# Pre-Lab Information

Purpose For this assignment, you will develop a model of convection currents. You will compare and contrast your observations of the model to the processes that drive plate tectonics. You will also create a model for the different types of plate boundaries caused by the interaction of plates to understand how plate tectonics can change the shape of Earth’s surface.

Time Approximately two 45-minute periods

Question What effect does plate movement have on geologic events and structures at Earth's surface?

**Summary** Movement of Earth’s plates slowly changes the planet’s appearance. Earth’s crust and upper mantle, called the lithosphere, are divided into tectonic plates that fit together like puzzle pieces. The plates rest on the asthenosphere. Through convection, heat from the interior of Earth rises toward the surface. Rising heat forces some plates apart and causes other plates to crash together. Over time, plate movement changes the landscape, creating mountain chains, volcanoes, the ocean floor, and earthquakes.

# Safety

* Always wear a lab coat and safety goggles when performing an experiment.
* Behavior in the lab needs to be purposeful.
* Be careful when working with hot water. Wear protective gloves in case of spillage.
* Be careful when working with food, as some fellow students may have food allergies.
* When you have completed the lab, please do not eat the food used in this lab.
* Report all accidents—no matter how big or small—to your teacher.

# Lab Procedure

1. **Gather materials.**

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| --- | --- | --- |
| **Convection Current Model**   * Transparent container * (5) Polystyrene cups * Hot and cold water * Thermos for hot water * (10) 2 cm x 2 cm pieces of paper * Food coloring * Eyedropper * Bucket for wastewater | **Boundary Type Model**   * 12 in. x 12 in. sheet of wax paper * Frosting * Plastic knife or spoon * Fruit roll-ups * Graham crackers * Water |  |

1. **Prepare for the project.** 
   1. Read through this guide before you begin, so you know the expectations for this lab.
   2. If anything is not clear to you, be sure to ask your teacher.
2. **Set up for the convection cycle model.** 
   1. Arrange 4 polystyrene cups into a square, with enough space in the middle to add another cup later. Make sure you place the cups with the bottom side pointing up.
   2. Rest the transparent container on the polystyrene cups.
   3. Fill the clear container approximately halfway with cold water.
   4. Place the squares of paper on the surface of the water.
   5. Use the eyedropper to get food coloring from its bottle.
   6. Submerging the eyedropper, place several drops of food coloring on the bottom of the transparent container in the center.
3. **Observe the convection cycle and record the water’s flow**.
   1. Watch the container for three minutes, recording your data in Table A in the **Data** section of this guide.
      * 1. Every 30 seconds, record any changes in the behavior of the drops of food coloring.
        2. Every 30 seconds, record any changes in the behavior of the paper squares.
   2. Fill a polystyrene cup with hot water (the hotter the better). Be careful when handling hot liquids. Wear protective gloves in case of spillage.
   3. Slowly and carefully slide the cup under the center of the container, just below the food coloring.
   4. Watch the container for five minutes, recording your data in Table B in the **Data** section of this guide.
      * 1. Every 30 seconds, record any changes in the behavior of the drops of food coloring.
        2. Every 30 seconds, record any changes in the behavior of the paper squares.
4. **Clean up your area.** 
   1. Return unused materials and dispose of any trash according to your teacher’s directions.
   2. Save some of your cold water to use for your plate boundary models.
   3. Pour the rest of your water into a bucket. Make sure you dispose of it properly.
5. **Model divergent boundaries.** Divergent boundaries are where two plates move apart from each other. At these boundaries, cracks in the crust occur, and trenches and rift valleys form.
   1. Using a plastic knife or spoon, spread the frosting on the wax paper. Make a layer that is about 0.5 centimeters thick.
   2. Place two squares of fruit roll-up on the frosting right next to each other.
   3. Gently press down on the fruit roll-ups. These represent oceanic plates.
   4. Slowly push the fruit roll-up squares apart from each other.
   5. Draw a cross-section of your model in Table C in the **Data** section of this guide. Label the plates and include arrows to show the direction of each plate’s movement.
6. **Model convergent boundaries.** Convergent boundaries are where two plates collide. These boundaries are where volcanoes form when a contitnental plate and an oceanic plate come together. Mountain chains form when two continental plates come together.
   1. Remove one of the fruit roll-ups from the frosting.
   2. Replace any frosting, if needed.
   3. Place one of the graham cracker halves onto the frosting approximately 1 inch from the fruit roll-up. The graham cracker piece represents continental crust.
   4. Push the graham cracker toward the fruit roll-up, slowly, until the graham cracker and the fruit roll-up overlap, with the graham cracker on top.
   5. Draw a cross-section of your model in Table D in the **Data** section of this guide. Label the plates and include arrows to show the direction of each plate’s movement.
   6. Remove both the fruit roll-up and graham cracker from the frosting.
   7. Replace any frosting that may have been removed with the graham cracker and fruit roll-up.
   8. Dip one edge of each graham cracker into a glass of water. Hold the graham cracker in the water for 3 to 5 seconds.
   9. Lightly place the graham crackers onto the frosting about an inch apart. Make sure the wet edges of each graham cracker are facing each other.
   10. Push the graham crackers toward each other until the wet edges “collide.”
   11. Draw a cross-section of your model in Table E in the **Data** section of this guide. Label the plates and include arrows to show the direction of each plate’s movement.
7. **Model transform boundaries.** Transform boundaries are when two plates slide past each other, moving in opposite directions. This is the boundary type where earthquakes occur.
   1. Pick up the graham crackers from the frosting.
   2. Rotate them and lightly place them back on the frosting, making sure two dry edges are touching each other.
   3. Push the graham crackers in opposite directions so they are rubbing against each other.
   4. Draw the top view of your model in Table F in the **Data** section of this guide. Label the plates and include arrows to show the direction of each plate’s movement.
8. **Clean up your area.** 
   1. Return unused materials and dispose of any trash according to your teacher’s directions.

