Name: Group:

Class: Date:

Hot Air

Introduction

Light has many interesting aspects. **Refraction** is the way that light bends as it travels through different mediums. The **medium** is the substance that light is traveling through. If you are looking at the Moon while standing by a pool, the medium is air. If you are looking at the Moon from under water after you jump into the pool, the mediums are both air and water. The Moon would look differently from underwater because the light is refracted. In this experiment you are going to decide if warm air and cool air are considered to be different mediums, or if they are the same medium.

Materials

- Candle holder (modeling clay, or sticky adhesive putty)
- Candle (birthday cake size) and matches or lighter
- Laser pointer
- Binder clip
- Graph paper (8.5 x 11 inches with 1/4 inch grid size)
- Masking tape
- Cup (8 to 12 inches high) preferably non-flammable.
- Meter stick

Preparation

1. Set up a table next to a wall
2. Measure a distance of 1.10 meters (1 meter and 10 centimeters) from the wall. Mark this spot on the table on masking tape with a pen as "Cool Air".
3. Measure 1 meter from the wall. Mark this spot as "Hot Air".
4. Center the cup (overturned) on the "Cool Air" mark.

Safety Cautions: During this activity, you will work with a laser and fire.
Laser: A laser beam **directed into your eye** will permanently damage it, possibly resulting in blindness. The reflected laser light off the paper screen is harmless.
Fire: Always monitor the candle while it burns. Be prepared with a fire extinguisher.

Engage

Consider the following questions, and write down what you think.
Do you think stars twinkle in the sky? Explain.

Imagine that you are an astronaut aboard the International Space Station. The station happens to be on Earth's night-side, so Earth blocks the Sun and you can see both the Earth and space. You can see lights from cities and stars.
Which lights do you think twinkle? Explain.

Listen to or read StarDate: "High-Flying Stargazer" November 19, 2003

Explore

Safety considerations: everyone stays behind the laser, unless ONE group member is marking the laser spot on the graph paper. **Never look directly at the laser beam or allow it to shine in someone's eyes.** Monitor the candle while it is burning, and be prepared with a fire extinguisher.
Cool Air experiment: This is a control condition.
1. Place the cup at the "Cool Air" mark (1.10 meters from the screen).
2. Turn the laser on. Use the binder clip to maintain the laser pointer in the ON position.
3. Place the laser pointer on top of the cup so that it makes a spot on the wall. The laser beam should be perpendicular to the wall.
4. Think laser safety – do not turn your head toward the laser as you tape up the graph paper or mark the laser spot. Face the wall until you are well away from the beam.
5. Tape the graph paper to the wall, centered on the laser spot.
6. Using a pencil, mark the laser spot on the graph paper. Observe the laser spot on the graph paper. Record your observations in a data table.
7. Do not disturb the cup or laser. Proceed to the "Hot Air" experiment.

Hot Air experiment: This is the experimental condition.
1. Place the candle into candleholder and set it at the "Hot Air" (1-meter) mark.
2. Light the candle.
3. Allow the candle to burn for 2 minutes. Be prepared with a fire extinguisher.
4. Record your observations in a data table.
5. Blow out the candle. Turn off the laser.

Explain

Answer the following questions based on your experimental results and observations:
Cool Air experiment:
1. What did the laser spot do during the Cool Air experiment?

2. What did the laser beam travel through on it's way to the graph paper?

Hot Air experiment:
3. What did the laser spot do during the Hot Air experiment?

4. What did the laser beam travel through on it's way to the graph paper?

5. What did the candle flame do to the air above it?

Real world application:
6. Why do you think stars appear to twinkle at night, observing them from Earth's surface? Can you related this to your experiment?

Evaluate

Conclusions: Are warm air and cool air considered to be different mediums, or are they the same medium? Use evidence from your lab to backup your claim.

Elaborate:

Read the response to the StarDate frequently asked question (FAQ) “Why do stars twinkle?”

Why do stars twinkle?

Because stars are so incredibly distant, to our eyes they appear strictly as points in the night sky. Irregularities in Earth's atmosphere cause starlight to dance around, and the minute changes in the path the starlight takes through the atmosphere results in apparent changes in color — the familiar "twinkling" effect.

Planets, however, actually form a tiny but definite circle on the sky just large enough to counter the distorting effect of turbulence. Such extended objects only "twinkle" when their light passes through very large amounts of atmosphere, such as when they lie close to the horizon.

Why do you think astronomers want telescopes in space, or on the Moon?