Introduction: This lab will demonstrate how currents caused by differences in density transfer heat through fluids. This method of energy transfer is believed to occur in Earth’s mantle below the lithosphere and also occurs in the hydrosphere and atmosphere.

Movement of Earth’s tectonic plates is believed to be the result of mantle convection. Within the atmosphere, differences in temperature cause the density variations that result in convective flow. This causes the basic forces that drive winds.

Objective: You will be able to predict convection patterns in fluids and describe the effects of varying densities in fluids.

Hypothesis: Predict the motion of the dye in a beaker of hot and cold water and why.

Vocabulary:
Convection:

Convection Current:

Part A:
1. Place cold water with red dye in one flask and hot water with red dye in another flask.
2. Place a laminated index card on top of the hot water flask.
3. Carefully turn over the hot water flask holding the index card over the open end to not allow any water to spill out and place on top of the cold water flask (cold water flask on the bottom, hot water flask on top).
4. Ask students to hypothesize what would happen if the card was removed and the fluids were allowed to mix.
5. While holding on to the flasks to keep them from falling, carefully remove the laminated index card to allow the water in the flasks to mix.
6. While making observations, ask students why they think the demonstration is behaving the way it is.
7. Repeat the demonstration using cold water with blue dye on top and warm water with red dye on the bottom.

Part B:
1. Place 800 ml of cold water in a 1000 ml beaker.
2. Put a few drops of red dye in a 50 ml flask. Fill the flask with hot water and put in a cork or rubber stopper.
3. Moving as slowly as possible so as not to disturb the water, lower the flask to the bottom of the beaker of cold water.
4. Holding the flask with tongs, carefully remove the stopper and gently remove your hand from the beaker. This will be “Time 0”. Observe what happens.
5. On your Report Sheet, draw and completely label diagrams of the apparatus at Time 0 and at 3 subsequent times.
6. Repeat the procedure using hot water in the beaker and cold water with blue dye in the flask.
## REPORT SHEET

<table>
<thead>
<tr>
<th>COLD BEAKER OF WATER</th>
<th>WARM BEAKER OF WATER</th>
</tr>
</thead>
<tbody>
<tr>
<td>WARM DYE</td>
<td>COLD DYE</td>
</tr>
</tbody>
</table>

### Diagrams

- **Cold Beaker of Water with Warm Dye**
- **Warm Beaker of Water with Cold Dye**
Discussion Questions:
1. Describe the pattern of the hot (red) dye during the first two observations.

2. Describe the pattern of the cold (blue) dye during the first two observations.

3. Why didn’t the cold (blue) dye immediately rise into the warm water?

4. What difference in densities caused the pattern of movement observed when the hot (red) dye was placed in the cold water?

5. What happens to the density of a fluid when heat is applied?

6. Draw a diagram of a convection current (cell) of air that would exist in a closed room with a heater on one side. Use arrows to show the movement of air in the room.

Conclusion: How is heat transferred by convection, and discuss how this relates to your hypothesis.
Reading Comprehension Read the portion of the article on Earth’s mantle below and answer the following questions based on the reading. Use complete sentences.

Earth’s Mantle

by Fraser Cain on March 9, 2009

http://www.universetoday.com/26717/earths-mantle/

The ground under your feet might seem solid, but you’re standing on a relatively thin crust of rock above a vast ocean of rock. This molten rock is the Earth’s mantle, and it comprises the largest part of the Earth’s volume.

The crust we stand on is only about 30 km thick. Out in the oceans, it’s even thinner, getting down to 5 km in places. Beneath this crust is the mantle of the Earth; a region that extends down a depth of almost 2,900 km.

Although the mantle is largely hidden from our view, we do see it in places where cracks open up, allowing the molten rock to escape. These are volcanos, of course, and the liquid rock we see pouring out is the same as you’d find in the mantle.

The Earth’s mantle is mostly composed of silicate rocks that are rich in iron and magnesium. Although it’s mostly solid, it’s hot enough that it can flow over long timescales. The upper mantle flows more easily than the lower mantle because of the increasing temperature and pressures as you descend into the Earth.

The Earth’s tectonic plates float on top of the mantle. In some places, the plates are sliding under one another, returning rock back to the interior of the Earth. In other places, the plates are spreading apart, and fresh volcanic material is welling up to fill the cracks.

Inside the mantle, convection is slowly taking place – like in a lava lamp. Hotter material, heated by the core of the Earth rise slowly to the surface of the mantle. Material cools near the crust and then sinks back down to the core, to repeat the process all over again. It’s believed that this convection helps drive the motions of Earth’s tectonic plates.

1. How thick is the Earth’s crust?

2. What is a “silicate” rock?

3. Why do “hotter” materials float to the top (think about what you learned in Unit 1)