A Short Course in Using Your Digital Camera

4. Capturing Light and Color

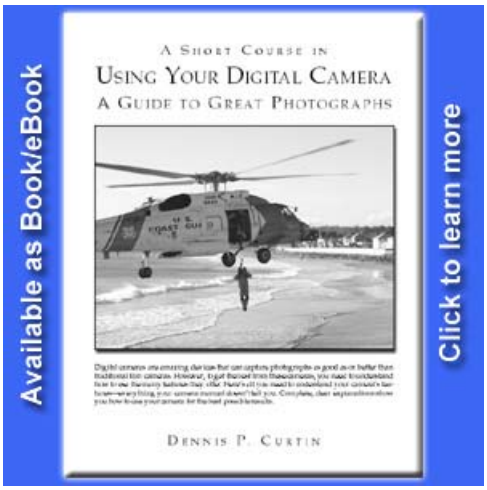

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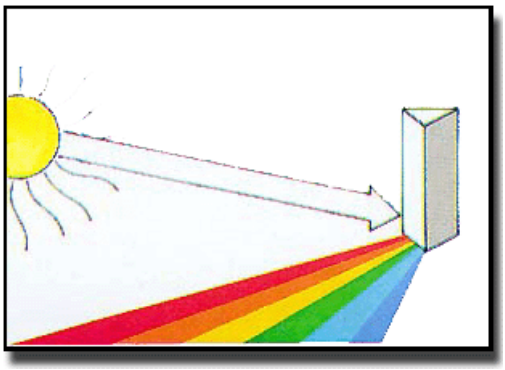
Image sensors in digital cameras are designed to produce colors that match those in the original scene. However, there is a lot of variation among sensors and among the circuits and software that process raw images into final photographs. The results you get depend, in part, on the accuracy with which you expose the image and the match between the color balance of the sensor and the color balance of the light illuminating your subject.

With film cameras, photographers usually explore a wide variety of films before settling on the one or two they like best. This is because each film type has it's own unique characteristics. In some the grain is small, in others it's larger. A film may have colors that are warmer than other films, or slightly colder. These subtle variations among films are slight but noticeable and photographers gravitate to one or the other. With digital cameras, you don't have the same choice offered by film cameras. The "film" in the form of an image sensor is built into your camera. Whatever its characteristics are, they are the characteristics you have to live with until you buy another camera.

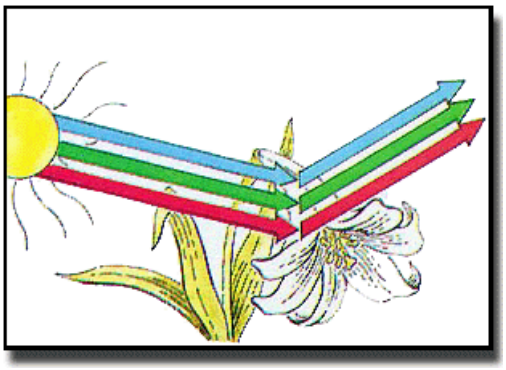
In this chapter, we explore the world of color and how you manage it in your photos.

Where Does Color Come From

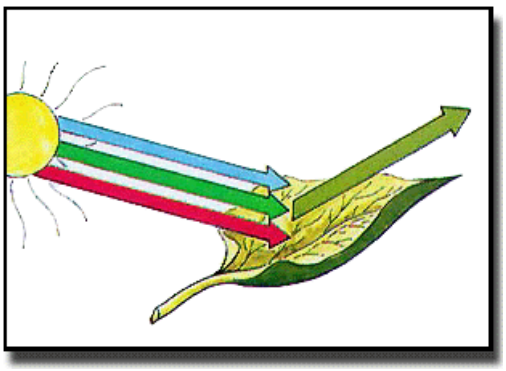
Why do we see colors? Light from the sun or from a lamp seems to have no particular color of its own. It appears simply to be "white" light. However, if you pass the light through a prism, you can see that it actually contains all colors, the same effect that occurs when water droplets in the atmosphere separate light into a rainbow. A colorful object such as a leaf appears green because when white light strikes it, the leaf reflects only the green wavelengths of light and absorbs the others. A white object such as a white flower appears white because it reflects most of the wavelengths that strike it, absorbing relatively few. Inks, dyes, or pigments in color prints also selectively absorb and reflect certain wavelengths of light and so produce the effect of color.



