Optional Spaghetti Fault Model

Lesson Concept
California has a strike-slip fault (San Andreas) on the transform boundary between the Pacific and North American plate.

Link
Lesson 6.5b deepens understanding of forces that cause stress and break “rock” at plate boundaries. The model demonstrates what happens along the San Andreas transform boundary developed in 6.5a Slip and Sliding Along. Types of faults are assessed in Assessment #1 and lesson 6.6 introduces how energy is released in waves during earthquakes.

Time
50 minutes

Materials
Per Group (groups of 4)
California Earthquake Fault Model (if you don’t have, use the attached directions to make your own)
20 Pieces of angel hair spaghetti
Metric ruler

Individual
H1 Spaghetti Strike-Slip Fault Model-Student Guide
H2a and H2b What’s at fault?
California Map used in Lesson 6.1

Advance Preparation
1. Place materials (California Earthquake Fault Model, 20 pieces of angel hair spaghetti, and metric ruler) in metal trays for distribution.
2. Duplicate handouts (H1, H2a, and H2b) for lab.
3. Review model on website:
   http://emvc.geol.ucsb.edu/3_downloads/M4WNACal/cCalifornia/California_20.mov

Procedure:

Engage
(10 minutes) California has a strike-slip fault (San Andreas) on the transform boundary between the Pacific and North American Plate.
Teacher Note: This lesson is optional only due to need for the California Earthquake Fault Model.

Project animation of the history of California and Baja California Plate Tectonics. http://emvc.geol.ucsb.edu/3_downloads/M4WNACal/cCalifornia/California_20.mov

1. Display the California map from lesson 6.1 and ask students to discuss the following questions with a partner: Where is Carpenteria / Santa Barbara located on the California map? What plate do we live on? How has Santa Barbara’s location changed over the years?

2. Ask students to watch the animation on the website. After animation, ask students to think-pair-share their ideas about: How did Santa Barbara (area marked SB on animation) move up along the coast of California over the past 20 million years? What would the rocks, the crust of the Pacific Plate and the North American plate, have to do in order to move? Record student ideas on a chart.

Explore (20 minutes) California has a strike-slip fault (San Andreas) on the transform boundary between the Pacific and North American Plate.

3. Explain to students we are going to use a model to show how the pressure builds along the San Andreas Fault, causing the northern movement of the Pacific Plate.

4. Distribute H2a and Hb (What’s at Fault?). Ask students to work in table groups, pairs, or whole class to complete H2a plate tectonic review questions. Ask students if any of the questions were difficult to answer. Discuss the difficult questions as a class.

5. Distribute materials (California Earthquake Fault Model, 20 pieces of spaghetti, metric ruler) and H1 (Spaghetti Strike-Slip Fault Model-Student Guide.)

6. On H2b (What’s at Fault?) ask students to make individual predictions about whether more resistance (stress) or less resistance (stress) will cause a bigger earthquake.

7. Ask students to read and discuss the lab instructions on H1 (Spaghetti Strike-Slip Fault Model Student Guide) with a partner. Ask partners if they need clarification of any of the lab instructions on H1.

8. Demonstrate the following procedures if needed.
   a. Write name, group number and class/period in the space at the top of the worksheet.
   b. At the southern end of the fault model, locate the three holes drilled in each piece of wood. Line up the sliding block so that the lines at the bottom of all three pieces of the model match up.
   c. Carefully, slide one piece of spaghetti completely through the uppermost of the three holes in the fault model. Gently wiggle the spaghetti a bit to get it through all three sections of the model.
d. Holding the side edges of the model with one or both hands, use a thumb to gently push on the bottom of the center block until the spaghetti breaks and releases the block. Make sure there is nothing blocking the top (northern end) of the block.

e. Measure the distance the block traveled from its original position, and enter the date in the “Group Data Table” under “1 piece of spaghetti, Trial 1.”

f. Remove the block, and shake any pieces of spaghetti out of the hole(s).

g. Perform steps c-f three more times, using one piece of spaghetti each time. Record the data for each trial under the appropriate trial number in the data table.

h. Next, create more stress at the fault by using additional pieces of spaghetti.

i. Place a piece of spaghetti in ANY TWO holes in the model. Perform four trials, using two pieces of spaghetti for each trial. Place the spaghetti in the same two holes for all four trials. Record data for these trials in the proper spaces of the data table.

j. After completing four trials with two pieces of spaghetti, place a piece of spaghetti in each of the three holes in the model. Perform four trials, using three pieces of spaghetti for each trial. Record data for these trials in the proper spaces of the data table.

k. Complete the rest of the worksheet.

