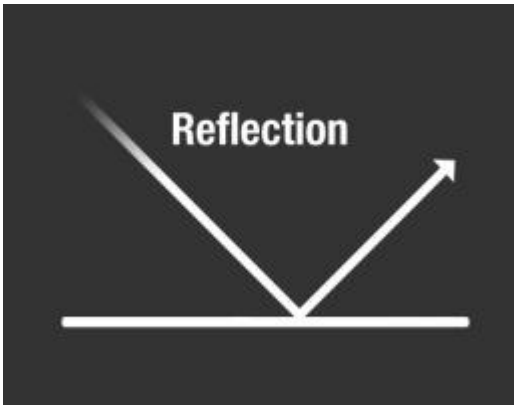
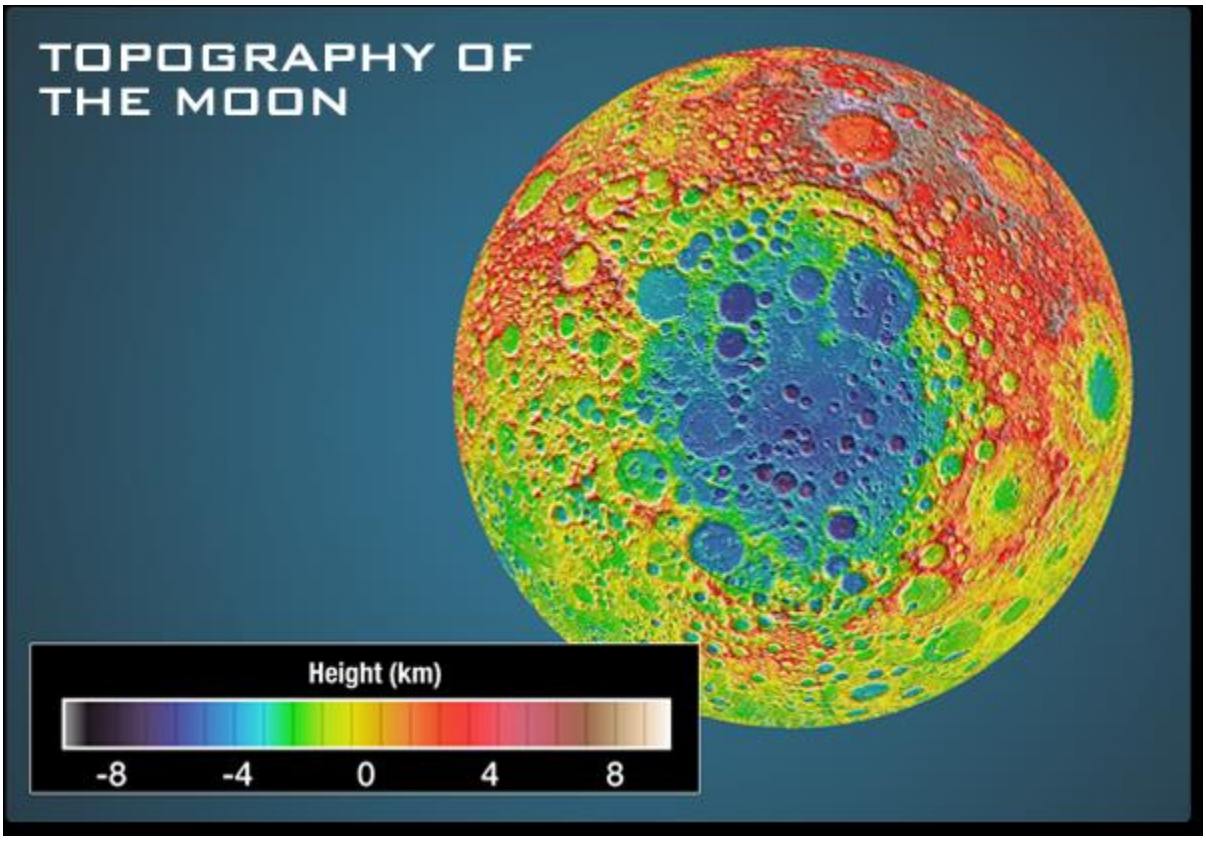
Reflection

Reflection is when incident light (incoming light) hits an object and bounces off. Very smooth surfaces such as mirrors reflect almost all incident light.



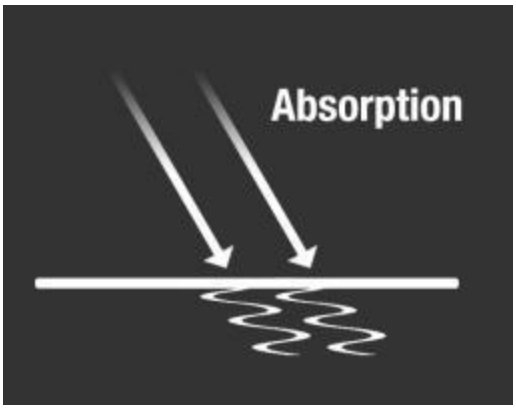
The color of an object is actually the wavelengths of the light reflected while all other wavelengths are absorbed. Color, in this case, refers to the different wavelengths of light in the visible light spectrum perceived by our eyes. The physical and chemical composition of matter determines which wavelength (or color) is reflected.

