

## Teacher Survey

**Instructions:** Please complete the following evaluation.

1. Did you make any adjustments to the learning module? If so, what did you change or omit?

2. From your observations, are the students more interested in atmospheric science?

3. What part of the lesson was most effective or interesting to them?

4. What concept did the students have most trouble understanding or applying?

## Student Survey

Please distribute this survey to the students before and after completing the module.

**Instructions:** Circle the answer that best describes your feelings about science.

1. I like science.
  - a. I strongly disagree.
  - b. I disagree.
  - c. I am indifferent or unsure.
  - d. I agree.
  - e. I strongly agree.
  
2. How often do you talk to your *family* about what you do in science class?
  - a. Never
  - b. Rarely (less than once a week)
  - c. Once a week
  - d. A few times a week
  - e. Every day
  
3. How often do you talk to your *friends* about what you do in science class?
  - a. Never
  - b. Rarely (less than once a week)
  - c. Once a week
  - d. A few times a week
  - e. Every day
  
4. I think science will be useful when I am older.
  - a. I strongly disagree.
  - b. I disagree.
  - c. I am indifferent or unsure.
  - d. I agree.
  - e. I strongly agree.
  
5. I would like to be a scientist when I am older.
  - a. I strongly disagree.
  - b. I disagree.
  - c. I am indifferent or unsure.
  - d. I agree.
  - e. I strongly agree.

## Effectiveness Assessment

### Part 1: Pre- and Post-Assessment (Student Evaluation)

**Instructions:** Please distribute and score the **Student Evaluation** for each student before and after completing the module. Each question is worth 1 point.

#### Student Evaluation

**Instructions:** After completing the lesson on atmospheric optics, please have the students answer the following questions.

1. The electromagnetic spectrum is made up of
  - a. all wavelengths of energy
  - b. all the colors in the rainbow
  - c. high frequency radiation
  - d. UVA and UVB radiation from the sun
  
2. Which of the following has the shortest wavelength of energy?
  - a. Radio waves
  - b. Microwaves
  - c. Visible light
  - d. X-rays
  - e. Blue light
  
3. What is refraction?
  - a. The direct transmission of x-rays through the human body
  - b. The trapping of heat in Earth's atmosphere by greenhouse gases
  - c. The bending of visible light as it passes through a medium
  - d. The reflection of light off a mirror in the same direction as the incoming light
  
4. White is the scattering of
  - a. all colors in the visible light spectrum.
  - b. outgoing infrared radiation from Earth's surface.
  - c. all wavelengths of energy.
  - d. none of the above
  
5. What factor changes a blue sky to red during sunset?
  - a. The wavelength of incoming light from the sun
  - b. The number of clouds in the sky
  - c. The distance the incoming light travels through the atmosphere
  - d. The temperature at which the sun is emitting light

6. Light travels faster in water than air. T F
7. Longwave energy carries more energy than shortwave energy. T F
8. The colors in a secondary rainbow are opposite of a primary rainbow. T F
9. Describe the process in which sunlight interacts with cloud particles to make clouds appear white. Be sure to include details on what type of energy is emitted from the sun, the shape of cloud droplets, and the type of scattering that occurs.
10. Visible light ranges in wavelength from  $0.38 \times 10^{-6}$  to  $0.70 \times 10^{-6}$  meters. Convert these wavelengths from scientific notation.
- 0.000038 and 0.00007 meters
  - 0.00000038 and 0.0000007 meters
  - 380 and 700 meters
  - 380,000 and 700,000 meters

**Part 2: Math & Science Proficiency (Take Home Assignment: Part 2)**

Please score **Take Home Assignment: Part 2** for each student using the rubric below. This problem is aligned with the following academic standards:

<b>NGSS.MS-PS4-2</b>
<b>MS-PS4-2. Waves and Electromagnetic Radiation:</b> Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

**Scoring Rubric**

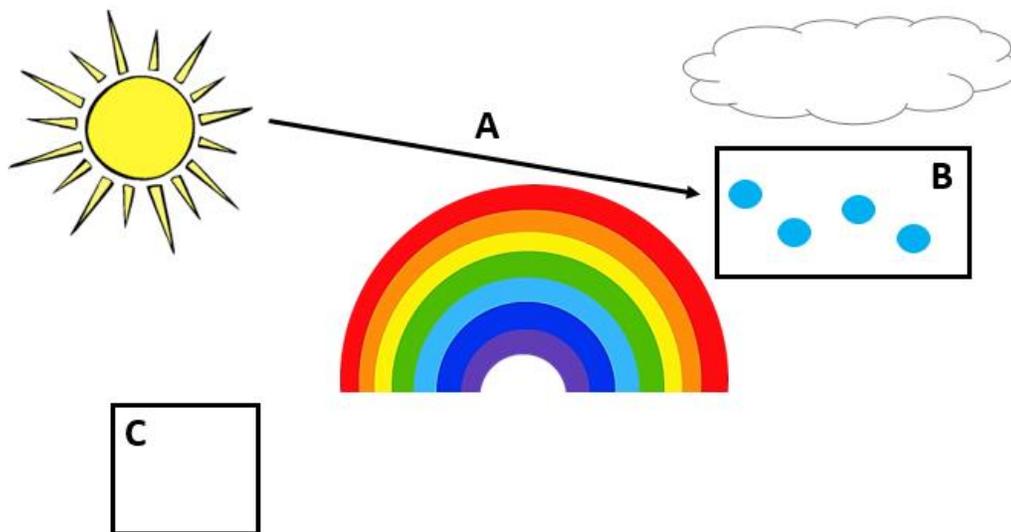
<b>Questions</b>	<b>Score (0 – 3)</b>
Did the student correctly identify the two ingredients necessary to form a rainbow (Q1)?	
Did the student demonstrate the ability to correctly identify the property of energy (Q2)?	
Did the student clearly identify the type of energy emitted from the sun (Q4a)?	
Did the student show how light reflects and refracts inside of raindrops (Q4b)?	

- 0 – Incomplete*
- 1 – Completed with incorrect answer*
- 2 – Complete with small errors*
- 3 – Complete with correct answer*

## Part 2. Rainbows 1

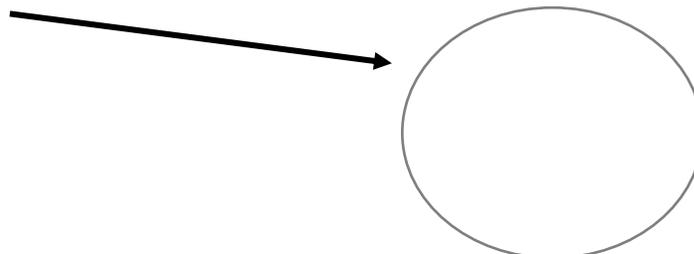
**Instructions:** Complete the following exercises on rainbows.

1. What are the two ingredients necessary to form a rainbow?  
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2. What process (transmission, reflection, etc.) occurs that causes this optical phenomenon?
3. Where should you stand if you want to see a rainbow?
4. Complete the following diagram to show how rainbows are visible to humans.



**A:** What type of electromagnetic radiation is incoming from the sun? What color is this energy?

**B:** Sketch how light moves through raindrops.



**C:** What is the third object necessary to see a rainbow? Sketch a picture in the box above.