11

Lights

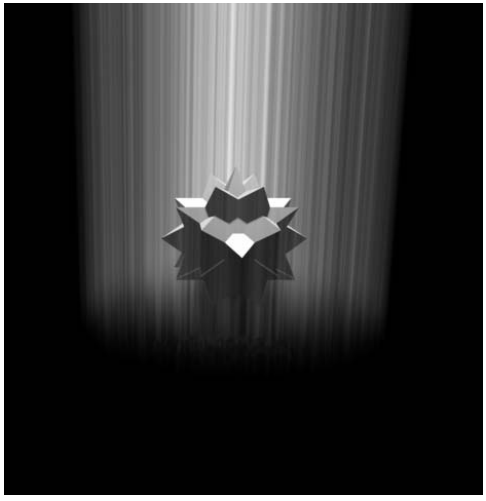


Figure 11.1 Light conveys mystery and magic.

In nature, light flows like a luminous tide, revealing and concealing form. Light radiates, reflects, refracts, reacts, and softly diffuses into air. Light is warm or cool, high or low, near or far, bright or dim, harsh or soft. These qualities make a scene happy, sad, harsh, soft, romantic, dull, mundane, or mysterious (**Figure 11.1**).

In the digital world, illumination is a calculated affair. Rendering algorithms, normal alignments, G-buffers, and Z-buffers determine the display of light and shadow. Where calculation fails, the eye of the artist must compensate.

The best lighting effects are achieved by artists who make themselves students of nature. Artists who study scene painting, drawing, photography, and cinematography develop sensitivity, awareness, and a practiced eye.

This chapter outlines the light sources available in 3ds max and how to control them.

Illuminating Scenes

In addition to making scenes more beautiful, working with light has practical applications. For instance, suppose you create a model of an office building for a prospective client. The client will want to see what it will look like under different lighting conditions. How will the building cast shadows? How will shadows be cast upon it? At what angle will light enter the windows at different times of the day and year?

The color and angle of a light place a scene in time and space. For morning or evening scenes, make the sun a warm color such as yellow, orange, or red. Then place the light source at a low angle (**Figure 11.2**). Cooler white lights placed at a high angle suggest the sun shining at midday. To make a midday scene more interesting, add clouds to the sky and project shadows from them (**Figure 11.3**). Fill lights above the ground should be blue or gray to match the sky. Fill lights below the ground should be green or brown to match the earth.

For night scenes, use a cool blue-white tint to suggest the light of the moon and stars (**Figure 11.4**). If there is fog, streetlights create warm, hazy cones of illumination. If there is a large or brightly colored object in the scene, match a nearby light to that color to create the effect of light radiating off of its surface.

Indoor lights also have color. Use warm, yellow colors for incandescent and halogen lights. Use a cold yellow-green color for fluorescent lighting. Be sure to create some fill lights to match the overall colors of the walls and carpets.

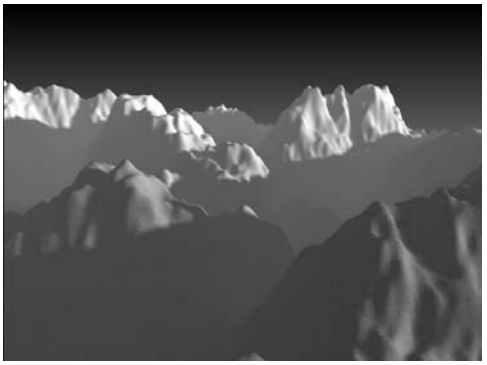


Figure 11.2 Morning in the mountains: Angled light, long shadows.

Figure 11.3 Midday in the hills: Cloud shadows add interest.

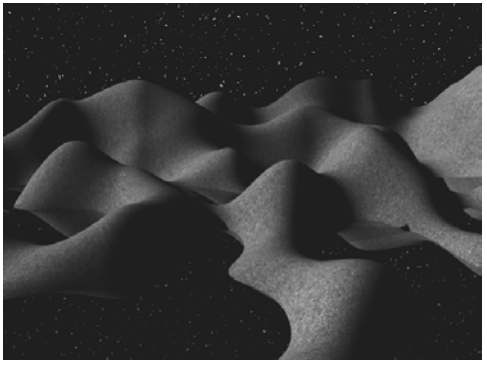


Figure 11.4 Moonlight in the desert: Stars in the sky and water create a feeling of space.

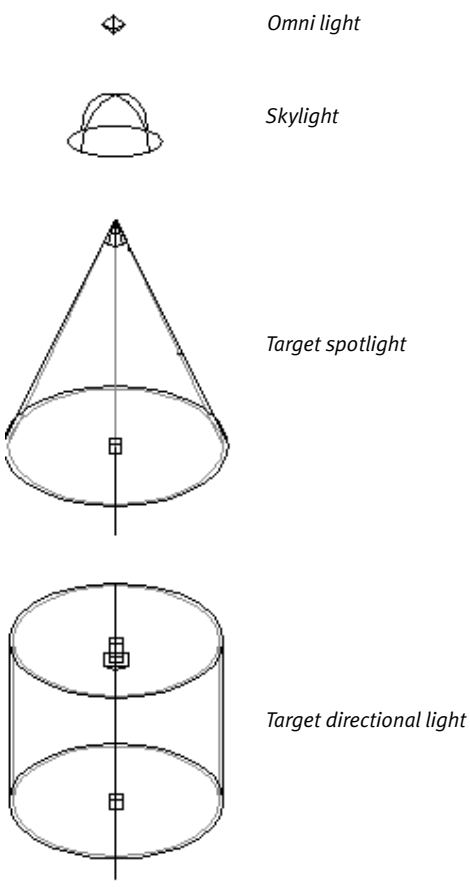


Figure 11.5 The basic light types. Free spotlights and free directional lights look the same as their targeted counterparts, minus the target box.

Figure 11.6 The Lights branch of the Create panel.

Creating Lights

As in nature, illumination in 3ds max is the product of a complex interaction of lights and objects. To participate, lights and objects must be placed so that there is a direct line of sight between them, and objects must be renderable.

3ds max 5 offers four basic types of lights (**Figure 11.5**):

- **Omni light**—Radiates light in all directions from a single source point.
- **Skylight**—Simulates diffuse outdoor lighting from the dome of the sky.
- **Spotlight (target and free)**—Illuminates an area within a cone, similar to a stage light. Target spotlights point at a target that you aim. Free spotlights have no target, so they can be maneuvered more easily.
- **Directional light (target and free)**—Like spotlights, directional lights use a cone of illumination, except that the cone sides are parallel. This is because directional lights have parallel rays, while spotlights spread light from a single source point.

You create basic lights in the Lights branch of the Create panel (**Figure 11.6**).

In addition to the basic light types, there are two types of lighting systems that you create in the Systems branch of the Create panel:

- **Sunlight system**—A hybrid light source that combines a free directional light with a Compass object to simulate the position of the sun as it moves across the sky over time.
- **Daylight system**—A hybrid light source that combines the direct light of the sun with the scattered light of the sky to produce realistic outdoor lighting that changes over time. Daylight systems use an advanced type of lighting called photometric lights by default (see sidebar).

By default, shadow casting is turned off for basic lights and turned on for lighting systems. Ambient light, the diffuse background light of a scene that fills in shadow areas, is turned off by default.

When you start building a scene in 3ds max, the default lighting has no direction. No matter which viewport you look in, the light appears brightest on the sides of the objects that face you. This lighting configuration was designed to make modeling easier, as the object facing you in the middle of the viewport is always fully lit.

There is a second default lighting configuration that places two omni lights along a diagonal through the world origin, from top-left-front to below-right-back. This lighting is more realistic and interesting.

Photometric Lights

Photometric lights simulate realistic lighting based on physical measurements of light intensity. 3ds max offers eight types of photometric lights: target point lights, free point lights, target linear lights, free linear lights, target area lights, free area lights, IES skylights, and IES sunlights. For more information on photometric lights and their settings, see the 3ds max 5 User Reference.

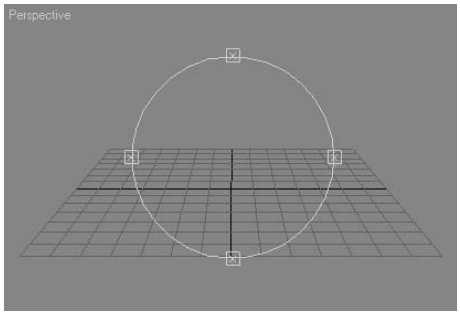


Figure 11.7 When you build a scene on a grid that is grid parallel to the viewport, it makes it easier to position lights around it.

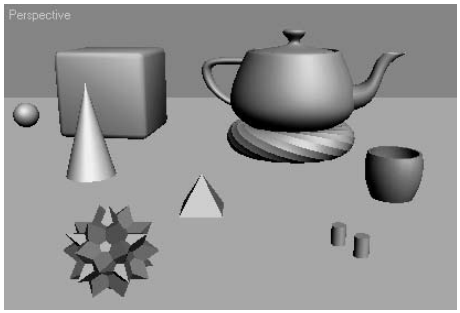


Figure 11.8 The practice scene consists of light-colored objects.

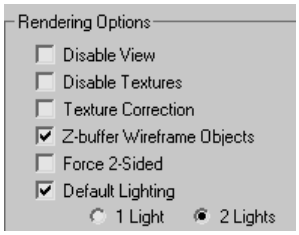


Figure 11.9 This setting creates two default lights that you can later add to the scene from the Views menu.

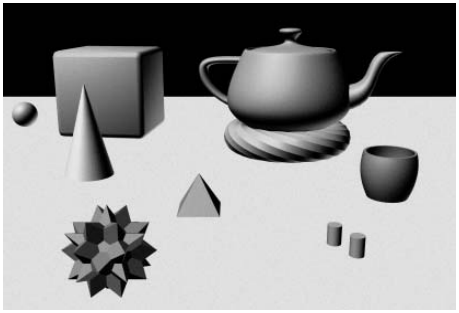


Figure 11.10 The ActiveShade viewport renders the new default lighting.

Lighting requires a bit of finesse. To make the process easier, you will start by creating a practice scene, and then add lights to it until the scene is fully illuminated.

To create a practice scene:

1. Rotate the Perspective view so that the grid is parallel to the edges of the viewport (**Figure 11.7**).
2. In the Perspective viewport, create some light-colored objects and place them near the origin. Then place a white plane underneath (**Figure 11.8**).

   The light colors of the objects will make it easier to see the effects of light.
3. With the Perspective viewport still active, open the Viewport Configuration dialog box by right-clicking a viewport label and choosing Configure, or right-clicking any viewport control button.
4. In the Rendering Method tab panel, check Default Lighting and select 2 Lights (**Figure 11.9**). Then click OK.
5. Change the Perspective viewport to an ActiveShade viewport by choosing ActiveShade Viewport in the Rendering menu, or by right clicking the viewport label and choosing ActiveShade under Views.

   The ActiveShade viewport renders the scene (**Figure 11.10**).
6. In the Front viewport, zoom out and pan so you will have plenty of room to place lights around the scene.
7. Choose File > Save, and name your scene Practice.max.
8. Choose File > Save As, and name your scene Practice00.max. This will serve as a back up copy in case you accidentally save over your scene.

As you do geometry objects, you create light objects by clicking and dragging. As soon as you create a light, the default lighting is turned off and the new light illuminates the scene.