# Data

Record your observations and data either in your lab notebook or in the space below.

**Table A: Cold Water**

|  |  |  |
| --- | --- | --- |
| **Time**  **(minutes: seconds)** | **Paper Movement** | **Food Coloring Movement** |
| **0:30** |  |  |
| **1:00** |  |  |
| **1:30** |  |  |
| **2:00** |  |  |
| **2:30** |  |  |
| **3:00** |  |  |

**Table B: Hot Water**

|  |  |  |
| --- | --- | --- |
| **Time**  **(minutes: seconds)** | **Paper Movement** | **Food Coloring Movement** |
| **0:30** |  |  |
| **1:00** |  |  |
| **1:30** |  |  |
| **2:00** |  |  |
| **2:30** |  |  |
| **3:00** |  |  |
| **3:30** |  |  |
| **4:00** |  |  |
| **4:30** |  |  |
| **5:00** |  |  |

**Table C**

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| **Drawing of Divergent Boundary Model** |
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**Table D**

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| --- |
| **Drawing of Convergent Boundary Model—Oceanic Crust vs. Continental Crust** |
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**Table E**

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| **Drawing of Convergent Boundary Model—Continental Crust vs. Continental Crust** |
|  |

**Table F**

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| --- |
| **Drawing of Transform Boundary Model** |
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# Follow-Up Questions

Answer the following questions.

1. Compare and contrast the behavior of the food coloring and the floating pieces of paper before and after adding heat to the system. What caused the changes you observed?
2. What part of the process of plate tectonics do the water currents represent? What part of the process of plate tectonics do the pieces of paper represent? What was the driving force that caused the pieces of paper to move along the water’s surface?
3. Recall your drawings for the different types of plate boundaries. What type of boundary creates earthquakes? What type of boundaries create volcanoes? Compare and contrast these two types of plate movements, and explain how these geologic events occur.