

# BLUE SKIES AND RED SUNSETS: THE LIGHT SCATTERING PHENOMENON

## Overview

Sunlight is scattered by gases and particles in the atmosphere. These particles are too small to see with the human eye, but we can detect the light they scatter. In this demonstration, we will observe how light is scattered by particles in a solution and discuss how this phenomenon is responsible for changes in the color of the sky.

**Target Audience:** K+, works well in small group / STEM fair format

## Learning Objectives

- Compare the intensity and color of light across water and water and milk mixture.
- Discuss how light scattering by particles in the air contributes to different colors of the sun and sky

## Materials List

- Two clear glass jars with flat sides
- Water
- A few drops of milk (or milk powder)
- Flashlight w/ incandescent bulb (note: a LED flashlight will not work)

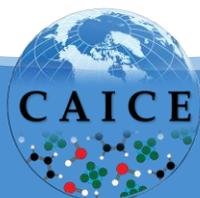


## Instructions

1. Fill the two jars with water. Add a few drops of milk with an eyedropper to one jar, one drop at a time, just until the water is murky and still allows light to pass through.
2. Place the flashlight so that the beam shines through the glass.
3. Instruct the audience to view the light from one side of the pitcher (at a 90° angle from the path of the beam). Ask *“What color is the light?”* It should appear blue.
4. Look at the beam of light again, this time from the end of the pitcher (at a 180° angle from the path of the flashlight). Ask: *“What color is it now?”* Now, it should have a reddish-orange hue!
5. As more milk is added dropwise, the color should appear redder.
6. The second page of these instructions includes an explanation of this phenomenon and can be used as a hand-out or for discussion.

## Safety and waste disposal

This experiment uses milk and water, which are not hazardous. At the end of the experiment, solutions may be poured down the drain.



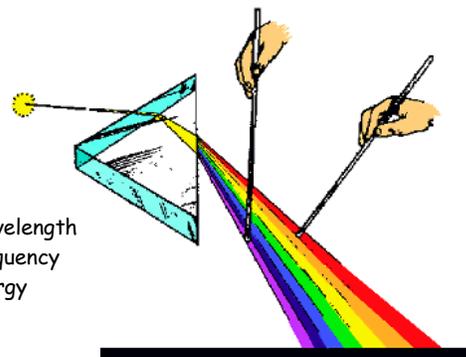
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The sun emits white light that contains all of the colors of the rainbow.

Shorter wavelength  
Higher frequency  
Higher energy



Longer wavelength  
Lower frequency  
Lower energy



Sunlight is scattered by gases and particles in the atmosphere. Scattering occurs when light encounters matter and is then bounces in a different direction. Light waves with the shortest wavelengths are scattered the most. Light waves with longer wavelengths are scattered less and more of them continue in their original direction.

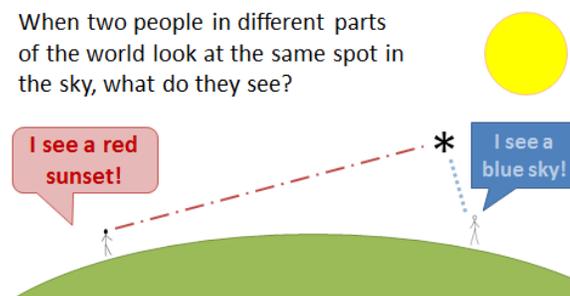
## Why is the sky blue?

We see the sky as colored because gases in the atmosphere (primarily nitrogen and oxygen) scatter the sun's light. **Blue light** is scattered the most because it has the shortest wavelength. It is scattered in all directions and that is why the sky appears blue.

## Why are sunsets red?

When the sun is directly above you, the sun's rays traverse a relatively short distance through the dense parts of the atmosphere until they reach your eye, but at sunset, the sun's rays have much farther to travel through the atmosphere to reach your eye. This increased distance amplifies the scattering that makes the sky blue, so that the blue in sunlight is lost. The light you see is the remaining shades of yellow and orange.

When two people in different parts of the world look at the same spot in the sky, what do they see?



**Why does the sun appear to change color at sunrise and sunset?** During the day sun looks yellow, but during sunrise and sunset, light must travel farther through the through the atmosphere before it gets to us. Consequently, more of its light is scattered and the sun appears dimmer. As the sun gets lower in the sky, it may appear orange and then red as shorter wavelengths of light are scattered and what we see shifts to the red side of the spectrum.



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## Tips and trouble-shooting

- Take care not to add too much milk so that light is not transmitted through the jar.
- *Having trouble seeing the different colors?* Try using a plain white index card to project the light onto for viewing, or conduct the experiment in a dark room.

