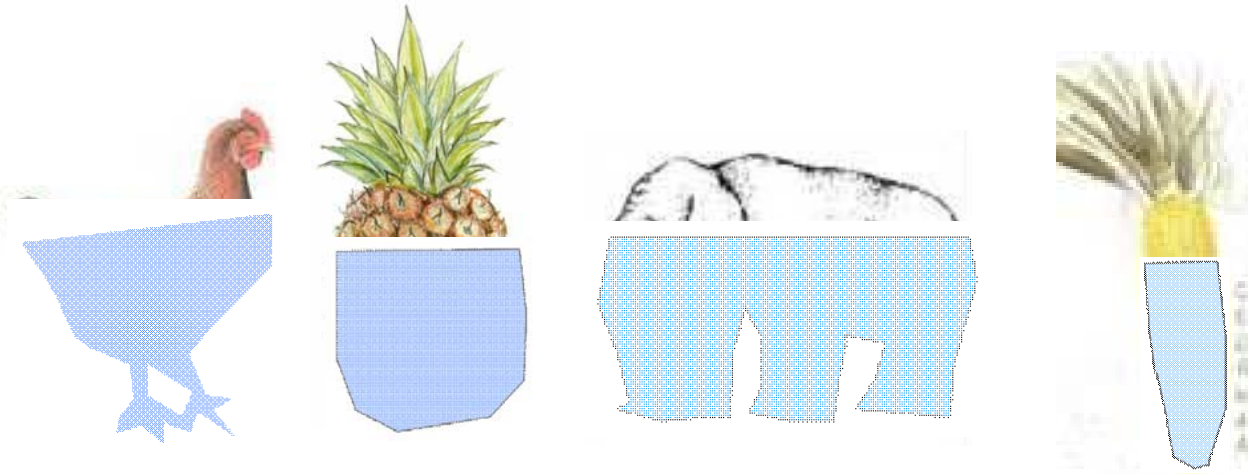
Wonderful Water

The Earth's surface is seventy-five percent water. It is very important for life on this planet. Let's explore some interesting things about water. We will learn why things float (buoyancy). We will also learn how water gets from the ground to the top of a tree (capillary action). Did you know that many of the things around you are mostly water? It might be hard to believe, but even a chicken, an elephant and you are mostly water.

HOW MUCH OF EACH IS WATER?



75% 80% 70% 80%

Here are the activities we'll do as we investigate water:

How things float: Make your own boat.
Buoyancy: Floating an egg
Capillary action: Colorful celery
Capillary action: Up and Over

Things in this kit:

1. clay
2. food coloring sealed in plastic tube
3. salt
4. a piece of cloth
5. 2 plastic cups
6. a spoon

*****Keep the clay for your basic kit when you are done. You will use it for the next unit!!!**

Other things you will need:

1. Water
2. A bowl
3. an egg
4. a piece of celery with leaves

How Things Float

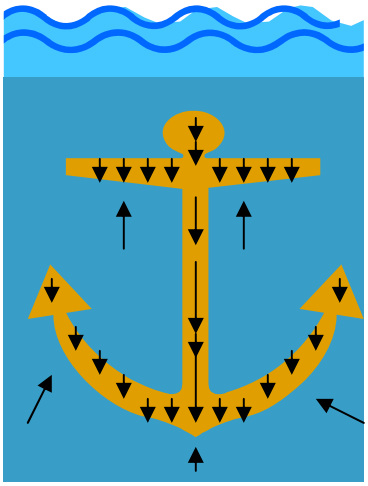
How does a boat carrying really heavy stuff float, while the same stuff would sink if you dumped it overboard? It has to do with **buoyancy** or how much the water is pushing against the object in the water.

An object in the water pushes water away to make room for itself. If you fill your bathtub with water, what happens when you get in? The water rises, right? (And sometimes goes over the side.) That is because you "displaced" some of the water with your body and it had to go somewhere. The key to floating is that the object must be big enough to displace an amount of water which is equal to its own weight. This principle was first explained long ago by a man called Archimedes (Ark-i'-meed-eez). This principle was cleverly named the Archimedes' Principle.

If the object pushes away enough water to equal its own weight, it will float. When this happens, the object is pushing down with the same force that the water is pushing back (**see picture 1 below**). The boat shown in the picture has lots of heavy animals, but it also has lots of air (which doesn't weigh hardly anything) trapped inside the boat. The boat is really big, and pushes lots of water out of the way. All the water pushed out of the way by the boat is heavier than the boat.

If the object doesn't push away enough water to equal its own weight, it will sink (**see picture 2**). The water moved by the anchor isn't as heavy as the anchor itself, so the anchor sinks.

PICTURE 1



PICTURE 2

How Things Float – Make Your Own Boat

What you need:

1. Clay – **After this experiment, add the clay to your basic kit**
2. water
3. a bowl

What to do:

1. Fill the bowl half full of water.
2. Take two equal pieces of clay.
3. Take one of the pieces of clay and roll it into a ball. Place it in the water. Did it float?
4. Take the second piece of clay and shape it into a boat. One way to do this is to roll it into a ball, then smash it flat and then turn up the edges like a cup. (If it is too stiff, work with it for a while. The more you work with it, the softer it becomes).
5. Place it in the water. Did it float?

