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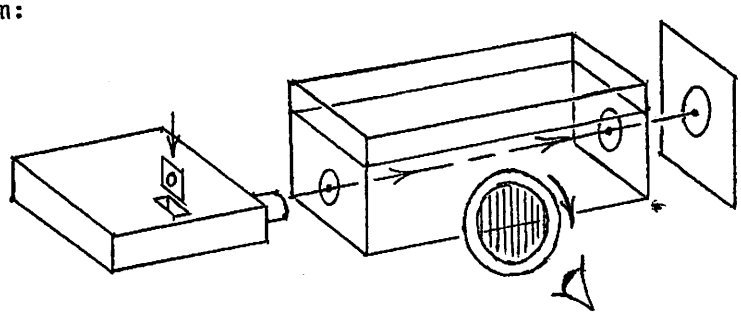
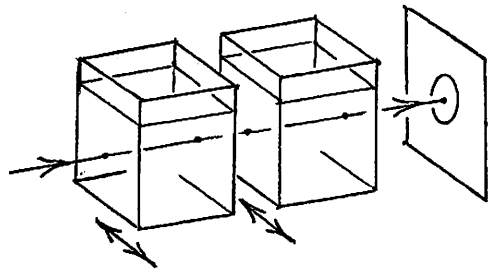
The blue sky and orange sunrises and sunsets. It's another set of nature's beautiful gifts that have heightened human emotion since the beginning of our existence. Modern science, mainly physics, has an explanation for these phenomena; they result from Rayleigh scattering.* These phenomena can easily be demonstrated, via simulation, in a darkened classroom with readily available equipment. Some Pine-Sol in water will produce satisfactory results like those found in our atmosphere.

Diagram:



(c) Alternative



Materials: slide projector, metal slide, water tank(s), screen, Polaroid filter (15 cm dia.?) water (distilled?), Pine-Sol, stirrer , kleenex

Preparation: (1) Make up a 2" x 2" metal slide with a 5/8" dia. aperature in the center to narrow the projector's beam.

(2) Locate a water tank with clear, flat sides like an aquarium (the longer, the better) and fill it with clean water.

(3) Set up a simple,white screen (a sheet of copy paper?).

(4) Line everything up as in the diagram with the beam shooting through the water onto the screen. The circle of light on the screen should be white.

Presentation: (a) Add some Pine-Sol (experiment?) to the water, gently stir it in, and watch the beam and water turn light blue and the white light on the screen dim and develop an orange hue. This is the result of Rayleigh scattering.

(b) It so happens that the scattered blue light is also polarized. To show this phenomenon, place a Polaroid filter in front of the tank facing the students and rotate it slowly. The blue light from the tank should lighten and darken noticeably during the rotation showing that it is polarized. Also, use the filter to test the white beam entering, and the orange beam leaving, the tank. These tests should show that these beams are not polarized.

(c) An alternative - using the "Johnston" acrylic boxes (5"x5"x5 3/4"). Set up as in diagram (c). Use one box first. Using a second box, the "orange" on the screen becomes more intense due to the longer pathlength as at sunrise and sunset. If you slide the boxes sideways you can easily view the changes in intensity on the screen, like a "split" screen. Neat!

(d) Easy clean-up. After the demonstration, immediately dump the tank-water and rinse the tank(s) thoroughly with warm water to eliminate any Pine-Sol residue. Also, immediately wipe the tank(s) dry with kleenex to remove any future waterspots.

* Explanation: Rayleigh scattering. See next page.

Rayleigh scattering - is the elastic scattering (not by reflection) of incident light or other E-M radiation by particles (individual atoms or molecules) much smaller than the wavelengths of the incident light. It can occur when light travels through transparent solids and liquids but most prominently through gases like nitrogen and oxygen. It results from the electric polarizability of the particles. The oscillating electric field of a light wave acts on the electrons within a particle causing them to oscillate (resonate) at the same frequency. The photons are immediately absorbed, change quantum levels up to "excited", and then are immediately emitted (radiated) in a new direction without any lose in energy. The particle therefore has become a small radiating dipole whose "new" radiation becomes the scattered light. In air, the shortest wavelengths (blue) are scattered easiest (most) from the incident white light, thus leaving the "orange" (R,O,Y "mix") to pass on through unscattered. Thus, the sky appears blue from the scattering and the sun "orange". The "orange" appears most intense at sunrise and sunset when the sun's white light must pass