

# Beaches: Sunset & Sky Colors

## **Why is the Sunset Red?**

On a clear sunny day, the sky above us looks bright blue. In the evening, the sunset puts on a brilliant show of reds, pinks and oranges. What makes the sunset red? Why is the sky blue? The answer involves learning about the earth's atmosphere and nature of light waves.

## **THE ATMOSPHERE**

The atmosphere is the mixture of gas molecules and other materials surrounding the earth. It is made of the gases: 78% nitrogen, 21% oxygen argon gas and water in the form of vapor, droplets and ice crystals. There are also small amounts of other gases and small solid particles, like dust, soot and ashes, pollen, and salt from the oceans.

The composition of the atmosphere varies, depending on your location, the weather, and many other things. There may be more water in the air after a rainstorm, or near the ocean. Volcanoes can put large amounts of dust particles high into the atmosphere. Pollution can add different gases or dust and soot. The atmosphere is densest (thickest) near the Earth. It gradually thins out as you go higher and higher up.

## **LIGHT WAVES**

Light is a kind of energy that radiates, or travels, in waves. Many different kinds of energy travel in waves. For example, sound is a wave of vibrating air. Light is a wave of vibrating electric and magnetic fields. It is one small part of a larger range of vibrating electromagnetic fields. This range is called the electromagnetic spectrum. Electromagnetic waves travel through space at 299,792 km/sec (186,282 miles/sec). This is called the speed of light.

The energy of the radiation depends on its wavelength and frequency. Wavelength is the distance between the tops (crests) of the waves. Frequency is the number of waves that pass by each second. The longer the wavelength of the light, the lower the frequency, and the less energy it contains.

## **COLORS OF LIGHT**

Visible light is the part of the electromagnetic spectrum that our eyes can see. Light from the sun or a light bulb may look white, but it is actually a combination of many colors. We can see the different colors of the spectrum by splitting the light with a prism. The spectrum is also visible when you see a rainbow in the sky.

The colors blend continuously into one another. At one end of the spectrum are the reds and oranges. These gradually shade into yellow, green, blue, indigo and violet. The colors have different wavelengths, frequencies, and energies. Violet has the shortest wavelength in the visible spectrum. That means it has the highest frequency and energy. Red has the longest wavelength, and lowest frequency and energy.

## **LIGHT IN THE AIR**

Light travels through space in a straight line as long as nothing disturbs it. As light moves through the atmosphere, it continues to go straight until it bumps into a bit of dust or a gas molecule. Then what happens to the light depends on its wavelength and the size of the thing it hits.

Dust particles and water droplets are much larger than the wavelength of visible light. When light hits these large particles, it gets reflected, or bounced off, in different directions. The different colors of light are all reflected by the particle in the same way. The reflected light appears white because it still contains all of the same colors.

Gas molecules are smaller than the wavelength of visible light. If light bumps into them, it acts differently. When light hits a gas molecule, some of it may get absorbed. After awhile, the molecule radiates (releases, or gives off) the light in a different direction. The color that is radiated is the same color that was absorbed. The different colors of light are affected differently. All of the colors can be absorbed. But the higher frequencies (blues) are absorbed more often than the lower frequencies (reds). This process is called Rayleigh scattering. (It is named after Lord John Rayleigh, an English physicist, who first described it in the 1870's.)

## **WHY IS THE SUNSET RED?**

As the sun begins to set, the light must travel farther through the atmosphere before it gets to you. More of the light is reflected and scattered. As less reaches you directly, the sun appears less bright. The color of the sun itself appears to change, first to orange and then to red. This is because even more of the short wavelength blues and greens are now scattered. Only the longer wavelengths are left in the direct beam that reaches your eyes.

The sky around the setting sun may take on many colors. The most spectacular shows occur when the air contains many small particles of dust or water. These particles reflect light in all directions. Then, as some of the light heads towards you, different amounts of the shorter wavelength colors are scattered out. You see the longer wavelengths, and the sky appears red, pink or orange.

## **WHY IS THE SKY BLUE?**

The blue color of the sky is due to Rayleigh scattering. As light moves through the atmosphere, most of the longer wavelengths pass straight through. Little of the red, orange and yellow light is affected by the air. However, much of the shorter wavelength light is absorbed by the gas molecules. The absorbed blue light is then radiated in different directions. It gets scattered all around the sky. Whichever direction you look, some of this scattered blue light reaches you. Since you see the blue light from everywhere overhead, the sky looks blue.

As you look closer to the horizon, the sky appears much paler in color. To reach you, the scattered blue light must pass through more air. Some of it gets scattered away again in other directions. Less blue light reaches your eyes. The color of the sky near the horizon appears paler or white.

## **THE BLACK SKY AND WHITE SUN**

On Earth, the sun appears yellow. If you were out in space, or on the moon, the sun would look white. In space, there is no atmosphere to scatter the sun's light. On Earth, some of the shorter wavelength light (the blues and violets) are removed from the direct rays of the sun by scattering. The remaining colors together appear yellow. Because there is no atmosphere out in space and no scattered light to reach your eyes, the sky looks dark and black, instead of blue.

Source: The Science Guy