Enlightening Explorations

Summary

This lesson contains three student experiments: How Light Travels, Comparing Light Sources, and Reflective Surfaces.

Group Size

Small Groups

Materials

Several prepared shoeboxes

How Light Travels:
(for each student)

- How Light Travels worksheet (pdf)

Book on light
Bag of assorted objects: canning jar lid, foil, transparency, waxed paper, fabric, netting, square of construction paper, 3 x 5 card, penny, empty spool, plastic test tube, 1 oz. food container, clear plastic cup, etc.
Flashlight
White board or white cardstock

Comparing Light Sources:

- Comparing Light worksheet (pdf)
- Situation Cards (pdf)

Three different types of flashlights that vary in intensity and size
Laser pen
Incandescent bulb in base (will need electric outlet nearby)
Fluorescent bulb in base (also needs electric outlet)
Set of situation cards copied on cardstock and/or laminated (master included)

Reflective Surfaces:
(for each student)

- Reflective Surfaces worksheet (pdf)

Square of aluminum foil (cannot be reused)
Flashlight
Laser pen
A sample of each of the following: sandpaper, white cardstock, black construction paper, stiff plastic (CD case), metal (canning jar lid, underside of stapler), glass baby food jar, small glass container, etc.)
White board or white cardstock

Additional Resources

Books

Light! Stop Faking It! Finally Understanding Science So You Can Teach It , by William C. Robertson (NSTA Press); ISBN 0-873355-215-6
Eyewitness Science: Light , by David Burnie; ISBN 1-879431-79-3
Focus on Light , by Barbara Taylor; ISBN 0-531-17381-X

Video

Light (National Geographic, 21 minutes, $69.00, 800-368-2728); ISBN 0-7922-6812-1

Background for Teachers

Light travels so fast that it seems we see things the instant they happen. Light travels at 300,000 km per second, or 186,000 miles per second. Light travels in straight lines. When light hits an object, it can be *absorbed, reflected*, or *pass through* (transmitted). If light passes through a transparent object at an angle, it can also be *refracted*, or bent, because the speed of light slows as it passes from one transparent object to another.

All objects reflect some light, because we can see them, but objects that are smooth and hard are better at reflecting light than others. Mirrors are excellent reflectors because the surface is smooth, and light is able to bounce back. When light hits a surface, it is always reflected at the same angle it strikes the surface. The law of reflection states that the *angle of incidence equals the angle of reflection*. This is best demonstrated by throwing a ball at a smooth surface. The angle at which it hits will equal the angle at which it bounces back (45° going in equals 45° going out).

With a transparent object (air, water, clear glass) almost all light passes through. Translucent materials (wax paper, bathroom windows) allow some light to pass through while some light is reflected. Opaque materials (wood, metal) block all light and either reflect or absorb the light. As light passes from one transparent material to another at an angle (from air to water, or air to glass), the light will slow down and appear bent. This is called *refraction*. A good example of this is placing a pencil in a clear glass of water. The part of the pencil above the water appears to be broken off from the part below the water. Light shining through a glass or Pyrex® baking pan filled with water demonstrates refraction.

Intended Learning Outcomes

1. Use Science Process and Thinking Skills
2. Manifest Scientific Attitudes and Interests
3. Understand Science Concepts and Principles

Instructional Procedures

Invitation to Learn

Send one or two prepared shoeboxes (1” hole cut in the lid with *Look Here* written next to the hole; line the inside with pictures, bright paper, etc.) around the room for students to look in. Instruct students not to open the box, but only to look in. After each student has looked in the box, discuss what was seen. Most students say that there was nothing in the box. Have someone open the box, then show what is inside. Why couldn’t they see it? There was no light. We can’t see anything without light. Today we’re going to experiment to discover some of the properties of light.

Instructional Procedures

The following experiments could be used as centers in a science lab, or as whole group activities. If you have limited materials and books, centers are a great way to keep
everyone involved with minimal materials. Students rotate from center to center, working and taking notes as they complete each experiment. If using centers, care will need to be taken to ensure that each center takes about the same length of time, and that all materials are carefully returned to the kits.

If you have adequate materials and books for the whole class to do the experiments at the same time, it will be easier to explain the procedure to everyone, and then you can have a discussion at the end of each experiment to ensure that students learned what was expected in the experiment.

Prepared worksheets that teachers can run off for the light centers are included with this activity. *However, greater learning takes place when students are able to design and construct their own lab sheets instead of continually using prepared ones*. The best way to facilitate this process is to have prepared worksheets for the teacher to model and
demonstrate, and students to fill in. Discuss what should be written and show examples of good and poorly completed lab sheets to help students gain the experience necessary to construct their own

lab sheets. By the middle of the year, or after quite a few labs, students may be given a lab sheet with one or two guidelines of what they should do. By the later part of the year, students should be given blank paper or a science journal to draw and write what they have learned.
As we do the labs together at the CORE Academy, we begin with completely outlined lab sheets, then learn how to create our own lab sheets, and finally blank paper will be distributed for the last light labs.

Center Set up

For easier set up and clean up, place materials for each student in gallon-size Ziploc® bags in a bin or container for each center. It is helpful to tape a list of what is in each kit on the bag. Number the centers so students will know which worksheet to use for each center. Instructions can be taped on the outside of the bin so that everyone understands what is expected. Explain how students rotate through the centers and how much time is allowed for each center. Spend some time explaining what you are expecting them to write about in their lab write-ups. It is helpful for students to see both good and poor examples of completed lab sheets. Discuss how these examples could be made better, helping them focus on what is expected.
If this is a first time students are working at centers, stop everyone at the end of the first center and have each group share one thing they did well as a group, and one way they could improve. Repeat one or more times as needed.

Extensions

Challenge students to list as many different reflective surfaces as they can (at least 100). A section of poster paper or bulletin board can be used to compile a class list. Encourage students to look for extremely unusual surfaces.

Learners with special needs can be put into groups with others. Instruct each member of the group to help the whole group complete the task. Provide alternative options for demonstrating knowledge, such as diagrams of what was learned, instead of written work.

Family Connections

This state Web site provides interactive exploration for students and their families. Click on the Light and Color box to access the light activities.
http://www.usoe.k12.ut.us/curr/Science/core/6th/sciber6/6th/index.htm

This Web site is filled with light information, experiments, and great things for kids and families.
http://www.gomilpitas.com/homeschooling/explore/optics.htm

Assessment Plan

Use the lab sheets to assess what students do and do not understand.

Mastery	Sub-mastery	Needs improvement
- Completed the task required at the center. - Wrote and drew what happened in the experiment. - Explained in their own words what they discovered.	- Completed the task required at the center. - Included some drawings and observations of what was seen. - Somewhat explained what was discovered.	- Task was somewhat completed. - Few drawings and observations included. - Little or no explanation of what was discovered.

Authors

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