A common way of lighting scenes is to use a bright **key light** for primary illumination of a scene, and one or more **fill lights** to make the dark edges of forms more discernable.

In the next three exercises, you'll create a spotlight and an omni light for your key light and a fill light, and then add a direct light to serve as an accent light.

To create a target spotlight:

1. Open Practice.max.
2.  In the Create panel, open the Lights sub-panel.
3. In the Object Type rollout, click Target Spotlight.
4. In the Front viewport, click in the upper-left corner to create the spotlight. Then drag to the center of the scene to create the target and aim the light (**Figure 11.11**).

   The spotlight illuminates the objects within its cone. The default lights are turned off (**Figure 11.12**).
5. In the General Parameters rollout, enable Shadows (**Figure 11.13**).

   The objects cast shadows. If the ActiveShade viewport does not show the shadows, right-click in the viewport and choose Initialize from the Tools quad menu.

   The viewport is redrawn. Shadows appear in the ActiveShade viewport and in rendered views (**Figure 11.14**).
6. Save the scene as Practice01.max.

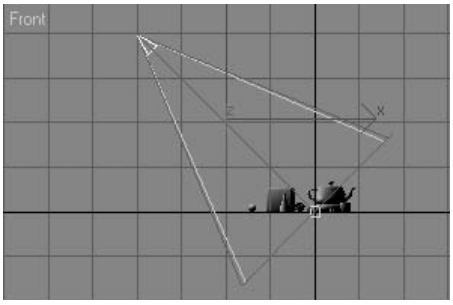


Figure 11.11 A target spotlight has a source, a cone of illumination, and a target.

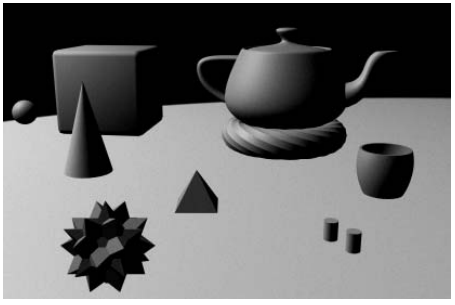


Figure 11.12 The cone of illumination delimits the pool of light.

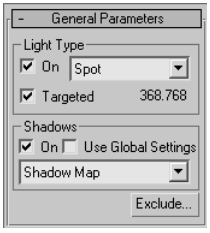


Figure 11.13 After enabling shadows for the spotlight.

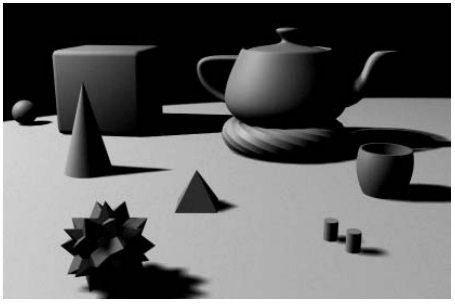


Figure 11.14 The objects cast shadows based on the position of the source.

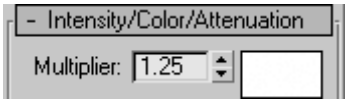


Figure 11.15 The Multiplier increased to 1.25.

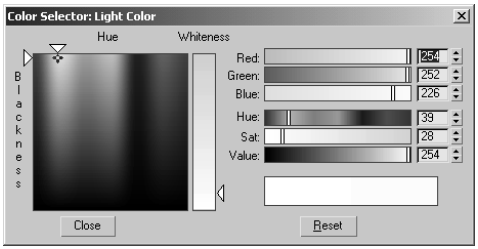


Figure 11.16 Selecting a color for the light.

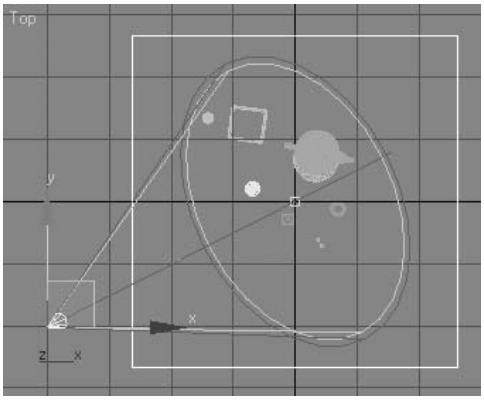


Figure 11.17 After positioning the light to the front of the scene.

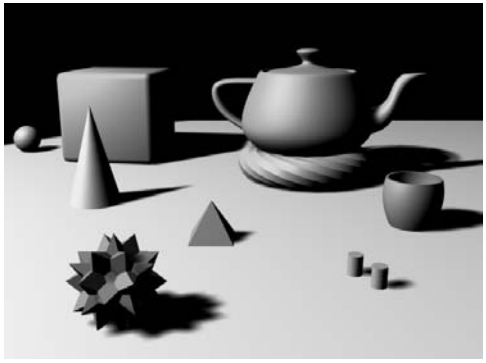


Figure 11.18 After repositioning the light and its target.

There are many parameters you can adjust on a light, but the settings that you usually adjust right away are the intensity, color, position, and aim. Additional light settings are explained in the sections on shadow casting and controlling illumination.

To adjust a target spotlight:

1. Open Practice01.max.
2. Select the spotlight.
3. Open the Modify panel.
4. In the Intensity/Color/Attenuation rollout, increase the Multiplier to 1.25, or just enough to brighten the scene without washing it out (**Figure 11.15**).
5. In the Intensity/Color/Attenuation rollout, click the white color swatch.
6. In the Color Selector: Light Color dialog box, select a color using the Hue and Whiteness sliders, or type in the RGB or HSV amounts (**Figure 11.16**).
7. In the Top viewport, select and move the light so that it is about 30° in front of the scene (**Figure 11.17**).
8. Right-click on the light and choose Select Target from the Tools 1 quad menu.
9. Move the target to the origin. You can do this easily by right-clicking the X, Y, and Z spinners of the Transform Type-in boxes on the status bar, while in Absolute mode.
10. Render your scene to see the result (**Figure 11.18**).
11. Adjust the light further until you are satisfied. Then save your scene.

Omni lights have only a single component. Similar to a bare light bulb, they are the simplest lights to create and adjust.

To create an omni light:

1. Open Practice01.max.
2. In the Create panel, open the Lights sub-panel.
3. In the Object Type rollout, click Omni.
4. In the Front viewport, click in the lower-right corner to create the omni light (**Figure 11.19**).

   The objects in the scene are lit from below and to the right. The plane does not block the light because its surface normals face away from the light (**Figure 11.20**).
5. In either the Top or Left viewport, move the omni light slightly in back of the scene so it is opposite the spotlight (**Figure 11.21**).
6. In the Intensity/Color/Attenuation rollout, reduce the Multiplier of the light to around .5, or just enough to dimly illuminate the dark sides of the objects.
7. Render the scene to see the result (**Figure 11.22**).
8. Save the scene as Practice02.max.

✔ Tips

- Click the plus sign "+" next to the Save button in the Save File As dialog box to increment your file by +01.
- If you add the two default lights in Practice.max to the scene they will turn into omni lights named DefaultKeyLight and DefaultFillLight. Once added, you can adjust them like other omni lights. To do so, choose Views > Add Default Lights to Scene. Note that the single default light cannot be added to a scene.

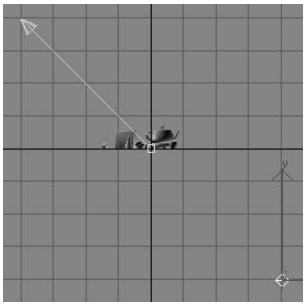


Figure 11.19 After creating the omni light in the Front viewport.

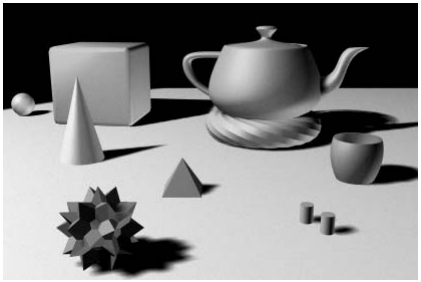


Figure 11.20 The scene is now lit from below right by the fill light.

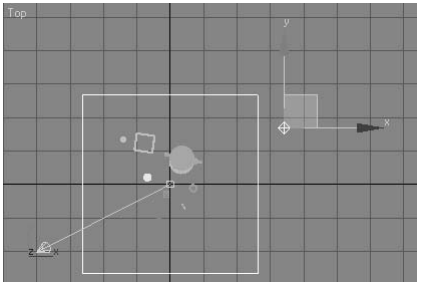


Figure 11.21 After moving the omni light into position.

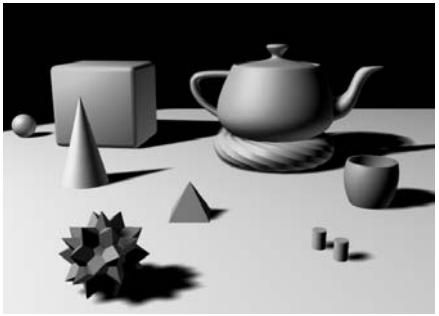


Figure 11.22 The key light and fill light illuminate the objects from the front left and back right.

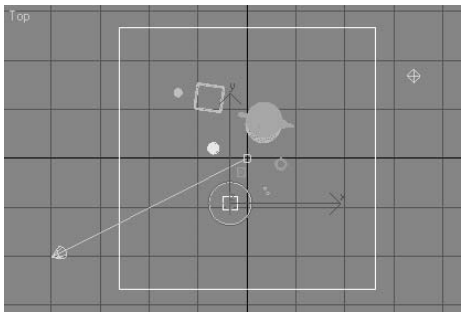


Figure 11.23 Place the free directional light directly over an object.

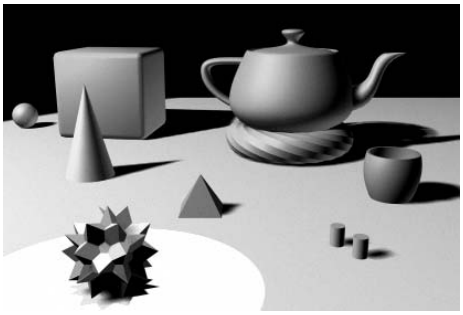


Figure 11.24 When you first set the directional light, it may be too bright.

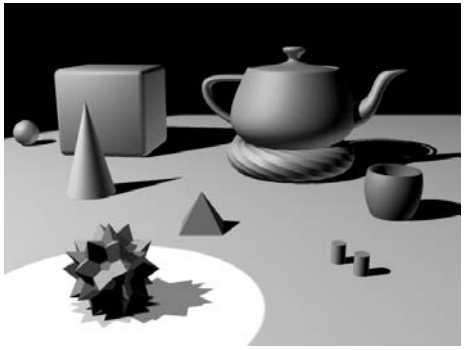


Figure 11.25 After adjusting the lights and turning on cast shadows.

Free lights are aimed without using a target. This makes them easier to transform and animate.

Free spotlights and directional lights are created with a single click. The light is automatically aimed at the grid of the viewport in which you clicked (a.k.a. the construction grid).

