

19B Plate Tectonics

What is plate tectonics?

Earth's crust plus the upper mantle forms the *lithosphere*. Earth's lithosphere is broken in a number of different pieces. How these pieces move and interact is what plate tectonics is all about. In this investigation, you will be an Earth detective and identify lithospheric plates using geologic evidence.

Materials

- Bathymetric map
- Colored pencils
- Pencil

1 Setting up

Part 1: Reading a bathymetric map

1. Examine your map. A bathymetric map shows what land looks like under a body of water like the ocean.
2. Find examples of the following features on your bathymetric map: mid-ocean ridges, rises, deep ocean trenches, and mountain ranges. List one example of each from your map in the second column of Table 1.
3. In the third column of Table 1, list which type of plate boundary, convergent or divergent, is associated with each feature. Note: A rise is like a ridge.
4. In the fourth column, there are small diagrams showing two plates and the boundary between these. Draw arrows showing how the plates move relative to each other at these boundaries.



Table 1: Features on a bathymetric map

Features	Examples from the map	Kind of plate boundary (convergent or divergent?)	How do the plates at this boundary move?		
mid-ocean ridge			<table border="1"> <tr> <td>Plate 1</td> <td>Plate 2</td> </tr> </table>	Plate 1	Plate 2
Plate 1	Plate 2				
rise			<table border="1"> <tr> <td>Plate 1</td> <td>Plate 2</td> </tr> </table>	Plate 1	Plate 2
Plate 1	Plate 2				
deep ocean trench			<table border="1"> <tr> <td>Plate 1</td> <td>Plate 2</td> </tr> </table>	Plate 1	Plate 2
Plate 1	Plate 2				

Part 2: Starting to find plate boundaries.

1. Earth has seven to ten large pieces and many small plates. To keep things simple on your map, you will identify seven large plates.

- Keep in mind that mid-ocean ridges, rises, deep ocean trenches, and mountain ranges are all geologic features that are formed at tectonic plate boundaries.
- With your pencil, draw a single line along the mid-ocean ridges, rises, deep ocean trenches, and mountain ranges. Draw your lines along the center of each of these features. Your lines represent the boundaries between tectonic plates.

Part 3: Using earthquake activity to find plate boundaries

- Once you have identified all of the mid-ocean ridges, deep ocean trenches, and mountain ranges, you may notice that many of your lines may not connect. Complete the following steps to help fill in some of the missing parts of your plate boundaries.

Table 2: Earthquake data table

	Location	Magnitude
1	Lat 36.3° N, Long 23.4° E	6.8
2	Lat 32.5° N, Long 104.5° W	4.2
3	Lat 5.7° S, Long 76.4° W	7.5
4	Lat 18.8° N, Long 155.4° W	5.2
5	Lat 34.5° N, Long 73.6° E	7.6
6	Lat 10.9° N, Long 140.8° E	6.6
7	Lat 45.1° N, Long 167.2° E	7.2
8	Lat 2.1° N, Long 97.0° E	8.7
9	Lat 55.5° N, Long 165.8° E	6.7
10	Lat 39.8° N, Long 43.8° E	5.2

	Location	Magnitude
11	Lat 4.5° S, Long 153.4° E	7.7
12	Lat 35.0° N, Long 119.0° W	4.7
13	Lat 36.4° N, Long 140.8° E	6.4
14	Lat 7.9° N, Long 92.1° E	7.3
15	Lat 9.6° N, Long 84.2° W	6.4
16	Lat 51.2° N, Long 179.4° W	6.8
17	Lat 41.3° N, Long 125.9° W	7.2
18	Lat 36.3° N, Long 51.6° E	6.3
19	Lat 49.3° N, Long 128.8° W	6.7
20	Lat 19.9° S, Long 69.0° W	7.8

- Earthquakes are common along tectonic plate boundaries. The earthquake data table (Table 2) shows the location and magnitude of recent earthquakes around the globe.
- You will be plotting 20 earthquakes according to latitude and longitude. Plot the earthquakes using a colored pencil according to their magnitude. Use this key for your earthquakes, draw this key on your map.