Although light from the sun appears colorless or "white," it actually contains a range of colors similar to a rainbow. You can see these colors using a prism to separate them out.



White objects reflect most of the wavelengths of light that strike them. When all of these wavelengths are combined, we see white. On the other hand, when all of them are absorbed, and none reflected, we see black.



A green object such as a leaf reflects only those wavelengths that create the visual effect of green. Other colors in the light are absorbed by the leaf.

Color Balance

Although light from the sun or from a light bulb looks white to us, it not only contains a mixture of all colors, it contains these colors in varying proportions. Light from the midday sun, for example, is much bluer than light from a sunrise or a tungsten lamp. To produce what appears to us to be normal or accurate color balance, the image we capture must contain the colors in the original scene. These colors are affected by the color of the light source.

One way to describe the color of a light source is by its color temperature. The color temperature scale is calibrated in degrees Kelvin, somewhat like a thermometer that calibrates heat temperatures in degrees centigrade. The color temperature scale ranges from the lower color temperatures of reddish light to the higher color temperatures of bluish light. Daylight contains proportionately more light toward the blue end of the spectrum. Incandescent light contains more toward the red end. That’s why we describe daylight as "cooler" and incandescent light as "warmer."

Daylight

Incandescent

Fluorescent

"White" light actually contains light of different colors and in different proportions, The overall color cast of the light changes as the proportions of the colors change. Although different white light sources have different "colors" you don't see the subtle differences because your brain compensates automatically.

Image sensors can be balanced to match light of a particular color temperature. This is done using a system called white balance that automatically or manually adjusts the sensor's relative sensitivity to different colors in order to match the overall color cast of the light it's recording. The daylight (or outdoor) setting matches the cooler, more bluish color of daylight. The incandescent (or indoor) setting matches the warmer, more reddish color of studio lights.

You can preview color balance by looking at a scene in the LCD monitor. You can also check the color balance of any image you've already taken the same way. If you examine the images closely you may notice that white areas in particular have some color cast to them. If so, you may want to adjust white balance for subsequent shots. Many digital cameras offer a number of white balance settings, some for specific lighting situations.

- **Auto** (the default) works in a wide variety of lighting conditions.
- **Manual** lets you set white balance manually by aiming the camera at a piece of white paper.
- **Daylight or Sunny** is best when photographing outdoors in bright sunlight.
- **Incandescent or tungsten** is best when photographing indoors under incandescent lights.
- **Fluorescent** is best when photographing indoors under fluorescent lights.
- **Cloudy** is best when photographing outdoors in cloudy or overcast conditions.
- **Flash** is best when photographing with flash.

How To: Adjusting White Balance

Look in your camera manual for a section on **white balance** or **color balance**. There may be a way to set it manually for unusual lighting situations.

Color Balance and Time of Day

In photography, there is a color of light called "daylight." However, this type of light occurs only at a specific time of day. Over the course of the day, the light can change from a warm red at sunset, to a cold blue at noon, and then back to a warm red or orange at sunset. "Daylight" on the color temperature scale is really set for midday sun between 10 A.M. and 2 P.M. During these hours, colors appear clear, bright, and accurately rendered in the photo.

Before and after midday, light from the sun is modified by the extra distance it travels through the Earth's atmosphere. Some of the blue light is filtered out, leaving the light with a more reddish cast than at midday. This is easily seen very early or late in the day when the light is often quite red-orange in tone. The change in color will affect your pictures strongly, but this reddish cast is a wonderful light to photograph in.

Just before dawn and at dusk, colors often appear muted or monochromatic. During these hours when light is relatively dim, you often have to use an extra-long exposure time.

Midday light on a sunny day will produce colors that appear natural and accurately rendered.

