



Activity Description and Estimated Class Time

This three-part activity takes about three class periods. The goal of the activity is for students to understand some important properties of air that contribute to weather, including high and low pressure systems.

Objectives

Students will develop an understanding of the following ideas and content:

- Air has weight.
- Large volumes of air with the same characteristics form high and low pressure systems.
- High pressure systems have cool, dry, falling air.
- Low pressure systems have warm, moist, rising air.

Correlations to North Carolina Science Standards

7.E.1.1 Compare the composition, properties and structure of Earth’s atmosphere to include mixtures of gases and differences in temperature and pressure within layers.

7.E.1.3 Explain the relationship between the movement of air masses, high and low pressure systems, and frontal boundaries to storms (including thunderstorms, hurricanes, and tornadoes) and other weather conditions that may result.

Brief Science Background

Air pressure is the weight of the column of air above us, going all the way out to space. At sea level, that column of air just 1 inch by 1 inch across weighs more than 14½ pounds. Because air pressure pushes on all sides at once, it balances out so that we don’t feel it. We feel it only when it changes. When it changes, the pressure inside and outside of us briefly becomes imbalanced. For example, our ears pop when we go up in an airplane because the pressure outside is briefly a little less than the pressure inside. The amount of water vapor in the air column and its temperature affect its weight, and this affects the air pressure. Warm moist air has low pressure and rises up. Cool dry air has high pressure and falls toward the earth. For example, a large volume of air over a whole state often has a consistent pressure, low or high. At its center is a low or high “pressure center.”

Part 1 – Air Has Weight (20 minutes)

Materials

Materials for the whole class

- Digital scale
- Glass bottle
- Vacuum stopper and pump



Procedure

Exploration – 5 minutes

1. Ask students to share what they think they know about air? **Accept all answers.**
Explorations are intended for students to engage with materials and concepts, ask questions, and share what they notice. Avoid teaching content in an exploration, even during discussions.

Activity – 20 minutes

1. This activity is a teacher-lead demonstration.
2. Show the class the empty glass bottle and ask them what they think is in it. Accept whatever they say and explain that we are going to test whether there is anything in the bottle. Show them the vacuum stopper and pump and explain that they are used to remove air from opened and partially-used bottles of wine to preserve the wine.
3. Tare the scale so that it reads 0.0 grams. Push the vacuum stopper into the mouth of the glass bottle and place them on the digital scale to weigh them both together. Write this weight for all to see, or project the reading with a document camera so that the whole class can see it.
4. Take the bottle off the scale and pump it 25 times. Keep the pump firmly pressed to the vacuum stopper as you pull. It should get more difficult to pull as you get closer to 25 pumps.
5. Place the bottle on the digital scale again. Record this number for the class to see. **The weight usually decreases by .4 - .5 grams.**
6. Ask the class what they think accounts for the bottle losing weight. Again, ask the class if they think there was anything in the bottle when you first showed it to them. **If there was nothing in the bottle before you pumped on it, how could it weigh less after you pumped it?**
7. Ask students to describe what they think air is made of. Explain that air is a mixture of gases – nitrogen, oxygen, and carbon dioxide. Each of these is matter and has weight. Explain that a 1-inch square of air above us going all the way to space weighs a little more than 14 pounds.

Part 2 – Keep the Cotton Dry (50 minutes)

Materials

Materials for the whole class

- Transparent tape (each pair of students will be allowed 1” of tape)

Materials for groups of 2 students**1 of each:**

- 9 oz. tall plastic cup, 3/4 full of water
- small rubber band (#8)
- 1 oz. plastic cup
- cotton ball

