Lighting

Art of lighting
Ultimately, lighting is about controlling and shaping light and shadows, reflections, refractions, and even color—whether you do it on a computer or on a film set. This kind of control requires an understanding of how light works, the aesthetic art of lighting, and techniques for lighting. This knowledge helps you develop your eye so that you can look with understanding at your image, clearly see it, and know what needs to be done. By looking and learning as much as you can about color and lighting, you can decide which information to use to create your lighting design—be it naturalistic or stylized in a myriad of ways.

Though the tools may differ, the principles involved in creating good lighting for computer graphics are used on film sets, as well. When referring to settings in a 3D package, most other 3D packages have settings for these same attributes, although their interfaces may be different.

Looking and Learning

For a computer graphics (CG) artist, understanding how light works in the natural world is important, because not only will you be called upon to produce naturalistic-looking imagery, but sometimes you will be asked to combine live-action footage and computer-generated imagery. Also, like a cartoonist who understands form and anatomy, if you want to stylize your lighting design, you need to understand which lighting attributes and qualities to work with. So, look at the world around you and study it (see Figure 1).

*Figure 1. Have you ever noticed how much more reflective a tide pool is around sunset, when it seems you can see the whole sky reflected in it, than earlier in the day? Look at the play of warm to cool colors in this photo.*

Shadows-

In lighting, darkness is just as important as light. This darkness can be caused by the absence of light (shade) or by an object blocking the light (shadow).

Shadows and Composition
How the shadows fall in any scene you are lighting contributes to the composition as well as the mood. Most often, to create the shadow design composition, you want only the key light (that is, the primary light source) casting the shadows. But there will be times when, in the interest of true realism, you will want every CG light in a scene that represents a practical real light to cast a shadow. For example, you may want all of the CG lights representing table lamps in a living room to cast shadows so that as your character walks by them, the shadows change.

In Maya* and most 3D animation packages, it is easier to control shadows than it is on a film set. You can selectively turn the shadow casting off on a light or change the render setting on an object to make it such that it does not receive or cast shadows (see Figure 2). On a live set, to get rid of unwanted shadows from a light, you must employ techniques such as bounce cards and diffusion filters.

*Figure 2. Light and shadow can create both mood and composition, and you can use light as a powerful metaphor. Light by its very nature is symbolic to us. I took this photo in a dance studio—an appropriate place for an inspirational ceiling.*
Shadows and Time of Day
Shadows are one big indicator of the time of day. Shadows late in the afternoon when the sun is low on the horizon are longer and softer versus the shadows at high noon, when the sun is directly overhead. At noon, shadows are shorter and sharper. That is one reason noon sunlight is referred to as hard, and late afternoon light is soft. Experiment with shadows by holding any light source lower, and then higher-directly over an object-and watch how the quality of the shadows changes.

Moving Shadows and Light Patterns
Moving shadows can help add to a sense of restlessness, danger, or suspense. Think of someone tossing in bed with shadows falling over him or her or shadows indicating an otherwise-unseen presence. You can break up the throw of a light using various devices. You've probably noticed the stripes of light coming in through Venetian blinds, for example. Walking at night, I often wonder at the dappled light and leaf shadows on the pavement caused by the street lamp light shining through the trees. Have you ever looked at beautiful cloud shadows traveling over mountains? Figure 3. When I light, I sometimes I like to do what I call overlighting, or really pushing a tonality change-a great contrast in tonality that often exists in life. Overlighting can actually add to the naturalism of your lighting. Look at the hot white lighting on some of that foliage: Go for the drama! On a film set, you can place a gobo (also known as a cucoloris or cookies) in front of a light to reshape it. Gobos are usually wood cut into various shapes blocking the throw pattern of the light, sometimes to imitate broken-up light and shadows. In working with lighting in a computer 3D package such as Maya*, you do the same thing using what is known as mapping on the intensity or the color of the light-usually a spotlight.

Key Light
Outdoors, the main source of light is the sun. Its rays come down to earth from one direction. You can think of the sun as the key light, because it is the dominant light outdoors. You can think of any light that is the dominant light in a scene as a key light, although a key light is generally used to highlight and add dimension to the main subject in a scene. The key light is generally the first light you set up, and it is part of the commonly used three-point lighting setup. It is the light that really sets the mood of a scene.

The key light in a scene can be animated, or it can constantly change as your character moves. Sometimes, you might want your character to be moving in and out of the light to add a sense of distance and depth or drama to your scene. Other times, you may want your character to be in the light at all times, so that nothing he or she is doing is lost. In a scene, the key light can be constantly changing, as for example when your character moves from under one street lamp to under another.

Reflected and Absorbed Light
Subjects can be lit by direct illumination from a light source as well as from reflected light. One of the most important things to understand about light is that some of it is reflected off of or absorbed by every surface it hits. In life, light can be reflected off one surface, then hit and bounce off of another surface again and again. Outdoors, the light from the sun creates a lot of bounce light. Besides adding to the general brightness and illumination of a scene, this reflected light creates highlights, spectral and diffuse light, as well as
reflections such as you see when you look in the mirror. This reflected light also has a lot to do with the colors you see
and color bleed.

**Radiosity**
Calculating every light bounce is a lot of information to retain in a computer's memory, so 3D packages have come up
with less memory-intensive ways of emulating this process. Some of these systems are called Global Illumination (GI)
or *radiosity*, but there are many even less memory-intensive ways to emulate light reflection. Cheats can be as simple as
making a cluster of directional lights aimed in different directions (see Figure 4).

*Figure 4. You can put colors on the lights to reflect the colors in the scene. Generally, a ground plane is warmer, so the
lights pointing up from the bottom would have warmer colors on them.*
You may have heard the term *ray tracing*. A ray trace light on a computer gives you the calculation of one bounce back
from a surface toward the camera. This one bounce is enough to give you a reflection.
A computer rendering/lighting system that just measures the direct illumination of a light is called ray casting. In ray
casting, there is no reflecting or refracting of light. It used to be that this functionality was all rendering packages were
capable of. Now, the ray casting is usually just the first calculation of light a renderer in a 3D package would make.

**Light Quality**

The quality of light—whether it is hard or soft—is important
in lighting, contributing to the mood of a scene. It is easier
to control whether a light is hard or soft on a computer
than on a live set.

**Hard Light**
The sun is obviously our largest light source, but because
of its great distance away, by the time the light rays reach
us on a clear, unclouded day, they are virtually parallel,
making it a hard light source. Parallel rays (or close to
parallel rays) are a characteristic of hard lighting.

Hard light creates crisp, dark, and harsh-edged shadows,
emphasizing angles and edges. Hard light is good for
showing contrast and giving dimension to a subject, a landscape, or an object. It’s also good for showing form and
volume. Hard lighting can show texture very well, as in leather or an engraving, and it’s good for lighting night scenes,
where you want dark, hard-edged shadows. On set, hard light can come from a point source, such as a naked light bulb
or a focused spotlight or a small, focused
source such as a Fresnel lens.

In a 3D program, a good hard light source might
be a light that starts from a single point, such as
a point light or a spotlight with the penumbra
set to 0. Hard light has no soft falloff. A
directional light, which is the closest light to the
sun in most 3D programs, also provides a good
hard light source. Like the sun, the directional
light sends down parallel rays of light at the
same angle over the entire scene (see Figure 5).
Figure 5. Notice the highlights caused by this focused hard light source. I have used only one spotlight as the key light, and there is no fill light to soften the lighting.

When light rays from the sun hit a heavy cloud bank, the clouds can act like a diffusion material, scattering the rays in different directions and creating a softer light. On a cloudy day, some things will be brightly lit and others not (see Figure 6).

Figure 6. I took this photo on a walk at lunch when I was working for DreamWorks Feature Animation in Glendale, California. The light in the valley could sometimes be extraordinary.

Soft Light

The term soft light refers to a light that wraps around objects and creates shadows with soft edges or (ideally) no shadows. The rays of a soft light are less parallel to the illuminated object than the rays of a hard light, illuminating an object from multiple directions, so a soft shadow or no shadow at all results. A soft light is a flattering light for a portrait, lessening the contrast of wrinkles on a face. It reduces texture and smoothes an object’s surface. The danger of soft lighting is that it can leave the subject a bit dimensionless (see Figure 7).

Figure 7. Here, I have used a key and fill light to create a softer look. Because I did this in Maya*, I was also able to turn off the emit specular and the shadows on my lights to help create a softer lighting on the face.

In Maya, a good soft light is an area light. In an area light, the light is not emitting just from a single point but from many points, thus spreading the light out. Area lights come in many shapes, and you can change their sizes. A bigger area light will emit light from a larger area. You can even make a spotlight into a soft light by increasing its penumbra and turning off its shadows. You can also make lights softer by turning off their shadow casting. A global illumination system or radiosity can produce soft lighting (see Figure 8).

Figure 8. This room is filled with soft lighting coming in through the windows. Most of the room is being lit by softly reflected light rather than a direct hard light source. Notice how the light varies on walls and all surfaces in the room. This is what radiosity on a computer tries to emulate—all of the reflected and bounce light.

Fill Light

You've set up your key light, but now you decide that you want to add more light to the scene. The first light typically added is called the fill light. Fill light is generally a soft light that doesn’t cast shadows. The fill light adds light to the scene, softening the light from the key light by lowering the contrast of the dark to light areas. Often, a fill light is set up lower than and opposite to the key light, on the other side of the camera axis, pointing toward the object to be illuminated. Fill lights are usually low, as they are often emulating the reflected light that would be coming off the floor. You can use bounce light to add to the fill light. Generally, when you are lighting a realistic or naturalistic scene, you do not want any totally black areas in the scene. In life, there are rarely any areas of complete black: Some light has bounced in. Fill light can help provide this light. Even when I am lighting a night scene, I try to add some light so that no area is totally black.
Key to Fill
You may have heard the terms key-to-fill ratio or low key and high key lighting. A key-to-fill ratio is just a measure of the brightness of your key light to that of your fill light. If your key light is 3 times as bright as your fill light, that's a 3:1 ratio. The expression high key lighting or low key lighting refers to the amount of fill light in your scene.