To create a free directional light:

1. Open Practice02.max.
2. In the Create panel, open the Lights sub-panel.
3. In the Object Type rollout, click Free Direct.
4. In the Top viewport, click on top of an object that you would like to highlight.
   The free directional light appears in the viewport on top of the object (**Figure 11.23**).
5. In the Front or Left viewport, move the directional light above the object.
   The light singles out the object with additional illumination (**Figure 11.24**).
6. In the Intensity/Color/Attenuation rollout, reduce the Multiplier so that it doesn't bleach out the object. Try a setting of around .5.
7. In the General Parameters rollout, check On to enable shadow casting.
8. Open the Modify panel. Then select the spotlight and reduce its intensity multiplier to around 1.1.
9. Render the scene to see the result (**Figure 11.25**).
10. Save the scene as Practice03.max.

✔ Tip

- Decreasing a Multiplier setting to a negative value causes a light to remove illumination from a scene.

A skylight acts as a dome of light to create the illusion of outdoor lighting. No matter where you place a skylight, it always illuminates the scene from above.

To create a skylight:

1. Open Practice.max.
2. In the Create panel, open the Lights sub-panel.
3. In the Object Type rollout, click Skylight.
4. Click in any viewport.
   The skylight appears in the viewport (**Figure 11.26**).
5. Choose Rendering > Advanced Lighting from the menu bar.
6. In the Advanced Lighting dialog box, open the drop-down menu and choose Light Tracer.
   The Light Tracer rollout appears and becomes active (**Figure 11.27**).
7. To make the scene more realistic, choose Render > Environment and change the Environment Background color to light gray.
8. Click the ActiveShade viewport to activate it.
9. From the Main toolbar, choose Quick Render (Production).
   The scene renders line by line. When it is done, the skylight diffusely illuminates the scene from above. Faint shadows gather below each object (**Figure 11.28**).
10. Save as Practice04.max.

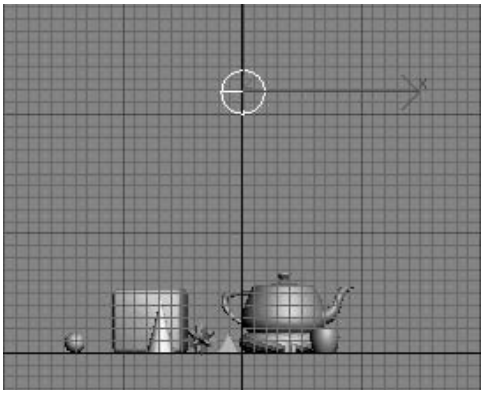


Figure 11.26 Placing a skylight in the scene.

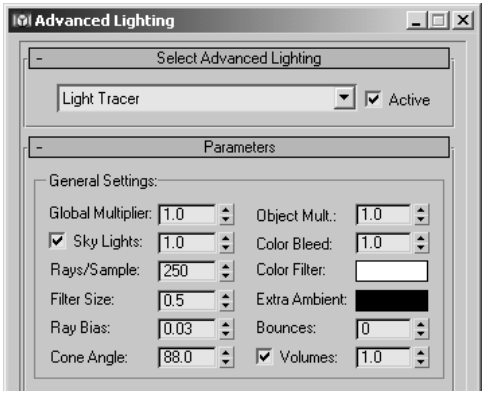


Figure 11.27 The Light Tracer controls skylights.

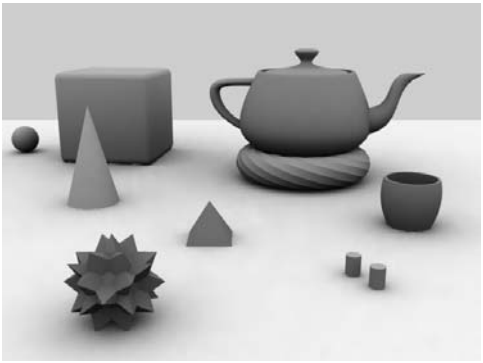


Figure 11.28 The skylight diffusely illuminates the scene from above.

Figure 11.29 The sunlight system uses the time and date on your computer to position the light.

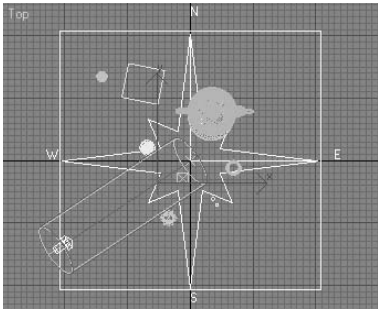


Figure 11.30 The compass sets the direction; the light illuminates the scene.

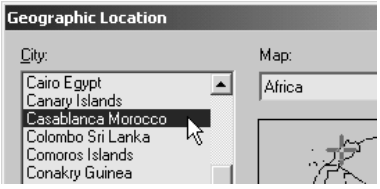


Figure 11.31 Get a new location from the list or click on a map of the world.

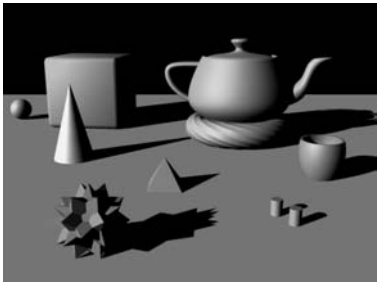


Figure 11.32 Sunlight renders with sharp-edged ray traced shadows by default.

A sunlight system is a combination of a free directional light and a compass rose that sets the orientation of the system. Ray-traced shadows are on by default.

To create a sunlight system:

1. Open Practice.max.
2. In the Create panel, open the Systems sub-panel.
3. In the Object Type rollout, click Sunlight.

   In sunlight system rollout, the time is set to the time on your computer, and the location is set to San Francisco, CA (**Figure 11.29**).
4. In the Top viewport, click and drag to create a compass rose of any size.
5. Move the cursor up or down to set the orbital distance of the sun. Then click to create the light (**Figure 11.30**).
6. In the Sunlight System rollout, set the time, date, and time zone for the light. You can also set the latitude and longitude, or pick a location by clicking Get Location (**Figure 11.31**).
7. Open the Directional Parameters rollout in the Modify panel, and uncheck Overshoot. Then increase the Hotspot until the cone of illumination encompasses the entire scene, so that shadows will appear throughout.
8. Click the ActiveShade viewport. Then click Quick Render (Production).

   Sunlight floods the scene. The ray-traced shadows are crisp and precise (**Figure 11.32**).
9. Save as Practice05.max.

✔ Tip

- After creating a sunlight system, you change its settings in the Motion panel.

A daylight system combines sunlight and skylight into one integrated system.

To create a daylight system:

1. Open Practice.max.
2. In the Create panel, open the Systems sub-panel.
3. In the Object Type rollout, click Daylight.

   The Daylight System rollout that appears looks just like a Sunlight System rollout.
4. In the Top viewport, click and drag to create a compass rose. Then move the cursor up or down and click to set the orbital distance of the daylight assembly head (**Figure 11.33**).
5. In the Daylight System rollout, set the time, date, and time zone for the light. You can also set the latitude and longitude, or pick a location by clicking Get Location.

   This positions the sun in the sky.
6. At the bottom of the rollout, set the brightness of the sky. Choose from Clear, Partly Cloudy, or Cloudy.
7. Choose Rendering > Advanced Lighting, or press 9 on your keyboard.
8. In the Advanced Lighting dialog box, choose Light Tracer.
9. Choose Rendering > Environment. In the Environment dialog box, match the Background color to the amount of cloud cover that you set for the sky.
10. In the Exposure Control rollout, choose Automatic Exposure control from the drop-down menu. Then Activate the ActiveShade viewport, and click Render Preview (**Figure 11.34**).
11. Adjust the exposure as needed. Then click Quick Render (Production).

    Sunlight and daylight illuminate the scene (**Figure 11.35**).
12. Save as Practice06.max.

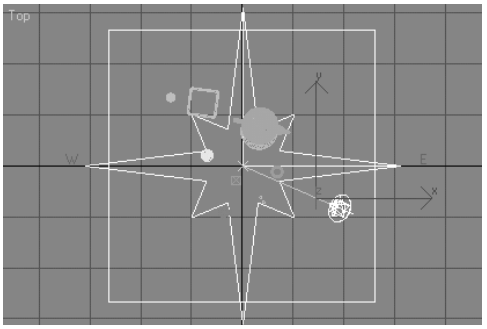


Figure 11.33 The compass orients the daylight assembly head to the location.

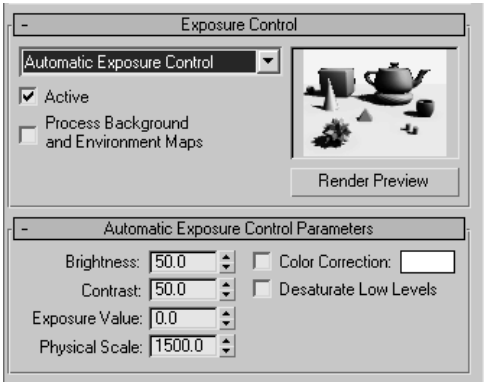


Figure 11.34 You adjust exposure in the Environment dialog box.

Figure 11.35 The final scene is illuminated with both sunlight and skylight.

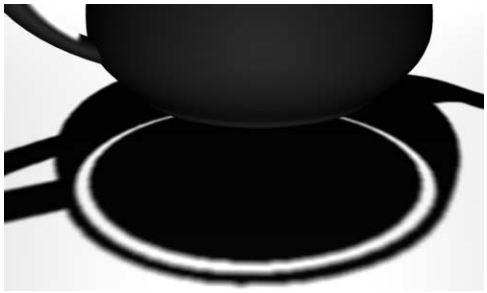


Figure 11.36 Shadow-map shadows have soft edges.

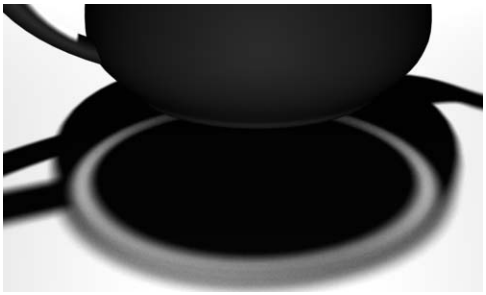


Figure 11.37 Area shadows produce soft, atmospheric shadows.

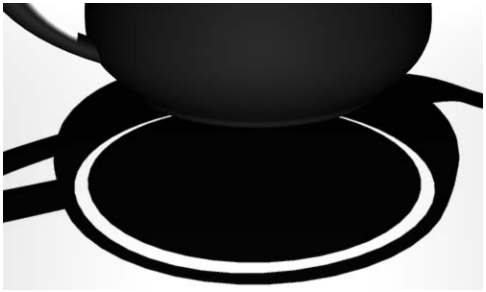


Figure 11.38 Ray-traced shadows have hard edges.

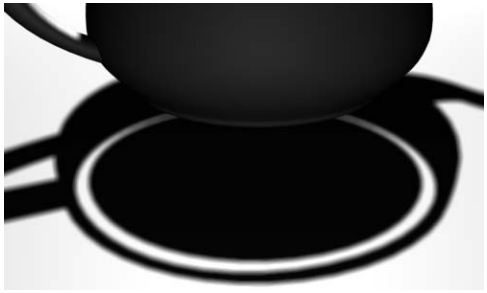


Figure 11.39 Advanced ray-traced shadows use anti-aliasing to produce soft edges.

