



## 6F40.10/8A70.21 Rayleigh Scattering

*6F40.10:* To show the wavelength dependence of Rayleigh scattering.

*8A70.21:* To model the scattering of the sun's rays in the Earth's atmosphere which makes the sky blue.

**DESCRIPTION:** A long aquarium tank is filled with water. A small amount of scattering liquid is mixed into the water. A white light beam from a slide projector is aimed through the tank. The red portion of the white light will be transmitted through the tank but the blue portion will be scattered away. As a result, the tank will appear blue to students looking at it from the side, but the projector beam spot on the wall will appear red. The scattered blue light can be shown to be polarized in one direction by holding a polarizing sheet up to the side of the tank and rotating it until no light passes through.

### SUGGESTED TECHNIQUE

1. The tank will already be filled with water and scattering fluid at the start of the demonstration. Turn all the lights in the room off and turn the projector on. Note that the light transmitted through the tank has a reddish hue while the light scattered out the sides has a bluish hue.
2. Hold a polarizing sheet at the end of the tank to intercept the transmitted beam.
3. Rotate the sheet and note that some light always passes through no matter the sheet's orientation.
4. Hold the polarizing sheet up to the side of the tank to intercept the scattered light.
5. Rotate the sheet until no light passes through.

### TECHNICAL DETAILS

#### LOCATION OF APPARATUS

| EQUIPMENT                         | LOCATION            |
|-----------------------------------|---------------------|
| Small Wood Riser (angled or flat) | Above General Use F |
| Large Wood Riser                  | Above Mechanics F   |
| Scattering Liquid                 | Sink (or Optics C)  |
| Dropper and Stirring Rod          | General Use E       |
| Large Aquarium Tank               | Fluids              |
| Slide Projector                   | General Use A       |
| Circular Projector Aperture       | Optics B            |
| Polarizing Sheet                  | Optics A            |
| Rolling Screen                    | Front of Astronomy  |

#### LOCATION OF COMMON ACCESSORIES

## **SETUP INSTRUCTIONS**

*Setup Time ~30 min*

1. Place the large aquarium tank on top of the large wooden riser (a cinder block is shown in the photo but this method is not recommended).
2. Fill the tank with water up to the black line.
3. Place the circular aperture in the slide projector.
4. Set the small wood riser and slide projector adjacent to the tank such that the projector beam will pass directly through the tank. You may need to angle the projector up slightly if you're using the flat riser (see photos).
5. Drop about 10 droppers full of scattering liquid into the aquarium tank (experiment to find the optimal amount). Stir thoroughly. Be careful not to oversaturate the scattering liquid!
6. Note: if there is no scattering fluid left, non-dairy coffee creamer can be substituted (see photos). In this case, combine approximately 1 teaspoon of non-dairy coffee creamer and 25 ml of water. Stir the mixture regularly for about an hour for the creamer to dissolve, then pour the mixture into the aquarium tank.
7. Provide a polarizing sheet.
8. Orient the table in the room such that the beam from the projector exiting the tank lands on a white background. A white wall is perfect, but if this is not available, use the rolling screen or whiteboard.

[\*\*LINK TO PICTURES\*\*](#)

## **ADDITIONAL RESOURCES**

### **REFERENCES**

1. [http://math.ucr.edu/home/baez/physics/General/BlueSky/blue\\_sky.html](http://math.ucr.edu/home/baez/physics/General/BlueSky/blue_sky.html)
2. <http://hyperphysics.phy-astr.gsu.edu/hbase/atmos/blusky.html>
3. <http://www.physics.umd.edu/~reberg/services/demos/demosm7/m7-31.htm>
4. D. Tattersfield, Projects and Demonstrations in Astronomy, p.109.
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7. Jay S. Huebner, Tricks of the Trade: "A Golden Oldie" - Projecting a Sunset, TPT 32, 147 (1994).
8. E-Qing Zhu and Se-yeun Mak, Demonstrating Colors of Sky and Sunset, TPT 32, 420-421 (1994).
9. Sutton, Demonstration Experiments in Physics, L-46 Scattering of Light, 387-388.
10. Ariel Cohen and Igal Galili, Where is the sky?, TPT 39, 92-96 (2001).
11. A. J. Cox, Alan J. DeWeerd, and Jennifer Linden, An experiment to measure Mie and Rayleigh total scattering cross sections, AJP 70, 620-625 (2002).