Early morning and late afternoon light outdoors will produce a warmer, more reddish color balance than you will get at midday.

Sunsets and Sunrises

Sunsets and sunrises are relatively easy to expose because the exposure is not as critical as it is with some other scenes. If you underexpose the scene slightly, the colors will simply be a bit richer and darker. Slight overexposure will make the same scene slightly lighter.

The sun often takes on a flattened appearance as it rises above the horizon. When partially obscured and softened by a haze, its warm, red glow illuminates the foreground.

Sunrises and sunsets by themselves aren't very interesting. It's objects in the foreground, such as the skyline, or unusual atmospheric effects such as this dark cloud that give them some punch.

The colors in the sky are often richest in the half hour before the sun rises and the half hour after it sets. It pays to be patient as you watch the sky change during these periods. For one thing, the sun itself is below the horizon and not in the image so exposure problems are greatly reduced. Also, clouds in the sky often light up dramatically and in some cases, reflect the light to other clouds until you find yourself under a wonderful canopy of reflected color.

Every sunrise and sunset is unique and the variations can be truly amazing. It's certainly not true that "if you've seen one sunrise or sunset, you've seen them all." If you want the sun in the photo, it's best if it is softened and partly obscured by a mist or haze. If it rises as a hot white or yellow ball, find another subject, or turn around and photograph the scene it's illuminating.

With the bright disk of the sun included in a sunset or sunrise, your picture may come out somewhat underexposed and darker than you expected it to be. Add 1 or 2 stops of exposure to a sunset or sunrise that includes the disk of the sun.

Warning!

Never look at the bright sun through the viewfinder. You can seriously damage you eyes.

It's tempting to take all of your photos of a rising or setting sun, but it often pays to turn around. The rich, warm light changes the colors of everything it hits. This is a magic time to capture images that will really stand out. Colors take on a warm, soft glow that can't be found at any other time of the day.

Instead of shooting into the sun at sunrise or sunset, shoot with it behind you to capture rich, warm colors of scenes bathed in the sun's light.

A long-focal-length lens will enlarge the disk of the sun so that it becomes a more important part of the picture. Foreground objects silhouetted against the bright sky, can also add interest.

Here the camera was positioned so the rising sun was behind one of the grain elevators and wouldn't burn out the image with its glare.

Anticipating the Sun and Moon

When planning to integrate the sun or moon into an image it helps to know when it rises or sets. With the moon, it also helps to anticipate the phase. This information is available in almanacs, and also on the Web at the U.S. Naval Observatory (http://aa.usno.navy.mil/AA/data/). You can view the phase of the Moon at http://tycho.usno.navy.mil/vphase.html.

The Moon

The moon, especially when full, adds a lot to an image. The best time to capture the moon is when it's near the horizon. Because it is close to foreground objects at that time, it looks much larger than when it's higher in the sky.

Keep in mind that the moon is relatively dim and usually requires long exposures. Since it's moving relative to the Earth, longer exposures can actually blur it, giving it an oblong shape. To reduce the chances of this happening, shoot just before sunrise or just after sunset when there is still some light in the atmosphere from the recently set sun. (It bends around the Earth's curvature due to refraction in the atmosphere.)

The rising full moon, and the trail it leaves across the water, adds a lot to this photo of an old-fashioned coal-burning power plant on Salem Harbor.

Long exposures on bright moonlit nights can be very attractive. Just keep in mind that the moon does move so exposures longer than a minute or so may show it elongated.

