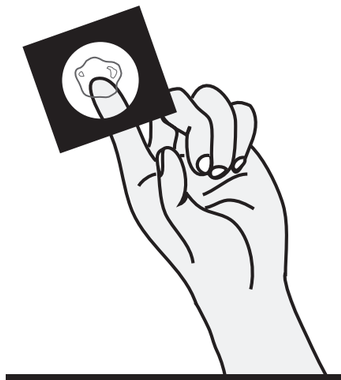
Light Through Water

Materials
(per student or team)

- water
- clear glass jar or bottle with wide mouth opening
- 1 page of newspaper or other printed material
- 1 square of cardboard, 10-12 cm wide (about 4 inches)
- clear tape (be sure to get clear rather than the frosted variety)
- drinking straw



When light is bent through a magnifying glass, it makes the objects you are looking at appear larger, or magnified. However, glass lenses aren't the only tools that can be used as magnifiers. One handy and fun tool to use as a magnifier is water. Below are two ways to use water to bend light and make objects appear larger.

Procedure

Have students do the following:

- Fill the glass bottle or jar with water.
- Hold the bottle or jar up against the newspaper page. Have students describe how the print looks through the bottle or jar. Discuss how the water in the bottle bends the light enough to make the print look larger or magnified. How many times larger does the print look?
- Put one finger into the water and see if it looks magnified. Discuss any details on their fingers the students are able to see better using water as a magnifier.
- Hold the bottles of water up to other objects around the classroom to see how they look when magnified.

Make a second type of water magnifier using the cardboard and clear tape.

- Cut a hole about the size of a quarter in the cardboard square.
- Cover the hole with clear tape.
- Use the straw as a dropper to place several drops of water on top of the clear tape.
- The water should form a small round lens on top of the tape. Place your fingertip under the hole in the cardboard to look at your fingerprint through the lens.
- Explore other objects around the classroom using this second type of water magnifier.

Resources

Find these books at your local library or bookstore:

101 Physics Tricks, by Terry Cash, 1991
175 Science Experiments to Amuse and Amaze Your Friends, by Brenda Walpole, 1988
175 More Science Experiments to Amuse and Amaze Your Friends, by Terry Cash, Steve Parker and Barbara Taylor, 1989
200 Illustrated Science Experiments for Children, by Robert J. Brown, 1987
Light, by John and Dorothy Paull, 1982
Physics for Every Kid, by Janice VanCleave, 1991
Physics for Kids: 49 Easy Experiments with Electricity and Magnetism, by Robert W. Wood, 1990
Physics for Kids: 49 Easy Experiments with Optics, by Robert W. Wood, 1990
Physics for Kids: 49 Easy Experiments with Acoustics, by Robert W. Wood, 1991
Simple Mechanics, by John and Dorothy Paull, 1982
Simple Physics Experiments with Everyday Materials, by Judy Breckenridge, 1993
Science On Wheels website: www.pacificsciencecenter.org/education/sow

Credits

Science On Wheels Staff:
Laura Hamilton, Barbara Johnson
Zeta Strickland, Catherine Valiant
Graphic Designer: Katie Dresel

© 2006 Pacific Science Center
200 Second Avenue North • Seattle, WA 98109
206-443-2001 • pacificsciencecenter.org

Printed on 100% post-consumer recycled paper.

SCIENCE On WHEELS

POW! Physics on Wheels

Dear Teacher,

Thank you for having the *Physics on Wheels* van visit your school. We hope you enjoyed investigating physics with your students during this Science On Wheels experience. This flier is intended to help continue the enthusiasm generated by our visit and extend your students' learning.

The following activities have been selected because they are straightforward, require few materials, and support state-adopted learning objectives. The one page insert is written for your students with activities you may choose to do as a class, or copy for home use.

Thank you again for having the *Physics on Wheels* van visit your classroom and remember, have fun!

