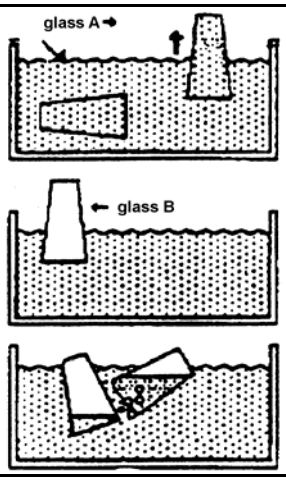
Physical Science 111 **Name:** _____
Section: _____ **Date:** _____

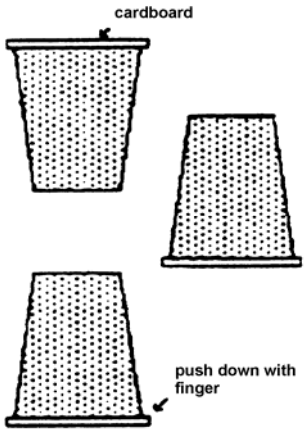
AIR AND AIR PRESSURE

This experiment will demonstrate the presence of air and some of the properties of air. Although the experiment will be demonstrated for you, the procedures and equipment are such that you can repeat most of it in your own home.

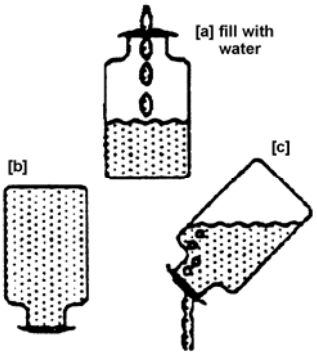
1. *Materials: clear glass container (small fish tank, etc.); two drinking glasses*
   a. Fill the container with water and place one glass (A) under water so it fills with water. Hold glass A by the bottom and raise it out of the water, keeping the mouth of the glass under water. Make observation and give an explanation.
   b. Turn the other glass (B) upside down and put it straight down into the water. Notice water does not run into the glass. Make observation and give reason why.
   c. Now, tip the glass of air (B) under the glass of water (A), forcing the water out. As you pour air out of glass (B), water will pour into it. Glass (A) which was full of water is now full of air and glass (B) which was full of water is now full of air. You can pour the air back and forth from glass to glass. Make observation and give explanation.



2. *Materials: glass; a piece of cardboard, waxed paper or an index card.*
   a. Fill the glass with water to the brim and place the cardboard on top. What's holding the cardboard up? The glass which is held by your hand, of course.
   b. Now, set the glass on the palm of your right hand and place the palm of your left hand on top of the cardboard. Quickly turn the glass upside down, being careful to keep the cardboard in place. Now what's holding the cardboard up? Again, your hand.
   c. With your right hand holding the glass firmly, slowly take your left hand from under the cardboard. Now, what's holding the cardboard up? Make your observation and give explanation.
   d. Put your finger at the edge of the cardboard and push down until a couple of air bubbles get in and help push down on top of the water. The cardboard and the water in the glass will fall down just as you might expect. Make observation and give an explanation why?

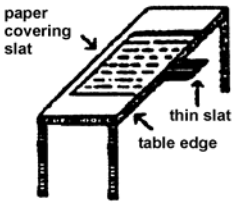


3. *Materials: milk bottle or other bottle, cheesecloth, string or rubber band.*
   a. Fasten a layer of cheesecloth over the mouth of the bottle with a rubber band or string. Fill the bottle with water by passing it through the cheesecloth.
   b. Now, holding the bottle upright, quickly turn it over so that it is upside down. The water went through the cheesecloth into the bottle easily; why won't it come out through the cheesecloth now? Make observations and explain why.
   c. Tip the bottle a little bit and you'll see the air flow in on the top side which the water flows out the bottom side of the mouth of the bottle. Make observations and explain why. This same type of thing occurs when you pour liquids out of a container.



