Why the Sky Is Blue

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Topic: Rayleigh Scattering

Purpose

To investigate the mechanism that causes light to scatter.

Discussion: Everybody enjoys a nice day when white puffy clouds dot a bright blue sky. Why *is* the sky blue? And why are sunsets and sunrises red? Did you know the sky is actually violet? Many people think the sky is blue because it reflects off the blue oceans. That might be true for people who lived on the coast near the ocean, why are the skies blue over Nebraska or other places where the ocean is a long way away? Have you ever noticed that while a glass of water looks clear yet a glass of non-fat milk has a faint bluish tint to it? That's because the milk has tiny little particles that cause the light to interact or *scatter* in all directions. Let's do some experimenting and see how light behaves in these circumstances and see if we can understand why the sky is blue!

Required Equipment and Supplies

long, skinny tank (fish tank will do)
Mop & Glo® (liquid floor cleaning fluid)
flashlight (mini Maglite® or equivalent preferred)
sympathetic tuning forks
tuning fork (same frequency as sympathetic tuning forks)
colored pencils (optional)

Pre-Lab Preparation

Your teacher will perform a series of demonstrations to help you understand the basic ideas of resonance and how it applies to scattering.

Listen to the sound of the tuning fork as your teacher strikes it. Notice both the pitch and the intensity (loudness). Now observe when the tuning fork is struck and the handle is placed against the table. Notice how the sound gets louder, but the pitch remains the same. That's because the vibration of the tuning fork is transmitted to the table that in turn vibrates. The vibration of the handle causes the tabletop in turn to vibrate *sympathetically*, hence the term sympathetic vibration. It's a form of *resonance*.

Your teacher will demonstrate a (single) tuning fork mounted on a wooden box open on one end. Notice the increase in volume. That's because the wooden box vibrates (sympathetically) as well as the tuning fork, which causes much more air to be moved—hence the louder sound.

Your teacher will demonstrate what happens when two tuning fork resonators are placed a meter apart and one fork is struck. Record your observations. Explain.

Procedure

Step 1: Fill the long-skinny tank with clean water. Shine the beam of the flashlight down the long axis of the tank by holding the flashlight up next to one end the tank. The water in the tank should look reasonably clear except for a few small bubbles.

Step 2: Slowly add a few drops of *Mop & Glo*® to the tank. Stir completely. View the side of the tank from all angles. View the bulb of the flashlight by peering down the long axis of the tank. Record your observations.

Step 3: Now slowly add *Mop & Glo*® drops to the tank while your lab partner stirs the tank until the end of the tank opposite to the flashlight begins to take on a slight reddish-hue. View the bulb of the flashlight by peering through the tank of water. Record your observations.

Step 4: Add enough *Mop & Glo* until the end opposite of the flashlight is red-orange.

Summing Up

1. How did the light change as you added more and more *Mop & Glo* from the side of the tank?

2. How did the color of the bulb change as you added more and more *Mop & Glo*?

Analysis

Think about the tuning fork demonstrations performed by your teacher at the beginning of the lab. In effect, the sound from the first tuning fork that was struck was "scattered" by the second tuning fork. How does this apply to why the sky is blue?

Draw and label the light from the sun that passes through the atmosphere as it reaches the three observers on the ground. Be sure to indicate what color the observer sees as a result of the light as it passing through the atmosphere.

[sun]

[earth graphic goes here]

As you added more and more *Mop & Glo* the water in the tank appeared white. Why? Can you explain why clouds are white? Name other examples of this effect.