~Science On Wheels Teachers

Pitch Paradox

The following activity presents an event which may appear contradictory until you discover what is vibrating to make the sound.

Materials
(for classroom demonstration)

- 8 identical glass bottles
- water
- pencil

Procedure

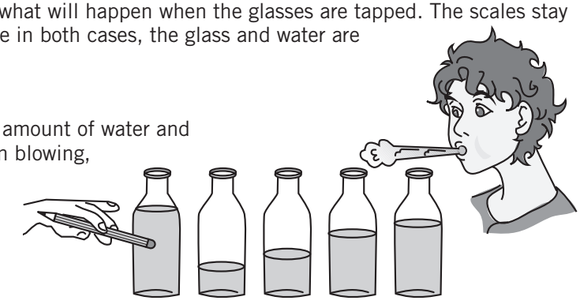
- Fill eight bottles with varying levels of water, so that a musical scale may be played when the bottle is tapped.
- Have a student come play a scale by tapping the bottles one after the other with a pencil.
- Have another student play the same song, this time blowing over the bottles. The students should notice that the scales are now reversed.

Challenge

Try this activity with eight wine glasses, this time rubbing a wet finger around the rim of the glasses while holding the glass by the base with your other hand (dipping your fingers in water decreases the friction and will make it easier to get the glasses to "sing"). Also, while rubbing your finger around the glass it is possible to see water waves produced by the vibrations. Have students make a prediction about what will happen when the glasses are tapped. The scales stay the same this time! This surprising result happens because in both cases, the glass and water are vibrating, instead of the air in the bottle.

What's going on?

What causes sound? What is the relationship between the amount of water and the sound produced? What is vibrating in each case? When blowing, the air in the bottle is vibrating; a larger column of air (i.e. an emptier bottle) produces a lower sound. When tapping the bottle, the bottle and the liquid are vibrating; a fuller bottle produces a lower sound. In each case, the larger the mass vibrating, the lower the sound!



Quiz Boards and Circuit Testers

Students will make their own quiz board and their own electric circuit tester to check their answers.

Step 1: Build a Quiz Board

Procedure

- Select a topic for the quiz board. Make a list of six questions with answers, or 6 pairs of matching items (e.g. math problems and answers, states and their capitals). Put the questions on the left side of the file folder and the answers (out of order) on the right side.
- Insert a brad to the left of each question and each answer.
- ***If you are using wire:*** On the back of the folder, use the wire to connect each question brad with the correct answer brad. Wrap the exposed wire ends around the brads. Fold the brad down flat.
- ***If you are using aluminum foil:*** Tear off 6 strips, each about an inch wide. Roll each long strip of foil to make a long wire. Wrap with a strip of paper towel and tape to secure, leaving the ends of the foil bare. This insulates the foil and prevents different strips from touching. Use the strips of foil to connect each question brad with its correct answer brad. Wrap the ends of the foil around the brad, and fold the brad flat.

Quiz Board Materials (per student)

- file folders (or a piece of cardboard)
- 12 brads (brass paper fasteners)
- 6 pieces of insulated wire (12 inches long) with one inch of insulation removed from each end (or aluminum foil and paper towels)
- tape

– continued below. . .

