1. CONTRIBUTOR'S NAME: KATIE HAILER

2. NAME OF INQUIRY: WHY IS THE SKY BLUE?

3. GOALS AND OBJECTIVES:

a. Inquiry Questions: Why is the sky blue? Why are sunrises/sunsets often red/orange?
b. Ecological Theme(s): Weather/atmosphere, light spectrum
c. General Goal: to illustrate why we see the sky as blue
d. Specific Objectives: to define wavelength of light; to teach the visible light spectrum; to talk about the principle of light absorption and scattering and how this leads to color.
e. Grade Level: 5-9
f. Duration/Time Required:
→ Prep time: 20 min.
→ Implementing Exercise During Class: 40 min-1hr
→ Assessment: 20 min. (overlapping with the exercise)

4. ECOLOGICAL AND SCIENCE CONTEXT:

a. Background (for Teachers): The sky is blue because of our atmosphere. With out our thick atmosphere, the sky would look black. When the light from the sun hits the oxygen, nitrogen, water, and smog in our atmosphere it is scattered. Small particles (like the ones in our atmosphere) scatter short wavelength light more than long wavelength light. Blue light has a wavelength of roughly half the wavelength of red light, so blue light is scattered more strongly than red light.

The students will be able to observe this through experimentation. Each group will be given a glass of water with a flashlight and a white sheet of paper. When shining the flashlight through the glass with just water, the beam of light is barely visible on the sheet of paper. The students will be instructed to add milk to the glass dropwise with stirring. They will be asked to record their observations. As they add more milk, they will first be able to see blue light on the white piece of paper. As they saturate the water with more milk, the color on the paper will start to look red/orange.

b. Background (to present to Students): What is light? Light is an energy particle that travels about 186,000 miles/second. The particles of light also exhibit the characteristics of a wave. This can be illustrated by a "slinky" or by using a rope attached with one stationary end. As you shake the rope rhythmically, each up and down shake of the rope is a cycle and the number of cycles per second is a frequency. The distance between the wave pattern of alternating crests and troughs is called the wavelength. The frequency of light determines the color. The visible light spectrum should be illustrated in detail at this point and the other forms of light should be discussed as well. Due to way our eyes have developed (rods and cones) we can only see in the visible spectrum of light. Blue light has a higher frequency and a shorter wavelength than red light. There are other spectrums of light. There is ultra-violet and infra-red light just beyond our eyes' range, radio waves with much lower frequencies than light, and gamma rays with the highest frequency of waves. Sunlight contains many different colors which can be separated through a prism or a rainbow into different colors.

Keep in mind these three facts: light must enter our eyes in order for us to see it; the sun emits light with different colors; different colored light has different wavelengths.

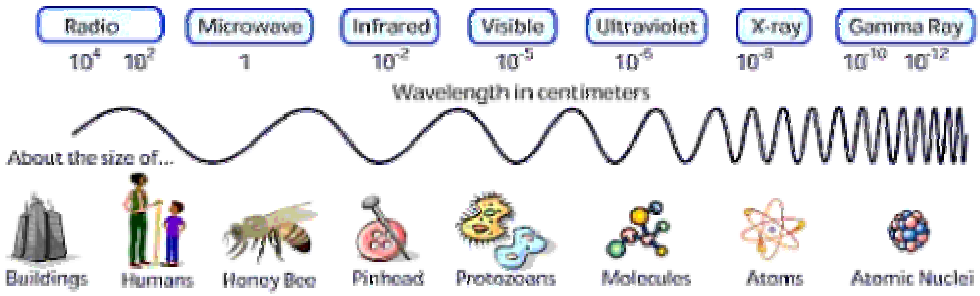
5. MOTIVATION AND INCENTIVE FOR LEARNING: The students get to set up and perform the experiment themselves. As they do the experiment they will be able to observe the color changes. These observations should lead to a number of ideas and questions.

