

# Air Explorations



## PURPOSE

Students will explore the properties of air and determine that air is a gas made up of matter—it has weight, takes up space, and can exert pressure. Through extended activities, students can use air to lift and move objects.

## BACKGROUND

While visiting the exhibition *From Here to There*, students are able to experience many different ways in which air is used to move people and things. Air, made up of a mixture of gasses, has properties that can be used in a variety of ways to move things over small and very great distances. Hot air balloons, airplanes, rockets, pneumatic tubes at the bank, and air-powered tools all take advantage of the properties of air.

## VOCABULARY

**Matter** — anything that has mass and occupies space

**Mass** — a measure of the amount of matter that an object contains

**Force** — a push or a pull

**Pressure** — the force applied to a unit area of surface

**Compressed air** — air that is at greater than atmospheric pressure

**Work** — measure of the energy used to move an object over a distance

**Pneumatic** — operated by air pressure

**Density** — the amount of mass per unit of volume

**Buoyancy** — the upward force exerted when an object is immersed in a fluid. This force is equal to the weight of fluid displaced by the object.

**Archimedes' principle** — A body immersed in a fluid is buoyed up by a force equal to the weight of the displaced fluid.

**Gas** — a phase of matter in which the atoms or molecules have a relatively low density, move freely, and take the shape of their container.

## ACTIVITIES

Activities have been grouped according to grade level, but you can combine or change the activities to fit the ability and interest level of your class.

# Air Explorations



## Grades K – 2

Air is all around us, constantly exerting pressure on us, although we don't see it or usually feel the pressure. If you hold up an empty glass and ask your students to tell you what's in it, you are likely to hear "nothing." We notice air when we see or feel its effects: the wind against our skin, swaying branches, or a waving flag. The following activities help students to see that air is a gas made up of matter—it has weight, takes up space, and can exert pressure.

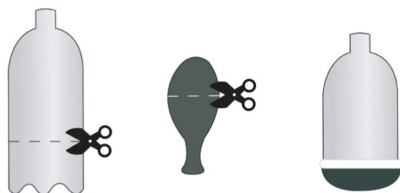
### —Teacher demonstration—

#### Materials:

- 2 one-liter plastic soda bottles
- 2 eight-inch balloons
- Tape

#### Teacher Preparation:

Cut off the bottom of the soda bottle. Cut a balloon top off about halfway down. Stretch the balloon bottom over the cut end of the soda bottle and securely tape it so that no air leaks out.



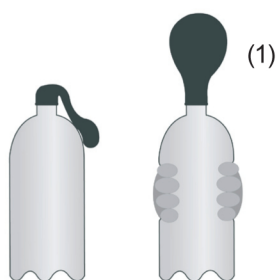
#### Demonstration:

Hold up the uncut soda bottle. Ask students what is in the bottle.

Place a balloon over the mouth of the bottle and squeeze the bottle (1). What happens? Why?

Put the balloon inside the bottle with the balloon opening overlapping the neck of the soda bottle. It should look like you are trying to blow up the balloon inside the bottle (2). Ask students to predict what will happen if you blow into the bottle. Try it, or have a student try it. The balloon will not inflate. Ask students to come up with reasons why.

The balloon doesn't inflate because the bottle is already full of air, and that air is taking up all the space. Use the other bottle (3) to demonstrate that you can add more air to the bottle and inflate the balloon, if the air already in the bottle has somewhere to go. In this case, it will push out the end with the stretched rubber.



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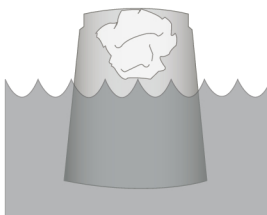
Grades K–2 continued...



## —Underwater cups—

### **Materials:**

- Small clear plastic disposable drink cups (one for each student)
- Paper towels
- Plastic tubs to hold water  
(These should be deep enough so that water can completely submerge the cup.)



### **Teacher preparation:**

Fill a plastic tub with enough water to almost completely submerge the plastic cup.  
(To give all students a chance to try this, you may want to set up several tubs and have students share.)

### **Activity:**

- Crumple and wedge a paper towel into the bottom of the cup, so that the paper towel stays inside when the cup is turned upside down.
- While the cup is upside down, without tipping it, push the cup into the water so that the paper towel is below the water level.
- Carefully raise the cup, and have the students check to see if the paper towel is wet.
- Is it wet? What is keeping the water out?
- To see that it's air, the students can try again; but this time, slowly tip the cup so that air bubbles out.

## —Straw Rockets—

Air can be used to move things.

### **Materials:**

- 1 pkg. of drinking straws
- Clay
- Colored paper
- Tape
- Several empty plastic ketchup or mustard bottles (the refillable, picnic type with a cone-shaped squirt top) to use as launchers



### **Teacher preparation:**

Prepare a sheet of small right triangles for the students to cut out and use as fins for the rocket. Older students could draw and cut out their own “fins.”

### **Activity:**

- Cut a straw in half.
- Tape two fins onto the straw near the bottom of the rocket.
- Place a small piece of clay over the top of the straw to make a nose cone.
- To launch: Place the rocket over the end of the ketchup bottle and squeeze.

### **Questions:**

What makes the rocket launch? How could you get it to go higher?



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## Grades 3–8

Air can be used to lift things. **Pressure = force/area** A pneumatic system uses air, usually compressed air, to do work. Fire departments use pneumatic systems to lift cars or heavy object off of people after accidents.

