THE SCIENCE OF
Air

About Air

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

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The Air Around Us

Physical Science Basics

WHAT IS OZONE?

Ozone is a molecule composed of three atoms of oxygen. Two oxygen atoms form the basic oxygen molecule—the oxygen we breathe that is essential to life. The third oxygen atom in ozone can detach from the molecule and re-attach to molecules of other substances, thereby altering their chemical composition.

Ozone in the upper atmosphere helps filter out damaging UV radiation from the sun. However, ozone in the lower atmosphere—the air we breathe—can be harmful to the respiratory system.

Ozone generators sold as air cleaners disburse ozone into the surrounding room/environment. No agency of the federal government has approved these devices for use in occupied spaces because ozone at high concentrations can cause health problems, and because scientific evidence shows that ozone generators do not remove contaminants or particles from the air.

Source: EPA, www.epa.gov

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.

COMPONENTS OF DRY AIR

- Nitrogen gas (N_2) 78%
- Oxygen gas (O_2) 20%
- Argon 0.9%
- Carbon dioxide (CO_2) 0.03%
- Minute amounts of:
  - Neon
  - Krypton
  - Helium
  - Xenon
- Other substances, including pollutants

Atmospheric air may contain 0.1% to 5% water vapor (H_2O) by volume.

About Air

Physical Science

About 78% of the volume of dry air is nitrogen gas (N_2). Oxygen (O_2), 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 (CO_2), 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.

Unit Links

Mr. Slaptail's Secret
Story, pp. 6–15

Explorations
It's in the Air, p. 4

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

Continued

CONCEPTS

- Gases occupy space.
- Air is a mixture of different gases.
- Oxygen, a gas needed by the human body, is not the principal component of air.

OVERVIEW

Students will use different colors of popcorn to model the composition of air.

SCIENCE, HEALTH & MATH SKILLS

- Measuring
- Observing

TIME

Preparation: 10 minutes
Class: 20 minutes

MATERIALS

Teacher (see Setup):

- 30 cups of popped popcorn (see Setup for alternatives)
- 3 clear resealable plastic bags, 1-gal size (12 in. x 15 in.)
- Clear plastic bag, 15-gal size (or a bag from the cleaners)
- Dry soft drink mix: 2 pkgs of yellow, 1 pkg each of green and red
- Transparency of "Let's Measure" student sheet

Each group will need:

- Clear resealable plastic bag, 1-gal size (12 in. x 15 in.)
- Measuring cup, 8-oz size
- Copy of "Let's Measure" student sheet

FIESTA POPCORN

8 cups of popped popcorn

1/4 cup of sugar

6 tbs of butter

3 tbs of light corn syrup

1/4 tsp of baking soda

Food coloring

In a 2-quart saucepan, combine sugar, butter and corn syrup. Cook and stir over medium heat until mixture comes to a boil. Cook without stirring for 5 minutes. Remove from heat and stir in baking soda and food coloring. (If more than one color is desired, separate mixture into containers before adding food coloring.) Pour mixture over popcorn and stir gently to coat. Bake in a 300°F oven for 15 minutes. Stir, and then bake for 10 more minutes. Place popcorn in a large bowl to cool.

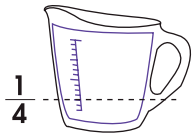
are very young, you may prefer to conduct the activity as a discovery lesson with the entire class.)

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.

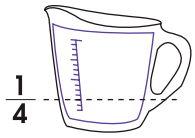
VARIATIONS

- Make your own colored and flavored popcorn using the "Fiesta Popcorn" recipe (left sidebar).

Let's Measure

Color of Popcorn	Cups of Popcorn
White	
White	
White	
Yellow	
Red	
Green	

Vamos a Medir

Color de las Palomitas	Tazas de Palomitas
Blancas	
Blancas	
Blancas	
Amarillas	
Rojas	
Verde