

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Student Exploration: Convection Cells

**Vocabulary:** convection, convection cell, density, global conveyor belt, mantle, mid-ocean ridge, subduction zone, vector, viscosity

**Prior Knowledge Questions** (Do these BEFORE using the Gizmo.)

You place a pot of soup on the stove. As the soup warms you notice some areas where soup is rising up and other areas where soup is sinking down.



1. Why do you think some of the soup is rising up?

Because the soup became warm and less dense, so it rose up.

2. Why do you think some of the soup is sinking down?

Because it is colder and denser than the other parts of the soup.

### Gizmo Warm-up

When fluids (gases or liquids) are

tend to move.

This motion is called **convection**. In the *Convection Cells* Gizmo, you will experiment with convection both in a laboratory setting and in several examples.

To begin, note the laboratory setup on the MODEL tab. A beaker of \_\_\_\_\_ is placed above a gas burner. Click **Play** (▶). The burner is now heating



heated, they

observe and real-world

liquid is the fluid.

1. What do you notice? The liquid inside the beaker is moving in a circular motion

2. Drag the eyedropper into the beaker just above the burner and let go to release a drop of orange liquid into the beaker. What do you notice about the path of the drop?

The path of the drop is circular, the drop is moving in a circular motion.

**Activity A:**

Get the Gizmo ready:

**Convection**

Click **Reset** (↺), and set **Burner A** to **High**.



**Question: What causes convection cells to form?**

1. Hypothesize: Click **Play**, add a drop, and watch the motion of the liquid. Why do you think convection tends to occur in heated fluids?



Because the heat allows the liquid to rise, while the less heated areas to sink. This pattern then is able create a convection.

2. **Observe** : Click **Clear drop**. Under **Show**, select **Temperature**. The temperature scale runs from red (hot) to dark blue (colder).
  - A. Where is the hottest liquid located? Right on top of the gas burner/left bottom corner of the beaker.
  - B. Where is the coldest liquid located? On the surface of the beaker/any part of the beaker far away from the gas burner.
  - C. Add a drop. Does the hottest liquid tend to rise or sink? Rise .
  - D. Does the coldest liquid tend to rise or sink? Sink .
  
3. **Observe** : Click **Clear drop**, and then add a new drop to the liquid. Turn on **Show micro view of drop**. This view shows 21 molecules in the drop. Pay attention to how fast the molecules move and how much space they occupy the drop moves around the beaker. (Note: If the drop gets stuck, add a new drop to the beaker.)
  - A. In which part of the beaker do the liquid molecules move fastest? Right on top of the gas burner/left bottom corner of the beaker.
  - B. In which part are the liquid molecules most spread out? Right on top of the gas burner/left bottom corner of the beaker.
  
4. **Explore** : Click **Clear drop** and drag the **probe** (⊕) into the beaker. **Density** is defined as the mass per unit volume is a measure of how tightly the particles of a substance are packed. Move the probe to different parts of the beaker observing the temperature and density.
  - A. What relationship do you observe between the temperature and density? The higher the density of the liquid the lower the temperature of a liquid. The higher the temperature of a liquid, the lower the density.
  - B. Why do you think this is so? The particles of a substance are not tightly packed when the temperatures are high, which means less density because density is how tightly the particles of a substance are packed. However, when the temperature of a substance is low, the particles of the substances are packed tightly which means it has a high density.

(Activity A continued on next page)

Activity A (continued from previous page)

5. **Explain** : In a liquid, objects denser than the liquid (such as rocks) tend to sink, while objects less dense than the liquid (such as inflatable rafts) tend to rise. How does this relate to the observed motions of the liquid in the beaker?

Because colder water is denser than the warm water, so the colder water sinks down while the warmer water rises up.

Convection occurs because heated fluids become less dense, causing them to rise. Cooled fluids become denser, causing them to sink.

