# Air Pressure

## Recommended for Grades K-6

There is air surrounding us everywhere. You can't see the air, but you can feel it when the wind blows, and see it pushing the leaves around. The air is made of small particles called **molecules** that we cannot see. Even though we cannot see them, they still take up space and have weight.

**TRY THIS:** Take a deep breath and feel the air going into your nose. Did your chest move?

We don't think about it, but we are living at the bottom of a large pool of air that surrounds the entire earth. This large pool of air is called ***the atmosphere***. The atmosphere is nearly 80 miles thick. Have you ever swum to the bottom of the swimming pool and felt the water push on your ears? The pool of air we live in is also pushing on us, but we are so used to it we don't even notice.

The weight of the air pushing on us is called ***air pressure*** and it is the equivalent of about 15 pounds weighing on every square inch of us. The big turkey you had at Thanksgiving weighed about 15 pounds and a square inch is about the size of a stamp. That is a lot of weight pushing on us! Luckily the air inside us is also pushing out, so we aren't squashed.

Let's try some experiments to see what all that air pressure does and some ways we can change it.

***Thank you to the WIN Chapter at Oak Ridge National Lab, Tennessee for lesson plan development.***

# HERE ARE THE ACTIVITIES WE'LL DO AS WE INVESTIGATE AIR PRESSURE:

## AIR IS ALL AROUND US:

- The Magic Cup of Water
- Water in a Tube

## MORE AND LESS AIR PRESSURE:

- Marshmallow Face
- The Water Fountain

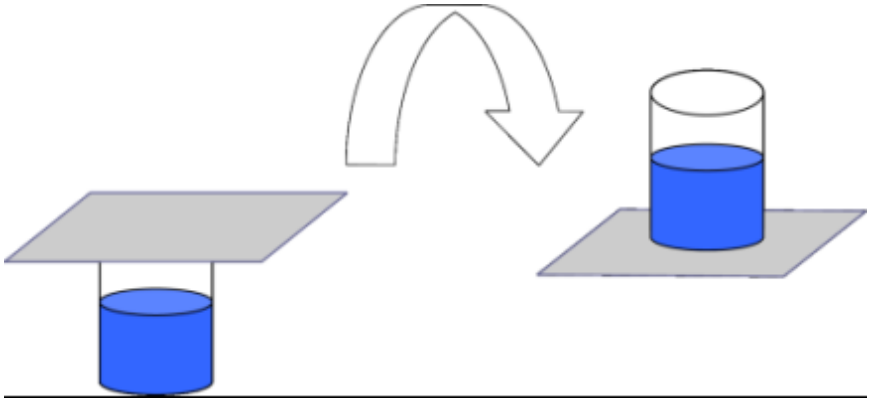
## HEATING AND COOLING AIR:

- The Inflating Balloon
- The Collapsing Bottle

# THINGS YOU WILL NEED:

1. Plastic cup
2. Index card
3. Plastic tubing
4. Tea bag
5. Mason jar
6. Marshmallow
7. Drinking straw
8. Piece of clay
9. Balloon
10. Water
11. Plastic bottle

# Air is All Around Us
# The Magic Glass of Water



## YOU WILL NEED:

- A plastic cup
- An index card
- Water

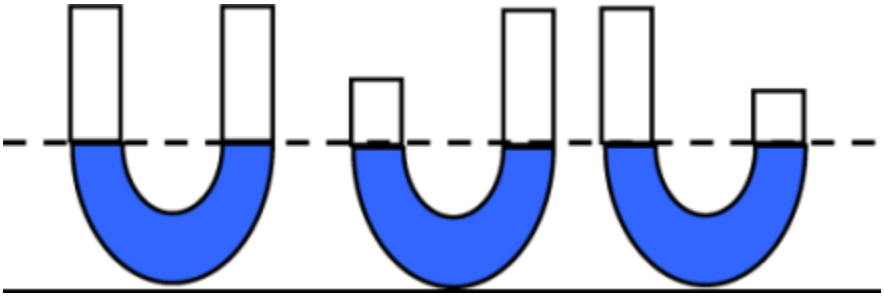
## WHAT TO DO:

1) Fill the glass 1/3 full of water. Cover the top of the cup with the index card.
2) Put your hand on the index card and hold it against the top of the glass and turn the glass and index card upside down.
3) What do you think will happen if you remove your hand from the index card (don't forget to hold onto the cup with your other hand)? Remove your hand from the index card and see what happens.