Step 2: Build a Circuit Tester

Procedure

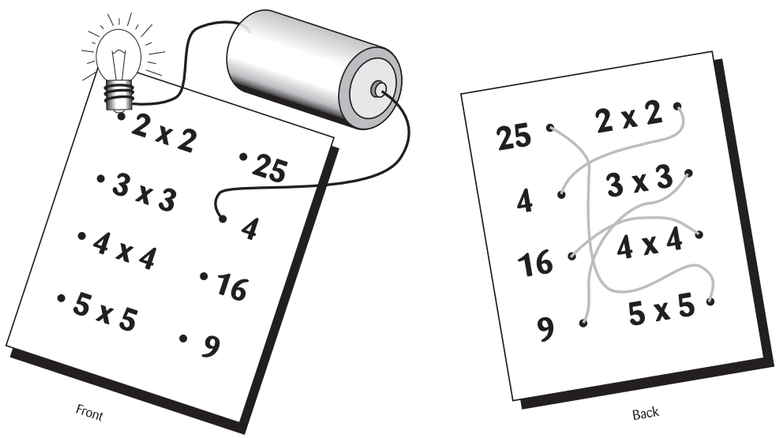
- Tape the end of one wire to the negative (-) end of the battery; wrap the other end of the wire around the metal side of the bulb, making sure it doesn't contact the bottom knob of the bulb.
- Tape the end of the second wire to the positive (+) end of the battery.
- Test the battery and bulb by holding the free end of the second wire to the base of the bulb. The bulb should light up.
- To test your quiz board, hold the base of the bulb on the brad next to a question on the board and touch the free end of the wire to the brad that has the correct answer. If the bulb lights up, your quiz board is ready! Trade quiz boards with a friend.

What's going on?

When you match the question with the right answer, you complete an electrical circuit. The electricity follows a complete path from the battery through the wires on the front and back of the board and causes the bulb to light up; this path is called a closed circuit. If the right answer is not selected or the wires are loose, the path for the electricity is broken; this is an open circuit, and the bulb won't be able to light!

Circuit Tester Materials (per student)

- battery (D cell works well)
- small flashlight bulb
- 2 pieces of insulated wire (insulation stripped from each end) or aluminum foil and paper towel (about 8 inches long)
- tape



Physics Careers

Have you ever wondered why helium-filled balloons rise? Why water boils? Or how a big, heavy airplane can fly? If you have, you were wondering about physics!

Physics is the study of energy and matter. Physicists explore the physical world and try to explain how things like light, sound, electricity and magnetism work. Physics provides us with guidelines for how the world works. This allows us to predict how things around us will behave, which, of course, is very useful. The study of physics has led to the invention of everything from the telephone and the engines in our cars, to computers and the Space Shuttle.

A physicist can study everything from the individual parts that make up an atom to the makeup of the human body. While it takes a lot of hard work in school to become a physicist, it can be very exciting!

Careers in physics require a strong background in math and science. In high school a student can prepare by taking courses such as algebra, geometry, chemistry and physics. Someone who goes to college and wants to major in physics can begin in elementary school by observing the world and asking "What would happen if?"

Once in college, a physics major takes calculus and introductory physics classes. A physics major will also take classes like thermodynamics, electromagnetic theory, mechanics and much more. Physics is an exciting science, in part because it includes so many different fields. After earning a bachelor's degree in physics, some students decide to go on to earn a master's degree or a Ph.D.

A person who earns a college degree in physics can enter a variety of career fields. Some professional physicists focus on fields like astronomy and astrophysics. They may study distant stars and galaxies, and try to discover how we can get there. Other traditional fields for physicists include electronics, geophysics and medical, nuclear or theoretical physics. A geophysicist, for example, studies our planet and the invisible forces within and around it.

As a medical physicist, you could use radiation to treat diseases of the human body, or use it to look inside the body to make a diagnosis.

Besides the traditional physics fields, there are some related fields that involve people who have studied physics. Some of these include computer science, environmental science, oceanography, aerospace engineering, civil engineering, electrical engineering or even working at the Pacific Science Center. These are all careers where physics is used to make important discoveries all the time!

Some people combine their interest in physics with other studies and enter fields such as software development, patent law, sports science, or telecommunications. Almost any field you could imagine uses knowledge of physics.

It is surprising how often knowing something about physics can come in handy. Have your class try to figure out how a knowledge of physics would help in each of the following careers or hobbies:

- violin maker
- professional athlete or coach
- sculptor
- race car driver
- movie stunt person
- tight-rope walker
- snow boarder
- bungee jumper
- special effects designer
- magician
- baton twirler
- furniture mover
- elevator operator or repair person
- bicycle designer
- police officer