Weather

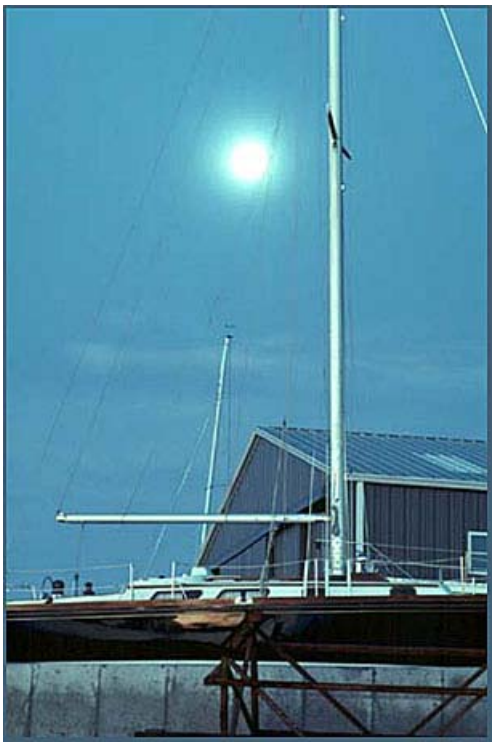
There's no need to leave your camera home just because the sun hasn't come out. In fact, rain, snow, fog, and mist can add interest to your pictures. Objects at a distance often appear diffused and gray in such weather, with foreground objects brighter than normal because they are seen against a muted background. Remember to take a little extra care in bad weather to protect your camera against excessive exposure to dampness.

Snow covered scenes are not only beautiful to look at, they make great photographs.

Even a light fog subdues colors and softens objects in the background.

Rainbows always make good pictures. The problem is, you rarely find them where you want them, when you want them. To get better at capturing them, you should know something about how they form so you can anticipate them. Rainbows are formed by sunlight being refracted by raindrops. You'll usually find the combination of rain and sun at the leading or trailing edge of a summer storm. You can't see rainbows at all times of the day. To understand why, visualize the way the rainbow works. If you stand with your back to the sun while looking at a rainbow, imagine a line from the sun passing through your eye, through the Earth, and out into space. (This is called the antisolar point.) The rainbow forms a complete circle around this imaginary line, however from ground level part of it is always below the horizon. A line drawn from your eye to the top of the rainbow forms a 42-degree angle with the imaginary line from the sun through your eye. (If there is a secondary rainbow, it forms an angle of 51-degrees.) Because these angles determine the position of the rainbow in the sky, it will sink as the sun rises and rise as the sun sinks. At some points, the entire rainbow, not just the bottom half, will be below the horizon where you can't see it. That's why you'll never see a rainbow at midday.

From a plane you can sometimes see all 360-degrees of a rainbow. Here you see a section of one shot through an airliner window. To the right of the brighter primary rainbow is a dimmer secondary one.



A very light mist can dim the sun enough to include it in a photograph. If it weren't partially obscured by the fog, it would appear as a white dot against a very dark background.

On the coldest days of the year "sea smoke" forms over the ice-cold water. Here it surrounds a lobster boat and is backlit by the rising sun.

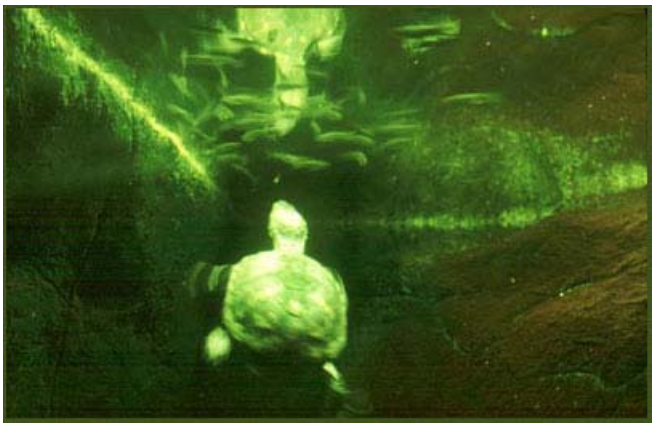
As a summer storm moves in, there are often times when the background is almost black with the sun shining on objects in the foreground. The contrasts can be very dramatic.

Storms are not a time to hide in the house, they are a time to get out and watch the light. As storms approach and recede, or when there are breaks in the clouds, you find some of the most interesting, at times almost surrealistic light. It's a time of muted contrasts but rich colors—a perfect environment for interesting photos.