Using Lights to Set Up Moods
In a bright and happy scene—a comedy, say—you would be well served by high key lighting. A brightly lit scene with low contrast can create a safe feeling, as nothing is completely hidden in shadow. The mood is calm and tranquil; no danger lurks. In contrast, a lot of cool florescent light can make a scene seem sterile. Cool-temperature high key lighting could be good for creating a scene in a drug store or laundromat, for example.

With high key lighting, because of the lessening of contrast, a scene can look a bit flatter. To give volume to an object or scene, you want that contrast of dark to light. A night scene is a good example of low key lighting. Low key lighting is also used in a film noir lighting style—a popular film genre and lighting/cinematography style developed in the 1940s and 1950s in American films. It speaks of danger and suspense with a touch of evil. In a film noir lighting style, darkness and shadows predominate: There would be very deep black shadows and light falling exactly where you want it to, with very little light spill. On the other end of the low key lighting spectrum, consider a romantic dinner scene: Soft, flickering candlelight can be sentimental or romantic. Candles would also work in a church scene.

Back Light
A third type of light commonly used in a three-point lighting setup is the back light, sometimes referred to as a rim light (see Figure 9). When the sun is lower in the sky, its rays can put rim lighting around people and objects out in the landscape, separating them from the background. Back lighting is a device you might want to try out in your lighting to help emphasize a figure or object. Often, you set up a back light to illuminate a subject this way. If there is already enough contrast between your character and the background, you might not want to use a backlight to rim and define your character's edges.

Figure 9. A three-point lighting setup illustrated in Maya*

Basics of Lighting
Here are some of the standard lighting options found in most 3D software suites:

- **Point/Omni Light:** A point light casts illumination outward in every direction from a single, infinitely small point in 3D space. Point lights are useful for simulating any omni directional light source: Light-bulbs, candles, Christmas tree lights, etc.
- **Directional Light:** Unlike point lights, which occupy a specific location in the 3D scene, a directional light is meant to represent an extremely distant light source (like the sun or moon). Rays cast from directional lights run parallel in a single direction from every point in the sky, and are typically used to simulate direct sunlight. Because a directional light represents a distant light source, its x,y,z coordinate means nothing—only its rotational attribute has any bearing on how the scene will be illuminated.

is used for publishing geometric data in a 3D web environment

- **Spot Light:** Spot lights in 3D applications are fairly self-explanatory due to the fact that they're rather similar to their real-world counterparts. A spot light emits a cone shaped light field from a single point in space. Spotlights are
often used for three-point studio lighting, and also for simulating any light fixture where there is a distinct visual falloff from light to dark—streetlights, desk lamps, overhead cone lighting, etc.

- **Area Light**: An area light is a physically based light that casts directional rays from within a set boundary. Area lights have a specific shape (either rectangular or circular) and size, making them very useful for simulating florescent light fixtures, back-lit panels, and other similar lighting features. Area lights can be used as photon emitters when using global illumination in Mental Ray, which makes them a popular choice in product lighting and architectural visualization. Although area lights do have an overall directionality, they do not emit parallel rays like a directional light would.

- **Volume Light**: The volumetric light is perhaps the toughest to wrap one's head around. With default settings, it's almost identical to a point light, emitting omnidirectional rays from a central point. However unlike a point light, a volumetric light has a specific shape and size, both of which affect its falloff pattern. A volumetric light can be set in the shape of any geometric primitive (cube, sphere, cylinder, etc.), and its light will only illuminate surfaces within that volume.

- **Ambient Light**: An ambient light casts soft light rays in every direction, and can be used to elevate the overall level of diffuse illumination in a scene. It has no specific directionality, and therefore casts no ground shadow, however it is not truly omni-directional like a point light. Ambient light is relatively similar to the light experienced at dusk, just after the sun has set.

The light types we've discussed here can be used for anything from simple three-point studio lighting to complex animated scenes that require 40+ lights. They're almost always used in conjunction with one another—it's very rare that a scene will only include point lights, or only include area lights, etc.

Nevertheless, we've only just begun to scratch the surface of a deep and varied topic.

**Basics**
Lighting is an essential tool for enhancing the video image. The subtle use of light creates atmosphere and mood, dimension, and texture. It can help to convey a plot line, enhance key elements such as set color or skin tone, and signals the difference between comedy and drama, reality and fantasy.

*Photo by Kristaps B.*

**Hard versus Soft**
All lighting falls into either “hard” with sharp and distinct shadows, or “soft” with less defined, softer shadows and fewer background images. The intensity and clarity of the bulb, or its diffusion, combines with placement to design a shooting environment.

- **Hard light**. Aimed directly on its subject, with a brighter single-source illumination. The sun is one example. Other hard light is incandescent, ellipsoidal, and quartz.
- **Soft light**. Diffused, created with less intense lamps that reflect or bounce light off a reflector, a ceiling, or another part of the set. Soft lighting effects are enhanced with scrims, strips, scoops, and banks.

Three-Point Production lighting involves three major lights and their positions in relation to each other (three-point lighting):

- **Key light**. Powerful, bright light that best defines a primary, or key, person or object, creating a deep shadow. It is positioned at roughly a 45-degree angle to the subject being shot.
- **Fill light(s)**. Softer light placed at an angle to “fill” any unwanted shadows created by the key light, at about half the key’s intensity. It is usually placed opposite the key light at about a 30-degree angle.
• Back light(s). Throwing light on the subject from behind, it’s positioned behind at around a 90-degree angle; it can also be adjusted higher or lower to create other lighting moods. This helps to create an illusion of depth behind the main subject and brings it forward from the background.

THREE-POINT LIGHTING

High-Key versus Low-Key Lighting
Most TV talk shows, sitcoms, variety shows, musicals, and family entertainment use high-key lighting: a high ratio of key light to fill light. Low-key lighting creates a more dramatic, moody, and textured effect for dramas, documentaries, music videos, and others.

Hot and Cold Lighting
All lights have a color temperature that influences what the camera records:
• Daylight (outdoor). The most powerful and brightest light. Daylight is hot and produces a blue tone on video.
• Artificial (indoor). Considered cold. On video, it creates a reddish-yellow cast.

Interior and Exterior Lighting
Everything you shoot is either indoors or outdoors. Each light has its advantages and limitations.
• Exterior lighting. As you shoot an exterior (outdoor) scene, you may want the spectacular intensity of the sun at high noon. Or, the scene calls for the Moody waning light immediately after sunset, known as the magic hour. Each option has its own effect on an exterior scene. However, outdoor shooting can pose real challenges. Along with the sun’s continual movement, its degrees of brightness can fluctuate dramatically through the shooting day. When the sun is your key light, it might need to be partially blocked out or augmented by fill lights or back lights. An exterior set can be shot at night but lit to look like daylight, or vice versa.
• Interior lighting. Shooting interior (indoor) scenes poses fewer challenges as video cameras and shooting formats become more advanced and light sensitive. A camera’s iris, for example, can play with light and color and go from automatic to manual. This avoids the camera’s normal tendency to focus on the best-lit object in the scene. Both interior and exterior lighting can be adjusted by using reflectors (also called bounce cards). These are glossy, white lightweight cards in various sizes that reflect light onto an object or actor. Large silks (squares of translucent material) can be strategically hung and positioned to filter the sunlight and maintain lighting consistency. In some cases, a light-filtering paper gel called neutral density (ND) is placed onto windows to keep outside light from being too harsh; in other situations, thick dark velvet curtain material blocks out sunlight entirely.

A typical three-point lighting setup

Three-point lighting is a standard method used in visual media such as theatre, video, film, still photography and computer-generated imagery. By using three separate positions, the photographer can illuminate the shot’s subject (such as a person) however desired, while also controlling (or eliminating entirely) the shading and shadows produced by direct lighting.

The key light, as the name suggests, shines directly upon the subject and serves as its principal illuminator; more than anything else, the strength, color and angle of the key determines the shot’s overall lighting design.

In indoor shots, the key is commonly a specialized lamp, or a camera’s flash. In outdoor daytime shots, the Sun often serves as the key light. In this case, of course, the photographer cannot set the light in the exact position he or she wants, so instead arranges it to best capture the sunlight, perhaps after waiting for the sun to position itself just right.
A portrait with three-point lighting: a 300 watt key light, a 150 watt back light, and fill light from a bounce board.

The fill light also shines on the subject, but from a side angle relative to the key and is often placed at a lower position than the key (about at the level of the subject’s face). It balances the key by illuminating shaded surfaces, and lessening or eliminating chiaroscuro effects, such as the shadow cast by a person’s nose upon the rest of the face. It is usually softer and less bright than the key light (up to half), and more to a flood. Not using a fill at all can result in stark contrasts (due to shadows) across the subject’s surface, depending upon the key light’s harshness. Sometimes, as in low-key lighting, this is a deliberate effect, but shots intended to look more natural and less stylistic require a fill.

In some situations a photographer can use a reflector (such as a piece of white cardstock mounted off-camera, or even a white-painted wall) as a fill light instead of an actual lamp. Reflecting and redirecting the key light’s rays back upon the subject from a different angle can cause a softer, subtler effect than using another lamp.

The back light (a.k.a. the rim, hair, or shoulder light) shines on the subject from behind, often (but not necessarily) to one side or the other. It gives the subject a rim of light, serving to separate the subject from the background and highlighting contours.

Back light or rim light is different from a kick in that a kick (or kicker) contributes to a portion of the shading on the visible surface of the subject, while a rim light only creates a thin outline around the subject without necessarily hitting the front (visible) surface of the subject at all.

Three-Point Lighting in Theatre

A three point system in theatre can be used in a variety of ways to help set a mood of the character. By having bright key light, but minimal fill and back light, this will give the effect of anger, whereas if the scene is very brightly lit with little shadow on the actor, this can make the scene look very happy.

Four-point lighting

A typical four-point lighting setup

The addition of a fourth light, the background light, makes for a four-point lighting setup.

The background light is placed behind the subject(s), on a high grid, or low to the ground. Unlike the other three lights, which illuminate foreground elements like actors and props, it illuminates background elements, such as walls or outdoor scenery. This technique can be used to eliminate shadows cast by foreground elements onto the background, or to draw more attention to the background. It also helps to offset the single eye nature of the camera, this means that it helps the camera give depth to the subject.