Casting Shadows

There are four types of shadows that you can assign to a light:

- **Shadow maps** are bitmaps that are projected from a light. They are created by the scanline renderer during a pre-rendering pass of the scene and applied during rendering. Shadow maps give shadows a soft edge, as if they are being diffused by the atmosphere (**Figure 11.36**).

  Shadow maps are the default shadow type for most lights.

- **Area shadows** simulate shadows that are cast from an illuminated area or volume. They use anti-aliasing to produce soft, atmospheric shadows (**Figure 11.37**).

- **Ray-traced shadows** are more precise and sharp-edged than shadow-map shadows. They are calculated by tracing a ray from source to object. Use ray-traced shadows whenever you need to precisely locate shadows, such as in shadow studies for architectural siting (**Figure 11.38**).

  Ray-traced shadows are the default type for sunlight systems.

- **Advanced ray-traced shadows** are a variation of ray-traced shadows that also use anti-aliasing to produce soft edges (**Figure 11.39**).

Once you select a shadow type, you can adjust its color, density, and position, plus other qualities specific to that type. The adjustments that you make to a shadow determine the speed at which it will render.

To change shadow type:

1. Open Practice02.max.
2. Render the scene to get an accurate idea of what the shadows currently look like (**Figure 11.40**).
3. Select a light that casts shadows.
4. Open the Modify panel.
5. In the General Parameters rollout, choose a shadow type from the drop-down list (**Figure 11.41**).
6. Render the scene to see the result (**Figure 11.42**).

✔ Tip

- Ray-traced shadows render more slowly when you use them with omni lights. If possible, use ray-traced shadows with spotlights or directional lights instead. If you still need the effect of an omni or directional light, check Overshoot so the shadows will only be calculated within the cone.

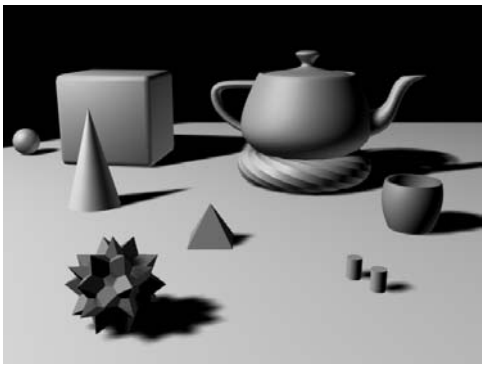


Figure 11.40 The practice scene has soft shadow mapped shadows.

Figure 11.41 Changing the shadow type to ray-traced shadows.

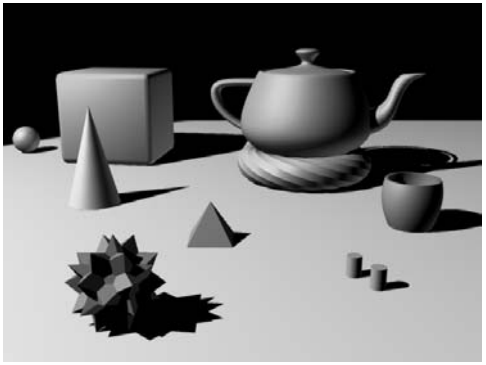


Figure 11.42 The ray-traced shadows are more crisp and precise.

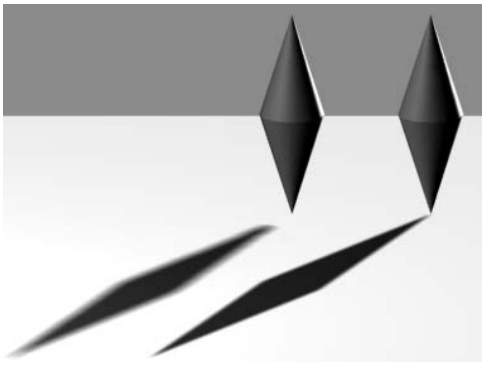


Figure 11.43 Before and after adjusting a shadow map.

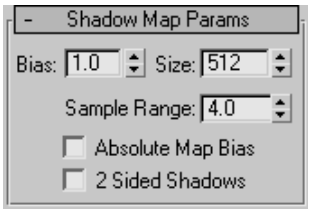


Figure 11.44 The Shadow Map Params rollout provides the means to correct shadow maps.

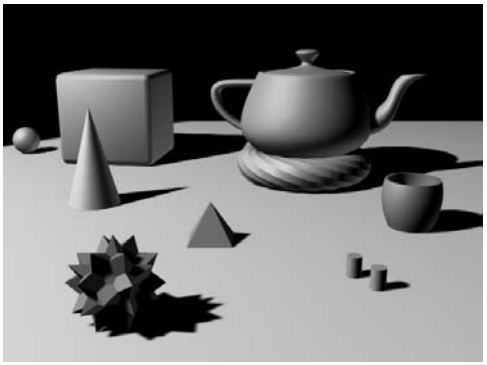


Figure 11.45 Increasing the map size and sample range focuses the shadow. Adjusting the map bias brings the shadow bank into alignment.

Shadow maps sometimes appear blurry, faint, or detached from the objects that cast them. Shadow-map parameters help you fix these problems (**Figure 11.43**):

- **Bias**—Offsets shadows from the object that casts them. Lowering the Bias value moves shadows closer to the object.
- **Size**—Controls the resolution of a shadow by setting the size of the bitmap that generates the shadow. Increasing this parameter sharpens shadow edges and increases rendering time.
- **Sample Range**—Controls the sharpness of shadows by averaging different sized areas of the shadow map. If a shadow smudges, streaks, or creates moiré patterns, the Sample Range setting is probably too high. A Sample Range setting that is too low creates jagged shadows.
- **Absolute Map Bias**—Determines how the map bias is computed in relation to the rest of the scene. Use this option to end flickering shadows in an animation.
- **2-Sided Shadows**—Causes surfaces to cast shadows as if they were double sided.

To get the most accurate feedback, render the scene after you change each parameter.

To adjust a shadow map:

1. Select a light that has a problematic shadow map, such as the spotlight in Practice02.max.
2.  Open the Modify panel.
3. Open the Shadow Map Params rollout (**Figure 11.44**).
4. Increase the Size and the Sample Range to improve the resolution of the shadow. Then decrease the Bias until the shadows touch the objects that cast them. To make the gap between the teapot and its lid disappear, check 2 Sided Shadows (**Figure 11.45**).
5. Save the scene.

Ray-Traced shadows produce hard-edged shadows that rarely need correcting. Like shadow map shadows, they allow you to adjust the shadow bias and render 2-sided shadows. In addition, the Max Quadtree Depth setting controls the rendering speed of ray-traced shadows by setting the maximum size of the data structure that generates them.

Advanced Ray-Traced shadows allow you to add anti-aliased edges and control their smoothness. You can also add noise to the shadows to offset shadow artifacts.

For more information on shadow parameters for each of the shadow types, open the 3ds max 5 User Reference and go to Contents > Lights and Cameras > Lights > Rollouts for Specific Shadow Types.

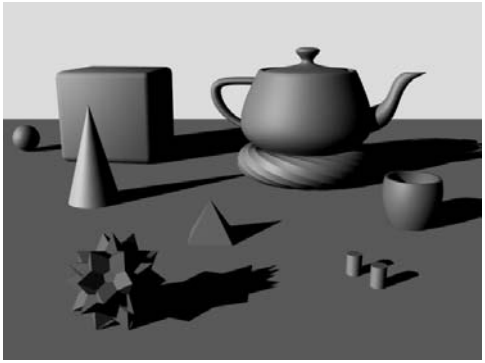


Figure 11.46 This sunlit scene has ray-traced shadows that are slow to render.

Figure 11.47 Increase the Max Quadtree Depth if you have plenty of RAM.

To speed up rendering of ray-traced shadows:

1. Open Practice05.max. Then select Sun01 (**Figure 11.46**).
2. Open the Modify panel.
3. Open the Ray Traced Shadow Params menu.
4. Increase the Max Quadtree depth (**Figure 11.47**).
5. Render the scene.
   The scene renders faster.

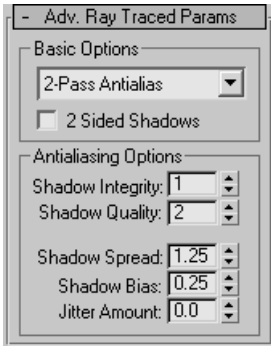


Figure 11.48 The Adv. Ray Traced Params rollout allows you to set options for anti-aliasing and adding noise to ray-traced shadows.

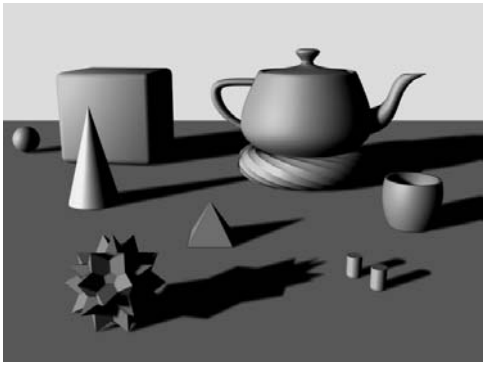


Figure 11.49 The anti-aliased shadows have softer edges.

To anti-alias ray-traced shadows:

1. In the General Parameters rollout, convert the shadows of the Sun01 object to advanced ray-traced shadows.
2. Open the Adv. Ray Traced rollout (**Figure 11.48**).
3. Increase the Shadow Integrity to 5 and the Shadow Quality to 10. Then increase the Shadow Spread to 4.
4. Render the scene (**Figure 11.49**).
5. Continue to play with the parameters until you get the effect that you like. Be sure to try increasing the Jitter Amount to see what it looks like when you add noise to the shadow.

You can set shadow color for all types of shadows independently of the color of the light. Use this feature to simulate reflected color from nearby objects or from secondary light sources such as the sky.

To set shadow color:

1. Select a light that casts shadows (**Figure 11.50**).
2.  Open the Modify panel.
3. Open the Shadow Parameters rollout.
4. Click the Color swatch (**Figure 11.51**).
5. Choose a color in the Color Selector: Shadow Color dialog box (**Figure 11.52**).
6. Render the scene.
   The shadow changes color (**Figure 11.53**).

Figure 11.50 The object casts a black shadow.

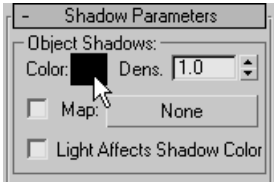


Figure 11.51 Click the color swatch.

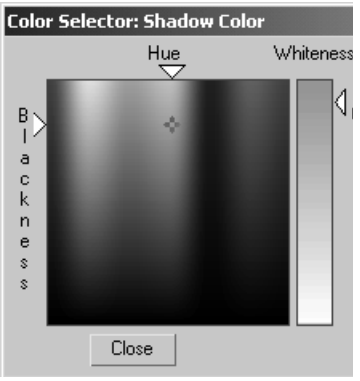


Figure 11.52 Choosing a light-blue color.

Figure 11.53 The object now casts a light-blue shadow.

Figure 11.54 The object casts a shadow of Density = 1.0.

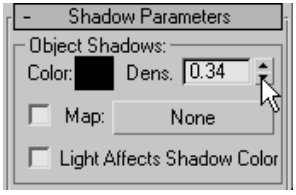


Figure 11.55 Decreasing the density of the shadow.

Figure 11.56 The shadow lightens.

The Density parameter sets the value, or darkness, of the shadows without affecting their hue and saturation. Use this feature to fill in shadows or to make them more transparent.

