

Types of lights and their properties

When there are no lights in a scene, the scene is shaded or rendered with default lighting. You add lights to give the scene a more realistic appearance. Lighting enhances the clarity and three-dimensionality of a scene. In addition to general lighting effects, lights can be used to project images. (See Advanced Effects Rollout.)

Light objects *replace* the default lighting. As soon as you create a light, the default lighting is turned off. If you delete all the lights in the scene, default lighting is turned back on. The default lighting consists of two invisible lights: one is above and to the left of the scene, and the other is below and to the right.

TipOne way to begin your work on lighting a scene is to convert the default lighting into light objects by using the command Add Default Lights To Scene. **Note**A scene's lighting is also affected by the Ambient Light setting on the Environment And Effects dialog ➤ Environment panel.

3ds Max provides two types of lights: photometric and standard. All types are displayed in viewports as light objects. They share many of the same parameters, including shadow generators.

Photometric Lights

Photometric lights use photometric (light energy) values that enable you to more accurately define lights as they would be in the real world. You can set their distribution, intensity, color temperature, and other characteristics of real-world lights. You can also import specific photometric files available from lighting manufacturers to design lighting based on commercially available lights.



Standard Lights

Standard lights are computer-based objects that simulate lights such as household or office lamps, the light instruments used in stage and film work, and the sun itself. Different kinds of light objects cast light in different ways, simulating different kinds of light sources. Unlike photometric lights, Standard lights do not have physically-based intensity values.

A nighttime scene that uses standard lights for atmosphere rather than realism. You can animate not only the location of a light, but also its color, intensity and some other creation parameters.

You can use the Place Highlight command to change a light's position. See the Procedures in Working with Lights. A Light viewport can be a useful way to adjust lights other than omni lights.

To simulate sunlight, use a daylight or sunlight system, which allows you to set the date, time, and geographic location of your model. The daylight system is photometric, while the sunlight system uses a standard directional light.

Name and Color Rollout (Lights)-The Name And Color rollout lets you change the name and geometry color of a light. Changing the color of the light geometry can be useful when working with many lights. For example, in a scene with many different types of lights, you could make all spotlights red, and all omni lights blue to easily distinguish them.

Using Lights-These topics provide a general introduction to using lights in 3ds Max.

Photometric Lights-Photometric lights use photometric (light energy) values that enable you to more accurately define lights as they would be in the real world. You can create lights with various distribution and color characteristics, or import specific photometric files available from lighting manufacturers.

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Common Lighting Rollouts and Dialogs-The topics in this section describe rollouts and dialogs whose controls are common to both photometric and standard lights.

Shadow Types and Shadow Controls-The General Parameters rollout for both photometric and standard lights lets you turn shadow-casting on or off for the light, and choose which type of shadow the light uses.

Sunlight and Daylight Systems-The Sunlight and Daylight systems use light in a system that follows the geographically correct angle and movement of the sun over the earth at a given location. You can choose location, date, time, and compass orientation. You can also animate the date and time. This system is suitable for shadow studies of proposed and existing structures. In addition, you can animate Latitude, Longitude, North Direction, and Orbital Scale.

Create panel >  (Lights) > Create a light. > Name and Color rollout

Create menu > Lights > Photometric Lights or Standard Lights > Create a light. >  Modify panel > Name and Color rollout

Create a light. >  Modify panel > Name and Color rollout

The Name And Color rollout lets you change the name and geometry color of a light. Changing the color of the light geometry can be useful when working with many lights. For example, in a scene with many different types of lights, you could make all spotlights red, and all omni lights blue to easily distinguish them.



To change the color of a light's geometry:

 Create or  select a light in your scene.

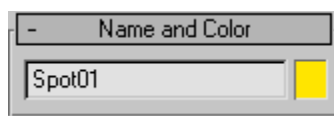
On the Name And Color rollout, click the color swatch to open a [Color Selector](#).

Choose a new color and click OK.

To change the name of a light:

 Create or  select a light in your scene. On the Name And Color rollout, click the name field and enter the new name, then press the **Enter** key.

The light's name has changed.



Name-The name of the selected light.

NoteWhen you rename a target-type light, the target object will be renamed to match the light.

Color-The color of the light's geometry. This has no effect on the color the light emits.

The procedures in this topic apply to both standard and photometric lights.



To change the color of a light's geometry:

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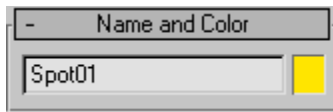
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To create shadows, do one of the following:

In the General Parameters rollout, make sure On is checked in the Shadows group. Adjust shadow parameters in the Shadow Parameters rollout and the additional (Shadow Map, Advanced Ray-traced, Area Shadows, or Ray Traced Shadows) shadow rollouts.