## WHAT HAPPENED:

Remember that ocean of air that we live in? Although we cannot see it, it is pushing on us and also on the index card. It is pushing so hard that the water cannot push the index card away. The water weighs less than 1 pound, but the air is pushing with 15 pounds for every square inch of the index card. The air holds the index card in place, and the water stays in the cup.

# Air is All Around Us
# Water in a Tube



## YOU WILL NEED:

- Plastic tubing
- Water
- Tea bag or food coloring

## WHAT TO DO:

1) Place the tea bag into a glass of water, or color the water with food coloring.
2) Pour water in the plastic tube, but don't fill it up all the way. Hold both ends of the tube and see if the water is at the same height.
3) Now try moving the tubing to make one side of the water higher than the other. Could you do it? Now put your finger over one end of the tubing and try again.

## WHAT HAPPENED:

The air was pushing on the water at both ends of the tube, so the water levels stay exactly the same. When you put your finger over one end of the tube, you blocked the air from getting to the water. Now the pressure on each side of the tube is different, and you can change the level of the water. You can use this principle when you are building a wall to make sure it is all at the same height. Just fill a garden hose with water and hold one end so the water level is at the top of the wall. Then stretch the hose to the other end of the wall. If your wall is level, the water level at that end should also be at the top of the wall.

# More and Less Air Pressure
# Marshmallow Face

## YOU WILL NEED:

- Marshmallow
- Marker
- Jar with a lid (insert hole in lid)
- Piece of clay
- Drinking straw

## WHAT TO DO:

1) Draw a face on the flat end of the marshmallow with the magic marker.
2) Put the marshmallow in the jar, and screw on the lid.
3) Put the straw through the hole in the lid until about an inch is inside the jar. Press the clay around the straw to make an air-tight seal. The clay will keep the straw from falling into the jar. The air-tight seal is essential!
4) Now suck the air out of the jar. Suck really hard. If you do this in front of a mirror, you can see what is happening to your marshmallow face.
5) Now quit sucking and see what happens.

## WHAT HAPPENED:

Although the marshmallow looks solid, it is full of pockets of air. When you suck the air out of the jar, there is not as much air to push on the marshmallow. This means there is less air pressure. The pockets of air in the marshmallow are still full of air and are pushing out, but there is not as much air in the jar to push back. The pockets of air push out and become bigger and the marshmallow puffs up. When you quit sucking on the straw, the air rushes back into the jar and pushes the marshmallow back to its original size.

# More and Less Air Pressure
# The Water Foundation

## YOU WILL NEED:

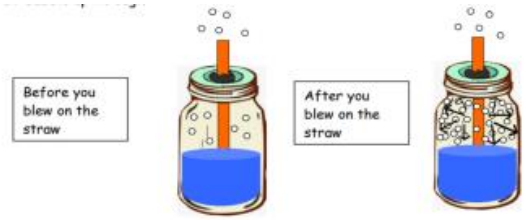
- Jar with lid
- Drinking straw
- Piece of clay
- Water
- A large bowl or a large sink

## WHAT TO DO:

1) Use the jar, lid, straw, and clay from the last experiment.
2) Fill the jar 1/2 full of water. Push the straw through the lid until 1 inch of the straw is below water. Make sure the clay makes a seal with the straw and the jar lid.
3) Place the jar in a large bowl or the sink.
4) Now blow as hard as you can into the jar. Quickly let go of the straw.