To set shadow density:

1. Select a light that casts shadows (**Figure 11.54**).
2.  Open the Modify panel.
3. Open the Shadow Parameters rollout.
4. Set the Density value of the shadow (**Figure 11.55**).
5. Render the scene.
   The shadow becomes darker or lighter (**Figure 11.56**).

✔ Tips

- To mix the color of the light with the shadow color, check Light Affects Shadow Color in the Shadow Parameters rollout.
- To project a map into a shadow, check Map, click the None button, and choose a map.

Shadow casting is an arrangement between two parties: Both the light and the object have to be set to cast shadows before shadows will be rendered. If you turn off the shadow-casting property of an object, it will not cast shadows for any light.

To turn off shadow casting for an object:

1. Open a scene that is illuminated by a light (**Figure 11.57**).
2. Select an object that is casting a shadow.
3. Right-click on the object, and choose Properties from the Transform quad menu.
4. In the Object Properties dialog box, uncheck Cast Shadows (**Figure 11.58**).
5. Click OK.
6. Render the scene to see the results (**Figure 11.59**).

✔ Tip

- To prevent any shadows from falling across an object, uncheck Receive Shadows in its Object Properties dialog box (**Figure 11.60**).

Figure 11.57 In this scene, the teapot overshadows the tube.

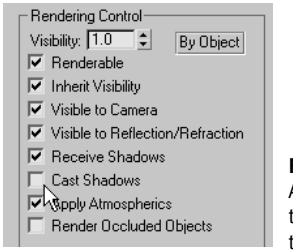


Figure 11.58 After turning off the teapot's shadow, the tube stands out.

Figure 11.59 Turning off Cast Shadows for the teapot.

Figure 11.60 The tube stands within the teapot's shadow but is not shaded by it.

Figure 11.61 The parameters of a spotlight are the same as those of a directional light, and have much in common with omni lights.

Controlling Illumination

Controlling illumination is essential to creating realistic scenes. The following parameters fine-tune colors and gradations of light, and determine the surfaces that light will affect (**Figure 11.61**):

- **On**—Enables illumination.
- **Type**—Sets the light type.
- **Targeted**—Enables a target.
- **Cast Shadows**—Enables shadow casting.
- **ShadowType**—Sets the shadow type.
- **Include/Exclude**—Determines which objects are illuminated by the light.
- **Multiplier**—Controls the intensity, or brightness, of a light.
- **Color**—Sets the hue (chroma), saturation (purity), and value (intensity) of a light.
- **Decay**—Diminishes the intensity of a light over its entire attenuation range.
- **Attenuation**—Fades the light at either end of its range.
- **Hot Spot and Falloff**—Sets the inner and outer boundaries of the cone of illumination.
- **Contrast**—Sets the contrast between ambient and diffuse areas of illumination.
- **Soften Diff. Edge**—Softens the edge between ambient and diffuse areas.
- **Diffuse**—Adds the light to diffuse (middle value) areas of illumination.
- **Specular**—Adds light to specular (high value) areas of illumination.
- **Ambient Only**—Adds light to the minimum level of scene illumination.
- **Projector Map**—Projects an image or animation into a scene.

By default, lights illuminate all objects within range. Turning off a light ends their illumination. Note that hiding a light does not turn it off.

To turn off a light:

1. Open Practice03.max (**Figure 11.62**).
2. Select a light.
3.  Open the Modify panel.
4. Uncheck the On box in the General Parameters rollout (**Figure 11.63**). The light is turned off (**Figure 11.64**).
5. To turn the light back on, check the On box.

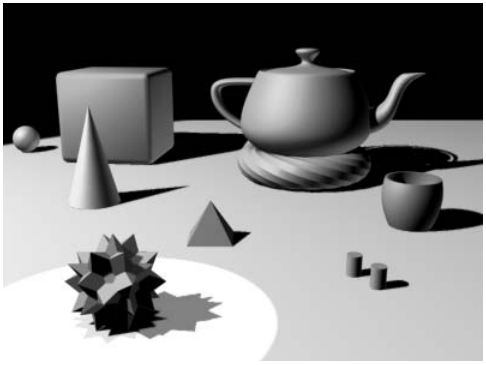


Figure 11.62 The practice scene before turning off the spotlight.

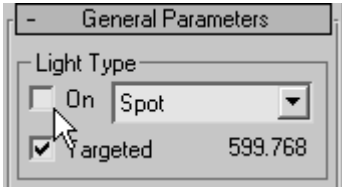


Figure 11.63 Uncheck the On box.

Figure 11.64 After turning off the spotlight, the scene is just illuminated by the direct light and the omni light.

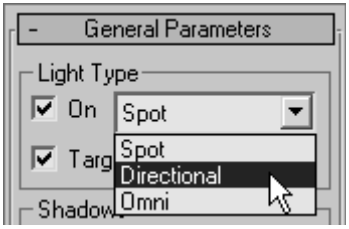


Figure 11.65 Changing the spotlight to a directional light.

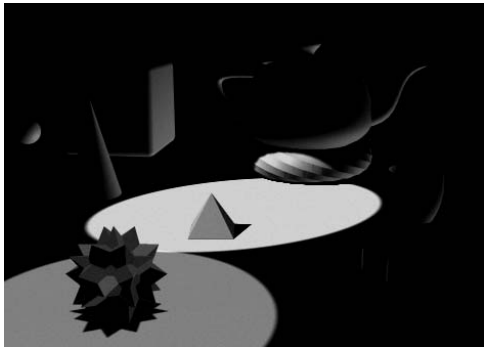


Figure 11.66 The spotlight has been changed to a direct light, which is narrower at the far end of its cone.

You can convert a light from one type to another in the Modify panel. When a light changes type, the illumination from the new light type replaces the illumination from the old type.

To change a light type:

1. Open Practice03.max.
2. Select a light.
3. Open the Modify panel.
4. In the General Parameters rollout, choose a light type from the Light Type drop-down list (**Figure 11.65**).

   The new light type replaces the selected light, using the same basic settings.

   The name of the light remains unchanged. If the name of the light is Omni01 and you have just changed it to a target spotlight, this is probably a good time to rename it.
5. Activate the ActiveShade viewport, and render the scene.

   The new light type replaces the old and illuminates the scene (**Figure 11.66**).

✔ Tips

- When you convert an omni light to any other type of light, it points toward the grid of the viewport it was created in.
- The Targeted check box toggles a target on or off.

The Exclude command turns off the illumination of objects that are within range of a light. It can also turn off shadow casting.

To exclude objects from a light:

1. Open Practice02.max.
2. Select the spotlight.
3. Open the Modify panel.
4. Click Exclude in the General Parameters rollout (**Figure 11.67**).
   The Exclude/Include dialog box appears.
5. Make sure Exclude and Both are selected in the upper-right corner.
6. Select the names of the objects or group of objects you do not want to be illuminated or to cast shadows.
7. Click the >> button.
   The names of the objects are moved to the Exclude list on the right (**Figure 11.68**).
8. Click OK.
9. Render the scene.
   The excluded objects neither receive illumination nor cast shadows, giving them an air of mystery (**Figure 11.69**).

✔ Tips

- To remove objects from the exclude list, and end the exclusion of objects, click the Clear button.
- Using the Include button, you can selectively choose just those objects you want to include in a light. All other objects will be excluded automatically.

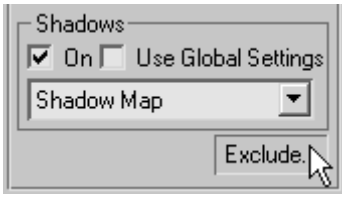


Figure 11.67 Click the Exclude button.

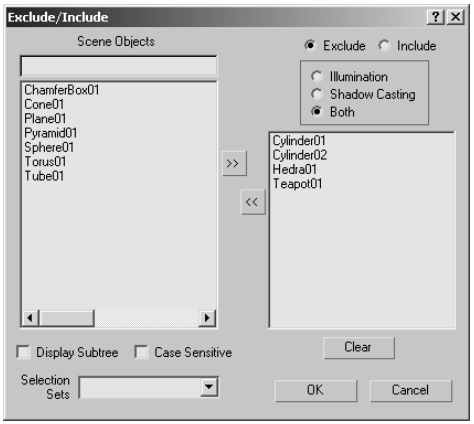


Figure 11.68 Turning off both illumination and shadow casting for the cylinders, hedra, and teapot.

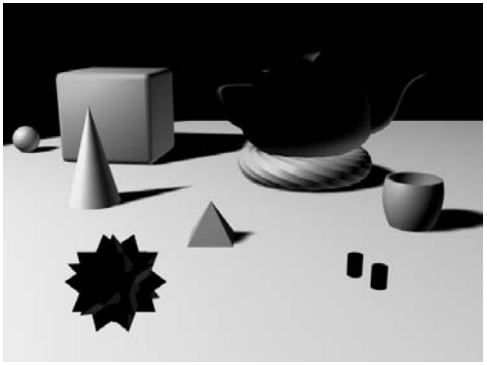


Figure 11.69 Without shadows or major illumination, the excluded objects appear to float in the scene.

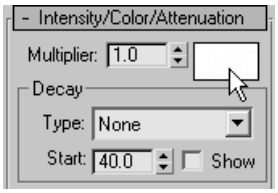


Figure 11.70 Click the color swatch.

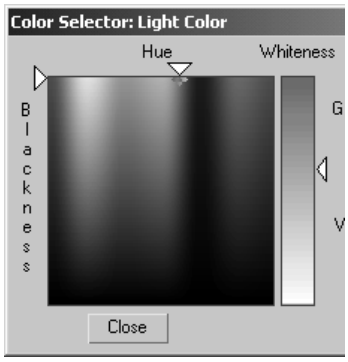


Figure 11.71 Picking a color using the palette and whiteness slider.

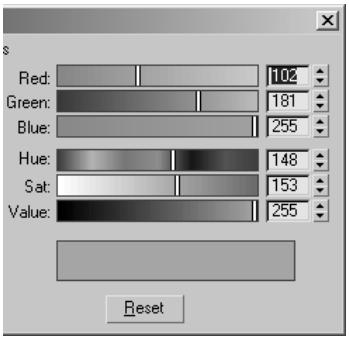


Figure 11.72 Picking the same color numerically.

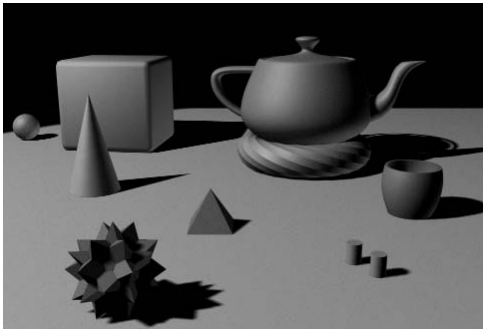


Figure 11.73 Blue light gives the scene a more somber cast.

Color settings assign hue, value, and saturation to a light. The value of a color also affects its intensity. Brighter colors create brighter lights. Darker colors create dimmer lights.

To set color:

1. Open Practice02.max.
2. Select the spotlight.
3. In the Intensity/Color/Attenuation rollout, click the color swatch just to the right of the Multiplier (**Figure 11.70**).
4. Choose a color from the Color Selector dialog box. There are two basic methods:

   The most intuitive way to do this is to click in the Hue palette on the left and drag the Whiteness slider next to it (**Figure 11.71**).

