PhyzLabSpringboard: Why the Sky is Blue

• Demo and Lab Apparatus •

__2 resonant tuning forks __optics tank (without insert) __access to scattering agent
__mini Maglite (incandescent or LED) (or equivalent bright light source)
__portable Bluetooth speaker + smart phone with FreqGen app (or equivalent)

• Discussion •

INITIAL IDEAS

1. Why is the sky blue? What are some of the ideas you've heard? What might people say if you were to take a survey of the general public?

2. Can you think of any problems with these ideas?

BLUE SKY INGREDIENTS

3. What is "the sky" and what is it made of?

4. Which of those materials—if any—are blue?

5. What color is the sky at night?

6. What is different during the day?

7. The daytime sky on a clear day appears to be blue. On the moon, the sky is on the illuminated side is black. What are the essential "ingredients" for a blue sky?

TUNING FORKS LESSON

8. To understand how these "ingredients" interact to create a blue sky, consider the following demonstration. A tuning fork is struck.

a. What happens when the tuning fork is struck? Why?

b. How can a tuning fork be silenced?

c. A second tuning fork (or portable Bluetooth speaker) is added to the arrangement. What is the surprising observation this time?

d. What is the name and explanation of this effect?

e. Imagine a huge collection of tuning forks with a wide range of different notes. Suppose they were all struck. Now imagine a second collection of tuning forks—each having the same note—near the first collection. Would any of the the forks in the second collection be activated by the sound coming from the first collection? Explain.

FROM THE SUN TO THE SKY

9. a. Does the sun emit one frequency of electromagnetic radiation or many frequencies? Describe.

b. Do atmospheric molecules resonate at all frequencies or do they "prefer" a particular area of the electromagnetic spectrum? Describe.

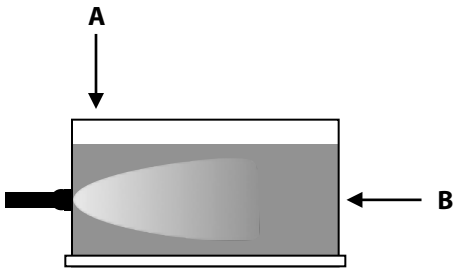
c. How does the lesson of the tuning forks apply to the scattering of light in the atmosphere?

10. a. Are our eyes equally sensitive to all frequencies of visible light? If not, what color(s) do our eyes "prefer?"

b. What are some examples of objects colored to take advantage of this sensitivity?

11. a. Our eyes are more sensitive to green than they are to blue. Why is the sky not green?

b. Violet light is scattered more than blue light is. Why is the sky not violet?



ONE SKY TWO SKY RED SKY BLUE SKY

• Procedure •

1. Fill the optics tank (with no back insert) with water.

2. Add and disperse the scattering agent.

3. Activate the light and shine it through the tank as shown in the diagram.

4. Observe the illuminated tank from the top (see "A" in the diagram).. Describe the coloration—if any—of the water near to the Maglite.

5. Observe the illuminated tank from the far end (see "B" in the diagram). Describe the coloration—if any—of the illuminated water.

• Questions •

Consider the diagram of the earth as seen from far above the North Pole. The earth rotates counterclockwise from this perspective. (The thickness of the atmosphere is highly exaggerated.)

1. What time of day is it at each location: A, B, and C?

2. What is the color of the sky at each location: A, B, and C?

3. Explain the difference in color making reference to your optics tank observations above.