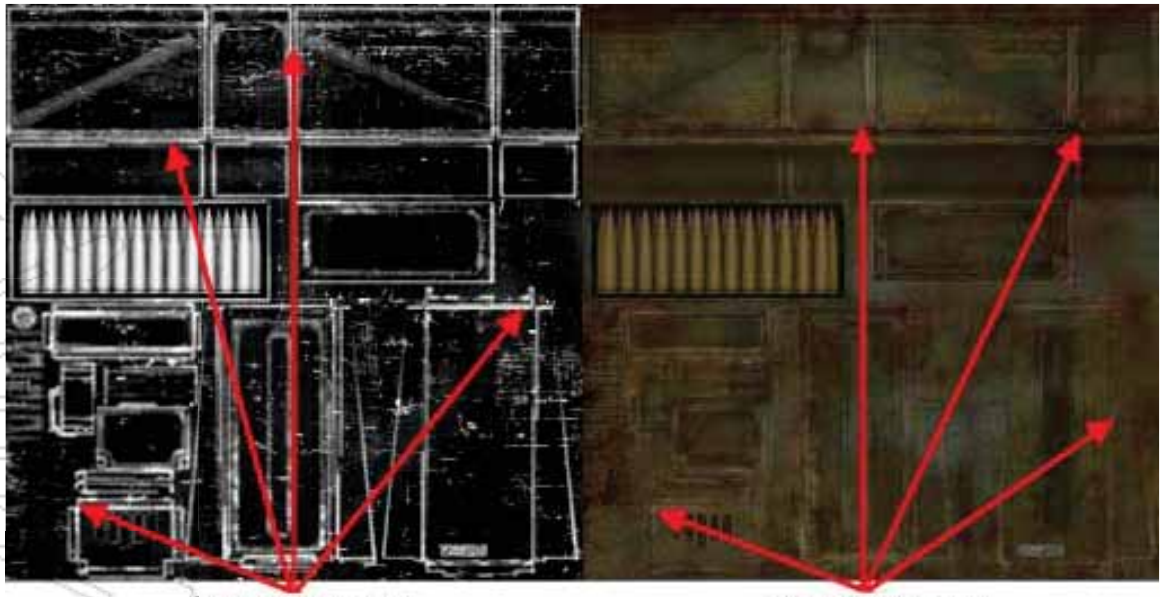
Texture Realistic Wear & Polish

Rust is a common detail that is separated by using the color selection method. Take textures while looking at buildings and finding areas of heavy run off.

Pictured is a layer selection of rust.

Edges may look worn down on the corners of the model's textures to simulate every day use. You use the Paint Brush tool and a light color to paint in the wear and tear. Use the specular map for the majority of this high contrast detail. When the light catches the edges of the surface, they create a nice highlight. The inset areas of an object usually collect dirt as illustrated in the diffuse texture. Dirt is trapped in the tread of a tire or along the trim of an automobile. Study real world objects with heavy outdoor use, and reproduce the localized areas on a texture.

The images displayed are the edges on a specular map and dirt on a diffuse map.



Edges are painted lighter in the specular map

Dirt and scratches are painted in the corners

Texture Realistic Wear & Polish

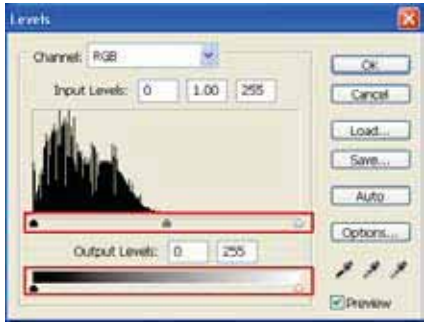
Color Correction

Texture polish refers to the time it takes an artist to refine a texture to match others. This can be a series of shader setting used by everyone working on a project. It takes time to become accustomed to using the Wacom tablet to draw in details. Painting by hand brings the external artist back into the more painterly and sculptural areas of art. The final texture looks like a piece of art, with clear form and resolution.

