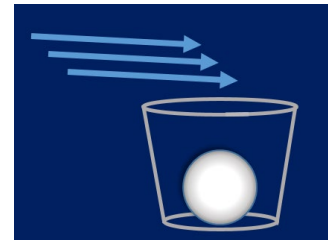


## Air and Water – The Pressure Is On!

**Overview:** Bernoulli's Principle addresses the behavior of fluids (liquids and gases) as they flow at different speeds and create differential pressure zones that allow aircraft to take off and remain airborne. Faster-moving fluids generate low-pressure zones. Heating and cooling also changes the air pressure as gases expand to fill available space in a closed container. Students will participate in several interactive demonstrations of these principles.

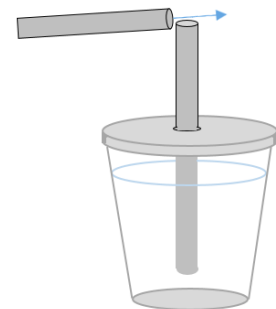
### Activity A: Bernoulli Ball

1. Demonstrate this first and then allow students to try it.
2. Place a ping pong ball in a plastic cup.
3. Ask the students to predict how to get the ball out of the cup without touching the table, the ball or the cup.
4. (If there is time) Have the students try a few of the ideas.
5. Gently blow across the top of the cup with the ball in it (see diagram).
6. The ball should jump out of the cup. This is because the air pressure moving across the top of the cup is lower than the pressure inside the cup. The higher pressure inside the cup forces the ping pong ball to jump out of the cup.



### Activity B: Bernoulli's Water Gun

1. Demonstrate this first and then allow students to try it.
2. In one hand, hold a cup filled with water, with a lid holding another straw upright in the water. In the other hand, hold one half-straw to act as a "blower."
3. Ask the students to predict what will happen if you blow across the top of one straw in the water with the other straw.
4. Blow hard through the half straw, angled slightly up, across the top of the straw in the cup (see diagram).
5. Expect the water to rise up in the first straw and blow across the table. This happens because the air blowing across the straw in the cup reduces the air pressure at that point. The normal pressure underneath pulls the water up the straw and the moving air blows the water out and across the room. *Warning: if people are standing in the blast radius, they will get wet!*



**NOTE: Experience has shown that not all people can do this easily. You should practice both activities yourself until you get the hang of them!**

### Activity C: Homemade Thermometer\*

1. Demonstrate this first, and then allow students to try it.
2. Show the students your homemade thermometer (see instructions that follow). Have them observe the level of water in the straw. *Water inside straw should be at or near the same level as the water in the bottle.*
3. Without squeezing, place one or both hands on the top half of the bottle. Students should observe the level of water in the straw rising up an inch or two.
4. Point a hair dryer (on low setting) at the top half of the bottle. Students should observe the level of water in the straw rise dramatically. *There is a good chance the water will completely fill the straw and overflow. Be prepared to do some mop-up.*
5. Place a frozen cold pack on the top half of the bottle (without squeezing). Students should observe the level of water in the straw drop below the level of the water in the bottle. *There is a good chance the water in the bottle will start bubbling.*
6. Review how heating and cooling cause atoms to become excited and spread out: heat expands, cold contracts. As the air in the bottle is heated and cooled, air pressure in the bottle rises and falls, so air is expelled or drawn in from outside, which causes the water to rise and fall.

#### Setting up the homemade thermometer:

1. Peel the label off a 16-oz water bottle (or equivalent). NOTE: A rigid bottle is better than one that is extremely flexible, to prevent inadvertent squeezing.
2. Drill a small hole in the bottle cap, just large enough for a clear drinking straw.
3. Thread the straw through the hole. NOTE: Make sure the straw does NOT touch the bottom of the bottle.
4. Seal any gaps between the straw and the bottle cap with glue or putty. Seal must be airtight for demonstration to work.
5. Fill the bottle halfway with water. Add a few drops of food coloring to make it easier to see the water level.
6. Place the cap on the bottle, screwing it down tightly. If necessary, wrap with electrical tape to form an airtight seal. (See diagram.)