6. VOCABULARY:
Light: A weightless particle of energy that also exhibits a wave-like nature and travels at about 186,000 miles per second.
Frequency: The number of cycles (up and down) that a wave goes through per second.
Wavelength: The distance from the crest of one wave to the next.
Visible spectrum: Light that has the correct wavelength for our eyes to detect as color.

7. SAFETY INFORMATION: NONE

8. MATERIALS LIST (including any handouts or transparency masters):
glass
water
milk
eyedropper
flashlight
white paper
worksheet

9. METHODS/PROCEDURE FOR STUDENTS:
a. Pre-investigation work: discussion on light, visible light spectrum, and the composition of our atmosphere.
b. Investigation work: setting up the experiment and working through the worksheet.
1) What evidence (data, samples) do students collect? The color change in light as they add more drops of milk to the water.
2) How do students present the evidence (data)? They will be filling out a worksheet as they go through this exercise recording the number of drops of milk as they see the color changes, and any other observations they may make.
3) What conclusions are drawn from the evidence students collect? We see blue light the best because it is scattered the most in our atmosphere and our eyes are better at detecting blue than violet. We see red in the morning/evening because the sun light is coming in at an angle and the blue light is scattered too much and does not reach our eyes. Red light is not scattered at all by our atmosphere and we see it in the evenings as the most intense color in the sky.
4) Include examples of data sheets.



Why is the Sky Blue?

Name:_____

Experimental Set-up:

Fill your glass with water. Set up your white sheet of paper so that paper is upright behind the glass. (Someone on you team needs to hold up the piece of paper.) Turn on the flashlight and shine it through the glass of water on to the piece of paper.

1. Suck up some milk with the eye-dropper. Add milk to the water in the glass drop-wise. After the addition of each drop of milk, slowly stir the solution and keep shinning the flashlight through the water/milk solution. Record the number of drops dispensed and any observations.

# of drops of milk added	Observations

2. As you add more drops of milk to the water, what kinds of changes did you observe?

_____

_____

_____

3. Based on what you learned at the beginning of the class (the lecture portion), and what you observed in this experiment, explain why, on a sunny day, you think the sky is blue.

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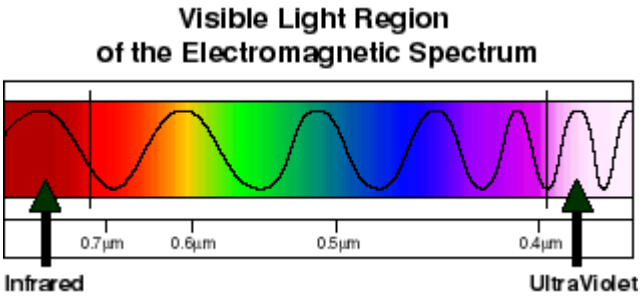

10. ASSESSMENT:

11. EXTENSION IDEAS:
THIS LESSON COULD BE MADE INTO A LONGER UNIT BY EXPANDING ON THE TERMS/IDEAS PRESENTED AND USING MORE PROPS, SUCH AS A PRISM, TO ILLUSTRATE THE VISIBLE SPECTRUM OF LIGHT.

12. SCALABILITY

13. REFERENCES: http://imagers.gsfc.nasa.gov/ems/visible.html (Diagrams)
HTTP://WWW.SCIENCEMADESIMPLE.COM/SKY_BLUE.HTML
HTTP://WWW.SKY-WATCH.COM/ARTICLES/SKYBLUE.HTML

14. LIST OF EXPERTS AND CONSULTANTS

15. EVALUATION/REFLECTION BY FELLOWS AND TEACHERS OF HOW IT WENT:
The first week, too much information was given at the beginning. The students were more interested in doing the hands-on portion and they didn't listen to the information presented at the start of the lesson. The second week went better. Less time was spent at the beginning of the class discussing the topic. A small amount of general information was given and then the students worked through the experiment. They not only had more time to work at the experiment, but there was also more time to discuss ideas/questions at the end. All of the students really enjoyed using the eyedropper and other equipment.