Three lights: the Key Light, Fill Light, and Rim Light (also called Back Light), are adjusted to achieve the classic Hollywood lighting scheme called three-point lighting.

1. Start in Darkness. Make sure there are no default lights, and there’s no global ambience. When you add your first light, there should be no other light in the scene.

2. Add your Key Light. The Key Light creates the subject's main illumination, and defines the most visible lighting and shadows. Your Key Light represents the dominant light source, such as the sun, a window, or ceiling light - although the Key does not have to be positioned exactly at this source.
Create a spot light to serve as the Key. From the top view, offset the Key Light 15 to 45 degrees to the side (to the left or right) of the camera. From a side view, raise the Key Light above the camera, so that it hits your subject from about 15 to 45 degrees higher than the camera angle.

The key light is brighter than any other light illuminating the front of the subject, is the main shadow-caster in your scene, and casts the darkest shadows. Specular highlights are triggered by the Key Light.

**NOTE:** Be sure to stop and do test-renders here. Your "one light" scene (with just the key light) should have a nice balance and contrast between light and dark, and shading that uses all of the grays in between. Your "one light" should look almost like the final rendering, except that the shadows are pitch black and it has very harsh contrast - see the GIF animation at the top of this page, while it only has the Key light visible.

3. **Add your Fill Light(s).** The Fill Light softens and extends the illumination provided by the key light, and makes more of the subject visible. Fill Light can simulate light from the sky (other than the sun), secondary light sources such as table lamps, or reflected and bounced light in your scene. With several functions for Fill Lights, you may add several of them to a scene. Spot lights are the most useful, but point lights may be used.

From the top view, a Fill Light should come from a generally opposite angle than the Key - if the Key is on the left, the Fill should be on the right - but don't make all of your lighting 100% symmetrical! The Fill can be raised to the subject's height, but should be lower than the Key.

At most, Fill Lights can be about half as bright as your Key (a Key-to-Fill ratio of 2:1). For more shadowy environments, use only 1/8th the Key's brightness (a Key-to-Fill ratio of 8:1). If multiple Fills overlap, their sum still shouldn't compete with the Key.

Shadows from a Fill Light are optional, and often skipped. To simulate reflected light, tint the Fill color to match colors from the...
environment. Fill Lights are sometimes set to be Diffuse-only (set not to cast specular highlights.)

4. Add Rim Light. The Rim Light (also called Back Light) creates a bright line around the edge of the object, to help visually separate the object from the background.

From the top view, add a spot light, and position it behind your subject, opposite from the camera. From the right view, position the Back Light above your subject.

Adjust the Rim Light until it gives you a clear, bright outline that highlights the top or side edge for your subject. Rim Lights can be as bright as necessary to achieve the glints you want around the hair or sides of your subject. A Rim Light usually needs to cast shadows. Often you will need to use light linking to link rim lights only with the main subject being lit, so that it creates a rim of light around the top or side of your subject, without affecting the background:

That's it. Three-Point Lighting can be a simple starting-point for lighting just about any subject. By walking through it, this tutorial introduced 3 of the main visual functions served by lights in your 3D scenes: Key Light, Fill Light, and Rim Light. In a more complex scene, there are other types of lights used as well: Practical Lights, Bounce Lights, Kickers, and Specular Lights, which serve other visual functions. The book Digital Lighting & Rendering goes into much more depth about these.

The vocabulary of describing lights by their visual function is something you can apply in any scene. However, even when
you use Key, Fill, and Rim lights, don't think of three-point lighting as an excuse to light by formula, or to make every scene look the same. You should begin each scene by looking at what is motivated, by which kinds of light would really be in that particular scene. There is usually some direction from which the light is brightest, and that is where the Key light should come from. If the object is back-lit, then there may be a rim, in other cases there isn't one. It is observing the actual colors, tones, contrast, and direction of real light that actually informs how to create believable scenes in 3D.

While the original first edition of *Digital Lighting & Rendering* had a chapter focused on Three Point Lighting (which was the inspiration for this tutorial), the new Second Edition de-emphasizes this approach. Three Point Lighting is still covered in the chapter on Lighting Creatures and Characters, but it is put into a context of understanding the different visual functions of lights that are commonly used in lighting animated characters. By not presenting it first, hopefully beginning artists won't mistake three point lighting for any kind of a formula or recipe. If you are trying to create believable lighting that fits with each unique situation, there's no shortcut to skip studying the motivations and qualities of real lights that would occur in a particular scene.

**Basic 3 Point Lighting (another explanation)**

Before we begin looking at an example let's consider what the function of lighting is. Lighting can be used to add mood and drama to a shot, but it's overriding function is to describe 3D objects onto a 2D area, be that a computer monitor, a print out or a cinema screen. To put it another way, the light is used to "model" the objects so that on a flat surface we can tell what shape they are, and how one object relates to another.

When considering what makes good lighting we need to balance the aesthetic requirements of the shot, lightness/darkness, colour etc. against the need to be able to see what is going on in order that the narrative may be advanced.

OK, so we know we want to model the objects with light, so their shapes become apparent to us, but how do we do that? To begin with take a torch and in a darkened room shine a light on different objects and see how they take the light and how much of their shape is revealed to us. For example if you light something front on, you will be able to make out its outline but shapes within that outline may not be so obvious. If you place the light above and slightly to one side the shape will probably be better defined. This main light is THE most important light as its placement influences all others. It is known as the KEY LIGHT. Let's look at a specific example.

**The Key Light**

A single key light

By placing the key light above and to the left we can see the volume of the oranges (i.e. that they're spherical). We can also see that they are on the floor by the shadows cast and that they are stacked on top of each other. However the image is lacking detail in the shadow regions and is a bit brutal. In order to fix this we need to add another light to the right of the oranges to add some illumination to those darkened areas. This light is called the FILL LIGHT. Let's look at what this light contributes to
the scene.

The Fill Light

The job of the fill light is to illuminate those areas of the image which are in shadow when the key light is placed. It should be pretty obvious therefore that the fill light is placed after and in relation to the key light. As the job of the fill is only to allow us to see a little more detail it should not be as intense as the key light. Look at this example; the key light is about 2-3 times brighter than the fill. Let’s take a look at how the key and fill light work together.

Key and Fill

Key and fill light

The image now looks a lot better than it did with just a key light. The image has more depth and detail. It is neither too dark, nor too washed out. However there is something more we can add. The right side of the oranges are getting a little lost against the background. In order to counteract this we can add a RIM LIGHT.

The Rim Light

The rim light

The rim light is placed behind the objects being illuminated and is angled so that the light glances off the surface of the object at the narrowest angle. The intensity of this light is often quite high, often brighter than the key. Due to its intensity and placement it creates a line of bright light around the object and in doing so lifts the object away from the background. The rim light is principally used to ensure that a dark object does not blend in with a dark background. OK now the lighting is complete let's examine the finished result.

The Finished Render
Key, fill and rim lights

The rim light has lifted the oranges away from the background, the orange at the bottom right was in danger of disappearing into the background but is much better modelled now. The image still has contrast and a good range of tones from black through to white. The floor shadows and the shadowing of one orange onto another are still there showing each object's relationship to the next, but you can see detail even in the shadow areas on the fruit. All that's left to do is a little bit of tweaking in post.

The Finished Image

Key, fill and rim lights

By adding a subtle glow to the strongest high-lights (those created by the rim light) and by softening the image to limit that super-crisp "CG look" the image can be improved a little more. You can tweak an image indefinitely like this by adding noise and so on but I've decided to leave it like this.
In the above example we have taken a look at the most basic, yet flexible lighting set-up which, with tweaks to the intensities, can be used to light almost any situation. This does not mean that you shouldn't experiment with light placement as long as you remember to place the key light first and let the other lights take their cue from it. Look at the work of the great painters of light like Vermeer or Rembrandt or at photographers like Irving Penn or Horst P. Horst or the great cinematographers like Gregg Toland or Gordon Willis.

One book I really recommend is "Painting with Light" by the late, great John Alton. This book is over 50 years old now but is still the best reference work on lighting for film. I got the idea of using oranges as my "models" for this tutorial from him. As you can tell we have only covered the tonality of light here. I'll probably do another tutorial when I get the chance covering colour and lighting. I hope this has proved useful to you and given you some ideas of your own about the art of lighting.

Zone lighting

Why do bathroom lights have an IP rating?

Lighting in the bathroom is important. Regulations are very strict as to which lights you are able to use in a bathroom and to complicate matters, bathrooms have different zones, which determine what type of light you may use within that zone. Light fittings that are used in a bathroom are IP rated.

What does IP rating mean for bathroom lights?

Ingress Protection rating

Ingress means entering, in the case of bathroom lights it means, water or steam entering a light fitting – Ingress protection means the amount it is protected. There are various Ingress Protection ratings = IP ratings. The higher the IP rate is, the more protected the light is.

The rating refers to the light fittings ability to prevent solids or liquids penetrating the device's enclosure.

IP rating

An IP rating usually has 2 or 3 numbers after it, for example IP 68. The first number corresponds to solid material entering the light fitting. E.g. Dust, tools, fingers etc. The second number would correspond to water or steam entering the light fitting.

<table>
<thead>
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<th>Protection Against Fluids</th>
</tr>
</thead>
<tbody>
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<td>Second Number</td>
</tr>
<tr>
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<tr>
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<td>0</td>
</tr>
<tr>
<td>No Protection</td>
<td>No Protection</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Protection against solid objects over 50mm, e.g. accidental touch by hands.</td>
<td>Protection against vertically falling drops of water.</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Protection against solid objects</td>
<td>Protection against direct sprays of</td>
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<td>Description</td>
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<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>3</td>
<td>Protection against solid objects over 2.5mm (tools / wires).</td>
</tr>
<tr>
<td>4</td>
<td>Protection against solid objects over 1mm (tools / wires / small wires).</td>
</tr>
<tr>
<td>5</td>
<td>Protection against dust - limited ingress (no harmful deposit).</td>
</tr>
<tr>
<td>6</td>
<td>Totally protected against dust.</td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

Every light fitting has an IP rating. Bathroom lights must have higher IP ratings than lights you would use in the lounge, dining room or bedrooms etc.

Once you have found an IP rated light fitting it must now comply with the different bathroom zone areas.

