



Photo courtesy of the National Cancer Institute.

About Air

The Science of Air: Activity 3

Nancy Moreno, PhD.
Barbara Tharp, MS.
Judith Dresden, MS.

Center for
Educational Outreach
Baylor College of Medicine



BioEd Online

About Air

This activity's objectives are aligned with the National Science Education Standards, specifically those related to Science as Inquiry and Physical Science. About Air uses guided inquiry to teach students that air consists of varying amounts of several gases (nitrogen, oxygen, argon, and carbon dioxide), the most abundant of which is nitrogen. Students will use different colors of popcorn to model the composition of air. They will make predictions, measure, record observations, and draw conclusions based on their investigations.

Concepts

- Gases occupy space.
- Air is a mixture of different gases.
- Oxygen is needed by the body but is NOT the main component of air.

Reference

Moreno N., B. Tharp, and J. Dresden. (2011). *The Science of Air Teacher's Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-74-3. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Image Reference

Photo courtesy of the National Cancer Institute.
<https://visualsonline.cancer.gov/details.cfm?imageid=2439>

Key Words

lesson, teaching slides, lesson demonstration, physical science, air, atmosphere, air temperature, heat, gas, gases, nitrogen, oxygen, argon, carbon dioxide, ozone, molecules, air particle

About Air © Baylor College of Medicine.

Materials



BioEd Online

Materials

Teacher Materials (see Setup)

- 30 cups of popped popcorn
- 3 clear, re-sealable plastic bags, 1-gal size (12 in. x 15 in.)
- Clear plastic bag, 15-gal size (or a bag from the dry cleaner)
- Powdered soft drink mix: 2 pkgs of yellow mix, 1 pkg green, 1 pkg red
- Measuring cup, 8-oz. size
- Transparency of “Let’ s Measure” student page.

Materials per Student Group

- Clear re-sealable plastic bag, 1-gal size (12x15 in.)
- Measuring cup, 8-oz. size
- Copies of “Let’ s Measure” student sheet

Setup

1. Before the activity, you will need to tint three small batches of popcorn (or buy flavored popcorn of different colors).
2. Pop enough popcorn to have 30 cups of white popped corn.
3. To tint the popcorn, measure 6 cups of popcorn into a sealable plastic bag. Add a tablespoon of yellow soft drink mix and 1-3 tablespoonfuls of water. Seal the bag and shake to distribute the color. Let the popcorn dry by spreading it on a paper towel or leaving the bag open.

4. Following the same process, create 1 cup of red popcorn and 1 cup of green popcorn. Do not tint the remaining 22 cups of white popcorn.
5. When all the popcorn is dry, separate it as follows: 3 bags containing 7 cups of white popcorn each; 1 bag containing 6 cups of yellow popcorn; 1 bag containing 1 cup of red popcorn; and 1 bag containing 1 cup of green popcorn.

Reference

Moreno N., B. Tharp, and J. Dresden. (2011). *The Science of Air Teacher's Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-74-3. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Image Reference

Photo by Christopher Burnett © Baylor College of Medicine.

Key Words

lesson, teaching slides, lesson demonstration, physical science, air, atmosphere, air temperature, heat, gas, gases, nitrogen, oxygen, argon, carbon dioxide, ozone, molecules, air particle

About Air © Baylor College of Medicine.

Science Safety Considerations

- Follow all instructions.
- Begin investigation only when instructed.
- Do not taste or smell any substances.
- Report accidents or spills.
- Wash hands thoroughly after the investigation.



BioEd Online

Science Safety Considerations

Safety first! Students always must think about safety when conducting science investigations. This slide may be used to review safety with your class prior to beginning the activity.

Also, keep the following points in mind.

- Always follow your district school safety guidelines.
- Have a clear understanding of the investigation in advance. Practice any investigation with which you are not familiar before conducting it with the class.
- Make sure appropriate safety equipment, such as safety goggles, is available.
- Continually monitor the area where the investigation is being conducted.