Color Choices

The choices you make when photographing in color, such as how to position a colored object against its background or whether to concentrate on bright, brilliant colors or muted, soft ones, affect the mood and general impact of your pictures. Stop for a moment before you make an exposure and try to focus your attention only on the viewfinder image. Ask yourself how the colors relate to each other. Perhaps a change in camera position might bring one colored object to a better position in relation to another. Or perhaps you should wait until sunset turns the sky a more brilliant hue. Don't limit yourself to taking the first view of a scene that comes to your attention.

Contrasting colors can make a subject stand out, for example, the magenta bush stands out against the more muted green and brown background. This contrast draws the eye to the more brightly colored object in the image.



We expect certain familiar objects like human skin or green grass to be within an accepted range of normal colors. However, if the color is not known the viewer will accept a wide range of possible colors as normal.

Colors often create a psychological temperature. Blues and greens seem to be associated with coolness, water, or ice, while reds and oranges seem related to fire and warmth.

Photographing at Night

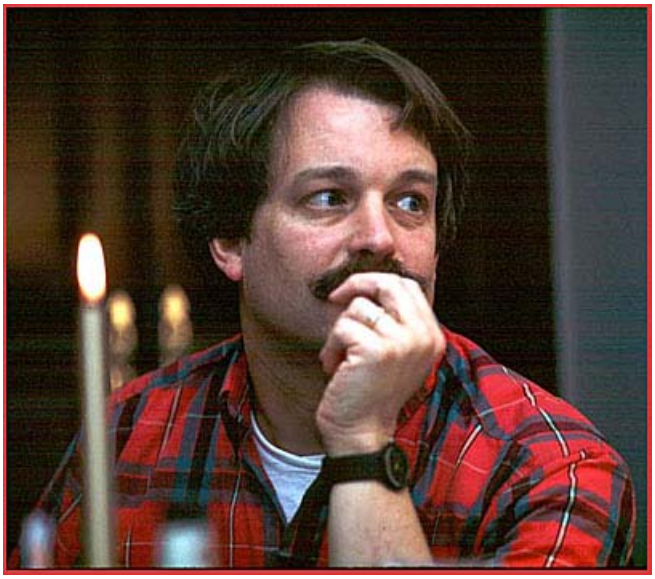
You can photograph many different things outdoors at night, so don't put your camera away just because the sun is gone for the day. Light sources (street lights, automobile lights, neon signs, or fires) or brightly lit areas (illuminated buildings or areas under street lights) will dominate pictures at night because they stand out strongly against darker backgrounds. Plan to use these bright areas as the dominant part of your picture. A tripod will support your camera during long exposures and prevent blur caused by camera motion during the time the shutter is open.

This exterior of the Paris Opera House was shot at night with just illumination from spotlights.

To capture interesting images of fireworks, put people or water in the foreground. It also helps if there are identifiable objects in the image such as an illuminated building or monument to give the viewer a sense of place. Get upwind from the show since fireworks generate a lot of smoke that can become a problem if you are downwind. If you are upwind, the smoke will become part of the image, illuminated by the fireworks. Automatic exposure doesn't work well with fireworks. Try a series of exposures of different bursts because there is a certain amount of luck involved. You might also use flash to illuminate foreground figures.

Fireworks can be dramatic, but are difficult to capture. You need to experiment and a digital camera is perfect for that because you can instantly review your results.

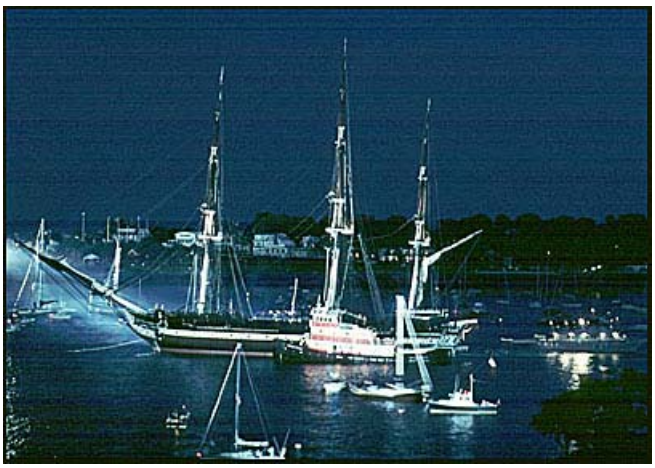
Set your exposure for fireworks by switching to aperture or shutter preferred mode and try for a setting of f/2.8 at 1/30 sec. You might also want to try increasing sensitivity, use exposure compensation, and try different combinations of aperture and shutter speed as well as those recommended here.