Key for Earthquake Magnitude	
●	Magnitude less than 5.0
⊙	Magnitude 5.0 to 6.9
★	Magnitude 7.0 and above

- When you have finished plotting the earthquake data, use your pencil and draw a single line along the earthquake dots. You may find that many of these lines will connect with the lines you drew for mountain ranges, deep-ocean trenches, and mid-ocean ridges. These lines represent the boundaries between tectonic plates.

Part 4: Using volcanic activity to find plate boundaries

- Once you have plotted your earthquake data, you may find that some of the lines still do not connect. Follow these steps to help fill in some of the missing parts of your plate boundaries.
- Volcanoes, like earthquake activity, are often found along plate boundaries. The volcano data table (Table 3 below) shows the location of recent volcanic eruptions around the globe.

Table 3: Volcano data table

Location		Location	
1	<i>Lat 59.4° N, Long 153.4° W</i>	7	<i>Lat 35.2° S, Long 70.6° W</i>
2	<i>Lat 12.3° N, Long 93.9° E</i>	8	<i>Lat 19.0° N, Long 98.6° W</i>
3	<i>Lat 1.2° N, Long 77.4° W</i>	9	<i>Lat 16.7° N, Long 62.2° W</i>
4	<i>Lat 5.5° S, Long 150.0° E</i>	10	<i>Lat 46.2° N, Long 122.2° W</i>
5	<i>Lat 19.5° N, Long 155.3° W</i>	11	<i>Lat 54.0° N, Long 159.5° E</i>
6	<i>Lat 16.5° S, Long 168.4° E</i>	12	<i>Lat 14.5° N, Long 90.9° W</i>

- You will be plotting volcano activity according to latitude and longitude. Plot the volcanoes using a colored pencil. Use a triangle to represent volcanoes. Include this in your key on your map.
- When you have finished plotting your volcano data, use your pencil and draw a single line along the triangles. You may find that the lines you draw for the volcanoes will connect with the previous lines you have drawn.

Part 5: Using your evidence to locate Earth's major tectonic plates

- Using your pencil, continue working on connecting the lines that mark tectonic plate boundaries. Remember you are trying to locate seven major tectonic plates: the American Plate, Eurasian Plate, African Plate, Pacific Plate, Antarctic Plate, Indo-Australian Plate, and the Nazca Plate. Label each of the plates you found.

2 Stop and think

- a. How well do you think you did in accurately locating the seven major tectonic plates? What further evidence would have been helpful in making your map more accurate?

- b. In what areas of your map could you have used more geologic evidence to help locate plate boundaries?

- c. Why is a bathymetric map more useful in this investigation than a regular world map that does not show the ocean floor?

3 Doing the experiment

1. Now that you have come up with a hypothesis of where the seven major tectonic plates are located, your teacher will help you distinguish the actual location of the seven plates.
2. When you have the actual locations of the seven major tectonic plates, use your colored pencils to shade in each of the plates a different color. Be sure you have written the name of each of the seven plates on your map as well.

4 Thinking about what you observed

- a. Find the Himalaya Mountains on your map. These mountains are continuing to grow taller. What does this tell you about the type of plate boundary between the Eurasian plate and the Indo-Australian plate?

- b. The boundary around the Pacific plate is commonly referred to as the “Ring of Fire.” Examine the geologic events along this boundary. Why do you think this boundary has been given this name?

- c. Find the Mid-Atlantic Ridge on your map. The Atlantic Ocean was once much smaller millions of years ago and has been growing in size to present day. What does this tell you about the type of plate boundary that exists at the Mid-Atlantic Ridge?

- d. The boundary between the African Plate and the Eurasian Plate in the Mediterranean Sea is a convergent boundary. Africa is slowly pushing northward towards Europe. What will eventually become of the Mediterranean Sea in the future? Why?

- e. The boundaries between the Eurasian Plate and the Indo-Australian Plate as well as the Nazca Plate and the South American plate are convergent boundaries. What is a major difference in the geologic features and events at these two plate boundaries?

- f. Lithospheric plates move about as fast as your fingernails grow—2.5 cm/year! Your teacher will help you figure out the main directions to move the plates on your map. Using this information and the rate of movement, figure out what Earth will look like in 50 million years!

