

10. Air Pressure

OBJECTIVES: After completing this lesson, a student should be able to:

- * Define AIR PRESSURE
- * Identify the instrument that measures pressure
- * Measure BAROMETRIC PRESSURE changes (Grades 4-8)

TEACHER BACKGROUND: (Grades 1-8)

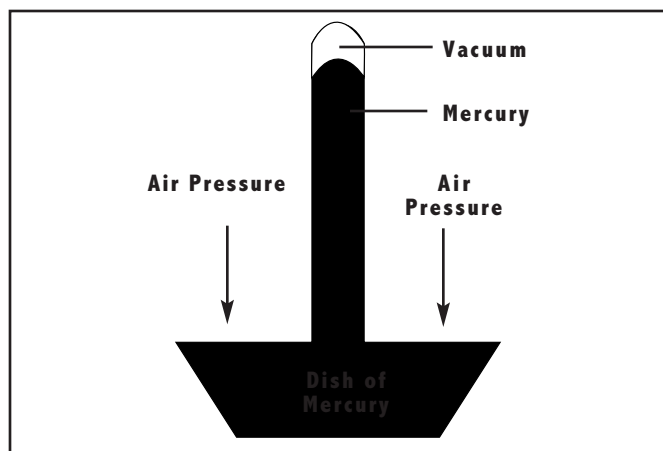
You may want to begin this lesson with a review of lesson 1, which compares the atmosphere to an ocean of water. This comparison helps to explain air pressure. AIR (OR ATMOSPHERIC) PRESSURE is the force created by the weight of the air above. Assuming you are at the bottom of the atmosphere, the weight of the air above creates a force on you much like the weight or force of water on a diver at the bottom of an ocean. Imagine the weight of approximately 400 miles of air! On the average, the atmosphere exerts a force of about 15 pounds per square inch of your body. Fortunately, air inside your body is pushing outward, which counteracts the atmospheric pressure pushing inward.

The BAROMETER is an instrument that measures changes in atmospheric pressure and does not have to be placed outdoors in order to provide accurate measurements.

Additional notes for grades 4-8:

Invented in 1643, the first barometer was a glass tube 91 cm (36") long, closed on one end. The open end was inverted and immersed into a dish of mercury. The pressure of the atmosphere at the earth's surface pushed mercury up 76 cm (30") in the glass tube. As the atmospheric pressure changed, so did the the level of mercury in the column. (See figure.) As atmospheric pressure increased its downward force, the mercury in the column was forced to a higher level. Hence the terms "high and low pressure" and "inches of mercury."

The weight of the air is greatest at the bottom of the atmosphere. If you read a barometer as you climb a mountain or rise in an elevator, you will see the pressure decrease as you get higher in



elevation.

There are two types of barometers. The one just described is called a *mercury* barometer. Mercury is more convenient than water, since the weight of the standard atmosphere would support a column of water 1034 cm (408") in height. A water barometer would be three stories tall! The second type of barometer used in most homes is the *aneroid* barometer, which contains no fluid. An aneroid barometer operates with a small metal box or cell inside. As atmospheric pressure changes, so does the size of the sensitive box. In later lessons, we will discuss areas of high and low pressure in the atmosphere, and we will learn how to use a barometer and the changes in atmospheric pressure to make a weather forecast.

Air Pressure Activity

GRADES 1-3

INTRODUCTORY: AIR EVERYWHERE

Is air present in every closed box, cabinet and drawer in the classroom? Distribute small plastic bags and ties for each student to trap air from different locations, twisting the tie around the top of the bag. To prove that air takes up space, place an object (pencil, book, etc.) on the bag. What holds it up?

ADVANCED: AIR HORN

Scoop up more air in your plastic bags used in the activity above. Obtain a *blow-out* party horn (the type that has a paper coil at the end which extends when you blow into the horn). Hold the plastic bag tightly around the neck of the party favor. One person should hold the bag and horn while another squeezes the air in the bag. What moves the paper coil?

GRADES 4-8

INTRODUCTORY: AIR UNDER WATER

Tape tissue or a paper towel to the inside of a drinking glass. Hold the glass upside down over a large bowl of water. Ask the class if the paper will get wet as you push the inverted glass into the water. Submerge the glass straight down in the water, holding it there a few seconds, then pulling it out. Is the paper wet? Why not?

ADVANCED: AIR ON YOU

Illustrate the weight of air (even though it is COMPRESSED AIR) by tying a balloon to each end of a ruler balanced on a string. Which side of the ruler weighs more? (Both balloons weigh the same.) Puncture one of the balloons with a pin. Which side of the balance is now heavier? Why? (Compressed air in the remaining balloon weighs more.)

MAKE A CLASSROOM BAROMETER (Time: 30-45 minute) GRADES 4-8

(Note: Traditional projects suggest a barometer made by covering a jar with a rubber balloon and a horizontal straw indicator to show pressure changes. This is NOT a barometer, since the rubber covering expands with changes in TEMPERATURE within the jar, not atmospheric pressure.)

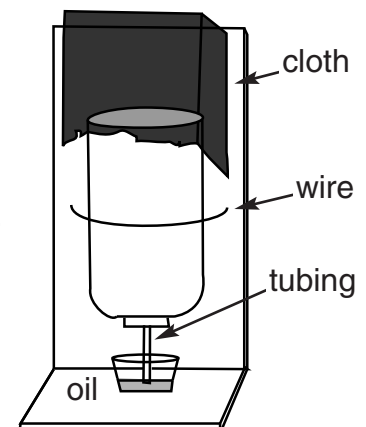
Materials: Glass jar, cloth to insulate outside of jar, rubber stopper to fit jar opening, about 15 cm (6") of plastic tubing (or a clear straw), cup, mineral oil, wire, wood, nails, optional oil-based dye to color oil

Preparation: Wrap the jar with cloth to protect it from temperature changes. Carefully push tubing (or straw) through stopper and place stopper in jar opening. Securely tie jar upside down on the wood base with wire. (The wood can be secured to a wall with screws or made into a stand.)

Procedure: Watch your Weatherschool channel for the barometric pressure to be 29.85" or lower and fill cup half full with mineral oil. Add optional dye. Place cup under inverted bottle with tubing in oil. As air pressure rises, the mineral oil will slowly rise up the tube. (It may take a couple of days.) Add oil when needed to keep tube in oil.

Evaluation: Chart the oil level for a week. How does it change with the weather?

Computer: Grades 4-8 students should obtain daily pressure measurements, use them in the computer and add them to their observation sheets.



WEATHERSCHOOL QUESTION:

TRUE OR FALSE? Air pressure is virtually the same indoors and outdoors.
Obtain the answer tonight on your Weatherschool television channel!