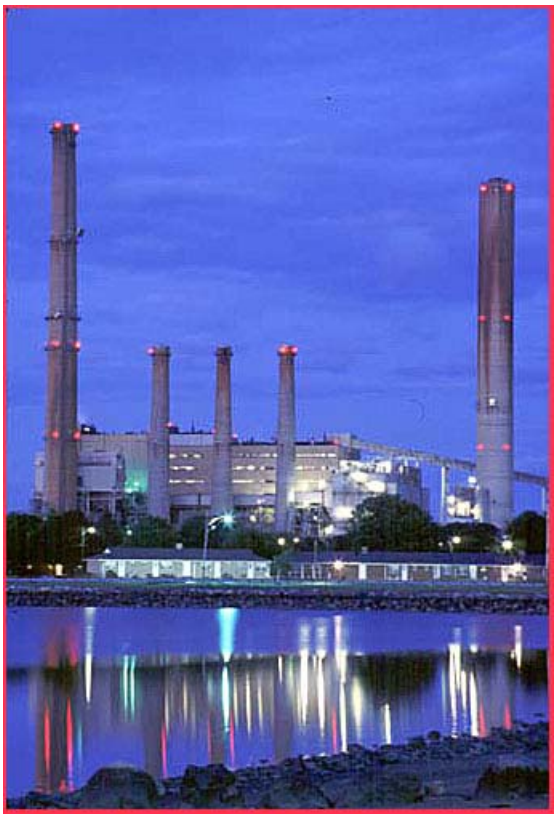
Candlelight provides a very warm glow to whatever it illuminates.

Use automatic exposure at night if brightly lit areas take up most of the scene visible in your viewfinder. If they do not, use exposure compensation to reduce the exposure and darken the image so bright lights aren't overexposed.

This picture of Chicago was taken just after sunset through an airliner window. A few minutes later the scene was too dark to capture without blurring due to long exposure times.



The U.S. Constitution lies floodlit in Marblehead Harbor.



There is a time at twilight and dawn where there is enough light in the sky so it has the same tonal value as the foreground.

Light: Its Direction

The direction that light is coming from relative to your camera's position is important because it affects the shadows that will be visible in your picture. Four main types of lighting are illustrated here: front-lighting, side-lighting, backlighting, and top-lighting. Notice the position of the shadows in these photographs and how they affect the subjects.

The direction of light can affect your automatic exposure. Backlighting, for example, can leave your subject silhouetted against a background so bright that your automatic exposure system will assume the subject is much brighter than it actually is, and so underexpose the scene and make the subject even darker. This is fine, if you want a silhouette. If you don't, you should use exposure compensation to lighten the image.

