# How-To Guide: Air Pressure Demonstrations

## Demonstration #1: Collapsing Can

This demonstration will show how rapid pressure changes can crush a can instantaneously. The total time for this demonstration is about 20-30 minutes.

**MATERIALS NEEDED**

- Large container or bowl
- Empty aluminum can (12 oz.)
- Ice
- Water
- Hot plate (or electric cook top)
- Pair of tongs

### Step 1

Fill the large container with cold water and ice and set aside.

### Step 2

Add 1 to 2 tablespoons of water to the can and place the aluminum can on the hot plate or cook top. Heat the can until the water is boiling. You will see steam escaping from the can when it is ready, let it continue to boil for 15-30 more seconds.

*Caution:* Do not heat the can when it is empty. The heat may melt the ink on the can or the aluminum itself.

### Step 3

Using the tongs, grasp the can and quickly dunk it in the bowl of ice water. Make sure to dunk it with the opening face down into the water.

### What Caused the Can to Crush?

Forces, like wind, always go from high pressure to low pressure!

When the water in the can began to boil, the water vapor (steam) pushed air out of the can. Then when you dunked the can quickly into the cold water, all of the water vapor (steam) cooled and condensed back to liquid water. When the vapor condensed, it created a partial vacuum (extremely low pressure) and allowed the higher air pressure outside of the can to crush it.

MRCC Midwestern Regional Climate Center

http://mrcc.isws.illinois.edu
mrcc@isws.illinois.edu
217-244-8226

***Warning:*** *The air pressure demonstrations require the use of a heating source like a hot plate or a stove burner and matches or a lighter. Children should not perform this experiment without adult supervision.*

# How-To Guide: Air Pressure Demonstrations

## Demonstration #2: Egg in a Bottle

This demonstration will show the relationship between temperature and pressure by fitting a hardboiled egg into a flask and getting it out again without breaking the egg. The total time for this demonstration is about 20-30 minutes.

**MATERIALS NEEDED**

- Flask (1000 mL) *(or any bottle with an opening just too small for an egg to fit)*
- 1 egg
- Small pot
- Water
- Stovetop
- Lighter *(or matches)*
- Paper

### Step 1

Hard-boil the egg by placing it in a pot of cool water and bring the water to a rolling boil. Remove the pot from the heat and let sit for 10-15 minutes. Cool the egg further by placing it in cold water for an additional 5 minutes.


### Step 2

Peel the shell off the egg.

### Step 3

Place the egg on the flask to show that it does not fit into the flask. Then remove the egg.

### Step 4

Fold up a small piece of paper so that it will fit into the flask. Light it on fire and drop it into the flask.

### Step 5

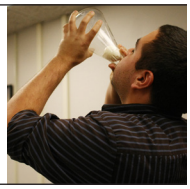
Quickly place the egg onto the mouth of the flask. Observe what happens.

### Step 6

Pour water into the flask to wash the ashes out of the flask and off the egg. Pour the water and ashes out.

### Step 7

Turn the flask upside-down so that the egg plugs up the mouth. Blow hard into the flask, with it nearly upside down. Observe what happens.



### Why was the egg forced into and out of the flask?

The egg will always go from high pressure to low pressure, just like the wind!

When the piece of paper is set on fire and dropped into the flask, it begins to heat the air. The heated air molecules spread out (some leave the flask). Once the egg is placed on the opening of the flask and the fire goes out, the air molecules cool and move closer together. This creates lower pressure inside the flask. Air with higher pressure from the outside attempts to get in the flask but cannot because the egg is blocking the opening – therefore, the egg is forced into the flask.

To get the egg out, blowing into the flask introduces more air molecules, creating higher pressure inside the flask than outside. The egg is then forced out of the flask in an attempt to even out the air pressure, the same reason it was forced into the flask.

***Warning:*** *The air pressure demonstrations require the use of a heating source like a hot plate or a stove burner and matches or a lighter. Children should not perform this experiment without adult supervision.*

# How-To Guide: Greenhouse Effect Demonstration

This demonstration will show the effect that increased carbon dioxide has on atmospheric temperature. The total time for this demonstration is about one hour.