Right-click the light, and turn on Cast Shadows in the Tools 1 (upper-left) quadrant of the quad menu. Turning on Cast Shadows also turns on the On toggle in the Shadows group of the General Parameters rollout, and vice versa. Shadows are visible only when rendered, either in a full rendering, in a viewport, or with Active Shader.

Properties of Light

This topic describes light in the real world. When you light a scene, it can be helpful to know how light naturally behaves.

When light rays strike a surface, the surface reflects them, or at least some of them, enabling us to see the surface. The appearance of a surface depends on the light that strikes it combined with the properties of the surface material, such as color, smoothness, and opacity.

[Materials](#) let you specify the visual properties of surfaces.

Intensity

The intensity of light at its point of origin affects how brightly the light illuminates an object. A dim light cast on a brightly colored object shows only dim colors.



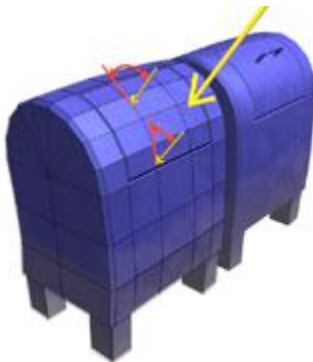
Left: A room lit by candles, which are a low-intensity source.

Right: The same room lit by a higher-intensity light bulb.

Angle of Incidence

The more a surface inclines away from a light source, the less light it receives and the darker it appears. The angle of the surface normal relative to the light source is known as the *angle of incidence*.

When the angle of incidence is 0 degrees (that is, the light source strikes the surface perpendicularly), the surface is illuminated with the full intensity of the light source. As the angle of incidence increases, the intensity of illumination decreases.



Angle of incidence affects intensity.

Attenuation

In the real world, light diminishes over distance. Objects far from the light source appear darker; objects near the source appear brighter. This effect is known as *attenuation*.



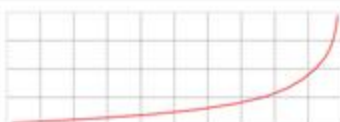
A



In nature, light attenuates at an inverse square rate. That is, its intensity diminishes in proportion to the square of the distance from the light source. It is common for attenuation to be even greater when light is dispersed by the atmosphere, especially when there are dust particles in the atmosphere, or fog or clouds.



B



A. Inverse decay

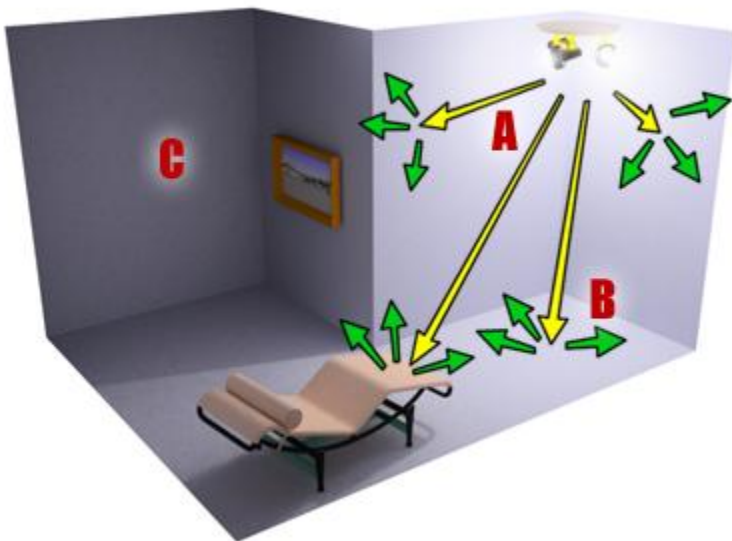
B. Inverse square decay

The graphs show the decay curves.

Reflected Light and Ambient Light

The light an object reflects can illuminate other objects. The more light a surface reflects, the more light it contributes to illuminating other objects in its environment.

Reflected light creates *ambient light*. Ambient light has a uniform intensity and is uniformly diffuse. It has no discernible source and no discernible direction.



A. Direct light

B. Reflected light

C. Resulting ambient light

Color and Light

The color of light depends partly on the process that generates the light. For example, a tungsten lamp casts orange-yellow light, a mercury vapor lamp casts cold blue-white light, and sunlight is

yellow-white. Light color also depends on the medium the light passes through. For example, clouds in the atmosphere tint daylight blue, and stained glass can tint light a highly saturated color.