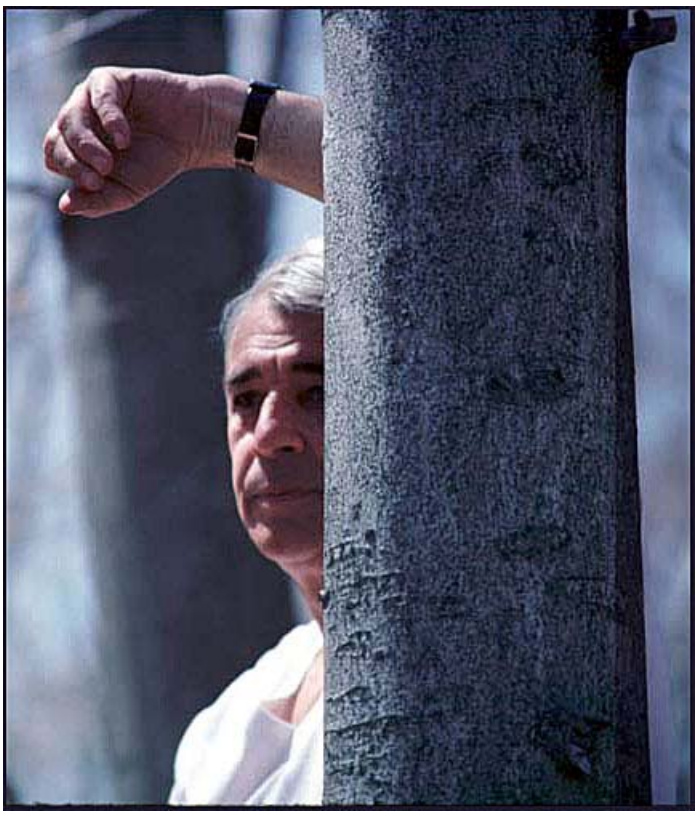
How To: Photographing Backlit Subjects

Look in your camera manual for sections on **fill flash** or **exposure compensation**.

Side-lighting, light that falls mainly on one side of the subject, increases the sense of texture and volume because such cross-lighting casts shadows visible from the camera's position that emphasize surface details. Landscape photographers often prefer to work early in the morning or late in the day because the sun low in the sky will sidelight scenes and add interesting surface textures.

Front-lighting, light that falls on the subject more or less from the camera's position, decreases visible shadows and so minimizes surface details such as skin texture. Front-lighting also tends to minimize the apparent roundness or volume of the subject.

Backlighting, light that comes from behind the subject, puts the side of the subject that is facing the camera in shade. Automatic exposure tends to make backlit scenes too dark. You can add exposure to lighten the picture, especially those parts that are in shade.



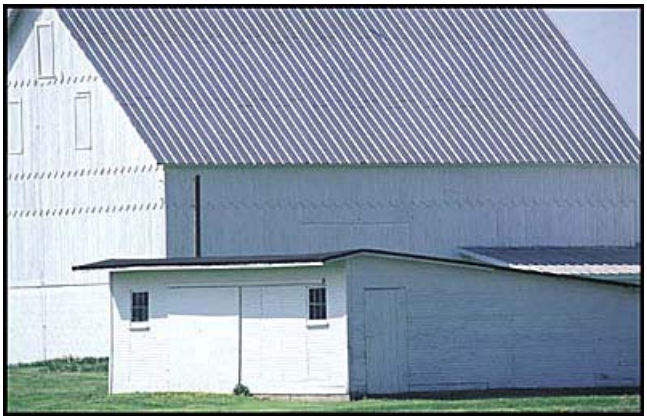
Top-lighting, light that comes from more or less overhead, can occur outdoors at noon or indoors in public buildings or other places where ceiling lights predominate. If you are photographing a person, you will notice that top-lighting tends to cast shadows in eye-sockets and illuminate the top of the nose brightly. To avoid this effect, you might try moving the person into the shade.

Top-lighting, such as that found at midday, can selectively illuminate things, such as this flag in the guy's back pocket, that would be in shadow with light coming from a lower angle.

Light: From Direct to Diffuse

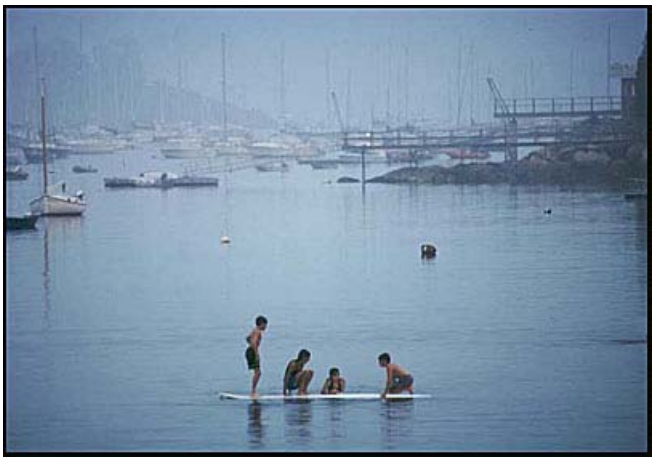
Light not only has direction, it can be direct or diffused. Direct light, light coming mainly from one direction, produces relatively high contrast between bright highlights and dark shadows. Diffused light bounces onto the subject from several directions, lowering contrast. Contrast, in turn, affects the brilliance of colors, the amount of visible texture and detail, and other visual characteristics.