Color correction is done at the end of creating a texture or multiple textures. Adjust them all to within a value and color range, so they look similar. There are ways to adjust a texture when it is completed. You create a brightness contrast layer, or a levels adjustment layer. These filters are accessed in the Image and Adjustments list. Using the Levels windows makes it easy to adjust the minimum and maximum light values. The keyboard shortcut for adjusting the Levels is CTRL + L.

The images are an over saturated texture of the ammo case, and a color corrected one.

Pictured is the Levels tab. Levels are adjusting by using the sliders to clamp the color values.

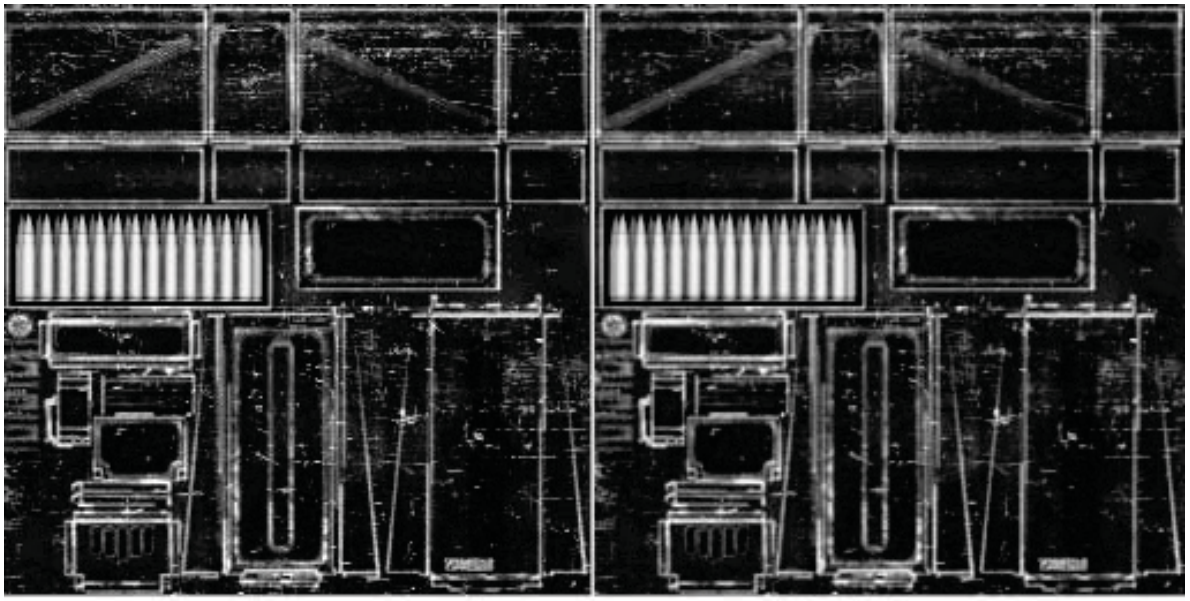


Texture Realistic Wear & Polish

When the texture is finished, sharpen it for a grittier look. It adds bang for your buck when the texture is rendered. Use the Photoshop Sharpen filter or un-sharp mask to sharpen the texture. If the specular map is too sharp, the texture appears to flicker on the screen. To adjust the specular map use a Gaussian blur. Set the blur of a few pixels to offset it, so that the texture looks smooth.

The images display a diffuse texture that has been sharpened, and a specular texture that has been blurred.