   When precision is important, you can set numeric RGB or HSV values using the color sliders, input fields, or spinners on the right (**Figure 11.72**).

   As you change the color of the light, the lighting updates in the shaded viewports.
5. When you are satisfied with the result, close the Color Selector dialog box.
6. Render the scene to verify the results (**Figure 11.73**).

✔ Tip

- Light and color can be animated over time.

Global lighting commands shift the base intensity and color of all the lights in a scene, including the default lights.

Initially, the base intensity is set to 1.0 and the base color is set to white. Ambient light, which sets the minimum level of scene illumination, is set to black (no light). Changing these settings will affect the overall amount of color and illumination of the scene.

Because ambient light brightens darker values, increasing it reduces contrast across surfaces. Use this setting sparingly, so it does not wash out your scene.

To set global lighting:

1. Open Practice03.max (**Figure 11.74**).
2. Choose Rendering > Environment to open the Environment dialog box.
3. In the Global Lighting group, set the base intensity of the lights by adjusting the Level (**Figure 11.75**).
   The scene brightens or dims (**Figure 11.76**).
4. Reset the Level to 1.0, then click the Tint color swatch.
5. In the Color Selector: Global Tint dialog box, choose a hue and whiteness value.
   The color and intensity of the illumination updates.
6. Click the Ambient color swatch.
   The Color Selector changes to the Color Selector: Ambient Light dialog box.
7. Drag the Whiteness slider to set the minimum level of illumination. Then select a hue.
   Gradations of value become lighter throughout the scene, and become tinted by the hue that you selected.
8. Render the scene to see the results (**Figure 11.77**).

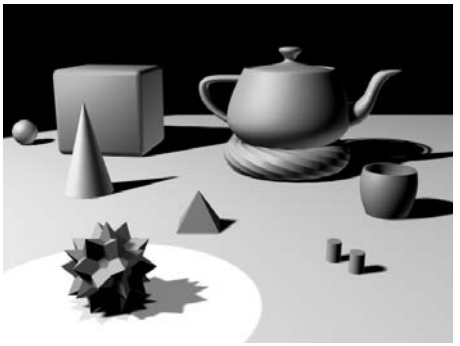


Figure 11.74 Before affecting the global lighting of the scene.

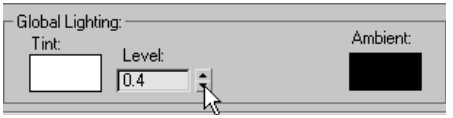


Figure 11.75 Reducing the global illumination.

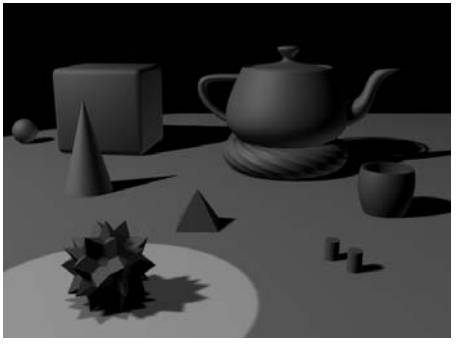


Figure 11.76 All the lights are dimmed.

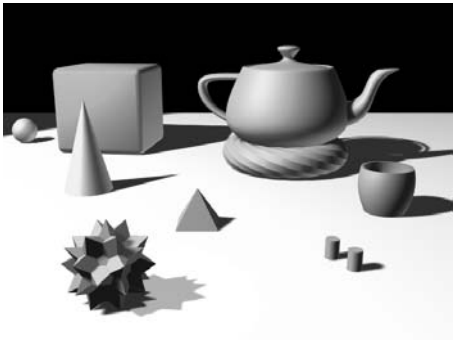


Figure 11.77 Increasing the value of the ambient color reduces contrast in the scene.

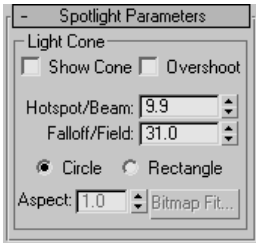


Figure 11.78 Adjust the hotspot and falloff in the spotlight parameters rollout.

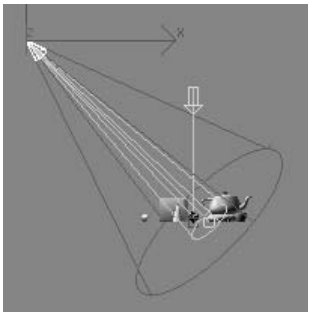


Figure 11.79 The hotspot and falloff cones move apart.

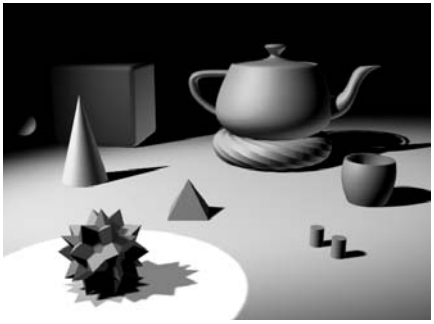


Figure 11.80 The pool of light gains a softer edge.

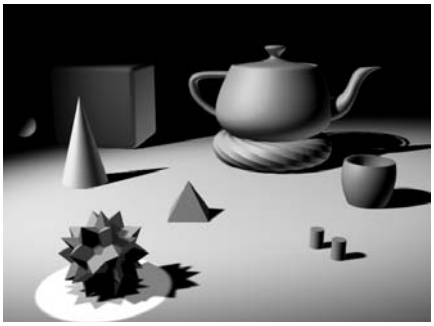


Figure 11.81 The cone of the directional light narrows.

A light cone is actually made of two concentric cones: the inner core of illumination, or **hotspot**, and the outer edge of illumination, or **falloff**. Between the hotspot and falloff cones, the intensity of the light gradually decreases to zero.

To set the hotspot and falloff:

1. Open Practice03.max
2. Select the spotlight.
3. Open the Modify panel.
4. In the Spotlight Parameters rollout, decrease the Falloff value. Then decrease the Hotspot value even more (**Figure 11.78**).

   The blue hotspot cone becomes narrower (**Figure 11.79**).

   In the ActiveShade viewport, the edge of the pool of light becomes softer (**Figure 11.80**).
5. Select the directional light.
6. In the Directional Parameters rollout, decrease the Falloff amount so that both the hotspot and falloff cones become narrower.
7. Render the ActiveShade viewport.

   The pool of light from the directional light becomes smaller, but its edges remain sharp (**Figure 11.81**).

✔ Tips

- Check Show Cone to display the cone even when the light is not selected.
- Checking Overshoot causes the light to ignore the boundaries of the hotspot and falloff cones and spread throughout the scene. Shadows, however, will be drawn within the cone of illumination only.
- Click Rectangle to make the pool of light rectangular or square. The Aspect parameter sets the aspect ratio of the length and width of the rectangle. The Bitmap Fit button will match the aspect ratio to an external bitmap, in case you want to project the map, as shown in the next exercise.

Projecting maps into a scene creates the illusion that there is more going on than meets the eye.

To project a map:

1. Open Practice02.max.
2. Select the spotlight.
3.  Open the Modify panel.
4. In the Advanced Effects rollout, click the Projector Map button labeled None (**Figure 11.82**).

   The Material/Map Browser window appears.
5. Double-click Bitmap (**Figure 11.83**).
6. Choose a bitmap image using the Select Bitmap Image File dialog box. For this example, I chose the SCATR4.gif in the 3dsmax5/Maps/Lights folder.

   When you click Open, the bitmap image is projected by the spotlight onto the scene.
7. Increase the light multiplier to compensate for the reduced intensity of the bitmap.
8. Render the scene (**Figure 11.84**).

✔ Tips

- A black-and-white map that is designed to be used with a spotlight is called a **gobo map**.
- Try some of the other maps in the Material/Map Browser such as Brick, Cellular, Checker, Dent, Gradient Ramp, Perlin Marble, and Smoke (**Figure 11.85**).

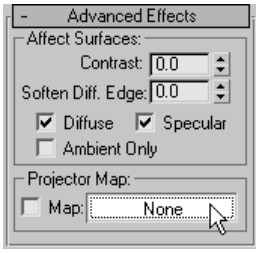


Figure 11.82 Click the Projector Map button.

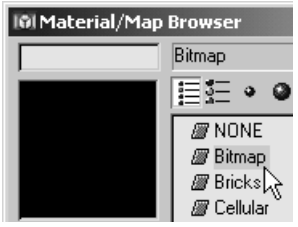


Figure 11.83 Click Bitmap in the Material/Map Browser.

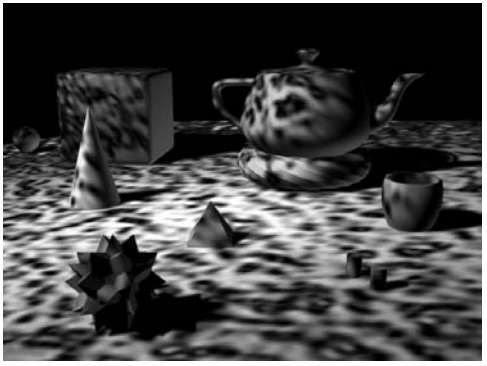


Figure 11.84 The SCATR4 map projects spots of light and shadow.

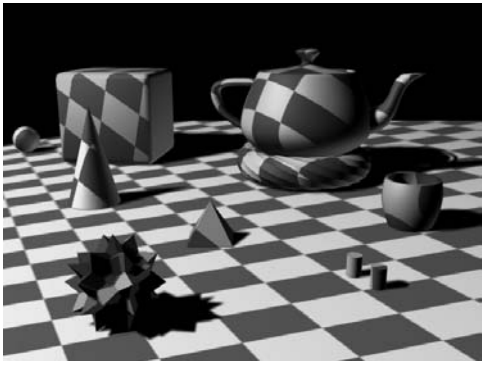


Figure 11.85 Projecting a checker map that has been tiled in the Material Editor.

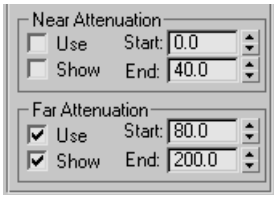


Figure 11.86 Check Use and Show for Far Attenuation.

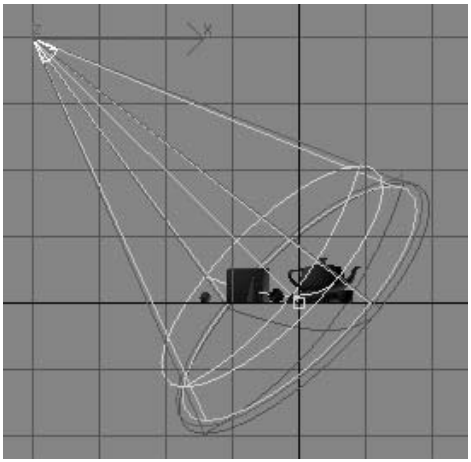


Figure 11.87 Setting the Far Attenuation range indicators.

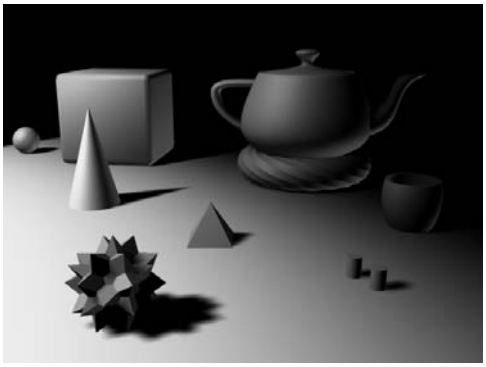


Figure 11.88 The light falls off across the scene more dramatically.