**Bathroom Zones**

![Bathroom Zones Diagram]

All installations must comply to the guidelines which are based on a zone area which is similar to the installation of lighting around a swimming pool area.

Each ZONE AREA has an *IP rating*. IP rating = Ingress Protection Rating. Each ZONE AREA is sought from the degree of the risk of electrical shock.

ZONE 0-Inside the bath or shower cubicle. Rated IPx7.

ZONE 1-The area directly above the bath or shower up to a height of 2.25 metres. Rated a minimum of IPx4.
ZONE 2 - This is the area immediately next to ZONE 1. This is 0.6 metres wide, and covers the area directly next to ZONE 1, all around ZONE 1 and also the area above the 2.25 metres high directly above the bath or shower cubicle.

ZONE 2 - is also the area around the wash basin. Rated a minimum of IPx4.

A minimum rating IPx5 are the areas of ZONES 1 and 2 for where water jets are likely to be used for cleaning purposes.

Whilst it is important to select the style of fitting to suit your decor, safety is the most important factor when choosing a light for your bathroom. The guidelines for bathroom lights, above will help you decide which zone sector the requirements are for the positioning of light fittings in the bathroom.

The light in a bathroom needs to be as bright and as evenly spread as possible without any glare to the eye. The most important area to concentrate on usually, is around the wash basin area for make-up application and shaving etc. It is important to remember that a central ceiling light will create shadows whilst facing into a mirror at the basin area. The use of mirror lights on or over the mirror will help combat this.

With all bathroom lighting there are set zones in which a light fitting must meet certain safety standards. These zones (as in the below picture) are to be strictly followed. The criteria for each zone is based on the risk of electric shock. The zones relate to the IP rating of products and where they can be safely installed.

(to see a larger picture follow this link)
http://www.northeastlighting.com/images/zones.jpg

**Zone 0** - the interior of the bath or shower that can hold water. Requires electrical products to be low voltage (max 12V) and rated IPX7.

**Zone 1** - the area directly above zone 0, limited to a height of 2.25m above the bath or shower. Requires electrical products to have an IPX4 or better. Products should use safety extra low voltage (SELV) with the transformer located in zone 3 or beyond.

**Zone 2** - the area beyond zones 0 and 1, stretching 0.6m horizontally and up to 2.25m vertically. Also includes the recessed area of a window with a sill next to the bath. Requires electrical products to have an IPX4 or better. SELV with the transformer located in zone 3 or beyond.

**Zone 3** - the area beyond zone 2, stretching 2.4m horizontally and up to 2.25m vertically. There is not a specified IP number for this zone, although some products are marked as not for bathroom use. SELV or shaver units are permitted, all other portable electrical equipment is not.

**Notes**
- When the size of the bathroom extends beyond zone 3, portable electrical equipment must be restricted, e.g. cable length is restricted so it cannot be moved into zone 3.
- Where ceiling heights exceed 2.25m, the zones effectively extend up to 3m with beyond 3m un-zoned.
- Basins are not covered, although they are usually consider to be zone 2.
- If the space under the bath cannot be accessed without using a tool (i.e. a screwdriver) then that space is considered un-zoned.

All electrical work in a bathroom must be carried out by a qualified electrician, if you have questions in relation to bathroom lighting that are specific to your situation we strongly advise you contact a professional for further
advice.

We hope this guide helps you find the right lighting for your bathroom and makes your life that tiny bit easier...and SAFER!

Kind Regards, Derek Thorpe Lighting Centre.

Mood lighting

Definition of "Mood Lighting"

Mood lighting creates an intimate mood, whether that mood is relaxing, romantic or sultry. Restaurants use mood lighting when they dim the overhead lights and place candles or small lamps on the table. The technique is frequently used in film and theatre to communicate mood to an audience. Create mood lighting in your home or business to help any room become a more relaxing, intimate space.

Light Sources

Mood lighting generally uses a small number of light sources that are not overhead, or are dropped lower than the ceiling, such as pendant lights. The light fixtures are dimmed or coloured, distinguishing them from general lighting, although you can use general light fixtures for mood lighting if they are dimmable.

Brightness

Light affects perception of your surroundings, not just by making things visible, but also by enhancing or detracting from what you see. Bright, general lighting can make all objects in a room appear to have the same quality, and if the lighting is diffused so there are few to no shadows, objects and people can look flat, because shadows are a large part of your perception of depth. This type of bright, diffused lighting can make people in a room feel bored, sleepy or restless because of the lack of visual interest. Mood lighting uses dim, distinct lighting sources to create shadows and enhance the perception of depth in a room.

Color

General lighting tends to be perceived as white, although it may be somewhat yellow, in the case of incandescent lights, or blue, in the case of cool fluorescents. These colours of light can help the eyes perceive colours the way they would in daylight. With coloured mood lighting, warm colours such as the red, yellow and orange candle glasses or lampshades in restaurants--or flames--can bring out the rich, warm colours of food, making it appear more appealing. Cool colours such as blue and purple can simulate a feeling of nighttime, which many people find relaxing.

Applications
Aside from personal relaxation and food or dining experience enhancement, mood lighting can be used in places like massage therapist studios, doctors' offices and other places where creating a relaxed mood is important. Several airlines are employing mood lighting in their aeroplane cabins to influence the passengers' perception of the flight experience. Mood lighting may be brighter, using blues as the passengers enter, then shifting to warmer colours at mealtimes, or it may be purple or red to lend a sultry, exciting feel to the experience of flying.

**Fixtures**

Create mood lighting with common household fixtures or specialised LED (light emitting diode) lighting. Place your desk lamp on a dimmer to create dimmable light that casts plenty of shadows that add depth to a room, or place coloured bulbs in fixtures that enhance the mood. Purchase LED bulbs that change colour at party supply stores, and use them to create a festive atmosphere with pulsing colour changes or a single atmospheric colour. String lights and rope lighting are popular choices to supplement mood lighting with a little bit of extra light, especially along walkways.

**Accent Lighting**

Accent lighting is a form of lighting used commonly for illuminating walks with subtle light. However, this form of lighting can also highlight key objects and focal points in or surrounding landscape. For instance, people like to display particular pieces of other collectible items in their home. Some of the most common accent lighting fixtures include track, recessed and mounted lights. Track lighting is probably considered the most flexible, placed as needed and aimed in any direction along the track. They can also be other light sources, like sconces or lamps. Recessed lighting fixtures blend into surroundings. These are usually installed in ceilings, under cabinets, or within bookshelves and are available in many styles.

Wall-mounted fixtures are attached directly to a wall or similar surface. They can also be placed above or below the frame of a hanging. Outdoors, light fixtures may include those placed in the ground or specialized lamp fixtures. Forms of accent lighting may include low-voltage halogen lights, fiber optics, metal halides, and LED (Light Emitting Diode) lighting.

Halogen lights are great for highlighting or spotlighting objects, as they emit a strong, white light. Fiber optics are good choices for lighting stairs; paths; or water features, like ponds and pools. Metal halides provide soft light and are best used for subtle lighting in small areas. LED lights are becoming more favored. They are more energy efficient, last longer, and are flexible enough for use in various lighting fixtures and situations.

Different types of accent lighting can be used, but path lighting is the most common. Not only does it provide nighttime safety but can also accent interesting patterns, stones, or plants along the way. The use of floodlights can also provide safety. These accents lights are ideal for emphasizing architectural features in the landscape as well. For a more dramatic effect, the use of well lights can be placed in ground or floor fixtures and concealed with plants to cast light upwards.

There is also submersible accent lighting, which is used for creating drama and highlighting ponds or other water features. Backlights are generally placed behind objects to create shadows or silhouettes. All of these types of accent
lighting can be used to create various effects with different techniques. For example, silhouetting is used to accentuate an object’s outline. This, as previously stated, is done by placing backlights behind the object and pointing it upwards.

Spotlighting an object involves pointing the lights directly at the intended feature. This popular method is most often used for highlighting focal points in the landscape. Moonlighting can be achieved with recessed light fixtures, which are placed in the ceiling or with floodlights placed in trees. The result is a downward light pattern that mimics natural light from the moon. The type of accent lighting and method used depends on the desired effect to be achieved.

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.

Tip One 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.

Tip For the most physically accurate, photorealistic lighting, use Photometric lights and the mental ray renderer. When you render with mental ray, use Final Gather and the mental ray Photographic exposure control. With this setup, you also can do lighting analysis of your model.

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. See Animating Lights.
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.

**Note** The standard **Skylight** light is distinct from the photometric daylight lights. The Skylight light is for use with **light tracing**.

**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.

**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 real-world light sources. Unlike **photometric lights**, standard lights do not have physically-based intensity values.

**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.

To change the color of a light’s geometry:

1. **Create panel** ➢ **(Lights)** ➢ **Create a light.** ➢ **Name and Color rollout**

2. **Create menu** ➢ **Lights** ➢ **Photometric Lights or Standard Lights** ➢ **Create a light.** ➢ **Modify panel** ➢ **Name and Color rollout**

3. **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.

   Changing a light’s geometry color has no effect on the color of the light itself. You can set the color the light emits on its **Intensity/Color/Attenuation rollout** for photometric lights, or the **Intensity/Color/Attenuation rollout** for standard lights.

   **To change the color of a light’s geometry:**

[www.a2zpapers.com](http://www.a2zpapers.com)
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.

Note - When 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.

Here are some general tips about working with lights:

One simple way to light a scene is to convert the default lighting into light objects by using the command Add Default Lights To Scene. Note Add Default Lights To Scene works only if you have used the Viewport Configuration dialog to have the scene use two default lights. You can turn the display of light objects on and off with an option in the Display panel. See the “Procedures” section, below. You can change the renderability of lights in your scene using the Renderable option on the General panel of the Object Properties dialog.

You can change the renderability of a group of lights in your scene using the Layer Manager. Note In order to be turned on/off through the Layer Manager, lights must have their Render Options set to ByLayer in the General panel of the Object Properties dialog. Tip To automatically set new lights as renderable ByLayer, turn on New Lights Renderable By Layer on the General panel of the Preferences dialog. You can use the Place Highlight button to change a light's position. See the “Procedures” section, below. A Light viewport can be a useful way to adjust spotlights in your scene.