How it worked:

The amount of water pushed aside or "displaced" by an object equals the amount of force that the water pushes upward on the object. The piece of clay shaped like a boat pushed aside more water then the piece shaped like a ball. The water pushed back with a greater force on the boat shape and it was able to float, just like in **picture 1**. The ball of clay did not displace enough water. The water did not exert enough upward force and the clay ball sank, like the anchor in **picture 2**.

Even though large ships are heavy, their shape displaces large amounts of water. A large boat pushes aside lots and lots of water. The water pushes back with a very large force (equal to the amount of water that was displaced). The boat is able to carry a lot of heavy objects and still float. Try adding a few objects to your boat and see if it still floats. If it sinks, try stretching the clay and making a bigger boat (and displace more water).

Interesting fact:

All ships have a mark on their side called the ***Plimsoll line*** after its inventor, Samuel Plimsoll. This mark tells the captain of the ship how low the ship can float in the water without sinking.

Don't forget to put your clay in your basic kit. You will need it later in the year.

Buoyancy- Floating an Egg

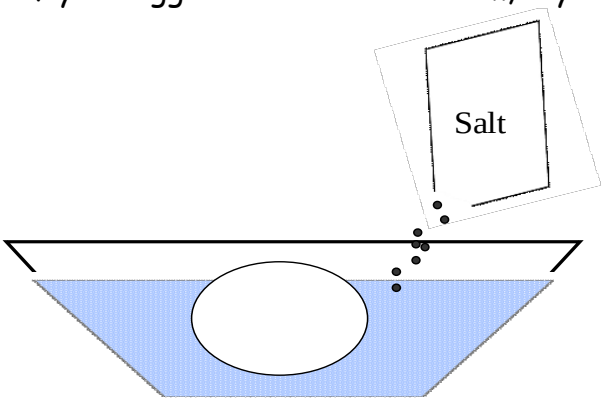
Have you ever tried floating in the ocean? If you have, you may have found out that it is much easier to float in the ocean then in a swimming pool. It is easier to float in the ocean because the water contains a lot of salt. Salt water has a greater upward lift or buoyancy than plain water. Let's see how adding salt to water changes how we can float things.

What you need:

1. salt
2. a fresh egg
3. water
4. a cup (9 oz) **(don't throw away your cup -you will need it again!)**
5. a spoon

What to do:

1. Put the egg in the cup.
2. Add enough water to cover the egg. Does the egg float?
3. Add one spoonful of salt to the water and stir gently. Does the egg float?
4. Add another spoonful of salt. Does the egg float?
5. If your egg is still on the bottom, try a few more spoonfuls of salt.



Now try this:

6. Keep your cup of salt water and fill another cup half full of plain water.
7. Test some other objects such as carrots, potatoes, pieces of wood, or a marble. Which objects floated in the plain water and which ones floated in the salt water? Were there some that would not float at all? Record your observations on the table on the next page.

Object	Floats in water	Floats in salt water	Doesn't float

How it works:

Plain water cannot support the weight of an egg, so the egg sinks. Salt water is denser than water. This means that it weighs more than plain water. If you weighed a cup of salt water and a cup of plain water, the salt water will weigh more. A liquid that is more dense has a greater upward lift or buoyancy.

Remember that the amount of water pushed aside or displaced by the egg equals the amount of force with which the water pushes upward on the egg. When you added salt to the water you made the water weigh more. The water displaced by the egg also weighed more. The water, therefore, exerted a greater force (or upward push) on the egg and it floated.

Capillary Action

How does water get from the ground all the way up to the top of a tree? Let's learn about capillary action, try some experiments, and see how it all happens.

Capillary action occurs because water is sticky! You can see this when you look closely at the side of a glass of water- see how is clings to the side of the cup? The tiny bits of water (the absolute tiniest drops you can have), called water molecules, like to stay close together. We call this **cohesion**. Water molecules also like to stick to anything else, like the side of a glass. We call this **adhesion**. So, water like to stick together, like a big water drop, and it likes to stick to glass, cloth, soil, you name it.

Try this to see cohesion and adhesion:
Touch some water in the sink with your finger and watch how the drop of water stays together in a drop and sticks to your finger. You can even shake your finger a little bit and the water still sticks together and to your finger. Try putting a drop of water on the table- see how it sticks together and makes a round blob?

Now try this to see adhesion:
Dip a paper towel into a puddle of water in the sink. The water sticks to the paper towel and you can lift the water out of the sink and into the garbage. The water moved into the spaces between and inside the fibers of the paper towel and adhered, or stuck, to the fibers.

