About Air

from The Science of Air Teacher’s Guide and for Mr. Slaptail’s Secret

Written by
Nancy P. Moreno, Ph.D.
Barbara Z. Tharp, M.S.
Judith H. Dresden, M.S.

BioEd™
Teacher Resources from the
Center for Educational Outreach at
Baylor College of Medicine

© 2010 Baylor College of Medicine. This activity is part of The Science of Air unit. The Science of Air Teacher’s Guide may be used alone or with integrated unit components. The Air unit is comprised of the guide, Mr. Slaptail’s Secret student storybook, Explorations magazine, and two supplements: The Reading Link and The Math Link. For more information on this and other educational programs, contact the Center for Educational Outreach at 713-798-8200, 800-798-8244, or visit www.bcm.edu/edoutreach.
Acknowledgments

The Science of Air educational materials, first developed as part of the My Health My World® project at Baylor College of Medicine, have benefited from the vision and expertise of scientists and educators representing a wide range of specialties. Our heartfelt appreciation goes to Michael Lieberman, M.D., Ph.D., William A. Thomson, Ph.D., and Carlos Vallbona, M.D., who have lent their support and expertise to the project.

Special acknowledgment is due to our original partners in this project, the Texas Medical Association and the American Physiological Society (APS). We especially thank Marsha Lakes Matyas, Ph.D., of APS, for her direction of field test activities and ongoing collaboration.

Several colleagues provided valuable assistance during the development of this guide. In particular, we would like to thank Zenaido Camacho, Ph.D., Cynthia Jumper, M.D., Fabiola Pineda, M.S., Ronald Sass, Ph.D., and Catheryn Whitener, M.S.

Special thanks go to the National Institute of Environmental Health Sciences, Allen Deyar, Ph.D., Frederick Tyson, Ph.D., and Liam O’Fallon for their support of the My Health My World project and the related Environment as a Context for Opportunities in Schools (ECOS) project.

We are especially grateful to the many classroom teachers in Washington, D.C., and Houston and Austin, Texas, who participated in the field tests of these materials and provided invaluable feedback.
Even though we normally can’t see it or smell it, the air that surrounds us is a chemical substance comprised of several different colorless and odorless gases (mostly nitrogen and oxygen). As in all gases, the molecules in air are distributed more or less evenly throughout any space in which they are found. When we breathe, all of the different gases in air enter and leave our lungs.

There is a lot of empty space around the molecules in gases, such as air, because they are packed much more loosely than the molecules in liquids or solids. For example, oxygen gas is about 1,000 times less dense than liquid oxygen. As anyone who has inflated a tire knows, air can be compressed, and the air inside a tire is more dense than air outside. Air also is heavy. At lower altitudes, one cubic meter of air has a mass of one kilogram.

Other gases, produced as a result of human activities, mix easily with the gases in air. Thus, the air we breathe may contain trace amounts of many different kinds of molecules.

At times, we are able to feel air currents, such as wind or the air rushing out of a balloon. Air, like any gas, will move from an area with higher pressure and density (inside the balloon) to an area with lower pressure and density (outside the balloon). Changes in temperature also will cause movement of air and other gases. In general, warmer air will rise and cooler air will sink. Movement of air masses of different temperatures is the driving force behind air currents and winds.

The atmosphere contains various types of particles, created through both natural and man-made processes. The largest particles are about the size of a grain of sand (0.5 millimeters in diameter). Some particles actually are tiny droplets of liquids, like the water particles that make up fog or mist. Others are solids. Smoke, for example, contains very tiny solid particles produced by the incomplete burning of fuel. Living organisms also contribute particles to the air. Pollen grains, mold and bacterial spores, viruses and animal dander (tiny flakes of skin) all are sources of atmospheric particles.
About Air

Physical Science

About 78% of the volume of dry air is nitrogen gas (N₂). Oxygen (O₂), the component of air required by our bodies, comprises less than one fourth of dry air. Argon, a non-reactive gas, makes up slightly less than 1% of dry air. Carbon dioxide (CO₂), a gas released from our bodies when we exhale, is present in even smaller quantities (less than one part per 1,000). Very minute amounts of many other naturally-occurring gases (such as neon, helium, methane and ammonia), as well as gases resulting from pollution, are present in air. Water vapor, when present, can occupy up to 5% of the total volume of air. When we breathe, nitrogen, oxygen and all the other components of air enter and exit our lungs.

SAFETY
Always follow district and school science laboratory safety procedures. It is good practice to have students wash hands before and after any laboratory activity. Clean work areas with disinfectant.