**Procedure**

- popsicle stick
- 1" of transparent tape

1. Inform the class that they will take part in an engineering design challenge.
2. Explain the challenge. You and a partner will have only the following items: a small rubber band, 1 oz. plastic cup, a cotton ball, a Popsicle stick, and 1 inch of transparent tape. **Hold each item for the class to see.** Using only these items, you and your partner must submerge the cotton ball into the 9oz. cup of water and remove it without the cotton ball getting wet. The cotton ball must remain completely dry after being submerged.
3. Go over the design process: **Plan, Test, Evaluate, and Repeat.**
4. **Plan.** Allow students access to the items without the cup of water and have them design a plan in their notebook.
5. **Test.** After you approve their plan, allow time and materials to test it. Provide 9oz. cups $\frac{3}{4}$ full of water. **This allows you to see what they are thinking. Do not advise them at this point even if you know their plan won't work.**
6. **Evaluate.** How did your plan work? If it was successful, explain what you did and why it was successful. If not, how did your plan fail? Design a new plan.
7. **Repeat.** Allow students several opportunities to retry the challenge. Provide dry cotton balls as needed.
8. After most teams have been successful, clean up. All items can be discarded or recycled. The 9oz. cups should be reused for future classes.

To keep the cotton ball dry, the cotton ball should be stuck to the bottom of the 1oz cup with a loop of tape. The 1 oz cup needs to be turned upside down and placed into the 9 oz cup. The popsicle stick and rubber band create a "handle" to submerge the cup into the water.





Content Wrap-Up and Discussion

1. Ask students to share what they did and what they discovered.
2. Remind students that during part 1 of this activity we learned that air has mass. From this challenge what are other properties of air?

Students should mention that air takes up space and can push the water down (apply pressure).

Extension

1. Using a successful setup, ask the class what would happen if you poked a hole into the bottom of the 1oz cup before you submerged it?
2. After students have shared their ideas, poke a hole using a push pin and test.
3. Students will notice bubbles escaping the cup as it is submerged. Ask students to describe why that happened. **The air escaped through the hole, causing bubbles. When the air had bubbled out, the water was able to come into the cup and get the cotton wet.**

The Rise and Fall of Raisins! (40 minutes)

Materials

Materials for the whole class

- Ability to project: <https://weather.com/maps/currentusweather>
- *Clear, non-diet soda such as Sprite or 7up. Each class will require 2 liters of soda.

*supplied by teacher

Materials for groups of 4 students

- 9 oz. tall plastic cup, 3/4 full of clear soda
- 1 raisin cut into 3 or 4 pieces
- 1 scissors

Procedure

1. Ask students to remind you of properties of air they have learned so far. **Air has mass, air takes up space and can create pressure.**
2. Hand each group of 4 a 9oz cup $\frac{3}{4}$ full of clear soda, a raisin and a scissors.
3. Tell students to cut their raisin into 3 or 4 pieces and drop them in the soda.
4. Ask students to observe the raisin and, in their notebook, record all of their observations.

Students will notice the raisin will rise and fall. As small bubbles attach themselves to the raisin it rises, then some of the bubbles pop and it falls. This process will repeat.

**Content Wrap-Up
and Discussion**

1. Ask students to describe what they see.
2. Explain to students that this is a model of how pockets of air behave. Air is moving around at all times, sometimes it rises and sometimes it falls. Air that is more dense (like the raisin with fewer bubbles) falls. As air picks up a gas that is lighter in weight (like the bubbles), it becomes less dense and rises. In the atmosphere, the lighter weight gas that acts like the bubbles is water vapor.
3. Project the current weather map:
<https://weather.com/maps/currentusweather>
4. Ask students if they know what the “L” and “H” on the current weather map indicate. Remind students of the High pressure and Low pressure systems that were introduced during the Weather Log activity. Inform them that large pockets of air take on similar pressure and are called high pressure and low pressure systems.
Low pressure systems have air that is rising, air that is warmer, and air that is more moist.
High pressure systems have air that is falling, air that is cooler, and air that is more dry.
5. Inform students this will be important as they begin to read weather maps and prepare a weather forecast during the next activity, *Understanding and Predicting Weather*.