

Filling Flask

Kitchen Table Demonstration

The Rundown

Time: 5 minutes-10 minutes

Content: Pressure, Gas Laws

Safety Concerns: Minimal

Materials Availability: Common

Atmospheric pressure is all around us. However, we hardly notice its force on our bodies. The following demonstration will allow students to “see” atmospheric pressure and appreciate the force it exerts upon objects.



Content Application

- Atmospheric Pressure
- Forces
- Gas Laws



Enduring Understandings

- Pressure is the force per unit area applied to an object in the direction perpendicular to its surface.
- Atmospheric pressure may vary, but it is generally measured to be around 14.7 psi at sea level.
- The pressure of a gas is directly proportional to its temperature if volume is constant.
- Forces on objects determine if and when they move.



Chemistry

Pressure is the force per unit area applied to an object in the direction perpendicular to its surface. It is often expressed in units of atmospheres (atm), pascals (Pa), millimeters of mercury (mm Hg), bars (bar), or pounds per square inch (psi). A gas exerts pressure when its molecules forcefully collide with the walls of its container.



Atmospheric pressure is the force exerted over a surface area created by the weight of the air above it. At sea level, atmospheric pressure equals around 14.6 psi. This pressure decreases with altitude as the air becomes thinner with distance from the surface of the Earth.

When a small amount of water is heated in the bottom of a flask with a narrow opening, some of the water soon becomes vapor that expands to fill the entire volume of the flask. If the flask is quickly inverted in a beaker of cool water, this vapor rapidly evacuates the flask, resulting in a partial vacuum. At this point, the air pressure within the flask is no longer balanced with the atmospheric pressure. This causes water to be pushed into the flask by the atmosphere.



Materials

- Small (~125 mL) flask
- Stopper with hole and glass tube through it
- Burner hose
- Heat source (hot plate or Bunsen Burner)
- Beaker with water
- Heat resistant gloves or tongs



Figure 1. Flask with stopper, glass tubing, and burner tubing



Safety

- Goggles
- Be sure that rubber hose is pointed away from individuals when steam is released.
- Ensure that stopper stays in the top of the flask when it is inverted.



Procedure

It's best to have several flasks available to repeat the demonstration. If using a hot plate, start heating the water in the flask(s) several minutes before the demonstration to save time.



Figure 2. Flask is filled with water from beaker

1. Prepare a stopper assembly (Figure 1) made up of a small piece of glass tubing going through a stopper with a piece of rubber burner hose at the end.
2. Fill the flask with slightly more water than it takes to cover the bottom of the flask.
3. Cover the top of the flask with the stopper, ensuring that it will not fall off when the flask is inverted.
4. Heat the flask. Make sure that the hose is not pointed directly at anyone.
5. Wait for 10 seconds after steam is initially seen coming from the burner hose. Invert the burner hose in a beaker of cold water as shown in Figure 2.
6. Wait for the flask to fill up with water from the beaker.



Disposal

- No special disposal procedure needed.



Follow-Up and Student Participation

This demonstration can be done quickly by a teacher in front of the class. It is probably not feasible to have students complete the demonstration on their own. However, it could be completed in medium-sized lab groups if multiple stopper/hose assemblies are made and several heat sources are available.

This demonstration works well in conjunction with the “Egg in a Flask” and “Crushing Can” demonstrations presented in this manual.

Try the following follow-up activities:

1. Respond to the following prompt using complete sentences:

People often think of suction as an attractive force, but it is not. Explain.

2. Students draw a diagram depicting the kinetic energy and volume of the gas inside the flask at various stages of the demonstration.
3. Present additional pressure-related demos using a bell jar and vacuum pump including:
 - Expanding a marshmallow
 - Expanding a rubber glove with warm air inside
 - Boiling water at room temperature