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What Role Does Light Play Within the Vision Process? **(Using the 5-E Model)**

Purpose/rationale: The purpose of this lesson is to explain the concept of light and the role that light plays in the process of sight. Students will explore the relationships between how light makes objects visible to the eye and how white light is divided into the visible color spectrum. Students will perform various discrepant events to demonstrate the above phenomena.

SOLs:

- BIO.5 The student will investigate and understand life functions of archaebacteria, monerans (eubacteria), protists, fungi, plants, and animals, including humans. Key concepts include
e) human health issues, human anatomy, body systems, and life functions; and
- LS.3 The student will investigate and understand that living things show patterns of cellular organization. Key concepts include
b) life functions and processes of cells, tissues, organs, and systems (respiration, removal of wastes, growth, reproduction, digestion, and cellular transport).
- PS.6 The student will investigate and understand states and forms of energy and how energy is transferred and transformed. Key concepts include
c) heat, light, and sound.
- PS.9 The student will investigate and understand the nature and technological applications of light. Key concepts include
a) the wave behavior of light (reflection, refraction, diffraction, and interference);
b) images formed by lenses and mirrors; and
c) the electromagnetic spectrum.

Materials and Resources:

Flashlight	Hairspray
Laser beam	Red food coloring
Water mister/spritzer	Projector
Mirrors	Dark room
10 to 25 cm in diameter piece of cardboard	Beaker (one that mirror fits in)
Colored paint (red, orange, yellow, green, blue, violet)	White piece of paper
	Safety goggles

Colorful pieces of construction paper
Pencil, string or hand drill

Protractor

Resources:

Friedl, Alfred and Koontz, Trish. Teaching Science to Children: An Inquiry Approach, pg. 131-6, 149-153.

<http://www.glenbrook.k12.il.us/gbssci/phys/Class/refln/u1311a.html>

The Role of Light to Sight- Lesson 1: Reflection and Its Importance pg.1-4.

<http://www.spatechsoftware.com/reeko/Experiments/ExpPrism.htm>

Science Experiment-See what light is actually made of (light reflection)

DiSpezio, M., M. Linner-Luebe, M. Lisowski, B. Sparks, & G. Skoog. Science Insights: Exploring Matter and Energy, pg. 408-439.

Masterton, W. & C. Hurley. Chemistry: Principles and Reactions, p. 141.

Safety: Students should use goggles while performing the experiments since they will be working with glassware and light. Students should also use extra precaution while handling the mirrors. Teachers might even consider having students place masking tape along the edge of the mirrors to help ensure that students do not get cut from the sharp edges.

Engage: (5 minutes)

Ask students open-ended questions such as: What is light? What role does light play in the vision process? The video will go through the various explanations of what light is and the role that light plays in the vision process. There will be a brief demonstration of these particular phenomena as well.

Demo #1: **Light Beams** (10 minutes)

Turn the lights off in the room and shine a laser beam on a mirror on one side of the room. The presence of the laser beam should only be visible on the mirror where the laser beam is being shined on and on the opposite wall where the laser beam is being reflected.

If laser beam is not available then use a flashlight and shine it on your hand with the lights off

-Ask the students: Why is the light not visible between the light source and the beam being produced either on the wall or your hand (which ever demo you end up using)?

-Then take a water bottle with a mister on the end or a bottle of hairspray and mist it where the beam of light should be present. Ask the students: Once the water or hairspray is misted, what happens to the light source.

-Explain to the students that the light source is only present in two places:

- 1) mirror and flashlight
- 2) opposite wall or hand

-Sight only occurs at these two places because these two places have objects that can reflect light to our eyes.

-Once the water or hairspray is misted, the laser beam can be seen in the region between the light source and the reflection of the light source either on the opposite wall or hand due to the fact that the water droplets or hairspray droplets are able to reflect light to our eyes. It is only through the reflection of light that we are able to see objects in our everyday lives.

Explore: (10 minutes)

Continue with the video with the next explanation or do your own explanation of the different colors we see.

Demo #2: Colorless Nothingness

Allow the students to perform the following activity to prove that white light is composed various wavelengths of light producing the 7 colors of the rainbow.

Ask the students some questions such as “Is white light really colorless?” “What colors do you think make up white light?”

Allow the students to get into groups to perform the following activity:

1. Place a mirror in the glass of water at an angle (let it lean against the side of the glass)
2. Turn the glass so the mirror is facing the sun. (You could use a projector or LCD projector for an intense light source)
3. Hold the paper at a slant in front of the glass. Move the paper around until you see the rainbow colors. You may need to move the paper around slightly until the colors come into full focus.