In direct light you may have to choose whether you want highlights or shadows to be correctly rendered because image sensors can accurately record only a limited range of contrast between light and dark areas. If this creates a problem because both highlights and shadowed areas are important, you can sometimes add fill light to lighten shadows and decrease contrast or adjust the contrast setting. In diffused light, colors tend to be softer than in direct light and textures are also softened because shadow edges are indistinct.



Direct light comes from a point source, such as the sun on a clear day. Direct light produces dark, hard-edged shadows that crisply outline details. Here the light and shadows almost form an abstraction.

Diffused light comes from a light source that is so large relative to the subject that it illuminates from several directions. On an hazy or overcast day, illumination comes from the entire dome of the sky, not from the brighter, but smaller, sun. Indoors, light bounced into an umbrella reflector or onto a wall or ceiling creates a broad source of light that wraps around the subject.



On a foggy or hazy day, objects in the foreground tend to stand out sharply against a background that is partially obscured by light reflecting from the atmosphere. You can emphasize this effect by increasing the exposure a stop or so more than recommended by your autoexposure system.

When the sky is overcast, yet still bright, interior rooms are flooded with a soft, even lighting.

Using Light and Color Creatively

Light is one of the elements of a scene that you can alter, play with, control, and make a less or more important part of your picture. Light can make a picture ominous or airy, glowing or velvety dark. To use light creatively, you may have to override your camera's autoexposure system.

An unusual color balance can be created with an image editing program or simply by taking advantage of the existing light on a scene. Try taking one picture in the usual way, then, before you move on, see if any other alteration of the image might be feasible.

Rays of light breaking through the clouds are more readily visible when positioned against a dark background, as in this scene of the sun pouring through a hole in the clouds.

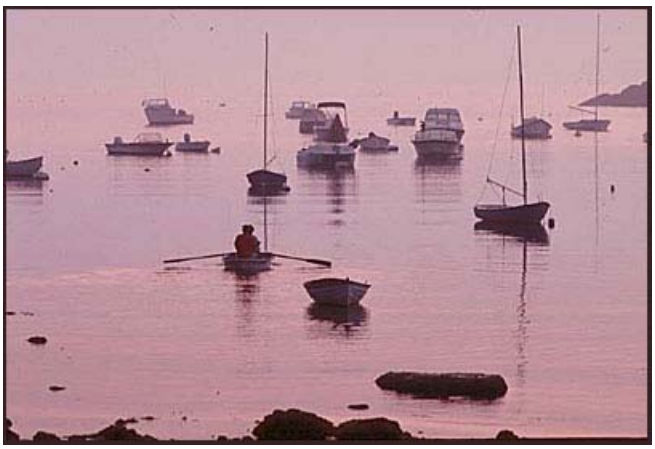
When photographing sunrises or sunsets, the sun needn't be the center of interest. Here your eye is drawn to the man returning to the club from a sailing race and lifting his arms in a sign of victory.

One thing that's easy to forget is that we photograph light. In most cases, you can't create the light, you can just recognize it when it's there. It's the light that gives this image the mood it has. With most other light this scene wouldn't be anywhere near as dramatic.

With backlighting, and the subject against a dark background, you can get a "halo" effect with the hair.

Shooting into the sun before sunrise gives soft muted colors.

Sunlight filtering through an orange dome makes everything take on an orange hue.



The soft morning light on a misty day mutes the colors and gives a soft look to the image.

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