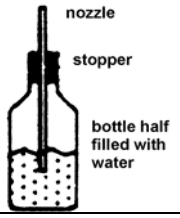
4. *Materials: two sheets* of newspaper, thin wooden slat, strong object

   Lay a thin wooden slat on a table and cover it with two sheets of newspaper. Smooth out the paper carefully all over the table and then with a strong object come down hard on the piece of wooden slat sticking out from the edge of the table. Instead of the paper and slat flying off the table, the slat breaks in two right at the edge of the table. Explain this observation.



5. *Materials: bottle, stopper with tubing*

   Fill a bottle half full of water and place the stopper and tubing into position. Blow hard into the nozzle. A bubble of air will come out of the bottom of the glass tubing because you are blowing air into the tubing. When you have blown as hard as you can, quickly move back and observe. Make your observation and explain why.



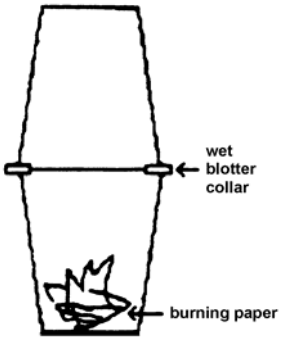
6. *Materials: harbottle, balloon*

   Try to blow up the balloon with the cork in place. Why can't you? Remove the cork at the bottom of the bottle. Blow up the balloon. While still blowing, replace the cork. Stop blowing. Why doesn't the balloon collapse? Fill the balloon about 3 full of water. Hold the bottle over a sink on tray and remove the cork. Why did you get a fountain?

7. *Materials: two glasses, piece of blotter*

   Out of the blotter cut a circle with a diameter of half an inch larger than the rim of the drinking glasses. Then cut a large round hole in the center of the circle to form a collar. Wet the collar thoroughly and place it on top of one of the glasses on the table. Light the paper with a match and hold the second glass upside down near the first glass.

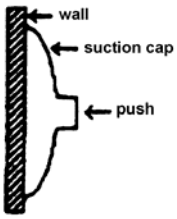
   Quickly toss the burning paper into the glass on the table and just as quickly place the second glass on the first so their rims are one above the other with the blotter collar in between. When the burning paper goes out, you can raise both glasses of the table by picking up the top one. Make observation and explain what has happened.



8. *Materials: suction cup, smooth surface, two plumber helpers*

   Hold the "suction cup" lightly against a smooth surface. There is atmospheric pressure inside and out. Now push it against the surface. You put pressure on the air inside and it escapes under the edges of the cup. When you stop pushing, the cup springs back to its original shape because it is made of rubber. As it does this, a partial vacuum forms inside and the atmospheric pressure holds the cup to the surface. Make your observation and give reason why.

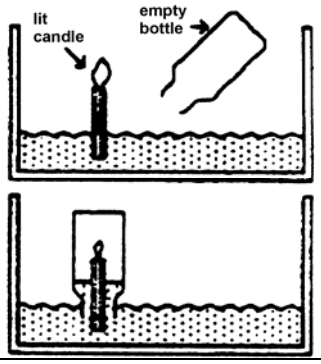
   Now try and inexpensive version of the Magdeburg hemispheres experiment. Carefully push two plumber helpers together with their edges aligned. Then try pulling them apart. Why do they hold together?



9. *Materials: clear glass container (small fish tank, etc.); candle, matches*

   Set the candle and holder in the water so that five or six inches of it is above the surface of the water. Now, light the candle and hold the bottle ready to put over the candle.

   When you put the bottle over the candle, the candle continues to burn for a short while. However, the flame gets lower and lower and finally goes out and the water in the dish rises into the neck of the bottle. The reason the candle went out is because the supply of oxygen ran out. Make your observations and explain why.