## WHAT HAPPENED:

Before you blew on the straw, the air pressure inside the jar and outside the jar were the same. Air is made of tiny particles that we can't see called molecules. There is lots of empty space between these molecules, so there is room for more air. When you blew on the straw, you pushed more air into the jar. Did you see how the air bubbled up?

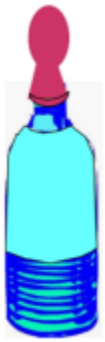



Where there is more air, there is more pressure. After blowing in the straw, there is more air and pressure inside the jar than there is outside the jar. Look at the "after you blew" jar above. All that air is pushing hard. It can't get back out of the jar, because the water is in the way. The air pushes on the water so hard that it pushes the water up the straw and out of the jar and you have a water fountain.

# Heating and Cooling Air
# The Inflating Balloon

Heat changes air pressure in a closed container. The more heat in the air, the higher the air pressure in the container. Let's try an experiment and watch how heat changes air pressure.

## YOU WILL NEED:



- A plastic bottle
- Ice cubes
- Balloon
- Bowl
- Hot water

## WHAT TO DO:

1) Put a balloon over the end of the plastic bottle.
2) Pour some hot water in a bowl. Hot tap water will work, but hot water from the stove is even better. Hot water can burn, so have your parent or teacher assist.
3) Place the bottle in the hot water. Watch what happens to the balloon (it may take a few minutes).
4) Let the air out of the balloon. If it breaks, get a new balloon.
5) Put the balloon back over the neck of the bottle.
6) Now place the plastic bottle in a bowl of ice water. Watch what happens to the balloon.

## WHAT HAPPENED:

Bottle in Hot Water

Heat causes things to expand or get bigger, while cold causes things to contract or get smaller. When the bottle is put in the hot water, the air inside the bottle is heated. The air tries to expand, and the air pressure increases because it cannot escape the bottle. The air pushes out of the bottle and into the balloon, which is why the balloon inflates or gets bigger.

Bottle in Cold Water

When the bottle is placed in the cold water, the air in the bottle cools and contracts (takes up less room). There is less air pressure in the bottle than outside in the room. Now the outside air is pushing harder (more air pressure), and it pushes the balloon into the bottle.

# Heating and Cooling Air
# The Collapsing Bottle

Remember how we said that there are pounds and pounds of air pressure pushing on us all the time, but we are so used to it that we don't even notice? The reason all that air pressure doesn't smash us is because we have air inside us also. The inside air is pushing out at the same pressure that the outside air is pushing in. What would happen if we took that inside air pressure away?

## YOU WILL NEED:

- A plastic bottle
- Hot water
- Ice cubes
- Bowl

## WHAT TO DO:

1) Put the plastic bottle into the hot water.
2) Wait a few minutes and put the lid tightly on the bottle.
3) Now put the bottle into a bowl with ice cubes or put it in the freezer for 15 minutes. Did anything happen to the bottle?

## WHAT HAPPENED:

When the bottle was heated, the air expanded and escaped from the bottle. When you put the lid on, the air could not return to the bottle. As the bottle cooled, the air that was left in the bottle contracted or became smaller, causing the air pressure to become lower. The outside air was pushing in a lot harder than the inside air was pushing out. The outside air pushed hard enough to collapse the sides of the bottle.

Another interesting fact about air pressure is that the higher we go in the atmosphere (the sea of air surrounding us), the thinner the air is and the lower the air pressure. That is why your ears hurt when you drive back down from the mountains. The air inside your ears is the still at the lower air pressure from the top of the hill, but now the outside pressure is getting higher. The outside pressure is pushing in harder than the inside pressure is pushing out.

Think of the bottle on the top of the page as your ear drum -- no wonder your ears hurt! When you yawn, you open a passage (called the Eustachian tube) in your head that allows more air to flow into your ears (that's when your ears pop). The pressure becomes the same inside and out, and your ears quit hurting.