**MATERIALS NEEDED**

- 2 clear 2-liter soda bottles (remove the label, bottle cap, and rinse it out)
- Water
- Duct tape *(alternative: clay)*
- Scissors
- 2 glass thermometers *(alternative: digital thermometer probes)*
- 2-4 seltzer tablets
- Tabletop lamp *(at least 100W bulb)*
- Timer

## Step 1

Partially fill both bottles with water.

## Step 2

Cover the top of one bottle with the duct tape and poke a small hole through the top with scissors (have an adult help you). Then, put the thermometer through the hole. *Alternatives would be to secure the thermometer using clay or using digital thermometers probes instead of glass thermometers.*

## Step 3

Drop the seltzer tablets in the second bottle. Cover immediately using one of the options above to secure the second thermometer in the top of the second bottle.

## Step 4

Record the temperature of each bottle immediately. Measuring the temperature immediately after adding the seltzer tables eliminates the possibility that adding seltzer adds heat somehow.

## Step 5

Turn the high-wattage lamp on, making sure that the light is shining *directly* and *evenly* on both bottles.

## Step 6

Observe and record the temperature of each bottle every 20 minutes (using the timer) for the next hour.

## At the end of the hour, which bottle is showing a higher temperature?

What does this mean for the effect that carbon dioxide has on atmospheric temperature?

How does this activity demonstrate the greenhouse effect that naturally occurs in Earth's atmosphere?

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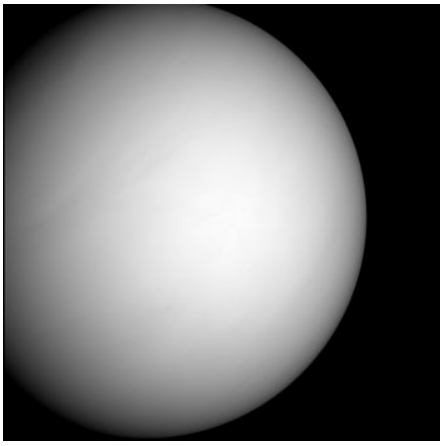
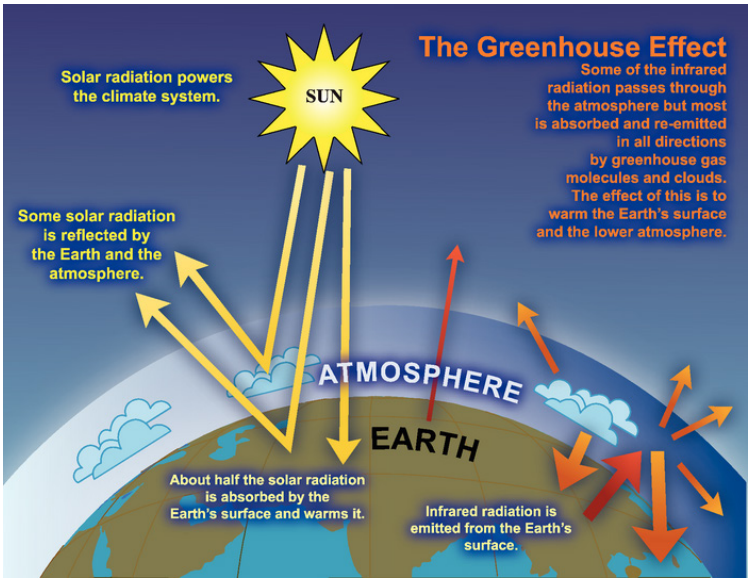
# Greenhouse Effect



## Fun Fact

To see the full effect of the greenhouse effect, look at the planet Venus. The atmosphere of Venus consists of 96% carbon dioxide, 3.5% nitrogen, with the remaining amount, less than 1%, of other gases. The carbon dioxide atmosphere has allowed the temperature of the surface to exceed 900°F (482°C). This is hot enough to melt lead. Spacecraft that has successfully landed on Venus, despite being well protected, have lasted only about an hour in the excessive heat and crushing pressure.

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**Sources**

Learning Lesson: It's a Gas, Man from National Weather Service's JetStream Online School for Weather (www.srh.noaa.gov/jetstream/atmos/ll_gas.htm)

Climate Literacy and Energy Awareness Network (http://cleanet.org/clean/community/activities/c2.html)