Reference

1. Dean, R., M. Dean, and L. Motz. (2003). *Safety in the Elementary Science Classroom*. Arlington, VA: National Science Teachers Association.
2. Moreno N., B. Tharp, and J. Dresden. (2011). *The Science of Air Teacher's Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-74-3. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National

Institutes of Health to Baylor College of Medicine.

Key Words

lesson, teaching slides, lesson demonstration, physical science, air, atmosphere, air temperature, heat, gas, gases, nitrogen, oxygen, argon, carbon dioxide, ozone, molecules, air particle

About Air © Baylor College of Medicine.

What's In the Air?

- Have you ever wondered what is in the air around us?
- Can you name a gas molecule in air that we depend upon?
- How many kinds of gas molecules are in air?



BioEd Online

What's in the Air?

To focus students, ask, *Can we see the air in this room?* Explain that air consists of a mixture of gases we cannot always see or smell. Ask students if they can name at least one molecule in air that humans need to live. You may need to remind them that we have to inhale this molecule (oxygen). Stimulate further conversation by asking, *Besides oxygen, how many other kinds of gas molecules are in the air?* (oxygen, nitrogen, carbon dioxide, argon, methane, etc.) Or ask, *Is oxygen the only gas in air?*

Reference

Moreno N., B. Tharp, and J. Dresden. (2011). *The Science of Air Teacher's Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-74-3. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Image Reference

Photo courtesy of NASA. Public domain.

http://en.wikipedia.org/wiki/File:Top_of_Atmosphere.jpg

Key Words

lesson, teaching slides, lesson demonstration, physical science, air, atmosphere, air

temperature, heat, gas, gases, nitrogen, oxygen, argon, carbon dioxide, ozone, molecules, air particle

About Air © Baylor College of Medicine.

Let's Get Started

1. Measure the correct amount of each color popcorn into your plastic bag.
 - White: 5 cups
 - Yellow: 4 cups
 - Red: 1/4 cup
 - Green: 1 piece of popcorn
2. Pour your measured popcorn into the teacher's large plastic bag.
3. Shake the bag.



BioEd Online

Let's Get Started

In this activity, students will use different colors of popcorn to model the composition of air. They will make predictions, measure, record observations, and draw conclusions based on their investigations. Students will learn that air is a mixture of different gases – mainly nitrogen, oxygen, argon, and carbon dioxide. They also will discover that nitrogen is the most abundant gas found in air.

Divide 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.) Ask the Materials Manager from each group to collect the required materials. Give three groups each a bag containing 7 cups of white popcorn. Give 1 bag of colored popcorn to each of the remaining 3 groups (a different color for each group). Students with white popcorn should measure out 5 cups of popcorn into their group's bag. Students with yellow popcorn should measure 4 cups into their bag. Students with red popcorn should measure 1/4 cup into their bag; and students with green popcorn should place 1 popcorn kernel into their bag.

Project a transparency of the "Let's Measure" student sheet. After students have finished measuring, have them study the Let's Measure sheet. Explain that each group will mix its popcorn into a single large bag, and that students will use their worksheets to calculate how many cups of popcorn are mixed together.

Hold a large plastic bag (15-gal size) in a central location. Before students empty the popcorn from their group bags into the large plastic bag, ask them to tell the class the amount and color of popcorn they are adding. As each group pours its popcorn into the

large bag, have students complete the appropriate sections of their Let's Measure worksheets. After all the popcorn has been added, shake the large bag. Ask students, "What do you think I'm doing?" Lead them to understand that the popcorn is being mixed together.

Reference

Moreno N., B. Tharp, and J. Dresden. (2011). *The Science of Air Teacher's Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-74-3. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Image Reference

Clipart (Adjusted image color settings)

Key Words

lesson, teaching slides, lesson demonstration, physical science, air, atmosphere, air temperature, heat, gas, gases, nitrogen, oxygen, argon, carbon dioxide, ozone, molecules, air particle

About Air © Baylor College of Medicine.