To create a light:

On the Create panel, click (Lights). Choose Photometric or Standard from the drop-down list. (Photometric is the default.) On the Object Type rollout, click the type of light you want to create. Click a viewport to create the light. This step varies slightly depending on the type of light. For example, if the light has a target, you drag and click to set the target's location. Light objects replace the default lighting. As soon as you create a light, the default lighting is turned off. If you delete all lights in the scene, the default lighting is restored. Set the creation parameters.

Like all objects, lights have a name, a color, and a General Parameters rollout.

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 ActiveShade.

**Tip** To turn shadows on or off for multiple lights, select the lights and then use the Light Lister.

You can set an object to not cast or not receive shadows. By default, objects do both. See Object Properties.

**To control the display of light objects:**

On the Display panel, on the Hide By Category rollout, turn on Lights.

All light objects in the scene disappear, but the lighting itself is unchanged. Light objects can cast light whether or not their display is turned off. The Zoom Extents commands are affected by whether light icons are displayed or not. When lights are displayed, Zoom Extents and Zoom Extents All includes the lights in the zoom.

**Tip** To control whether a light casts light in the scene, you can use its On toggle, or you can toggle its Renderable property on the light’s Object Properties dialog.

**To change a light’s parameters:**

- Select the light. **Tip** Lights can be hard to select by clicking. You can use the keyboard shortcut H to select the light by name.
- Open the Modify panel.
- Change the light’s parameters in the General Parameters rollout and other rollouts available for that light.

**To position a light so it highlights a face:**

Make sure the viewport you plan to render is active, and that the object you want to highlight is visible in it.

- The result of Place Highlight depends on what is visible in the viewport.
- Select a light object.
- On the main toolbar, choose (Place Highlight) from the Align flyout.
- You can also choose Tools menu ➪ Place Highlight.

Drag over the object to place the highlight. When you place an omni light, free direct light, or a photometric Free Light, 3ds Max displays a face normal for the face the mouse indicates.

When you place a target direct light or photometric Target Light, 3ds Max displays the light’s target and the base of its cone. Release the mouse when the normal or target display indicates the face you want to highlight. The light now has a new position and orientation. You can see the highlight illumination in shaded viewports that show the face you chose, and when you render those views. Place Highlight works with any kind of selected object. You can also use Place Highlight with a selection set of multiple objects. All objects maintain their initial distance from the face. **Note** For materials, highlight rendering depends on the material’s specular properties and the type of rendering you use.
Place Highlight, available from the Align flyout, enables you to align a light or object to another object so that its highlight or reflection can be precisely positioned. In Place Highlight mode, you can click and drag the mouse around in any viewport. Place Highlight is a viewport-dependent function, so use the viewport that you're going to be rendering. As you drag the mouse in the scene, a ray is shot from the mouse cursor into the scene. If it hits a surface, you see the surface normal at that point on the surface. When you designate a surface, any selected objects are positioned along a line that represents the ray reflected off the surface about the surface normal. The objects are positioned along this line based on their original distance from the surface point. For example, if the object is 100 units from the surface point before being moved, it will be positioned 100 units from the surface point along the reflected ray.

If the object is a light, the position of the highlight on the surface of the object will be the surface point that you've chosen.

**Tip** Place Highlight works with any kind of selected object. It can be used to move objects based on a combination of face normals and initial distance from the face. You can also use Place Highlight with a selection set that contains more than one object. All objects maintain their initial distance from the face. In this case it has nothing to do with highlights, but is simply being used to position objects.

**Note** Highlight rendering depends on the material's specular properties and the type of rendering you use.

---

**Procedures**

To position a light to highlight a face:

1. Make sure the viewport you plan to render is active, and that the object you want to highlight is visible in it.

The result of Place Highlight depends on what is visible in the viewport.

2. Select a light object.

3. Do one of the following:

   - On the main toolbar, click (Place Highlight), which is on the Align flyout.
   - On the Tools menu, choose Align ➤ Place Highlight.
4. Drag over the object to place the highlight.
   When you place an omni, free spot, or directional light, 3ds Max displays a face normal for the face the mouse indicates.
   When you place a target spotlight, 3ds Max displays the light's target and the base of its cone.

5. Release the mouse when the normal or target display indicates the face you want to highlight.
   The light now has a new position and orientation. You can see the highlight illumination in shaded viewports that show the face you chose, and when you render those views.

### 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.

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.

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.

Additive mixing of colored lights
**Color Temperature**

Color *temperature* describes a color in terms of degrees Kelvin (K). This is useful for describing the color of light sources and other color values that are close to white. The following table shows color temperatures for some common types of light, with the equivalent hue number (from the HSV color description).

If you use these hue numbers for lights in a scene, set the value to full (255) and then adjust the saturation to meet the needs of your scene. Mentally we tend to correct light color so that objects appear to be lit by white light; usually the effect of color temperature in a scene should be subtle.

<table>
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<th>Light source</th>
<th>Color Temperature</th>
<th>Hue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overcast daylight</td>
<td>6000 K</td>
<td>130</td>
</tr>
<tr>
<td>Noontime sunlight</td>
<td>5000 K</td>
<td>58</td>
</tr>
<tr>
<td>White fluorescent</td>
<td>4000 K</td>
<td>27</td>
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<tr>
<td>Tungsten/halogen lamp</td>
<td>3300 K</td>
<td>20</td>
</tr>
<tr>
<td>Incandescent lamp (100 to 200 W)</td>
<td>2900 K</td>
<td>16</td>
</tr>
<tr>
<td>Incandescent lamp (25 W)</td>
<td>2500 K</td>
<td>12</td>
</tr>
<tr>
<td>Sunlight at sunset or sunrise</td>
<td>2000 K</td>
<td>7</td>
</tr>
<tr>
<td>Candle flame</td>
<td>1750 K</td>
<td>5</td>
</tr>
</tbody>
</table>

**Lighting in 3ds Max**

Lighting in 3ds Max simulates natural lighting. However, standard lights are simpler than natural lighting. Using photometric lights with a radiosity solution with your lights provides a better model of the real world.
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.

Note See Designing Materials for more information about material color and how it interacts with light intensity.

The intensity of a photometric light is set by a real-world intensity value, measured in either lumens, candelas, or lux. See Intensity/Color/Attenuation Rollout (Photometric Lights).

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.

Attenuation

For standard lights, attenuation is turned off by default. To shade or render a scene with attenuation, you turn it on for one or more lights. All types of standard lights support attenuation. You can set explicitly where attenuation begins and where it ends. This is partly so you don’t have to worry about setting up strictly realistic distances between light objects and the objects they illuminate. More importantly, this feature lets you fine-tune the effect of attenuation.

In outdoor scenes, attenuation can enhance the effect of distance. (Another way to model environmental effects is to use the atmospheric settings when you render. See Environment and Atmosphere Effects.) In an indoor setting, attenuation is useful for low-intensity light sources such as candles. Photometric lights always attenuate, using an inverse-square falloff, as in nature. (In the case of the IES Sun Light, its great intensity makes its attenuation hardly apparent.)

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.

Tip To better simulate reflected light and variations in it due to the varying reflectivity of objects in the scene, you can add more lights to a scene and set them to exclude the objects you don’t want them to affect. You can also set up lights to affect only the ambient component of surfaces. See General Lighting Parameters.

Color

You can set the color of 3ds Max lights. You can use the RGB values for color temperatures as a guide for the principal lighting of a scene; see Properties of Light. Be aware, however, that we tend to perceive scenes as always being lit by
white light (this is a perceptual phenomenon known as color constancy), so accurately reproducing the color of a light source can make the rendered scene appear to be tinted oddly. Use the light source values as a general guideline only.

Guidelines for Lighting

The guidelines for lighting used by photographers, filmmakers, and stage designers can also help you set up the lighting for scenes in 3ds Max.

Your choice of lighting depends on whether your scene simulates natural or artificial illumination. Naturally lit scenes, such as daylight or moonlight, get their most important illumination from a single light source. Artificially lit scenes, on the other hand, often have multiple light sources of similar intensity.

Note: If you use standard instead of photometric lights, both kinds of scenes require multiple secondary light sources for effective illumination.

Whether a scene is indoors or outdoors can also affect your choice of material colors. See Designing Materials.

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.
Ambient light can be another element of your fill lighting. You can also add lights to emphasize secondary subjects in a scene. In stage terminology, these lights are known as specials. Special lights are usually brighter than the fill light but less bright than the main key light. To design using physically based energy values, distributions, and color temperature, you can create photometric lights.

Ambient light in 3ds Max simulates the general illumination from light reflecting off diffuse surfaces. Ambient settings determine the illumination level of surfaces in shadow, or those not receiving direct illumination from light sources. The Ambient level on the Environment dialog establishes the scene's basic illumination level before any light sources are taken into account, and is the dimmest any portion of the scene can ever become.

Ambient light is most often used for exterior scenes, when the sky's broad lighting produces an even distribution of reflected light to surfaces not in direct sun. A common technique for deepening the shadows is to tint the ambient light color to be the complement of the scene's key light. Unlike the outside, interior scenes typically have numerous lights, and a general ambient light level is not ideal for simulating the diffuse reflection of local light sources. For interiors, it's common to set the scene's environment ambient level to black, and use lights that effect ambient only to simulate the regional areas of diffuse reflection. You set the scene's ambient light using the Environment And Effects dialog ➤ Environment panel. You set a light to affect only ambient illumination with its Advanced Effects rollout ➤ Ambient Only check box.

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 real-world light sources. Unlike photometric lights, standard lights do not have physically-based intensity values.

Target Spotlight

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.
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 Spotlight](image)

Top: Top view of a target spotlight

Bottom: Perspective view of the same light

**NOTE:** When you add a target spotlight, 3ds Max automatically assigns a Look At controller to it, with the light's target object assigned as the Look At target. You can use the controller settings on the Motion panel to assign any other object in the scene as the Look At target.

**Procedures**

**To create a target spotlight:**

1. On the Create panel, click (Lights).
2. Choose Standard from the drop-down list.
3. On the Object Type rollout, click Target Spot.
4. Drag in a viewport. The initial point of the drag is the location of the spotlight, and the point where you release the mouse is the location of the target.
   The light is now part of the scene.
5. Set the creation parameters.