Attenuation fades in a light near its source and fades out a light at the far end of its range.

To set attenuation:

1. Open Practice02.max.
2. Select the spotlight.
3. Open the Modify panel and the Intensity/Color Attenuation rollout.
4. In the Far Attenuation group, check Use and Show (**Figure 11.86**).

   The far attenuation ranges appear. In the ActiveShade view, the light from the spotlight will disappear if the objects are out of the light's current attenuation range.
5. Drag the Far Attenuation spinners so that the Start and End ranges just enclose the scene objects (**Figure 11.87**).
6. Render the scene to see the final result (**Figure 11.88**).

✔ Tips

- Because light can continue shining forever, it is a good idea to use far attenuation so that the program won't waste time making unnecessary calculations.
- The Decay parameter increases the rate at which a beam of light diminishes as it moves away from its source.

Volume lighting is an atmospheric effect that is based on the real-world interaction between light and particulate matter such as fog, haze, dust, and smoke. It gives you the hazy glow of streetlights on a misty evening, the sweep of a lighthouse beacon on a foggy morning, or the rays of sunlight streaming through a window.

Volumetric lighting works with all types of light sources, although it is most commonly used with spotlights. Because volume lighting is a true 3D effect, you can render it only from viewports that use perspective projection.

To create a volume light:

1. Select a light that illuminates a scene.
2. Open the Modify panel.
3. Open the Atmospheres & Effects rollout. (Note: This rollout does not appear in the Create panel.)
4. Click the Add button (**Figure 11.89**).
5. Choose Volume Light from the Add Atmosphere or Effect dialog box (**Figure 11.90**). Then click OK.
6. Render the scene from a Perspective, Camera, or Light viewport.

   The light is rendered volumetrically (**Figure 11.91**).

✔ Tips

- Decreasing the size of the hotspot can make a Volume Light easier to control.
- By animating attenuation, you can make a Volume Light "touch down" and "beam up."
- Combining a projector map with a Volume Light creates interesting effects (**Figure 11.92**).

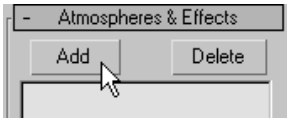


Figure 11.89 Click Add in the Atmospheres & Effects rollout.

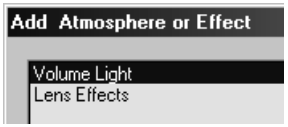


Figure 11.90 Add Volume Light to the spotlight.

Figure 11.91 The Volume Light renders in three dimensions.

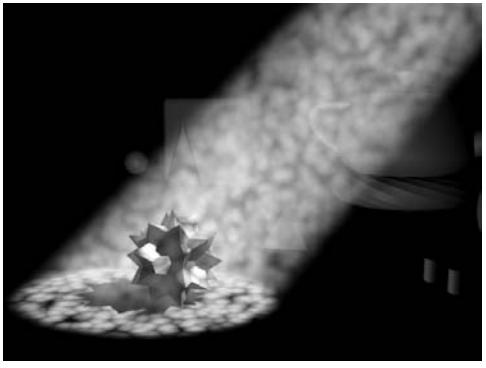


Figure 11.92 When added to a Volume Light, a Cellular map projects in three dimensions.

Figure 11.93 The Light window controls navigate Light viewports.

Navigating Lights

When you activate a light view, the viewport window controls change to a new set of navigation buttons called the light viewport controls (**Figure 11.93**). By navigating lights with the light viewport controls, you can fine-tune their placement and animate them over time.

The names of light viewport controls are based on traditional terms for making movies. For a complete description of the light viewport controls, see **Table 11.1**.

Table 11.1

Light Viewport Controls

Icon	Name	Description
	Dolly Light	Moves light along its local Z axis or line of sight.
	Dolly Light + Target	Moves light and target along light's Z axis.
	Dolly Target	Moves target along light's Z axis.
	Light Hotspot	Changes the size of the hotspot.
	Light Falloff	Changes the size of the falloff.
	Roll Light	Rotates light around its Z axis.
	Zoom Extents All	Centers objects in all non-fixed viewports.
	Zoom Extents All Selected	Centers selected objects in all non-fixed viewports.
	Truck Light	Moves light and target parallel to the view plane.
	Orbit Light	Rotates light around its target.
	Pan Light	Rotates light. Target rotates around light.
	Min/Max Toggle	Toggles between viewport layout and full display.

Note: Free lights use virtual targets for the Dolly, Truck, Pan, and Orbit commands.

You can look at a scene from the point of view of a spotlight or a directional light.

To change a view to a light view:

1. Open a scene that has a spotlight or directional light in it.
2. Activate the viewport you want to change.
3. Type $ (Shift + 4).
   The Select Light dialog box appears (**Figure 11.94**).
4. Select a light, and click OK.
   The view in the viewport changes to the Light view (**Figure 11.95**).

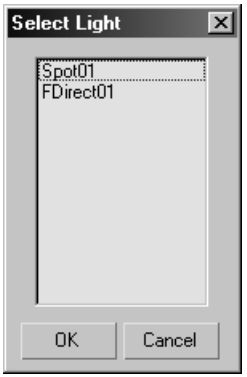


Figure 11.94 The Select Light dialog box prompts you to choose a light.

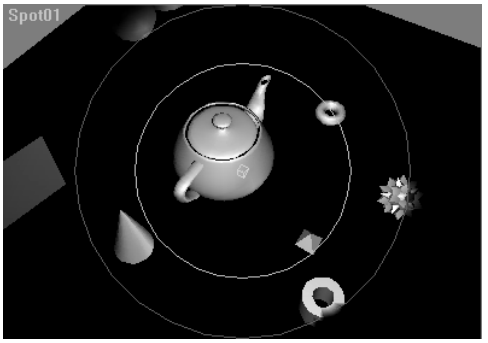


Figure 11.95 The Light viewport shows how the scene looks from the standpoint of the light.

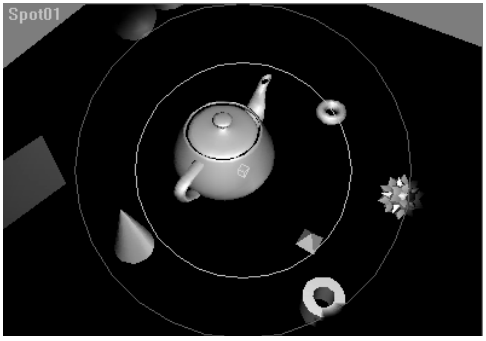


Figure 11.96 Open the Spotlight viewport.

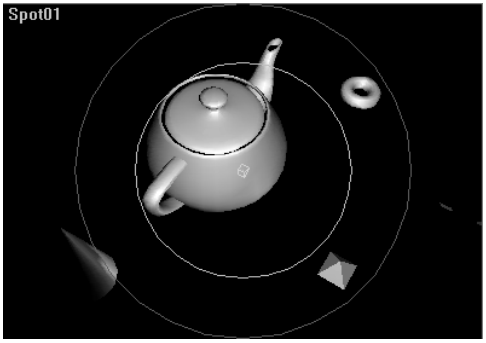


Figure 11.97 The scene enlarges in the viewport after you dolly the light closer to its target.

Figure 11.98 The pool of illumination shrinks as a result.

To dolly a light:

1. Change a view to a Light view (**Figure 11.96**).
2. Click the Dolly Light button in the light viewport controls.
3. Drag the dolly cursor up or down in the Light viewport.

   The light moves in or out along its local Z axis, or "line of shine" (**Figure 11.97**).

   The pool of illumination shrinks or expands (**Figure 11.98**).

✔ Tips

- To dolly a target, choose Dolly Target from the Dolly Light flyout.
- To dolly a light and its target together, choose Dolly Light + Target from the same flyout.

The Truck command moves a light and its target across a scene parallel to the plane of the Light viewport.

To truck a light:

1. Open a scene with a light in it (**Figure 11.99**).
2. Change a view to a Light view (**Figure 11.100**).
3. Click the Truck Light button.
4. Drag the panning hand across the Light viewport.

   The Light viewport moves across the scene (**Figure 11.101**).

   The cone of illumination moves as well (**Figure 11.102**).

Figure 11.99 The scene before you truck the light.

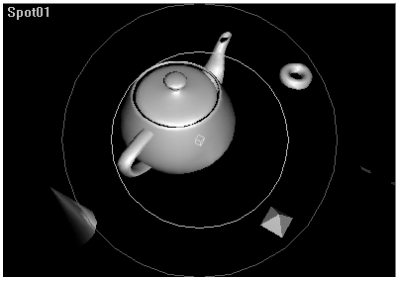


Figure 11.100 The view from the light shows the pool of illumination from above.

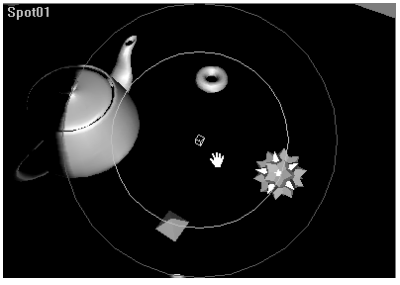


Figure 11.101 Use the panning hand to truck the light.

Figure 11.102 Compare the result to the Light viewport.

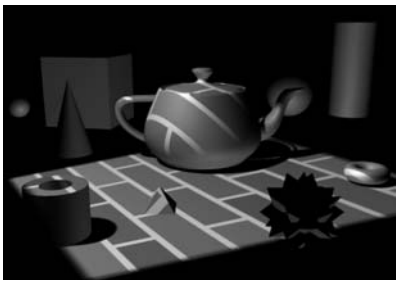


Figure 11.103 Using a rectangular cone of illumination, the light projects a Brick map onto the scene.

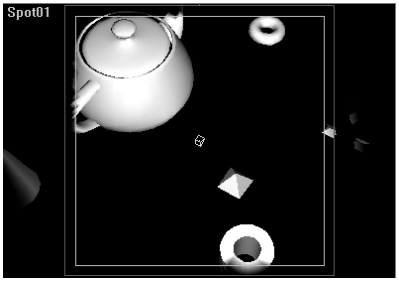


Figure 11.104 Before rolling the light.

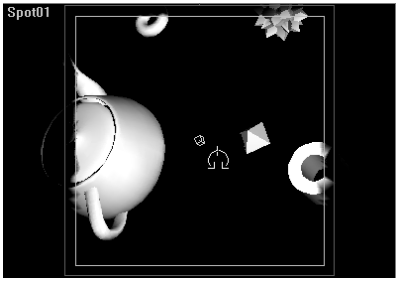


Figure 11.105 After rolling the light about 50°.

Figure 11.106 The map rolls with the projector.

Roll rotates a light along its line of sight. This affects the scene only if the light casts a rectangular cone or uses a projector map.

To roll a light:

1. Open a scene that is lit by a rectangular cone of illumination (**Figure 11.103**).
2. Change a view to a Light view (**Figure 11.104**).
3. Click Roll Light.
4. Drag the roll cursor across the Light viewport.

   The light rotates around its depth axis (**Figure 11.105**).

