



## AIR ON THE RISE ENGAGE

# Balloon on a Bottle

*Students brainstorm various ways a balloon placed on a bottle's opening can be inflated. The catch is, the balloon cannot be touched.*

### For Teachers:

#### Student Learning Objectives

Students will:

- learn that air's volume changes with temperature
- learn that air can both expand and contract depending on if its temperature increases or decreases

#### Class time

- 30-45 minutes

#### Grades

- K - 4th grade

#### National Science Standards

- A: Science as Inquiry
- D: Earth Science

#### **What you'll need:**

- one clear glass bottle, 1 liter or more in size
- a large round-shaped balloon to place on the bottle opening
- hot water heated in a large kettle, pan, or coffee urn
- "Magic" wand (optional)

#### **Preparation to Directions:**

1. Begin the activity by telling students that you need their help solving a problem you've been presented with. Show them the large glass bottle with a balloon on it. Tell them that someone gave you a challenge: to blow up the balloon without touching it in any way.
2. Ask the students if this can be done and if they have any ideas as to how? Solicit and encourage their input by telling them you are willing to try just about anything to succeed in answering this challenge correctly.
3. Equate student responses with particular fields of science. For example, if they say "mix baking soda and vinegar," then tell them that there's no way at this point to get that into the bottle but that they are thinking like a chemist, which is a smart way to think! If someone suggests putting a hole in the bottle with glass cutters, tell them they might be a future engineer as that is the type of solution that they might come up with.... Should some suggest placing the bottle in a heat source, tell them that they are thinking like a meteorologist or physicist, someone who studies how air moves.
4. If a student fails to come up with the suggestion to heat the bottle, tell the students that you have been wondering about hot air balloons. What causes a hot air balloon to rise? Tell them, that you would like to see if the methods used to get a hot air balloon to rise will work with your balloon on the bottle.

#### **Directions:**

1. Place the bottle into the hot water source so that all students can observe any results. Wait briefly until the balloon begins to inflate. It is likely that many students will be surprised.
2. Ask the students if you added anything to the bottle or if there was something in the bottle all along?
3. Ask the students if the same thing that happened to the balloon happens to them when they take a hot bath? Why do they think this experiment doesn't work on them like it does on a balloon? Accept all answers and tell them that that can be an extension lesson.
4. Explain to the students that air can be a bit of a mystery to many people because it is invisible. What seems like magic, can actually be explained using knowledge about science and how a fluid like air and water behave when heated.
5. Use the applets on Spark's **Web Weather for Kids** website (<http://eo.ucar.edu/webweather/basic.html>) under *Weather Ingredients -- Temperature, Volume* to illustrate how molecules of air behave differently when they are heated or cooled, and how the temperature of the air relates to its volume. If web access is not available or in addition to the web activity, try the kinesthetic activity that follows.

## Kinesthetic Engagement

1. Tell the students that you know a way that they can actually see air. Using your magic wand, you can turn everyone's fingers into the particles of air comprised mostly of nitrogen, oxygen and few other trace gases. On the count of three, tell them to clap their hands and the magic will occur.
2. Most of the students' hands will remain together following the clap. Exclaim that their air is cold air: hardly moving and more closely compact than warmer air in the room. Tell the students that if cold air could talk, it would say, "I don't need much room," and encourage the class to repeat the refrain.
3. With your own fingers and hands, show the students how warm, warmer and hot air behaves. Start moving your fingers and hands quicker and quicker, and use more space as your fingers move rapidly. Tell your class that if warm and hot air could talk, it would say, "I need more room!" Ask the students to demonstrate the motion of warm air, hot air, and cold air and to exclaim what that temperature of air would say if it could talk. How does temperature impact the motion of air?
4. Turn the students' "air" back into fingers. To have students explore properties of air further using the Spark activity, ***Bubbles on Bottles***.

## Reflection and Assessment

Ask the students the following questions:

1. What caused the balloon to grow in size?
2. What will happen to the balloon once it and the bottle are removed from the hot water? How long do you think it will take? Why?

## Avoiding Misconceptions

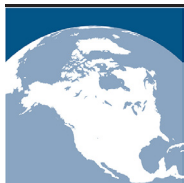
It is possible that many or a few students will tell you that the balloon blows up because hot air rises, however, the balloon inflates primarily as a result of its greater volume as it is heated. To illustrate these to students, turn the balloon and bottle upside down while it is inflated. The balloon will remain inflated. Hot air will only rise in the presence of cooler air next to it. On a hot day, for example, the air can be very still.

## Background Information

Volume refers to the amount of space occupied by a substance or object, such as air. When air is heated, its volume increases as particles move faster and faster. When air is cooled, its motion slows and its volume decreases resulting in an increase in its density (the mass per unit volume of an object). The formula that scientists and others use to determine the volume of a substance is:  $\text{Volume} = \text{Mass} \times \text{Density}$

## Related Web Pages for Students

- <http://eo.ucar.edu/webweather/>
- <http://eo.ucar.edu/kids/sky/index.htm>
- <http://www.ucar.edu/learn>
- <http://spark.ucar.edu>



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