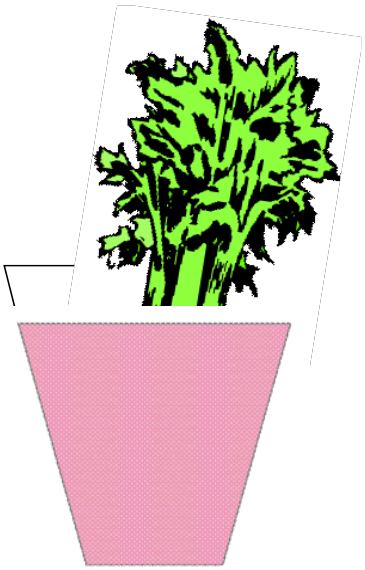
Colorful Celery

What you need:

1. A cup
2. Some water
3. Food coloring
4. A piece of celery with leaves on it, or a white carnation flower

What to do:

1. Fill the cup 1/2 full of water.
2. Hold the food coloring tube with the small end pointing toward the ceiling. Snip off the end of the food coloring tube and add the food coloring to the water **(BE Careful, it is easy to squirt food coloring all over the place).**
3. Cut the end off of the celery (the end without the leaves) and place immediately in the cup.
4. Leave the celery overnight……Did your celery change color?



How it works:

Inside the celery are tiny tubes (like tiny drinking straws) called **capillary tubes.** Ask your adult helper to cut a slice of the celery off so you can see the small tubes. The water in the cup touches the inside of the capillary tubes and sticks (**adhesion**). Then because of **cohesion**, the water molecules below stay with the water molecules above (remember the drop of water on your finger) and are slowly pulled up the capillary tube. You can see the water rise in the capillary tubes because of the food coloring you added.

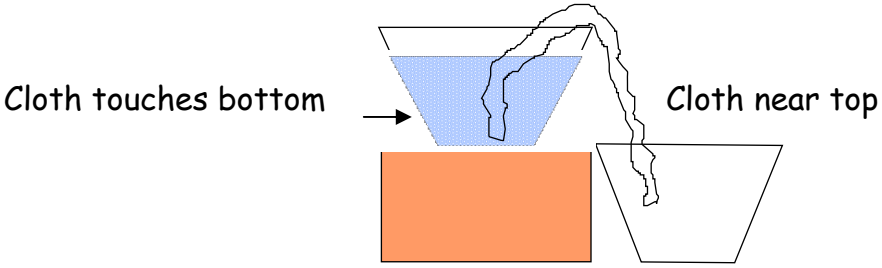
Up and Over

What you need:

1. A piece of cloth
2. Two plastic cups
3. Some water
4. An old cardboard box (an empty cereal box will work)
5. Some rocks or marbles

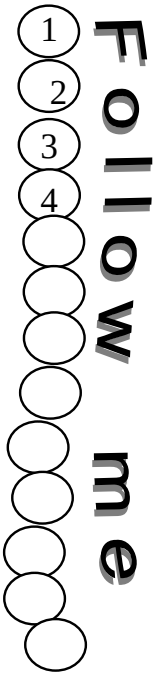
What to do:

1. Fill one cup with water (put a few rocks or marbles in the bottom to keep it from tiping over).
2. Place it on a box.
3. Take the other cup and place it on the counter near the cup that is filled with water. Take the piece of cloth and dip it in the water. Now twist it into a long rope.
4. Put one end of the twisted cloth in the cup of water on the box. Make sure it is touching the bottom of the cup.
5. Put the other end of the twisted cloth over the edge of the empty cup, but only a short distance below the rim.
6. Leave the cups overnight.



How it works

The fibers in the cloth and the spaces between act like capillary tube. The water moves up the tubes just like it did in the celery. After that, it flows down the other side into the second cup of water.



How water moves up a tree

Just like the fibers in the cloth and the tiny tubes inside the piece of celery, the tissue inside a tree acts like tiny capillary tubes. The water from the soil gets into the root and starts to climb the tiny tubes. As water molecule #1 starts climbing, it pulls along water molecule #2, which, of course is dragging water molecule #3, and so on. After a while another force called transpiration helps to pull the water to the top of the tree, but it all starts with capillary action.

More Capillary action

Look in the mirror at the tiny tear ducts that are in the corner of your eye near your nose. These are the ends of capillary tubes. Your tears move up these tubes into your eyes.

Credit where credit is due….

The experiments, discussions, and pictures in this handout were taken or adapted from the following websites and books:

Why boats float was taken from the following website:

- Reeko's Mad Scientist Lab
  http://www.spartechsoftware.com/reeko/Experiments/floating.htm
- http://www.boatsafe.com/kids/021598kidsques.htm

The floating egg experiment was adapted from the following website:

- http://education.wes.army.mil/clubhouse/science/list.cfm?Topic=bouyancy

Capillary Action experiments were from

- http://ga.water.usgs.gov/edu/capillaryaction.html
- http://www.sciencefair-projects.org/physics-projects/capillary-acition.html

Questionnaire

Were the materials provided appropriate? Yes _____ No _____
Please explain._____

1. Did you have enough materials for each experiment? Yes_____ No_____

Please explain._____

2. Did the experiments work? Yes_____ No_____

If not, please explain_____

3. Please provide any suggestions for improvements or additional

experiments/explanations._____

_____