Light colors are *additive colors*; the primary light colors are red, green, and blue (RGB). As multiple colored lights mix together, the total light in the scene gets lighter and eventually turns white.



Intensity

The intensity of a standard light is its HSV Value. At full value (255), the light is at its brightest; at 0, the light is completely dark.

The intensity of a photometric light is set by a real-world intensity value, measured in either lumens, candelas, or lux.

Angle of Incidence

3ds Max uses a vector from the light object to the face, along with the face normal, to calculate the angle of incidence. A surface is fully illuminated when the angle of incidence is 0 degrees (that is, the light source strikes the surface perpendicularly). If the angle of incidence increases, attenuation is in effect, or if the light has a color, the surface intensity can be reduced. In other words, the position and orientation of the light, relative to the object, are what control the angle of incidence in a scene. The Place Highlight command is one way to fine-tune the location of a light.

Reflected Light and Ambient Light

Rendering with the default renderer and standard lights does not calculate the effect of lights reflected from objects in the scene. Because of this, lighting a scene with standard lights often requires you to add more light objects than would be needed in real life. You can, however, use radiosity to show the results of reflected light.

When you do not use a radiosity solution, you can use the Environment panel to adjust the color and intensity of ambient light. Ambient light affects contrast. The higher the intensity of ambient light, the lower the contrast in the scene. The color of ambient light tints the scene. Sometimes ambient light is bounced light that gets its color from other objects in the scene. Most of the time, however, the color of ambient light should be the complement of the color of the principal light source for the scene.

Natural Light



Outdoor scene with natural sunlight

At ground level, for practical purposes, sunlight has parallel rays coming from a single direction. The direction and angle vary depending on the time of day, the latitude, and the season. In clear weather, the color of sunlight is a pale yellow: for example, RGB values of 250, 255, 175 (HSV 45, 80, 255). Cloudy weather can tint sunlight blue, shading into dark gray for stormy weather. Particles in the air can give sunlight an orange or brownish tint. At sunrise and sunset, the color can be more orange or red than yellow.

3ds Max provides several *daylight systems* to simulate the sun. See Sunlight and Daylight Systems. A single daylight system is appropriate as the main light source for sunlit scenes.

When rendering with mental ray, you can gather skylight from a daylight system efficiently into an interior with the mr Sky Portal. Shadows are more distinct the clearer the day is, and can be essential for bringing out the three-dimensionality of a naturally lit scene. A directional light can also simulate moonlight, which is white but dim compared to the sun.

Artificial Light



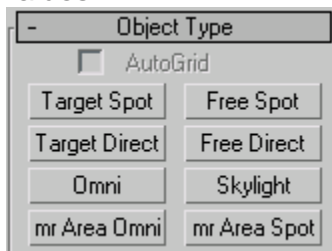
Outdoor scene with natural twilight and one streetlight

Artificial light, whether used indoors or outdoors at night, uses multiple lights. The following guidelines are for creating normally lit, easily legible scenes. You don't have to follow the guidelines, of course, but then you call attention to the lighting itself, rather than to the subject of the scene. The subject of a scene should be lit by a single bright light, known as the *key light*. Position the key light in front of the subject and slightly above. In

addition to the key light, position one or more other lights to illuminate the background and the side of the subject. These are known as *fill lights*. Fill lights are less bright than the key light. When you use only one fill light, the angle at ground level between it, the subject, and the key light should be approximately 90 degrees. Key-and-fill lighting emphasizes the subject of a scene. It also emphasizes the three-dimensionality of the scene. In 3ds Max, a spotlight is usually best for the key light, and either spotlights or omni lights are good for creating the fill lighting. See Target Spot, Free Spot, and Omni.

Standard Lights

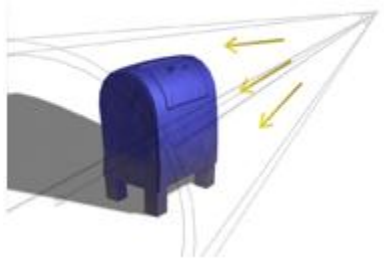
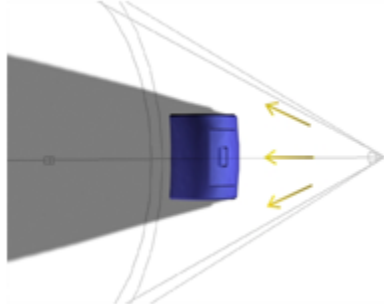
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For parameters specific to a particular kind of light, see the description of that light type. Parameters specific to standard lights in general, as well as rollouts specific to spotlights and directional lights, are described in Rollouts for Standard Lights.