Let's Talk About It

- Are the colors of popcorn in any special order arrangement?
- What are some other kinds of random mixtures?
- What color popcorn do you see the most?
- What color popcorn do you see the least?
- What gas molecule does the yellow popcorn represent?

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

My World: Air © 2005 Texas College of Medicine About Air



BioEd Online

Let's Talk About It

This activity allows students to model the composition of air using different colors of popcorn. Students will discover that air contains several different gases, including nitrogen (which makes up 78% of the air we breathe), oxygen (less than 21%), argon (slightly less than 1%), and carbon dioxide (less than 1%).

Begin a class discussion about what happened to the popcorn after it was shaken in the large plastic bag. Ask students, *Are the colors of popcorn arranged in a special order in the bag?* Students should observe that the colors are mixed randomly. To follow up, ask, *Can you think of any other kinds of mixtures?* Examples might include fruit salad, a bag of different colored marbles, chocolate chip ice cream, etc. You may want to introduce the term, “homogeneous” to describe a mixture in which the components are distributed evenly.

Next, ask students, *What color popcorn do you see the most? Second-most?* Finally, ask, *What color popcorn do you see the least?* Students should notice that white popcorn makes up most of the mixture, and that green popcorn is the least common component.

Tell students that air also is a mixture—one made of different gases—and that the different colors of popcorn in the large bag represent the various gases in air. Ask the students to guess which color of popcorn represents nitrogen molecules (white), oxygen molecules (yellow), argon molecules (red), and carbon dioxide molecules (green). You may wish to use the pie chart on the following slide to help illustrate this concept. Point out that while air is mostly nitrogen, we need the oxygen found in the air

to live. We also must exhale excess carbon dioxide from our bodies.

Reference

Moreno N., B. Tharp, and J. Dresden. (2011). *The Science of Air Teacher's Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-74-3. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Key Words

lesson, teaching slides, lesson demonstration, physical science, air, atmosphere, air temperature, heat, gas, gases, nitrogen, oxygen, argon, carbon dioxide, ozone, molecules, air particle

About Air © Baylor College of Medicine.

The Science of Air

Air is a mixture of the following gases.

- Nitrogen (N₂) 78.08%
- Oxygen (O₂) 20.95%
- Argon (Ar) 0.93%
- Carbon Dioxide (CO₂) 0.038%
- These molecules are evenly distributed throughout the air we breathe.
- Other substances (such as pollutants) easily mix with the air.

7 14.007 N Nitrogen Nitrógeno	8 15.999 O Oxygen Oxígeno
18 39.948 Ar Argon Argón	6 12.011 C Carbon Carbono



BioEd Online

The Science of Air

During this activity, students learned that air is a mixture of different gases. Air is comprised of about 78% nitrogen gas (N₂) and less than 21% oxygen (O₂). Argon is a non-reactive gas that makes up slightly less than 1% of air, while carbon dioxide (CO₂) is present in even smaller quantities (less than 1 part per 1,000).

Image Reference

Mysid. (2006). *Gas proportions in the Earth's atmosphere (modified image)*. Retrieved 07-28-2010, from http://en.wikipedia.org/wiki/File:Atmosphere_gas_proportions.svg.

Reference

Moreno N., B. Tharp, and J. Dresden. (2011). *The Science of Air Teacher's Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-74-3. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Image Reference