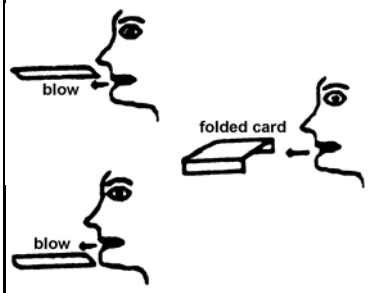


10. *Materials: two inch strip of paper, index cards*

    a. Hold the end of a two-inch width of paper with one finger under your nose and blow through your mouth. You expect the paper to rise. The air you blow hits the paper and forces it up.

    b. Now hold the paper against your chin and blow hard. Again, the paper will rise. You expected the paper to rise when you blew under it. Why does it also go up when you blow over it?

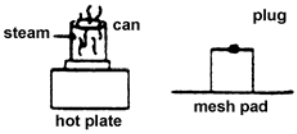
    c. Fold the index card edges as shown. Try to blow it over by first blowing under and then blowing over the top. When does it flip over? Why?



11. *Materials: boiling water, hot plate, empty soda cans, putty or clay, beaker tongs or oven gloves, wire mesh pad*

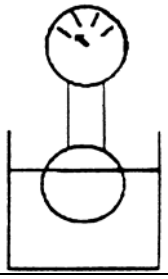
Pour a little boiling water into an empty aluminum soda can, just enough to cover the bottom of the can. Put the can on the hot plate with control set on high. When steam starts to come out of the can opening, hold the can with the tongs/gloves, quickly plug the hole with putty/clay, take the can from the hot plate and put it on the wire mesh pad to cool. What happens? Why?

Note: when steam condenses the liquid water takes up 1/1700 of the volume of the vapor. What is in the rest of the can?



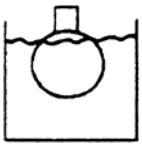
12. *Materials: hollow copper ball attached by tubing to pressure gauge; beakers of boiling water (100EC), ice water (0EC), dry ice-alcohol slush (-78EC)*

Submerge copper ball in each beaker. Note pressure change on gauge. Record equilibrium (stable) reading of gauge in each case. At the higher (lower) temperatures the gas molecules in the ball are moving faster (slower) and hit the inside walls more often which is indicated as a higher pressure reading. Why are there more tire blowouts in July than in December? At what temperature would the pressure gauge show zero?



13. *Materials: small balloons, tongs, beakers of boiling water (100EC), ice water (0EC), and dry ice alcohol slush (-78EC)*

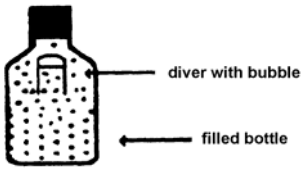
Blow up the balloon to a size of or few centimeters in diameter that will easily fit into an empty beaker. Tie off the neck of the balloon to keep it inflated. Use tongs to submerge the balloon in each beaker. Note the size changes of the balloon. At higher (lower) temperatures the gas molecules in the balloon are moving faster (slower) and take more (less) room to move around in if the pressure on them is fixed (What is the fixed pressure here?) Thus, warm air is less dense than cold air. Less dense air rises; more dense air sinks. Why does smoke rise over a fire?



14. *Materials: empty plastic 2-liter soda bottle with cap, cartesian diver bob*

Fill the bottle to the very top with water and let the bubbles of air escape. Put the diver (a weighted, upside down tube) into the bottle. Some water will spill out. The diver has a trapped air bubble in its top so it will float. Make sure the bottle is still filled to the top and tightly cap it. Squeeze the bottle sides. What happens? Why?

Note pressure on the side gets transmitted to pressure on the bubble in the diver.



15. *Materials: Magdeburg hemispheres apparatus, bike pump*

In the famous Otto Von Guericke experiment of 1654 in Magdeburg, Germany, evacuated one-half meter diameter hemispheres could not be pulled apart by two teams of horses. To repeat the experiment on a smaller scale: attach the reverse bike pump hose to the nozzle on the hemisphere, open the valve, places the hemispheres together with the gasket in place between them, pump the air out until the pump is hard to push, close the valve, remove the hose, and try to pull the hemispheres apart. Why are they held together? Slowly open the valve. What happens?