   The pool of illumination, and any maps that are being projected, roll with the light (**Figure 11.106**).

Orbit Light moves a spot or directional light around its target. If the light is a free light, it uses a virtual target located at the end of the light cone.

To orbit a light:

1. Open a scene (**Figure 11.107**).
2. Change a viewport to a Light view (**Figure 11.108**).
3. Click the Orbit Light button in the Light viewport controls.
4. Drag the cursor in the Light viewport.
   The light rotates around its target (**Figure 11.109**).
   The light orbits around the scene (**Figure 11.110**).

✔ Tip

- To align a light to a surface normal, select the light and choose Place Highlight from the Align flyout. Then click the object. The light aligns to the normal and creates a highlight on the surface. It remains at the same distance from the object as it was before. For more information on controlling highlights, see Chapter 13, "Creating Materials."

Figure 11.107 This scene is mainly lit from above and to the left.

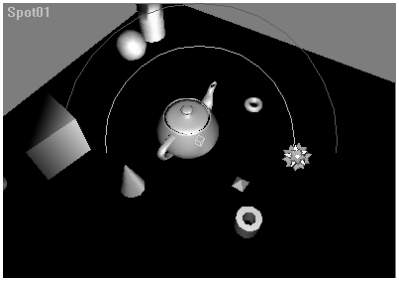


Figure 11.108 The view from the spotlight that provides most of the illumination.

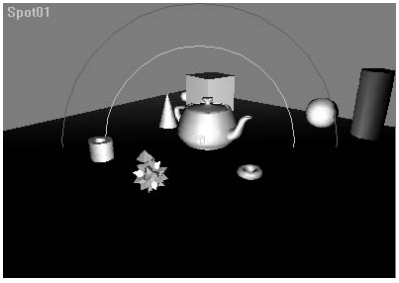


Figure 11.109 Orbiting the light around its target.

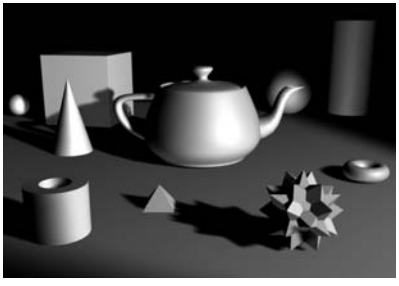


Figure 11.110 The scene is now illuminated from above and to the right.

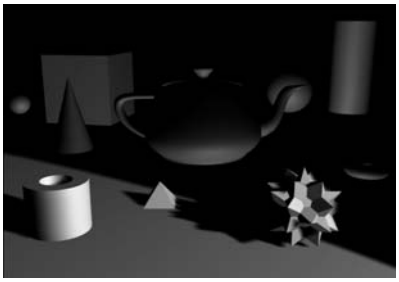


Figure 11.111 The light initially falls on the left front corner of the scene.

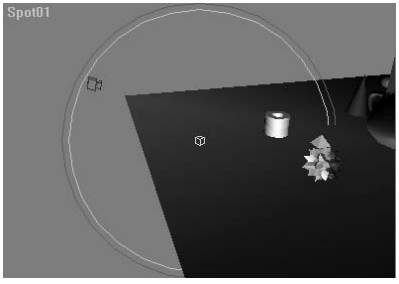


Figure 11.112 The view from the Light viewport shows the area of illumination.

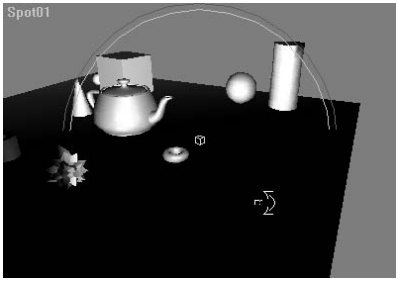


Figure 11.113 Panning the light across the scene.

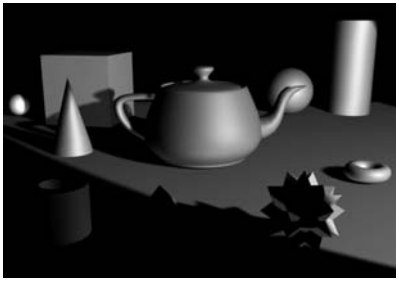


Figure 11.114 The light sweeps across the scene.

Pan rotates a target around a light. If the light is a free light, it uses a virtual target located at the end of the light cone.

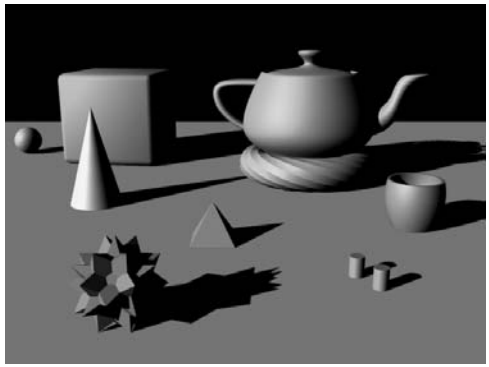
To pan a light:

1. Open a scene that is lit by a spotlight or a directional light (**Figure 11.111**).
2. Change a view to a Light view (**Figure 11.112**).
3. Click the Pan Light button in the Light viewport controls, located on the Orbit Light flyout.
4. Drag the cursor across the Light viewport.

   The Light view pans across the scene (**Figure 11.113**).

   The light sweeps across the scene (**Figure 11.114**).

Animating Lights



Lights are animated by keyframing or linking, or by assigning animation controllers to them.

Any numerical parameter of a light can be keyframed, including intensity, color, contrast, hotspot, falloff, attenuation, and shadow density. You can also keyframe the position and orientation of a light using the Move and Rotate transforms and the Light window controls. However, parameters that use checkboxes cannot be keyframed.

Linking a light to a moving object ensures that the light will illuminate the object or objects nearby—think running lights or headlights on a car. If the light is linked to a camera, the light will shine wherever the camera is pointed.

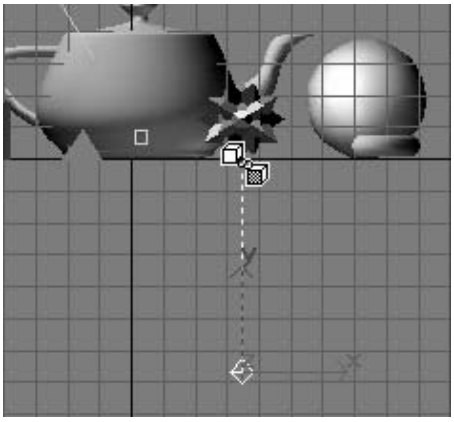


Figure 11.115 Linking the omni light to the hedra.

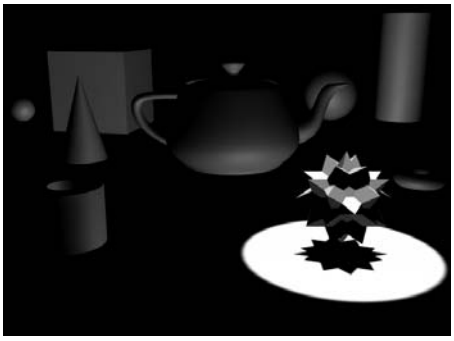


Figure 11.116 The hedra is lit from above and below.

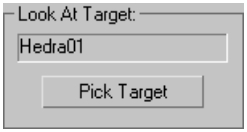


Figure 11.117 Pick the hedra to be the Look At target.

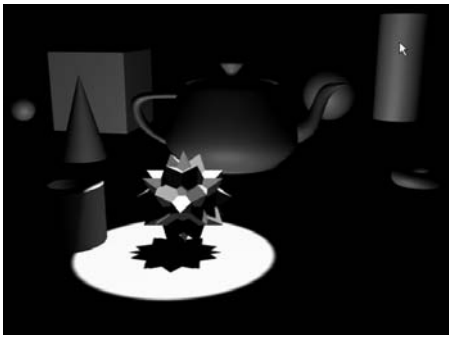


Figure 11.118 When you move the hedra, the omni light and the target light follow it.

The Look At constraint turns a light into a searchlight that always points at a target object. Moving the target over time is an easy way to animate the light. (Use a non-rendering helper object such as a dummy or a point if you do not want the target to be seen.) 3ds max automatically assigns the Look At constraint to spotlights and directional lights, so all you need to do is tell the light where to look.

To make lights follow an object:

1. Open Practice03.max, and close the ActiveShade view. (Note: The scene may shift a little when you close the view.)
2. Link the omni light to the object above it (**Figure 11.115**).
3. Turn off the spotlight. Then increase the Multiplier of the directional light to 1.5 (**Figure 11.116**).
4. In the Modify panel, convert the directional light to a Target Direct type.
5.  Open the Motion panel.
6. In the Look At Parameters rollout, click the Pick Target button (**Figure 11.117**). Then click the highlighted object.
7. Move the object.

   The lights follow the object (**Figure 11.118**).

By animating the intensity multiplier, you can make lights dim and brighten over time.

To animate light intensity:

1. Open Practice03.max.
2. Close the ActiveShade view. Then pan the Perspective viewport so that the hedra is in the center of the composition.
3. Choose Tools > Light Lister.
4. In the Light Lister dialog box, turn off the spotlight and set the omni Multiplier to 0 (**Figure 11.119**).
   The scene dims (**Figure 11.120**).
5. Turn on the Auto Key button, and drag the time slider to frame 50.
6. In the Light Lister, set the directional light multiplier to 1.5. Then set the omni light multiplier to.5 (**Figure 11.121**).
7. Drag the time slider to frame 100.
8. Set the intensity of both the directional light and the omni light to 0.
9. Play back the animation.
   The lights brighten and dim to darkness.

✔ Tips

- To animate a light turning on and off, change the tangent type of the Multiplier keys to Step, or assign an On/Off controller to the Multiplier track.
- By cloning the directional light and adding volume and a projector map, you can create a transporter that beams up your objects (**Figure 11.122**).

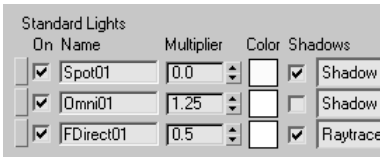


Figure 11.119 Adjust the light settings in the Light Lister utility.

Figure 11.120 Start with a dim illumination.

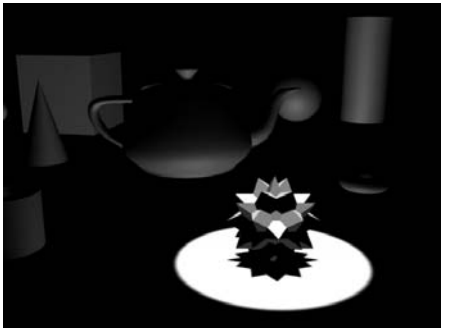


Figure 11.121 As the overhead light brightens to full intensity, the fill light brightens with it.

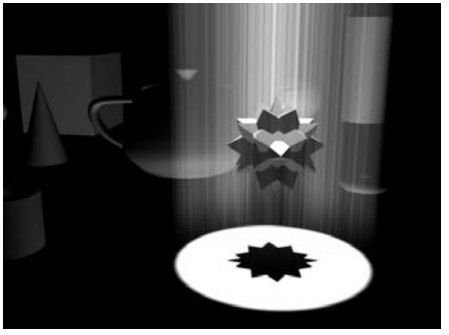


Figure 11.122 Beam me up, Scotty!