### —Air Power—

#### Materials:

- eight-inch diameter balloons (one for each student)
- A variety of different sized/weight books

#### Activity:

Challenge your students to lift a book (a heavy textbook) by blowing on it. Can they do it?

Hand out balloons.

Place a deflated balloon under each book and have the students blow them up.

### —Air Lift Your Teacher—

#### Materials:

- A table (large enough for a student or teacher to sit on when it's turned upside down)
- One-gallon, zipper-top storage bags (Freezer bags work well, because they are thicker.)
- Flexible straws
- Optional: You can also try small kitchen garbage bags.



#### Activity:

- Turn a table upside down on the floor.
- Place the bags around the perimeter of the table and most of the way underneath it.
- Have a student sit on top of the upturned table. (You might want to try this first with the student and then with a teacher.)
- Station a student at each bag with a straw.
- Insert a straw into each bag and zipper the bags closed on each side of the straw.
- Bend the straws up to make it easier to blow.
- Hold the bags closed tightly on each side of the straw and have everyone blow at the same time.
- As the table lifts, make sure that it's stabilized so that it doesn't slide off the bags.

#### Questions:

What would you need to take into consideration if you wanted to lift something heavier?  
Could you use the same materials? What makes this activity possible?

Deflated bags are placed under objects and then filled with air to lift them. What other things that use pneumatic systems can students identify?





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## Grades 6–12

Hot air balloons were first used in the 1700s. Although hot air balloons can be used as a mode of transportation, the rider has no real control over the speed or direction of the balloon. Hot air balloons work because the hot air inside the balloon is less dense than the surrounding, cooler air. This makes the balloon lighter than the air it is displacing, and the balloon rises because it is buoyant.

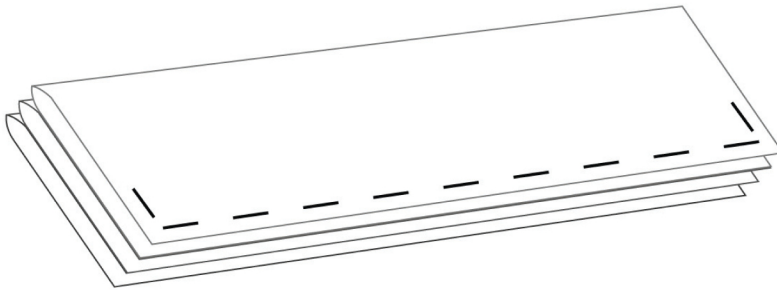
### —Hot Air Balloons—

#### **Materials (for each balloon):**

- 12 sheets of tissue paper (20" x 30" sheets)
- Glue stick
- Stapler
- Pen or marker
- Ruler or yardstick
- Scissors
- Hot air blow drier or a hot air popcorn popper
- Wire (18 or 20 gauge)
- Balloon template, see attached

#### **Activity: This can be done in groups or teams.**

1. Glue together the short sides of two pieces of tissue paper.
2. Repeat five more times until you have six long sheets of paper.
3. Fold each sheet of paper in half the long way, and stack the sheets on top of each other. Keep all of the folded edges together on one side.
4. After making sure the edges are as even as possible, staple the stack together along the loose side and the two ends only. DO NOT staple the folded side. The stapling makes the cutting step easier.



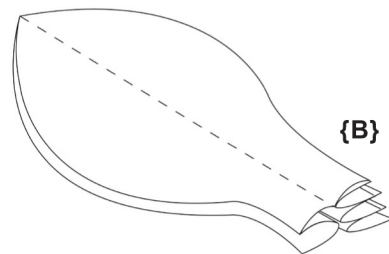
# Air Explorations



5. {A} Cut carefully through the whole stack of stapled paper along the line. {B} You will have cut off the stapled pieces and will be left with a folded stack of identical sheets of tissue paper.



6. Take the top sheet off and put glue along the outside of the curved edge. Put the next sheet down on top of the first, so that they are glued together. Put glue along the top edge of this sheet. Repeat until all of the tissue paper sheets are in a stack, folded on one side and glued together like an accordion on the other.
7. Fold the bottom sheet open, put glue on the top sheet, and fold the bottom sheet up to the top. All of the balloon pieces are now joined.
8. Make a wire hoop of the same diameter as the opening of the balloon.
9. Place the wire inside the opening of the balloon. Fold and glue the tissue paper over the wire. The wire helps keep the balloon open.



**Optional:** Once you've experimented with how the balloon works, you may want to add a basket. Make sure you consider what effect the added weight will have.

The balloon can be inflated indoors or out. Outdoors allows the balloon to rise higher, but make sure it's not a windy day.

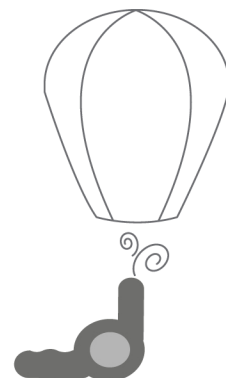
10. Have someone hold the balloon by the top over the hair dryer or the hot air popper. If using a dryer, have one student hold it on the ground pointing upwards and turn it on.
11. Release the balloon when it is inflated.

## Questions:

What modifications can be made to the hot air balloons to make them work better? If the air in the balloon is less dense than the surrounding air, then why doesn't the denser air crush the balloon?

## Extended Activities

Challenge your students to move an object (cotton ball, ping pong ball, wad of paper) from one place to another without touching the object.





Enlarge this pattern by 82% on a photocopier. Align the edge of your tissue paper with the straight edge of the pattern and trace the shape. Then cut along the dotted line, discarding the white portion of the pattern.