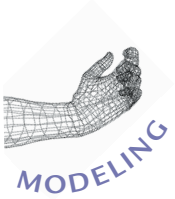
43 Measuring Earthquakes

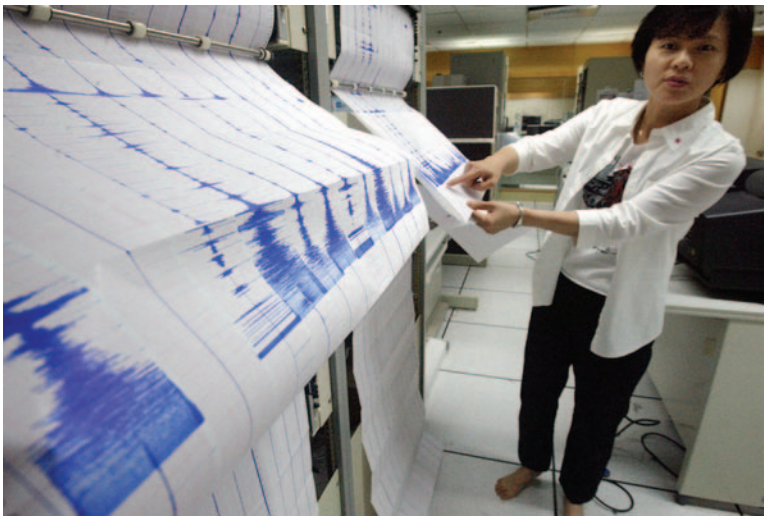


The earth's plates continue to move. Today, the plate that includes North America is moving away from the plate that includes Europe at a rate of about two centimeters (cm) each year. Moving these huge plates takes lots of energy. Some of this energy causes large sections of underground rock to break and shift position, resulting in an earthquake.

Scientists measure the intensity of an earthquake using a tool known as a **seismograph** (SYZ-mo-graf). A seismograph contains a thin needle-like pen that records the movements detected within the earth on a roll of paper. The lines recorded on the paper are called a **seismogram.**

CHALLENGE

How can a seismograph be used to measure earthquakes?



During earthquakes, rocks shift along a crack that geologists call a fault. *The deep line shown in the middle of the picture on the left shows one of the best-known faults in the United States: the San Andreas Fault in California. Geologists have placed many seismographs along this fault. On the seismogram shown above, the large blue areas were recorded during an earthquake.*

MATERIALS

For each group of four students

- 1 seismograph model
- 1 black marker
- 4 sheets of plain paper
- 8 toothpicks

For each student

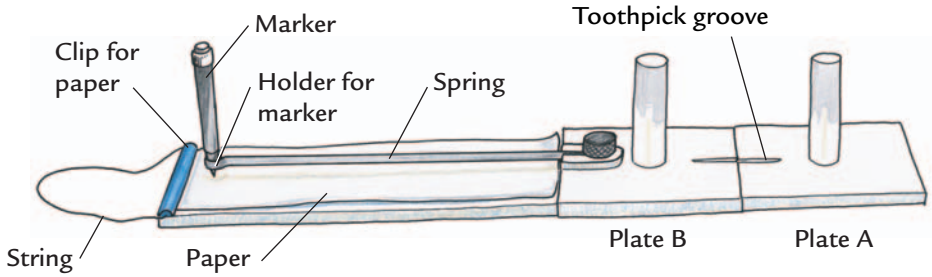
- 1 pair of safety goggles

SAFETY

Be aware of your surroundings when moving the different parts of the seismograph model. If you have long fingernails, hold the seismograph so that your nails point away from the hands of other group members.

PROCEDURE

1. Work with your group to set up the seismograph model as described in Steps a–d below.



   a. Set up the model as shown in the drawing above.

   b. Fold a sheet of plain paper in half, lengthwise. Slide the top of the folded sheet into the clip at the end of the paper tray of Plate B (the larger half of the model). Note: You may need to use a fingernail or the tip of a pen to open the clip wide enough to slide the paper in.

c. Remove the cap from the marker and insert it point-down into the holder attached to the end of the spring on Plate B.

d. Adjust the marker and the spring so that the marker is pressed firmly enough against the paper to leave a mark, but not so firmly that it can no longer move. Check to see if the marker is positioned properly by gently pulling back the spring and then releasing it. The marker should leave a curved line on the paper.

2. Decide which person in your group will perform each of the following roles. During the activity, each person will have a chance to perform each role.

- *Plate A Holder:* Hold the handle of Plate A and press down to keep it steady.
- *Plate B Holder:* Push Plate B directly away from you, just hard enough so that Plate B slides past Plate A and the toothpick breaks. Don't start pushing until the Data Recorder tells you to start.
- *Data Recorder:* Slowly pull the string to slide the paper tray out of Plate B (leaving a straight marker line on the paper). After the line is about 3–5 cm long (1–2 inches), tell the Plate B person to start pushing Plate B while you keep slowly pulling the paper tray. You should stop pulling the tray when you have almost reached the end of the paper.
- *Observer:* Carefully observe the movement of each plate and the resulting seismogram.

3. Push the two plates together and place a toothpick into the groove formed by the two halves.
4. Simulate an earthquake along a plate boundary by completing your roles as described in Step 2.
5. As a group, discuss your observations of the seismograph model, the seismogram, and the force required to break the toothpick. Then record your observations for this trial in your science notebook.
6. Remove any toothpick pieces left in the groove of either Plate A or Plate B, and collect any toothpick pieces that may have fallen onto the table or the floor. Throw these pieces away at the end of the activity.
7. Remove the folded paper from the clip and turn it to the blank side. Insert the paper back into the clip with the blank side face up.
8. Keep the same roles and repeat Steps 3–6 one more time.
9. Now, replace the folded sheet of paper with a new sheet. Switch the roles among your group members and repeat Steps 3–8 until every member of your group has pushed Plate B two times.
10. Unfold the 4 sheets of paper so that all of the recorded data can be seen at the same time. Compare the 8 seismograms. Discuss your observations with your group.

ANALYSIS

1. What similarities and differences did you observe among your group's 8 seismograms?
2. **a.** What did each half of the seismograph model represent?
   b. What did the toothpick represent? (**Hint:** Reread the introduction to this activity.)
   c. When did an "earthquake" occur? It occurred when:
   - the Data Recorder began pulling the paper tray.
   - Plate B was first pushed.
   - the toothpick broke.

d. What type of plate movement did you simulate?

- plates colliding
- plates sliding past each other
- plates pulling apart

3. Describe what the seismogram looked like:

   a. when there was little or no movement.

   b. when the toothpick broke.

4. This activity modeled an earthquake occurring along a plate boundary. What do you think are the strengths and weaknesses of this model?