Target Spotlight



A spotlight casts a focused beam of light like a flashlight, a follow spot in a theater, or a headlight. A target spotlight uses a movable target object to aim the light.



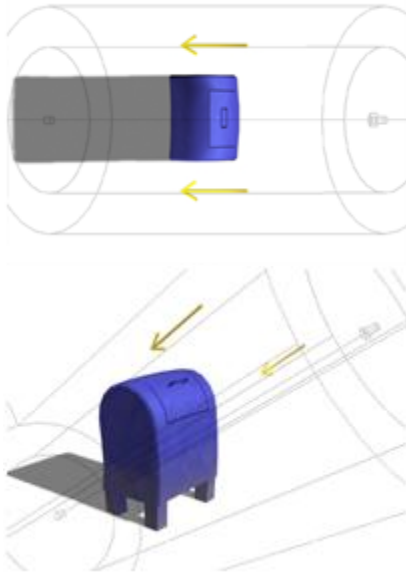
-  Create panel >  (Lights) > Standard > Object Type rollout > Target Spot button
- Standard menu: Create menu > Lights > Standard Lights > Target Spotlight
- Enhanced menu: Objects menu > Lights > Target Spotlight

Target Directional Light

Directional lights cast parallel light rays in a single direction, as the sun does (for all practical purposes) at the surface of the earth. Directional lights are primarily used to simulate sunlight. You can adjust the color of the light and position and rotate the light in 3D space.

-  Create panel >  (Lights) > Standard > Object Type rollout > Target Direct button
- Standard menu: Create menu > Lights > Standard Lights > Target Directional

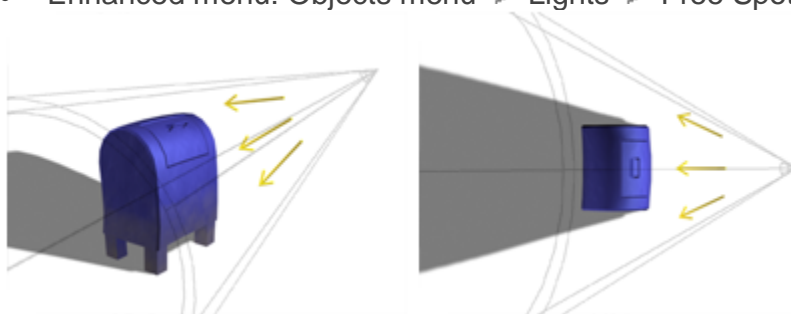
- Enhanced menu: Objects menu > Lights > Target Directional



Free Spotlight



A spotlight casts a focused beam of light like a flashlight, a follow spot in a theater, or a headlight. Unlike a targeted spotlight, a Free Spot has no target object. You can move and rotate the free spot to aim it in any direction.

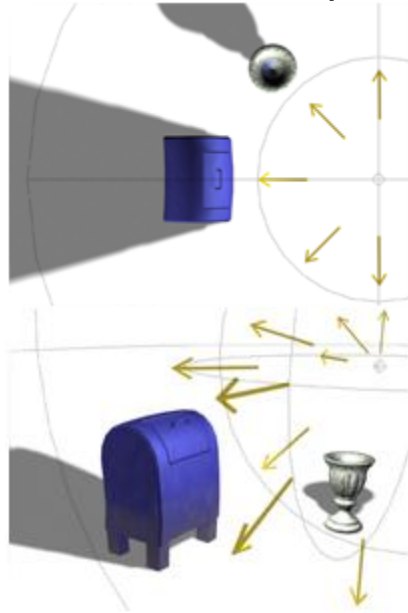
-  Create panel >  (Lights) > Standard > Object Type rollout > Free Spot button
- Standard menu: Create menu > Lights > Standard Lights > Free Spotlight
- Enhanced menu: Objects menu > Lights > Free Spotlight



Omni Light

An Omni light casts rays in all directions from a single source. Omni lights are useful for adding "fill lighting" to your scene, or simulating point source lights.

-  Create panel >  (Lights) > Standard > Object Type rollout > Omni button
- Standard menu: Create menu > Lights > Standard Lights > Omni
- Enhanced menu: Objects menu > Lights > Omni



Top: Top view of an omni light

Bottom: Perspective view of the same light

Omni lights can cast shadows and projections. A single shadow-casting omni light is the equivalent of six shadow-casting spotlights, pointing outward from the center.

When you set a map projected by an Omni light to be projected using the Spherical, Cylindrical, or Shrink Wrap Environment coordinates, the map is projected in the same way as it would be mapped to the environment. When you use the Screen Environment coordinates or Explicit Map Channel Texture coordinates, six copies of the map are projected radially.