SETUP
You will need to pop and tint three small batches of popcorn before you begin this activity. First, pop the corn. To tint it, measure 6 cups of popcorn into a sealable plastic bag. Add a tablespoon of yellow soft drink mix and 1–3 teaspoonfuls of water. Seal the bag and shake to distribute the color. Repeat the tinting process with the red, and again with the green mix—but use only 1 cup of white popcorn with each of these colors. Ultimately, you should have 6 cups of yellow popcorn in the first bag, 1 cup of red popcorn in the second bag, and 1 cup of green popcorn in the third bag. Let the popcorn dry by spreading it on a paper towel or leaving the bags open.

When dry, put each color of popcorn in separate containers. You also will need about 22 cups of white popped corn.

As an alternative, you may use purchased popcorn. Select different flavors to represent three colors. You also can use different colored styrofoam packing peanuts or small balls of crumpled paper in different colors.

If you would like to create a larger model of air, multiply the materials by two or more.

PROCEDURE
1. Divide the students into six small groups. (If your students
are very young, you may prefer to conduct the activity as a discovery lesson with the entire class.)

2. Have the Materials Manager from each group collect a measuring cup and a sealable plastic bag. Give three groups approximately 7 cups of white popcorn each. Give 1 bag of colored popcorn to each of the remaining three groups.

3. Project a transparency of the “Let’s Measure” student sheet while you explain that each group with white popcorn will measure 5 cups of popcorn into its bag; the group with yellow popcorn will measure 4 cups; the group with red popcorn will measure 1/4 cup; and the group with green popcorn will place only one kernel in its bag.

4. When the students have finished measuring, ask one student from each group to empty the popcorn from the group’s bag into the large, clear plastic bag (which you will hold in a central location).

5. Shake the large plastic bag. Ask, What do you think I’m doing? Lead the students to understand that the popcorn is being mixed. Ask, Are the colors of popcorn arranged in a special way in the bag? Students should note that the colors are mixed randomly.

6. Have the students identify which color of popcorn is represented by the most kernels in the bag, by the second-most kernels and so on, until you mention the single kernel of green popcorn. Follow by asking students to name other kinds of mixtures (e.g., fruit salad, crayons of different colors in a container, etc.).

7. Explain that air also is a mixture, made up of different kinds of gases. The different colors of popcorn in the large bag are present in the same proportions as the different gases in air. (Some students already will know that oxygen and carbon dioxide are involved in breathing. If the class is not familiar with this information, point out that the gas we take out of air when we breathe in is known as oxygen, and the gas we release when we breathe out is carbon dioxide.) Ask students to guess which color of popcorn represents oxygen molecules (yellow) and carbon dioxide molecules (green) in air.

8. Finally, point out that air is mostly nitrogen, represented by the white popcorn. The red popcorn corresponds to argon, gases present in air, but not absorbed by the body during breathing.

**VARIATIONS**

- Make your own colored and flavored popcorn using the “Fiesta Popcorn” recipe (left sidebar).
## Let’s Measure

<table>
<thead>
<tr>
<th>Color of Popcorn</th>
<th>Cups of Popcorn</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td><img src="image1" alt="Image of cups" /></td>
</tr>
<tr>
<td>White</td>
<td><img src="image2" alt="Image of cups" /></td>
</tr>
<tr>
<td>White</td>
<td><img src="image3" alt="Image of cups" /></td>
</tr>
<tr>
<td>Yellow</td>
<td><img src="image4" alt="Image of cups" /></td>
</tr>
<tr>
<td>Red</td>
<td><img src="image5" alt="Image of cups" /></td>
</tr>
<tr>
<td>Green</td>
<td><img src="image6" alt="Image of cups" /></td>
</tr>
<tr>
<td>Color de las Palomitas</td>
<td>Tazas de Palomitas</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Blancas</td>
<td><img src="image1" alt="Blancas" /></td>
</tr>
<tr>
<td>Blancas</td>
<td><img src="image2" alt="Blancas" /></td>
</tr>
<tr>
<td>Blancas</td>
<td><img src="image3" alt="Blancas" /></td>
</tr>
<tr>
<td>Amarillas</td>
<td><img src="image4" alt="Amarillas" /></td>
</tr>
<tr>
<td>Rojas</td>
<td><img src="image5" alt="Rojas" /></td>
</tr>
<tr>
<td>Verde</td>
<td><img src="image6" alt="Verde" /></td>
</tr>
</tbody>
</table>