Lesson 1: What is Air?

Air: A Weighty Topic

Background Information

Air is essential for life on Earth. Without air to breathe, we could not survive, but what exactly is air?

Air is all around us but it is difficult to investigate because we cannot see, taste, or touch it. With this lesson, the students will become familiar with some of the different properties of air by participating in a few simple hands-on experiments.

The students will find that even though air seems thin and light, it has weight. For example, the air inside a bus weighs as much as one of the passengers! Air is one thousand times lighter than water. This means that a bathtub full of air weighs about the same as a cupful of water. Scientists use complex and delicate instruments to measure the weight of air. This activity will allow the students to use everyday materials to weigh air.

Even though we cannot feel it, there is more than 14 pounds of air pressing on every square inch of our skin! Air pressure is a powerful force that is caused by a layer of air called the atmosphere which surrounds the earth. Air pressure is measured with an instrument called a barometer.

Objectives

After completing the lesson, the students will understand the following:

1. Air is all around us.
2. Two objects cannot occupy the same space at the same time.
3. Air is matter because it takes up space and has mass (weight).
4. Air presses down.

5. Air is fluid and takes the shape of the container it is in.

Materials Needed

1. A clear, empty squeeze bottle
2. A plastic bag
3. A plastic (watertight), shoebox-size container for each group of four students
4. One clear plastic cup per group
5. One or two paper towels per group
6. Two balloons of equal size per group
7. One wire hanger per group
8. 12 inches of thread per group
9. One ruler per group
10. One balance scale

Optional:

11. One Scientific Procedure Sheet per child

Preparation

1. Before class, fill plastic containers with water.
2. Organize group materials.

Procedure

1. Begin the lesson by going around the room and squeezing the "empty" squeeze bottle at all the students. They will jump as the air rushes out of the bottle toward them. Ask the students if the bottle is really empty and what is coming out of the bottle. The students will tell you that air was in the bottle. Show the students that the air flows back into the bottle the second you stop squeezing it. (Air is fluid.)

2. Ask the students to predict what shape air will take if you pull a plastic bag through the air. (Air takes the shape of its container.) Demonstrate that air is all around the students by pulling the plastic bag through different areas of the classroom- the closet, inside a desk or file cabinet.

3. To prove that air takes up room, each group of four students needs a plastic container filled with water plus the cup and paper towel. Each group will ball up the dry paper towel and place it securely in the bottom of the cup.

4. Ask the students to predict what will happen to the paper towel if they place the cup into the water upside down.

5. Have the groups invert the cup and hold it straight down as they slowly submerge it in the water. They will then pull it out of the water still keeping it totally vertical.

6. Have the groups remove the paper towels. They will find that the paper towels are still dry.

7. Ask why the paper towel stayed dry. Elicit that there was air taking up room in the cup along with the paper towel. The air prevented water from entering the cup, because two objects cannot be in the same place at the same time.

8. To show the effects of air pressure, have each group place a ruler on their tables so that about one third of the rulers extend over the edge. The students will tap this end gently. They will find that the rulers fall off the tables.

9. With the rulers in the same positions on the tables, the students will place a sheet of copy paper or newspaper over them. Have the students tap the rulers with the same degree of force as used the first time. This time the ruler should not fall.

10. Elicit that air was pressing on the larger surfaces of the paper and therefore the rulers as well. This pressure was greater on the papers than on the ruler by itself.

11. To demonstrate that air has weight, ask the students to predict which is heavier, an inflated balloon or an empty balloon. Many students may predict that the empty balloon is heavier, because they associate filled balloons with “floatability” in the air.

12. Demonstrate that two empty balloons are the same weight on the balance scale.

13. Have the groups use the wire hanger, thread, and two empty balloons to prove that air has weight. Do not tell them how to do it. It probably will not take long for the students to figure out how to turn the thread and hanger into a balance scale. (They can tie equal lengths of thread to each end of the hanger. Then tie the end of each thread around each tied off balloon end. To use the balance, the students can raise it by placing a pencil under the hanger hook.) After they make their balance scale, they can compare the weight of an inflated balloon and an empty balloon.
The balloon filled with air will make its side of the scale tip slightly lower because the air in the balloon has weight.

Extensions

1. The students can complete the Scientific Procedure Form for the experiments. The steps of the scientific method can be discussed.
2. The students can design their own experiments to prove each of the properties of air. The students can share their experiment procedures and results.

Sources

Glover, D., (1987). *Flying and Floating*. New York: Kingfisher Books.

Walpole, B., (1988). 175 *Science Experiments*. New York: Random House.

Weiner, E., (1992). *Dirt-Cheap Science*. New York: Scholastic.