This reflective behavior of light is used by lasers onboard NASA's Lunar Reconnaissance Orbiter to map the surface of the Moon. The instrument measures the time it takes a laser pulse to hit the surface and return. The longer the response time, the farther away the surface and lower the elevation. A shorter response time means the surface is closer or higher in elevation. In this image of the Moon's southern hemisphere, low elevations are shown as purple and blue, and high elevations are shown in red and brown.



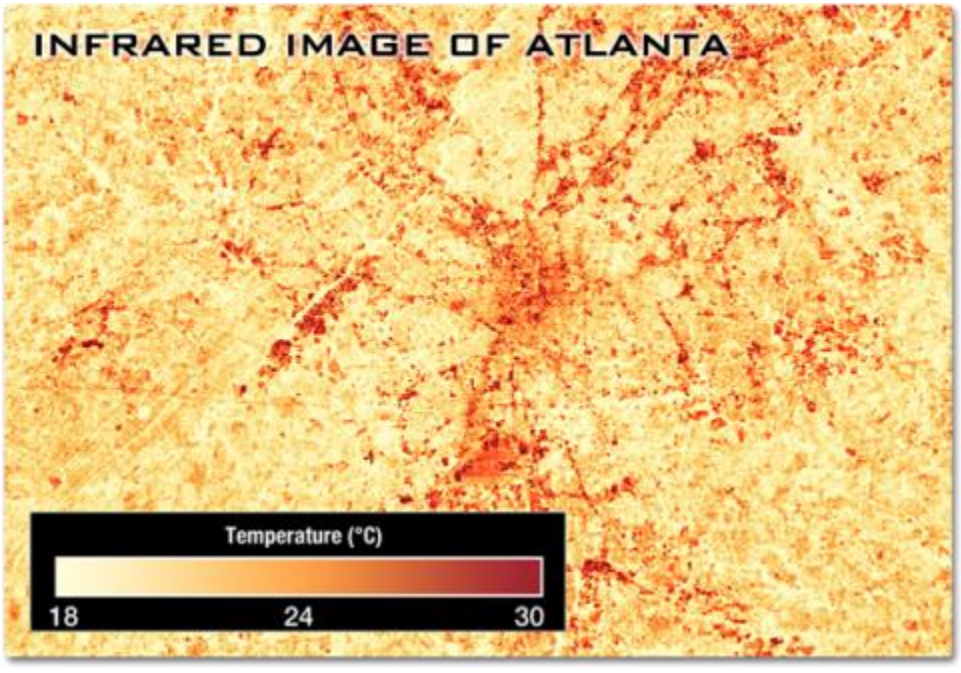
Absorption

Absorption occurs when photons from incident light hit atoms and molecules and cause them to vibrate. The more an object's molecules move and vibrate, the hotter it becomes. This heat is then emitted from the object as thermal energy.



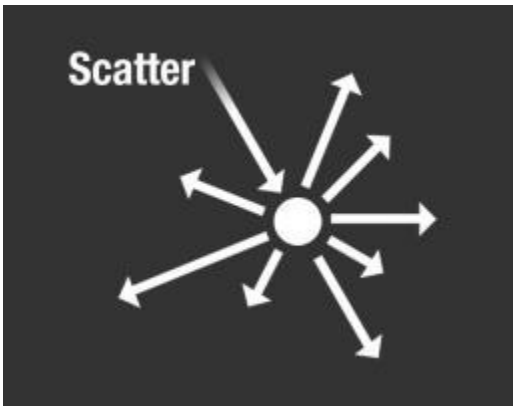
Some objects, such as darker colored objects, absorb more incident light energy than others. For example, black pavement absorbs most visible and UV energy and reflects very little, while a light-colored concrete sidewalk reflects more energy than it absorbs. Thus, the black pavement is hotter than the sidewalk on a hot summer day. Photons bounce around during this absorption process and lose bits of energy to numerous molecules along the way. This thermal energy then radiates in the form of longer wavelength infrared energy.

Thermal radiation from the energy-absorbing asphalt and roofs in a city can raise its surface temperature by as much as 10° Celsius. The Landsat 7 satellite image below shows the city of Atlanta as an island of heat compared to the surrounding area. Sometimes this warming of air above cities can influence weather, which is called the "urban heat island" effect.



Scattering

Scattering occurs when light bounces off an object in a variety of directions. The amount of scattering that takes place depends on the wavelength of the light and the size and structure of the object.



The sky appears blue because of this scattering behavior. Light at shorter wavelengths—blue and violet—is scattered by nitrogen and oxygen as it passes through the atmosphere. Longer wavelengths of light—red and yellow—transmit through the atmosphere. This scattering of light at shorter wavelengths illuminates the skies with light from the blue and violet end of the visible spectrum. Even though violet is scattered more than blue, the sky looks blue to us because our eyes are more sensitive to blue light.

Aerosols in the atmosphere can also scatter light. NASA's Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) satellite can observe the scattering of laser pulses to "see" the distributions of aerosols from sources such as dust storms and forest fires. The image below shows a volcanic ash cloud drifting over Europe from an eruption of Iceland's Eyjafjallajökull Volcano in 2010.