Normal Texture | Sharpened Texture



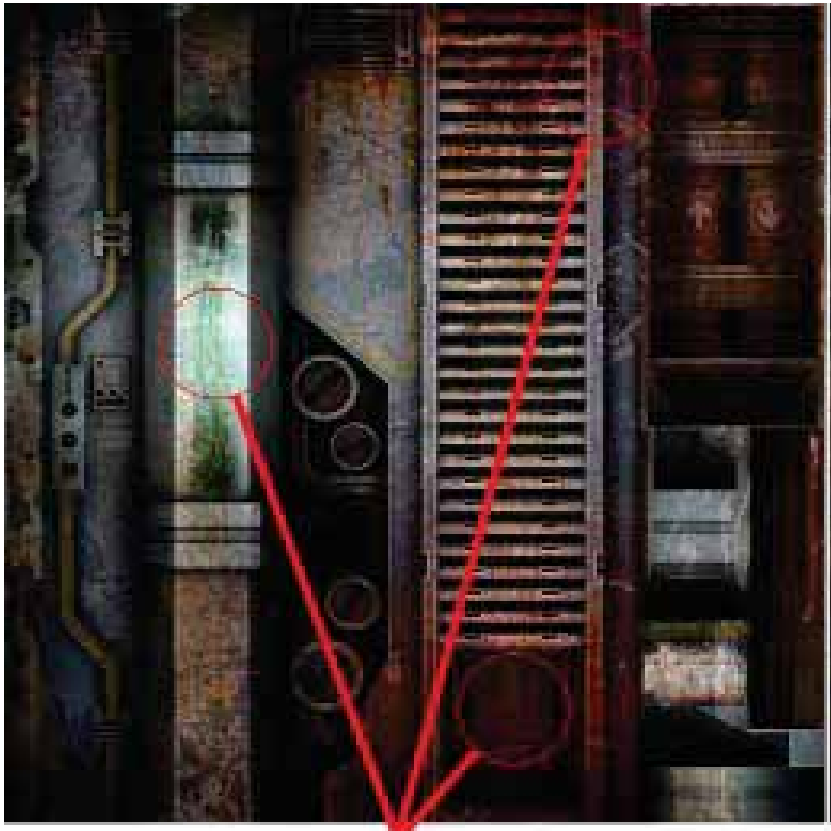
Normal Texture | Blurred Texture

Texture Realistic Wear & Polish

Rendering

When a texture has a light source directly over it, a bright area is created and shadows are cast. A secondary shadow map that includes lighting and color information is added as a multiply layer during rendering. The process bakes the lighting and shadows into the texture. This saves processing power and enables the computer to run faster. A light map is similar to a secondary ambient occlusion pass, multiplied over the diffuse layer when rendered in game or for film.

The images are textures that have lights and shadows baked into them.



Blue and Red Lights baked on the wall from a light source

Texture with no lights baked, only shadows

Texture Realistic Wear & Polish

Rendering for video games and films is a different process. Video games attempt to get all of the artwork rendered in real time, which means it has to render it on the fly. In film and TV, it is rendered out to a video file that is replayed. This is called pre-visualization. Mental Ray is a rendering engine used for film that takes texture sizes up to 4096 by 4096 pixels. This is the standard for film quality resolution.

A video game engine may only handle 100 megabytes of texture memory at once, and may require lower quality textures, such as 1024 by 1024 pixels. 3D software packages such as Maya, Softimage, and 3ds Max render images in mental ray. Rendering a final shot and setting up the lighting may take hours. A specialized artist may only work on rendering and lighting for a project.

Pictured are renders of the Bio Chamber in mental ray.

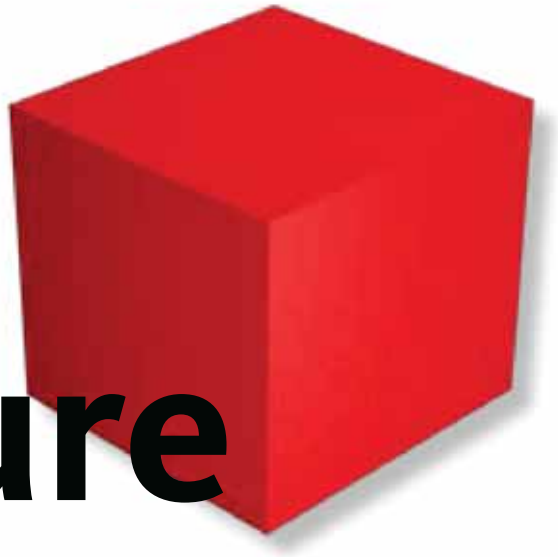
Workbook

SkillsUSA™ CHAMPIONSHIPS

2010

3D Visualization & Animation Competition

This Workbook provided through a generous grant from Autodesk®



Texture