**Explain** (10 minutes) *The size of the earthquake is directly related to the stress.*

9. Ask students to answer questions on the bottom of H2b (What’s at Fault?) after completing the lab.

10. Debrief the lab by discussing questions as a whole class.

**Extend/Evaluate** (10 minutes) *The size of the earthquake is directly related to the stress.*

11. Ask students to do a quick write in their science notebook answering the following question: Does greater or less stress cause a bigger earthquake? How do you know?
Spaghetti Strike-Slip Fault Model — 
Student Guide

INTRODUCTION

In a strike-slip fault, the slabs of crust on either side of the fault travel sideways past each other with little vertical motion. The San Andreas Fault in California is an excellent example of this type of fault. At the San Andreas Fault, the Pacific Plate moves northwest along the North American Plate at approximately the same rate that your fingernails grow — 3.2 meters (10-1/2 feet) in 100 years! If the sides of the fault slide by each other with little friction, there is not much stress and the strength of any resulting earthquake will be small. However, if there is a great deal of friction and the rocks along the fault become locked together, the pressure along the fault builds up. When the pressure increases enough to overcome the friction, the rocks suddenly move forward. This sudden release of built-up pressure results in a stronger earthquake. The greater the friction and pressure along the fault, the greater the magnitude of the earthquake when the rocks break free.

In this lab exercise you will be given a working model of the San Andreas Fault. The movable center block in the model represents movement along the fault. You will use pieces of uncooked spaghetti to simulate locked segments of rock along the fault.

MATERIALS

California Earthquake Fault Model; 20 pieces of angel hair spaghetti, each about 8-13 cm long; metric ruler

PREDICTION

Predict whether pressure will cause the block to travel farther after it has been locked with one, two, or three pieces of spaghetti. Write your answer on your worksheet.

ACTIVITY INSTRUCTIONS

1. Your teacher will tell you your group number. Write your name, group number, and class/period in the space at the top of the worksheet.

2. At the southern end of the fault model, locate the three holes drilled in each piece of wood. Line up the sliding block so that the lines at the bottom of all three pieces of the model match up.

3. a) Carefully slide one piece of spaghetti completely through the uppermost of the three holes in the fault model. (You may need to gently wiggle the spaghetti a bit to get it through all three sections of the model.)

   b) Holding the side edges of the model with one or both hands, use your thumb to gently push on the bottom of the center block until the spaghetti breaks and releases the block. Make sure there is nothing blocking the top (northern end) of the block.

   c) Measure the distance the block traveled from its original position, and enter your data in the “Group Data Table” under “1 piece of spaghetti, Trial 1.”

   d) Remove the block, and shake any pieces of spaghetti out of the hole(s).

4. Perform Step 3 three more times, using one piece of spaghetti each time. Record the data for each trial under the appropriate trial number in the data table.

5. You will now create more stress at the fault by using additional pieces of spaghetti.

   a) Place a piece of spaghetti in ANY TWO holes in the model. Perform four trials, using two pieces of spaghetti for each trial. Place the spaghetti in the same two holes for all four trials. Record your data for these trials in the proper spaces of the data table.

   b) After completing four trials with two pieces of spaghetti, place a piece of spaghetti in each of the three holes in the model. Perform four trials, using three pieces of spaghetti for each trial. Record your data for these trials in the proper spaces of the data table.

6. Complete the rest of the worksheet, as instructed by your teacher.
Transform Boundaries, Earthquakes, and the Big One: What's at fault?

Plate tectonics review:
The earth's crust is made up of many p________ that float on top of the liquid mantle. C_________________ currents cause the plates to move.

The plates of the earth's crust come together in three different ways:
∞ C________ boundaries are where the plates push together and form mountains.
∞ D________ boundaries are where the plates pull apart and new magma seeps out of the crust's surface.
∞ T________ boundaries are where the plates are sliding next to each other. Today's lab will focus on plate movement along transform boundaries.

Transform boundaries and Earthquakes:
∞ The S________ A________ Fault in California stretches over 1000 miles from Mexico to Oregon, where the P plate and the N_________ A plate meet.
∞ This is a Strike-slip fault: its movement is primarily h__________.
∞ Movement isn't smooth because the plates have rough, crooked edges. The topography of the earth's surface cause the plates to get stuck on each other.
∞ When pressure builds up enough to break through the resistance, an e__________ is produced.
This lab will answer the following question:

**Why are some earthquakes stronger than others?**

Using your Strike-slip Fault board and uncooked spaghetti, determine whether more stress (more spaghetti) or less stress (less spaghetti) produces a bigger earthquake.

**My hypothesis:**
I predict that ____________________________
will cause a bigger earthquake because ____________________________

**Results:**

<table>
<thead>
<tr>
<th># of strands of spaghetti</th>
<th>Distance the Fault Block Traveled (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trial #1 (cm)</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

∞ On average, the fault moved the most with ___ pieces of spaghetti to break through.

∞ On average, the fault moved the least with ___ pieces of spaghetti to break through.

**Answer the following questions:**

1. Did your prediction match your test data? Why or why not?

2. How does your data show the size of the earthquakes that result when there is more stress (more built up pressure)?

3. Compare the Spaghetti Strike-Slip Fault model to the San Andreas Fault.