**To adjust a target spotlight:**

1. Select the light.
2. On the main toolbar, turn on (Select And Move), or right-click the light and from the quad menu, choose Move. Move the light to adjust its aim.
Because the spotlight is always aimed at its target, you can't rotate it about its local X or Y axis. However, you can select and move the target object as well as the light itself. When you move either the light or the target, the light's orientation changes so it always points at the target.

**NOTE:** The target's distance from the light does not affect the attenuation or brightness of the light.

**To select the target:**
The target, displayed as a small square, is often in the same area as objects that you want to illuminate. It can be difficult to select it by clicking.

1. Select the spotlight itself.

2. Right-click the light, and from the Tools 1 (upper-left) quadrant of the quad menu, choose Select Target.
   Clicking the line that connects the light and its target selects both objects. However, region selection doesn't recognize the link line.
   Another way to adjust a spotlight is to use a Spotlight Parameters.

**To change a viewport to a Light view:**

1. Click or right-click the POV viewport label.
   3ds Max opens the Point-Of-View viewport label menu.

2. Choose Lights.
   The Lights submenu shows the name of each spotlight or directional light in the scene.

3. Choose the name of the light you want.
   The viewport now shows the light's point of view. You can use the Light viewport to adjust the light.
   The default keyboard shortcut for switching to a Light viewport is $.$

**Interface**
When you rename a target spotlight, the target is automatically renamed to match. For example, renaming Light01 to Klieg causes Light01.Target to become Klieg.Target. The target's name must have the extension .Target. Renaming the target object does not rename the light object.

**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
A target directional light uses a target object to aim the light. Because directional rays are parallel, directional lights have a beam in the shape of a circular or rectangular prism instead of a "cone."

NOTE: When you add a target directional light, 3ds Max automatically assigns a Look At controller to it, with the light's target object assigned as the Look At target. You can use the controller settings on the Motion panel to assign any other object in the scene as the Look At target.

NOTE: Direct lights are supported in a radiosity solution only if they are pointed downwards, outside the boundary box of the scene geometry.

Procedures

To create a target direct light:

1. On the Create panel, click (Lights).
2. Choose Standard from the drop-down list.
3. On the Object Type rollout, click Target Direct.
4. Drag in a viewport. The initial point of the drag is the location of the light, and the point where you release the mouse is the location of the target.
   The light is now part of the scene.
5. Set the creation parameters.
   To adjust the light's direction, move the target object.

To change a viewport to a Light view:

1. Click or right-click the POV viewport label.
   3ds Max opens the Point-Of-View viewport label menu.
2. Choose Lights.
The Lights submenu shows the name of each spotlight or directional light in the scene.

3. Choose the name of the light you want.
   The viewport now shows the light’s point of view. You can use the Light Viewport Controls to adjust the light.
   The default keyboard shortcut for switching to a Light viewport is $.

**Interface**
Clicking the line that connects the light and its target selects both objects. However, region selection doesn't recognize the link line.
When you rename a target directional light, the target is automatically renamed to match. For example, renaming `Light01` to `Sol` causes `Light01.Target` to become `Sol.Target`. The target's name must have the extension `.Target`. Renaming the target object does not rename the light object.

**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

Top: Perspective view of a free spotlight

Bottom: Top view of the same light

**Procedures**

**To create a free spotlight:**

1. On the Create panel, click (Lights).
2. Choose Standard from the drop-down list.
3. On the Object Type rollout, click Free Spot.

4. Click the viewport location where you want the light to be.
   The light is now part of the scene. It points away from you in the viewport you clicked.
   You can adjust the light's direction with (Move) and (Rotate) or by using a Light viewport.

5. Set the creation parameters.

   **To change a viewport to a Light view:**

   1. Click or right-click the POV viewport label.
      3ds Max opens the Point-Of-View viewport label menu.

   2. Choose Lights.
      The Lights submenu shows the name of each spotlight or directional light in the scene.

   3. Choose the name of the light you want.
      The viewport now shows the light's point of view. You can use the Light Viewport Controls to adjust the light.
      The default keyboard shortcut for switching to a Light viewport is $.

**Interface**

You aim a free spotlight by adjusting its orientation in a scene using Move and Rotate.
The free spotlight is useful when you want a spotlight to follow a path and either don't want to bother with linking a spotlight and target to a dummy object, or you need banking along the path.

**General Parameters rollout**

When you create a Free Spot light, the Targeted parameter is adjustable on the General Parameters Rollout (Standard Lights). This is a fixed value for target lights.

**Targeted**

When on, 3ds Max sets a point to use as an invisible target about which the Free Spot can orbit.
   The spinner adjusts the distance to the target.
   The target distance is animatable.

**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.

**TIP:** Omni lights can generate up to six quadtrees, so they generate ray-traced shadows more slowly than spotlights. Avoid using ray-traced shadows with omni lights unless your scene requires this.

**Procedures**

**To create an omni light:**

1. On the Create panel, click (Lights).
2. Choose Standard from the drop-down list.
3. On the Object Type rollout, click Omni.
4. Click the viewport location where you want the light to be. If you drag the mouse, you can move the light around before releasing the mouse to fix its position.
   The light is now part of the scene.
5. Set the creation parameters.
   To adjust the light's effect, you can move it as you would any object.

**Skylight**

The Skylight light models daylight. You can set the color of the sky or assign it a map. The sky is modeled as a dome above the scene.

- Create panel ➤ (Lights) ➤ Standard ➤ Object Type rollout ➤ Skylight button
- Standard menu: Create menu ➤ Lights ➤ Standard Lights ➤ Skylight
- Enhanced menu: Objects menu ➤ Lights ➤ Skylight
Model rendered with a single skylight, and light tracing

When you render with the default scanline renderer, Skylight works best with advanced lighting: either the Light Tracer or radiosity. **WARNING:** When you render with the mental ray renderer, objects illuminated by a Skylight appear dark unless you turn on Final Gathering. The toggle for Final Gathering is on the Final Gathering (FG) rollout of the Render Setup dialog.

A skylight is modeled as a dome above the scene.

**TIP:** There are several ways to model daylight in 3ds Max, but if you use the Light Tracer, a Skylight often gives the best results. **TIP:** If you encounter visual anomalies when rendering a bump-mapped material with a Skylight, convert the material to an Advanced Lighting Override material and then reduce the Indirect Light Bump Scale value.

**Using a Map with the Skylight**

If you use a map with a Skylight, the following guidelines can improve its effect:

- Make sure that the mapping coordinates are spherical or cylindrical.
For light tracing, make sure you use sufficient samples. A good rule of thumb is to use at least 1,000 samples: set Initial Sample Spacing to 8x8 or 4x4, and increase the value of Filter Size to 2.0.

Use an image-processing application to blur the map before you use it. With a blurred map, you can use fewer samples to obtain good results. When used with Skylight, a blurred map will still render well.

Be aware that using sufficient samples with a mapped Skylight will take longer to render than if the light were not mapped.

**Skylight and Radiosity in Architectural Design**

In order for radiosity to be processed correctly when a Skylight is added to the scene, you need to make sure that walls have closed corners and floors and ceilings have thickness under and over the walls. In essence, your 3D model should be built just like the real-world structure is built.

If you build your model with walls that meet along a single edge or floors and ceilings are simple planes, when you process radiosity after adding a Skylight, you can end up with “light leaks” along those edges. Some of the ways to repair a model so light leaks do not occur are as follows:

- Make sure floors and ceilings have thickness.
  You can fix this by extruding those surfaces at a sub-object level or by applying modifiers like **Shell** or **Extrude**.

- Use the **Wall command** to create walls.
  The Wall command is programmed to make sure corners are constructed of solid objects instead of leaving a single, thin edge.

- Ensure that floor and ceiling objects extend beyond walls.
  Floor objects need to extend under walls and ceilings need to extend over walls.

By building your 3D model using these guidelines, light leaks will not occur when you process radiosity after adding a Skylight to the scene.

**Using Render Elements with a Skylight**

If you use **Render Elements** to output the lighting element of a skylight in a scene using either radiosity or the light tracer, you cannot separate the direct, indirect, and shadow channels of the light. All three elements of the skylight lighting are output to the Indirect Light channel.

**Procedures**

**To create a Skylight:**

1. On the ☀️ Create panel, click 🏠 (Lights).
2. Choose Standard from the drop-down list.
3. On the Object Type rollout, click Skylight.
4. Click a viewport.
   The light is now part of the scene.
   **NOTE:** The position of the Skylight, and its distance from objects, has no effect. The Skylight object is simply a helper. Skylight always comes from “overhead.”
5. Set the creation parameters.

**Interface**
On

Turns the light on and off. When On is on, shading and rendering use the light to illuminate the scene. When off, the light is not used in shading or rendering. Default=on.

Multiplier

Amplifies the power of the light by a positive or negative amount. For example, if you set the multiplier to 2, the light will be twice as bright. Default=1.0. Using this parameter to increase intensity can cause colors to appear "burned out." It can also generate colors not usable in videos. In general, leave Multiplier set to its default of 1.0 except for special effects and special cases.

Sky Color group

- Use Scene Environment Colors the light using the environment set up on the Environment panel.
- Sky Color Click the color swatch to display a Color Selector and choose a tint for the Skylight.

[map controls] These let you use a map to affect Skylight color. The button assigns a map, the toggle sets whether the map is active, and the spinner sets the percentage of the map to use (when the value is less than 100%, map colors are mixed with the Sky Color).

TIP: For best results, use a high dynamic range (HDR) format such as OpenEXR.

Sky Color maps, including HDR maps, provide illumination for all renderers. They also provide lighting levels and shadows for Nitrous viewports. Unlike releases prior to Autodesk 3ds Max 2015, Sky Color maps do not require the Light Tracer.

TIP: Shadows from a Sky Color map enhance outdoor scenes, but they can cause interior scenes to appear too dark in Nitrous viewports. You can avoid this by setting the Skylight to cast light but no shadows. See Skylights as Ambient Color.
Car rendered with a plain white skylight

Skylight color and levels from an HDR image

Render group

**NOTE:** If the renderer is not set to Default Scanline, or if the Light Tracer is active, these controls are disabled.

**Cast Shadows**

Causes the skylight to cast shadows. Default=off.
NOTE: The Cast Shadows toggle has no effect when using radiosity or the light tracer.
NOTE: Skylight objects will not cast shadows in an ActiveShade rendering.