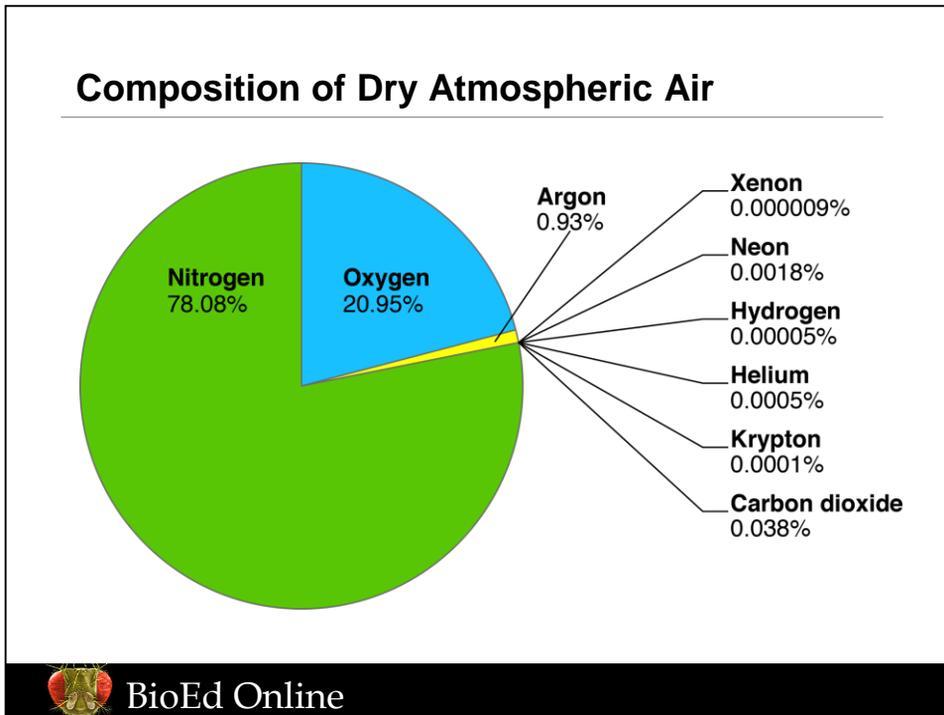
Illustration © User:Life of Riley, CC-BY-SA 3.0.
<http://commons.wikimedia.org/wiki/File:Atmosphere3.svg>

Key Words

lesson, teaching slides, lesson demonstration, physical science, air, atmosphere, air

temperature, heat, gas, gases, nitrogen, oxygen, argon, carbon dioxide, ozone, molecules, air particle

About Air © Baylor College of Medicine.



Composition of Dry Atmospheric Air

The graphic shows components of dry atmospheric air. Air also includes trace amounts of many other naturally occurring gases, such as neon, helium, methane, and ammonia, as well as gases from pollution. Water vapor can occupy up to 5% of the total volume of air.

Oxygen is needed by the body but is NOT the main component of air. When we breathe, nitrogen, oxygen and all the other components of air enter and exit our lungs. Our bodies require oxygen (O_2), and they release carbon dioxide (CO_2) when we exhale.

Reference

Moreno N., B. Tharp, and J. Dresden. (2011). *The Science of Air Teacher's Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-74-3. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Image Reference

1.Data courtesy of NASA.

<http://nssdc.gsfc.nasa.gov/planetary/factsheet/earthfact.html>

2.Graph by User: Life of Riley, CC-BY-SA 3.0.

http://en.wikipedia.org/wiki/Air_separation#mediaviewer/File:Atmosphere3

Key Words

lesson, teaching slides, lesson demonstration, physical science, air, atmosphere, air temperature, heat, gas, gases, nitrogen, oxygen, argon, carbon dioxide, ozone, molecules, air particle

About Air © Baylor College of Medicine.

Extensions

- Create a larger model of the composition of air.
- All organisms need nitrogen but few can convert nitrogen from a gas to a form that can be used by the body. Find out how plants and bacteria help us solve this problem.



BioEd Online

Extensions

Encourage students to suggest variations of the investigation. For example, they may wish to create a larger air model. To do this, multiply the materials by two or three. Students also may want to remove popcorn from the large bag using the measuring cup to determine how many cups of popcorn must be taken from the large bag before the green popcorn kernel is removed.

Reference

Moreno N., B. Tharp, and J. Dresden. (2011). *The Science of Air Teacher's Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-74-3. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Key Words

lesson, teaching slides, lesson demonstration, physical science, air, atmosphere, air temperature, heat, gas, gases, nitrogen, oxygen, argon, carbon dioxide, ozone, molecules, air particle

About Air © Baylor College of Medicine.