TEXAS
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GRACE Educational Curriculum WEATHER / CLIMATE / ATMOSPHERE	
Teachers	Grades 9-12
Science	

Fluid Motion

Background Information:

The air near the floor of a room is much cooler than the air at ceiling height. Why? The water in the ocean is cooler the deeper you go. Why? The answer is fluid motion. You can feel the different temperatures and the effects of fluid motion, but you cannot see fluid motion in these cases. Fluid motion can take a variety of forms ranging from simple flows to complex vortex shedding to wave motion and turbulence. Air and water are both fluids and can both exhibit fluid motion. Fluid motions in the oceans are called currents. Daniel Bernoulli, an 18th century Swiss scientist, discovered that as the velocity of a fluid increases, its pressure decreases. Bernoulli's Principle can be applied to explain lift in an airplane. The bottom of the plane's wing is flat, while the top is curved. As the air speeds up, the pressure is lowered. A wing generates lift because the air goes faster over the top creating a region of low pressure, and thus creating lift. The relationship between the velocity and pressure exerted by a moving liquid is described by the **Bernoulli's principle**: as the velocity of a fluid increases, the pressure exerted by that fluid decreases. The GRACE mission will increase our understanding of ocean currents and changes in sea level.

Objectives: Students will observe liquid movement due to temperature differences.

Standards: Science: science as inquiry; physical science; earth & space science

Vocabulary:
Ocean Currents
Gulf Stream
Fluids
Bernoulli's Principle

Materials:

safety goggles	paper towels
250-mL flask	food coloring
stirring rod	hot plate

thermometer (Celsius)	two-hole rubber stopper
ice	glass tubing
battery or pickle jar	

Directions to the Teacher:

1. Using the two-hole rubber stopper place a 3" piece of glass tubing in one side so that most of it extends above the stopper. Place another piece of glass tubing, about the height of the flask, in the other side so that one end is flush with the top of the stopper and the rest is below it.
2. Put on the safety goggles. Fill the flask almost to the top and mix in some of the food coloring. Heat the flask until the water is about 70° C.
3. Remove the flask using the appropriate method so you do not burn yourself. Insert the stopper into the flask. Carefully wipe the outside of the flask where any colored water may have spilled.
4. Fill the battery jar with plain water at room temperature. You will need enough water to totally immerse the flask and glass tubing.
5. Observe and record what happens over the next ten minutes.
6. Ask the students:
    - What causes the movement that you observed?
    - What would happen if you changed the temperature of the water that you set the flask in? Cooler? Warmer?
    - How can you use this experiment to make conclusions about air currents?
    - How can you apply Bernoulli's Principle to what you observed?
7. Track air currents on a world map. How do they affect temperature?

Extensions:

- To gather more data you can have each group of students change the temperature of water in the battery jar. Caution: be sure to use the Pyrex type of flask so the glass will not crack from too much temperature change.
- Daniel Bernoulli, an eighteenth-century Swiss scientist, discovered that as the velocity of a fluid increases, its pressure decreases. How and why does this work, and what does it have to do with aircraft in flight? Discuss this in your group and write a list of things that you already know and a list of things that you would like to learn. Share your list with other teams and with your teacher.

References / Resources:

http://library.thinkquest.org/27948/bernoulli.html?tqskip1=1&tqtime=0411
http://www.mste.uiuc.edu/davea/aviation/bernoulliPrinciple.html