**Rays per Sample**

The number of rays used to calculate skylight falling on a given point in the scene. For animation, you should set this to a high value to eliminate flickering. A value of around 30 should eliminate flickering.

Increasing the number of rays increases the quality of your image. However, it also increases rendering time.

**Ray Bias**

The closest distance at which objects can cast shadows on a given point in the scene. Setting this value to 0 can cause the point to cast shadows upon itself, and setting it to a large value can prevent objects close to a point from casting shadows on the point.

**mr Area Omni Light**

The area omni light emits light from a spherical or cylindrical volume, rather than from a point source, when you render a scene using the mental ray renderer. With the default scanline renderer, the area omni light behaves like any other standard omni light.

- ![Create panel](Lights) ➤ Standard ➤ mr Area Omni button ➤ Area Light Parameters rollout

**NOTE:** In 3ds Max, area omni lights are created and supported by a MAXScript script. Only the mental ray renderer uses the parameters on the Area Light Parameters rollout. See [Enhancements to Standard Features](#) for more details.

**TIP:** Area lights take longer to render than point lights. To create a quick test (or draft) rendering, you can use the Area/Linear Lights as Point Lights toggle in the Common Parameters rollout of the Render Setup dialog to speed up your rendering.

**Procedures**

**To create an area omni light:**

1. On the ![Create panel](Lights) ➤ (Lights).
2. Choose Standard from the drop-down list.
3. On the Object Type rollout, click mr Area Omni.

4. Click in a viewport.

5. Set the shape and size of the area light in the Area Light Parameters rollout. While you use the spinners to adjust the size of the area light, a gizmo (yellow by default) appears in viewports to show the adjusted size. This gizmo disappears once you finish adjusting the value.

   **TIP:** You can use (Rotate) to adjust the orientation of a cylindrical area omni light. However, no gizmo appears while you rotate the light.

**To convert a standard 3ds Max light to an area light:**

1. ![Select one or more lights.](image)

2. Go to the **Utilities panel.**

3. On the Utilities rollout, click MAXScript.
   The MAXScript rollout is displayed.

4. On the MAXScript rollout, choose “Convert To mr Area Lights” from the Utilities drop-down list. The “Convert To mr Area Lights” rollout is displayed.

5. On the “Convert To mr Area Lights” rollout, click Convert Selected Lights. A MAXScript alert is displayed, that says “Delete Old Lights?” Click Yes to delete the original light and replace it with the area light. Click No to leave the original light in place. If you click No there are now two lights in the scene: the original light, and the area light based on it.

6. Click Close to dismiss the “Convert To mr Area Lights” and MAXScript rollouts.

**Interface**

<table>
<thead>
<tr>
<th><strong>Area Light Parameters</strong></th>
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<tr>
<td><strong>On</strong></td>
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<td><strong>Show Icon in Renderer</strong></td>
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</tbody>
</table>

**Type drop-down list**

- **Sphere**
  - Radius: 20.0
  - Height: 20.0

**Samples**

- U: 5
- V: 5

**On**

Turns the area light on and off. When On is on, the mental ray renderer uses the light to illuminate the scene. When On is off, the mental ray renderer doesn’t use the light. Default=on.

**Show Icon in Renderer**

When on, the mental ray renderer renders a dark shape at the light’s location. When off, the area light doesn’t render. Default=off.
Changes the shape of the area light. The choices are Sphere, for a spherical volume, and Cylinder, for a cylindrical volume. Default=Sphere.

**TIP:** You can use Rotate to adjust the orientation of a cylindrical area omni light. However, no gizmo appears while you rotate the light.

**Radius**

Sets the radius of the sphere or cylinder, in 3ds Max units. Default=20.0.

**Height**

Available only when Cylinder is the active type of area light. Sets the height of the cylinder, in 3ds Max units. Default=20.0.

As you use these spinners to adjust the size of the area light, a gizmo appears in viewports to show the adjusted size. This gizmo disappears once you finish adjusting the value.

**Samples group**

**U and V**

Adjust the quality of shadows cast by the area light. These values specify how many samples to take within the light's area. Higher values can improve rendering quality at a cost of rendering time. For a spherical light, U specifies the number of subdivisions along the radius, and V specifies the number of angular subdivisions. For a cylindrical light, U specifies the number of sampled subdivisions along the height, and V specifies the number of angular subdivisions. Default=5 for both U and V.

**mr Area Spotlight**

The area spotlight emits light from a rectangular or disc-shaped area, rather than from a point source, when you render a scene using the mental ray renderer. With the default scanline renderer, the area spotlight behaves like any other standard spotlight.

- Create panel ➤ (Lights) ➤ Standard ➤ mr Area Spot button ➤ Area Light Parameters rollout

**NOTE:** In 3ds Max, area spotlights are created and supported by a MAXScript script. Only the mental ray renderer uses the parameters in the Area Light Parameters rollout. See [Enhancements to Standard Features](#) for more details.

**TIP:** Area lights take longer to render than point lights. To create a quick test (or draft) rendering, you can use the Area/Linear Lights as Point Lights toggle on the Common Parameters rollout of the Render Setup dialog to speed up your rendering.

**Procedures**

**To create an area spotlight:**

1. Go to the Create panel and click (Lights).

2. Choose Standard from the drop-down list.

3. On the Object Type rollout, click mr Area Spot.

4. Drag in a viewport. The initial point of the drag is the location of the light, and the point where you release the mouse is the location of the target.
The mental ray renderer will ignore the spotlight cone, but the location of the spotlight target
determines the orientation of the plane of the area light, and the direction in which it’s projected.

5. Set the shape and size of the area light in the Area Light Parameters rollout.
   While you use the spinners to adjust the size of the area light, a gizmo (yellow by default) appears in
   viewports to show the adjusted size. This gizmo disappears once you finish adjusting the value.

To convert a standard 3ds Max light to an area light:

1. Select one or more lights.
2. Go to the Utilities panel.
3. On the Utilities rollout, click MAXScript.
   The MAXScript rollout is displayed.
4. On the MAXScript rollout, choose Convert To Area Lights from the Utilities drop-down list.
   The Convert To Area Lights rollout is displayed.
5. On the Convert To Area Lights rollout, click Convert Selected Lights. A MAXScript alert is
   displayed, that says "Delete Converted Lights?" Click Yes to delete the original light and replace it with
   the area light. Click No to leave the original light in place. If you click No there are now two lights in the
   scene: the original light, and the area light based on it.
6. Click Close to dismiss the Convert To Area Lights and MAXScript rollouts.

Interface

- Area Light Parameters

  - On
  - Show Icon in Renderer
  - Type: [Rectangle, Disc]
    - Radius: 20.0
    - Height: 20.0
    - Width: 20.0
  - Samples: [U: 5, V: 5]

On

Turns the area light on and off. When On is on, the mental ray renderer uses the light to illuminate
the scene. When On is off, the mental ray renderer doesn’t use the light. Default=on.

Show Icon in Renderer

When on, the mental ray renderer renders a dark shape where the area light is. When off, the area
light is invisible. Default=off.

Type drop-down list

Changes the shape of the area light. Can be either Rectangle, for a rectangular area, or Disc, for a
circular area. Default=Rectangle.
Radius

Available only when Disc is the active type of area light. Sets the radius of the circular light area, in 3ds Max units. Default=20.0.

Height and Width

Available only when Rectangle is the active type of area light. Set the height and width of the rectangular light area, in 3ds Max units. Default=20.0 for both Height and Width.

While you use these spinners to adjust the size of the area light, a gizmo (yellow by default) appears in viewports to show the adjusted size. This gizmo disappears once you finish adjusting the value.

Samples group

U and V

Adjust the quality of shadows cast by the area light. These values specify how many samples to take within the light’s area. Higher values can improve rendering quality at a cost of rendering time. For a rectangular light, U specifies the number of sampled subdivisions in one local dimension, and V the number of subdivisions in the other local dimension. For a circular (disc) light, U specifies the number of subdivisions along the radius, and V specifies the number of angular subdivisions. Default=5 for both U and V.

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.

NOTE: Photometric lights always attenuate using an inverse-square falloff, and rely on your scene using realistic units.

When you create lights from the Create panel, photometric lights appear as the default.

3ds Max includes the following types of photometric light objects:

- Target Light (Photometric)
- Free Light (Photometric)
- mr Sky Portal

NOTE: The remainder of this section discusses standard photometric lights, target and free. It does not discuss the mr Sky Portal. Additional photometric light types are provided as part of the Daylight system; see Sunlight and Daylight Systems.

Distribution Capabilities of Photometric Lights

You can choose how a photometric light is distributed. This can model how the light is generated and how it is mounted. There are four options:

- Uniform Spherical
- Uniform Diffuse
- Spotlight
- Photometric Web

The drop-down list that lets you choose the distribution type appears on the **General Parameters rollout** for photometric lights. In viewports, Uniform distribution is represented by a small sphere (the position of the sphere indicates whether the distribution is Spherical or Hemispherical), Spotlight distribution is represented by a cone, and Web distribution is represented as the shape of the web.

**Light Shapes for Shadow Generation**

While your distribution choice affects how light is spread throughout the scene, the light shape affects the way objects cast shadows. This setting is an independent choice. In general, larger areas cast softer shadows. There are six options:

- **Point**
  Objects cast shadows as if the light were emitted from a single geometric point, like a naked lightbulb.

- **Line**
  Objects cast shadows as if the light were emitted from a line, like a fluorescent tube.

- **Rectangle**
  Objects cast shadows as if the light were emitted from a rectangular area, like a skylight.

- **Disc**
  Objects cast shadows as if the light were emitted from a disc, like a circular porthole.

- **Sphere**
  Objects cast shadows as if the light were emitted from a sphere, like a globular lighting fixture.

- **Cylinder**
  Objects cast shadows as if the light were emitted from a cylinder, like a tubular lighting fixture.

You choose the light shape on the **Shape/Area Shadows rollout**.

**Lights from Older Scenes**

Prior to 3ds Max 2009, there were several types of photometric light, based on the light shape for shadow calculation. There are now just the two types of photometric light, Target and Free, and you choose the shape for shadow casting independently of the light type.