Have the students jot down the colors that they see. Ask them where they have seen these colors before in a succession such as this. The answer would be a rainbow.

Explain: (10 minutes)

Demo #3: Color Wheel:

Explain to the children that they are seeing various wavelengths of light broken apart. Sunlight is composed of 7 different colors. Bring out the color wheel. Ask the students what colors are present on the wheel. Ask the students what should happen if you spin the wheel. Ask for a volunteer to spin the wheel. What color appears when you spin the wheel? A white color should be created from the spinning effect. Explain to the students that each of the colors is effectively “held” by the retina or the eye for a short period of time. This is called persistence of vision. These colors combine together so all in all they appear white.

Next, explain to the children how you see different colors. For example, when you look at a red object, the object is absorbing every color except red. Hence, your eye perceives the object as red.

Next either show the portion of the video on the visible portion of the electromagnetic spectrum or do your own explanation.

Elaborate: (10 minutes)

Demo #4: Two-Toned Fluid

Allow the students now to do some investigations on their own. The students will complete their activity sheet for the evaluation. Have a bottle of water prepared with red food coloring in it. Turn the classroom lights off and allow the students to shine a flashlight at the bottle from the front. The students will answer questions such as “What color is the water?” “If you shine the light from the back of the bottle, will the water appear to be the same color?” on their activity sheets. The students should then view the bottle with light shining from behind it. What color do you see now? Allow students to discuss why they think this is?

Complementary colors are any two colors that when added to each other produce white light. When the light shines through the fluid, only a reddish color is transmitted. When you shine the light from behind, the balance of colors (the complementary color) is often scattered and will appear as green.

Evaluate: (5 minutes)

Allow the students to watch the rest of the video on the sky and its colors. The evaluation will be based on the activity sheet that the students complete. Upon completion of the activity, students should understand such concept as a luminous/illuminating object, the different colors of white light, the visible portion of the electromagnetic spectrum, how the eye perceives light, and how different colors are seen. The following rubric could be used when grading the activity sheets. The overall grade will be based upon participation, recording observations, comprehension of scientific concepts, appearance/organization, and safety.

- 2) Form a hypothesis about what will happen when white light is shined into a mirror.

Demo #3:

- 1) What do you think will happen when the color wheel spins very fast?
- 2) What color should you ideally see?

Demo #4:

- 1) What color does the beaker appear when the light is shined on the front of the beaker?
- 2) What color does the beaker appear when the light is shined on the back of the beaker?

Discrepant Event:

- 1) What is one reason why the sky appears blue?
- 2) Why does the sky appear orange and red during a sunrise or sunset?

Lab Report : The Many Colors of Light

Teacher Name: **Jennifer Trent and Heather Sapp**

Student Name: _____

CATEGORY	20	15	10	5
Participation	Used time well in lab and focused attention on the experiment. Attempted all questions.	Used time pretty well. Stayed focused on the experiment most of the time. Attempted all question.	Did the lab but did not appear very interested. Focus was lost on several occasions. Did not answer all questions.	Participation was minimal OR student was hostile about participating. Did not answer questions.
Data	Wrote down what happened during the experiment. These reflect accurate results.	Wrote down what hapened during the experiment. Some results are accurate, while others are incorrect.	Wrote down incorrectly what happened during the experiment.	Did not write anything down.
Scientific Concepts	Report illustrates an accurate and thorough understanding of scientific concepts underlying the lab after the completion of the experiments.	Report illustrates an accurate understanding of most scientific concepts underlying the lab after the experiments are completed.	Report illustrates a limited understanding of scientific concepts underlying the lab after the experiments are completed.	Report illustrates inaccurate understanding of scientific concepts underlying the lab after the experiments are completed.
Appearance/Organization	Answers to questions are in complete sentences and written neatly.	Answers to questions are in fragments OR are sloppy.	Answers to the question are in fragments AND are sloppy.	Answers to questions are incomplete and sloppy.
Safety	Lab is carried out with full attention to relevant safety procedures. The set-up, experiment, and tear-down posed no safety threat to any individual.	Lab is generally carried out with attention to relevant safety procedures. The set-up, experiment, and tear-down posed no safety threat to any individual, but one safety procedure needs to be reviewed.	Lab is carried out with some attention to relevant safety procedures. The set-up, experiment, and tear-down posed no safety threat to any individual, but several safety procedures need to be reviewed.	Safety procedures were ignored and/or some aspect of the experiment posed a threat to the safety of the student or others.

Date Created: **Oct 14, 2003 03:29 pm (CDT)**