A Model of Three Faults

Background

One of the most frightening and destructive phenomena of nature is a severe earthquake and its terrible aftereffects. An earthquake is a sudden movement of the Earth, caused by the abrupt release of strain that has accumulated over a long time. For hundreds of millions of years, the forces of plate tectonics have shaped the Earth as the huge plates that form the Earth's surface slowly move over, under and past each other. Sometimes the movement is gradual. At other times, the plates are locked together, unable to release the accumulating energy. When the accumulated energy grows strong enough, the plates break free. If the earthquake occurs in a populated area, it may cause many deaths and injuries and extensive property damage.

Today we are challenging the assumption that earthquakes must present an uncontrollable and unforecastable hazard to life and property. Scientists have begun to estimate the locations and likelihoods of future damaging earthquakes. Sites of greatest hazard are being identified structures are being designed that will withstand the effects of earthquakes.

Objective: Students will observe fault movements on a model of the earth’s surface.

Time Needed: at least 1 class period

Materials Needed (per group)

- Crayons or coloring pencils
- Scissors
- Tape
- Fault Model Sheet (included)
- Student Worksheet (included)

Instructions:

1. Explain that faults are often (but not always) found near plate boundaries and that each type of fault is frequently associated with specific types of plate movements. However, you can probably find all types of fault movement associated with each type of plate boundary. Normal faults are often associated with divergent (tensional) boundaries. Thrust faults are often associated with convergent (compressional) boundaries. Strike-slip faults are often associated with transform (sliding) boundaries.

2. Ask the following questions:
   What kind of faults would you expect to find in the Himalaya Mountains? Why?
   What kind of faults would you expect to find along the Mid-Atlantic Ridge? Why?
   What kind of fault is the San Andreas Fault? Is California likely to “fall off into the Pacific Ocean”? Why?

3. Explain that not all faults are associated with plate boundaries. Explain that there is a broad range of faults based on type, linear extension, displacement, age, current or historical activity and location on continental or oceanic crust.
4. Explain to students that the stresses and strains in the earth’s upper layers are induced by many causes: thermal expansion and contraction, gravitational forces, solid-earth tidal forces, specific volume changes because of mineral phase transitions, etc. Faulting is one of the various manners of mechanical adjustment or release of such stress and strain.

5. Illustrate compressive earth movements using a large sponge by squeezing from both sides, causing uplift. Using a piece of latex rubber with a wide mark drawn on it, illustrate earth tension, by pulling the ends of the latex to show stretching and thinning.

6. Have students construct a fault model using the Fault Model Sheet. Instructions to students:

7. Color the fault model that is included according to the color key provided.
   - Cut out the fault model and fold each side down to form a box with the drawn features on top.
   - Tape the corners together. This box is a three dimensional model of the top layers of the Earth’s crust.
   - The dashed lines on your model represent a fault. Carefully cut along the dashed lines. You will end up with two pieces. You may wish to have your students tape or glue a piece of construction paper on the side of the two fault blocks along the fault face. This will help with the demonstration.

8. Instructions to students: Locate points A and B on your model. Move point B so that it is next to Point A

9. Have students answer the corresponding questions on their student sheet. Go over answers with students. Explain that this type of fault is known as a normal fault. Many normal faults are found in Nevada. This is because Nevada is located in a region called the Basin and Range Province where the lithosphere is stretching.

10. Instructions to students: Locate points C and D on your model. Move Point C next to point D. Observe the cross-section of your model.

11. Have students answer the corresponding questions on their student sheet. Go over the answers with students. Explain that this type of fault if known as a thrust fault. An example of a thrust fault is the fault in which the Northridge earthquake occurred. The thrusting movement raised the mountains in the area by as much as 70 cm.

12. Instructions to students: Locate points F and G on your model. Move the pieces of the model so that point F is next to point G.

13. Have students answer the corresponding questions on their student sheet. Go over the answers with students. Explain that this type of fault is known as a strike-slip fault. A strike-slip fault can be described as having right or left-lateral movement. The San Andreas fault in California is a right-lateral strike-slip fault.
1. Construct a fault model using the Fault Model diagram above. Color the fault model according to the color key provided.

2. Cut out the fault model and fold each side down to form a box with the drawn features on top.

3. Tape the corners together. This box is a three dimensional model of the top layers of the Earth’s crust.

4. The dashed lines on your model represent a fault. Carefully cut along the dashed lines. You will end up with two pieces.

5. Follow the directions on the student worksheet and answer the corresponding questions.
A Model of Three Faults

Step 1: Locate points A and B on your model. Move point B so that it is next to Point A. Observe the cross-section of your model. Answer the following questions:

1. Which way did point B move relative to point A? ________________________________

2. What happened to rock layers X, Y, and Z? ________________________________

3. Are the rock layers still continuous? ________________________________

4. What likely happened to the river? the road? the railroad? __________________________

5. Is this type of fault caused by tension, compression or shearing? ____________________

6. Which type of fault did you demonstrate? ________________________________________

Step 2: Locate points C and D on your model. Move Point C next to point D. Observe the cross-section of your model. Answer the following questions.

7. Which way did point B move relative to point A? ________________________________

9. What happened to rock layers X, Y, and Z? ________________________________

9. Are the rock layers still continuous? ________________________________

10. What likely happened to the river? the road? the railroad? __________________________

________________________________________________________________________

11. Is this type of fault caused by tension, compression or shearing? ____________________

12. Which type of fault did you demonstrate? ________________________________________

Step 3: Locate points F and G on your model. Move the pieces of the model so that point F is next to point G. Observe the cross-section of your model. Answer the following questions.

13. If you are standing at point F and looking across the fault, which way did the block on the opposite side move? ________________________________

14. What happened to rock layers X, Y, and Z? ________________________________

15. Are the rock layers still continuous? ________________________________

16. What likely happened to the river? the road? the railroad tracks? __________________________

________________________________________________________________________

17. Is this type of fault caused by tension, compression or shearing? ____________________

18. Which type of fault did you demonstrate? ________________________________________

Name: ___________________________ Date: ________