When you open a scene created in an earlier version of 3ds Max, the scene's photometric lights are converted to their equivalent in the new scheme. For example, a Target Linear Light with Isometric distribution becomes a Target Light with Line shadows and Uniform Spherical distribution. No information is lost, and the light behaves as it did in prior releases.

**Parameters for Photometric Lights**

The parameters specific to photometric lights are described in **Rollouts for Photometric Lights**. Other photometric light parameters are shared with standard lights, and are described in the following topics:

- **Name and Color Rollout (Lights)**
- **Common Lighting Rollouts and Dialogs**
- **Shadow Types and Shadow Controls**

**Notes**

- A scene's lighting can also be affected by the Ambient Light setting on the **Environment panel**.
- You can use the **Place Highlight** command to change a light's position.
• You can use templates to create lights that have the properties of common lamp types.

Target Light (Photometric)

A target light has a target sub-object that you can use to aim the light.

• Create panel ➤ (Lights) ➤ Photometric ➤ Object Type rollout ➤ Target Light button
• Standard menu: Create menu ➤ Lights ➤ Photometric Lights ➤ Target Light
• Enhanced menu: Objects menu ➤ Lights ➤ Target Light (Photometric)

Viewport representations of Target lights with spherical, spotlight, and web distribution

NOTE: When you add a Target light, 3ds Max automatically assigns a Look At controller to it, with the light's target object assigned as the Look At target. You can use the controller settings on the Motion panel to assign any other object in the scene as the Look At target.

NOTE: When you rename a Target Point light, the target is automatically renamed to match. For example, renaming TPhotometricLight01 to Klieg causes TPhotometricLight01.Target to become Klieg.Target. The target's name must have the extension .Target. Renaming the target object does not rename the light object.

Procedures
To create a Target light:

1. On the Create panel, click (Lights).

2. Choose Photometric from the drop-down list. (This is the default.)

3. In the Object Type rollout, click Target Light.

4. Drag in a viewport. The initial point of the drag is the location of the light, and the point where you release the mouse is the location of the target.
   The light is now part of the scene.

5. Set the creation parameters.
   You can use the Move transform to adjust the light's position and direction.

   To select the target:
   The target, displayed as a small square, is often in the same area as objects that you want to illuminate. It can be difficult to select it by clicking.

1. First, select the target point light.

2. Right-click the light and from the quad menu, choose Select Target.
You can also choose Lights from the Selection Filters list on the main toolbar, and then click the target. Clicking the line that connects the light and its target selects both objects.

**To adjust the light and target position:**

1. Select the light or target or both.

2. On the main toolbar, turn on (Select And Move). Drag the selection to adjust the light.

   You can also right-click the light and choose Move from the quad menu ➤ Transform quadrant.

   Because the light is always aimed at its target, you can't rotate it about its local X or Y axes. However, you can select and move the target object as well as the light itself. When you move either the light or the target, the light's orientation changes so it always points at the target. Clicking the line that connects the light and its target selects both objects. However, region selection doesn't recognize the link line.

   You can use the Place Highlight command to change a light's position.

   For target lights with spotlight distributions, you can also adjust the light using a **Light viewport**.

**To change a viewport to a light view:**

**NOTE:** The viewport can only be set to a light view when the target light's distribution is spotlight.

1. Click or right-click the Point-Of-View viewport label.
   
   3ds Max opens the **POV viewport label menu**.

2. Choose Lights.
   
   3ds Max opens a submenu that shows the name of each light. By default, Target lights are named *TPhotometricLight01*, *TPhotometricLight02*, and so on.

3. Choose the name of the light you want.
   
   The viewport now shows the light's point of view. You can use the **Light viewport** controls to adjust the light.

   **TIP:** The default keyboard shortcut for Light viewports is $.

**Free Light (Photometric)**

A free light has no target sub-object. You can aim it by using transforms.

- Create panel ➤ (Lights) ➤ Photometric ➤ Object Type rollout ➤ Free Light button
- Standard menu: Create menu ➤ Lights ➤ Photometric Lights ➤ Free Light
- Enhanced menu: Objects menu ➤ Lights ➤ Free Light (Photometric)

**Viewport representations of a Free light with spherical, spotlight, and web distribution**

**Procedures**

**To create a Free light:**
1. On the ⚡ Create panel, click 🌃 (Lights).

2. Choose Photometric from the drop-down list. (This is the default.)

3. On the Object Type rollout, click Free Light.

4. Click the viewport location where you want the light to be.
   The light is now part of the scene. Initially it points away from you in the viewport you clicked (down the negative Z-axis of the viewport).

5. Set the creation parameters.
   You can position the light and adjust its direction with the transform tools or by using a Light viewport. You can also adjust the light's position with the Place Highlights command.

To adjust the light position:

1. Select the light.

2. On the main toolbar, turn on 🌆 (Select And Move) or ⬠ (Select And Rotate). Drag the selection to adjust the light.
   You can also right-click the light and choose Move or Rotate from the quad menu ➤ Transform quadrant.
   TIP: You can also adjust the light's position with the Place Highlight command.

To change a viewport to a light view:

NOTE: This is available only for lights with Spot distribution.

1. Click or right-click the Point-Of-View (POV) viewport label.
   3ds Max opens the POV viewport label menu.

2. Choose Lights.
   3ds Max opens a submenu that shows the name of each light. By default, Free Point lights are named PhotometricLight01, PhotometricLight02, and so on.

3. Choose the name of the light you want.
   The viewport now shows the light's point of view. You can use the Light Viewport Controls to adjust the light.
   TIP: The default keyboard shortcut for Light viewports is $.

mr Sky Portal

The mr (mental ray) Sky Portal object provides an efficient method of “gathering” existing sky lighting in interior scenes without requiring high final gather or global illumination settings that would result in excessively long render times. In effect, a portal acts as an area light that derives its brightness and coloring from the environment.

- Create panel ➤ 🌃 (Lights) ➤ Photometric ➤ Object Type rollout ➤ mr Sky Portal button
- Standard menu: Create menu ➤ Lights ➤ Photometric Lights ➤ mr Sky Portal
- Enhanced menu: Objects menu ➤ Lights ➤ mr Sky Portal
**IMPORTANT:** For mr Sky Portal to work correctly, the scene must contain a Skylight component. This can be an IES Sky light, an mr Sky light, or a Skylight.

**Procedures**

**Example: To use the mr Sky Portal object:**

1. Make sure mental ray is the active production renderer.
2. Create a scene with a windowed interior. Set up a camera in the interior and set a viewport to show the camera view.
3. Add a Daylight system to the scene:
   1. Create menu ➤ Systems ➤ Daylight System. When prompted to use the mr Photographic Exposure Control, click Yes.
   2. On the mr Photographic Exposure Control rollout, set Preset to Physically Based Lighting, Indoor Daylight.
      This changes the exposure value to 10.0.
3. Change the Sunlight object to mr Sun and the Skylight object to mr Sky. (see mental ray Sun & Sky)

For best results, position the sun so it’s not shining directly into the interior, or turn it off. Otherwise, the direct lighting could overwhelm the indirect lighting from the portal, especially when you use final gathering or global illumination.

4. For each window, add an mr Skylight Portal object. The portal object takes the form of a wireframe rectangle with a central, perpendicular arrow showing the direction of light flow, or flux. Make each portal slightly larger than its respective opening, and position it immediately outside or inside the opening.

TIP: To help place the portal object as close as possible to the outside surface, use AutoGrid when you add the portal. Also, make sure portals do not overlap; this would cause the illumination from the overlapping area to be doubled.
Adding the Sky Portal object with AutoGrid on. Note the Light Flux Direction arrow pointing outward.

5. Make sure all the portals’ arrows are pointing inside. If a portal’s arrow points outside, toggle its Flip Light Flux Direction checkbox on the mr Skylight Portal Parameters rollout.

With Flip Light Flux Direction on, the arrow points inward.

6. Turn on Final Gather and render the scene. If the image looks grainy, increase the Shadow Samples setting on the mr Skylight Portal Parameters rollout.
Scene lit by mr Sky Portal with final gather at Draft preset, no diffuse bounces

**Interface**

**mr Skylight Portal Parameters rollout**

- **On**
  - Toggles the illumination from the portal. When off, the portal has no effect on scene lighting.

- **Multiplier**
  - Amplifies the power of the light. For example, if you set the value to 2.0, the light will be twice as bright.

- **Filter Color**
  - Tints the coloring coming in from the outside.

- **Shadows group**
  - **On**
    - Toggles shadow casting by the light from the portal.
By default, the portal casts shadows only from objects inside the portal; that is, on the arrow side.

**From “Outdoors”**

When on, casts shadows from objects outside the portal; that is, on the side away from the arrow icon. This is off by default, because turning it on can significantly increase render times.

**Shadow Samples**

The overall quality of shadows cast by the portal. If the rendered image is grainy, increase this value.

**Dimensions group**

**Length and Width**

Set the Length and Width using these spinners.

**TIP:** To change the arrow size, use the Preferences ➤ Viewports panel ➤ Viewport Parameters group ➤ Non-scaling object size setting.

**Flip Light Flux Direction**

Determines the direction in which light flows through the portal. The arrow must point toward the interior for the portal to cast light from the sky or environment. If it points outside, toggle this setting.

**Advanced Parameters rollout**

**Visible to Renderer**

When on, the mr Sky Portal Object appears in the rendered image. Turn this on to prevent outside objects from appearing in the window.

**Transparency**

Filters the view outside the window. Changing this color doesn’t change the light coming in, but has the effect of darkening outside objects, which can help if they’re overexposed. To avoid recoloring the outside view, use a shade of gray, such as R=G=B=0.5.

**Color Source group**

Sets the source of the light from which the mr Sky Portal derives its illumination.

- **Use existing Skylight** Uses the skylight. By default, with the mr Sky light using the mr Physical Sky environment map at their default values, this tends to give a bluish illumination, as with real-world skylight.
- **Use Scene Environment** Uses the environment map for illumination color. Use this if your sky light and environment map are different colors, and you wish to use the latter for the interior illumination.

- **Custom** Lets you use any map for the illumination coloring. Choose Custom, and then click the button (“None”) to open the Material Map Browser. Choose a map and click OK.