Building Up and Breaking Down

Content Concepts

1. The major landscape features we see on the continents are mountains, plains, and plateaus.

2. Tectonic movements, including earthquakes, are among the forces which create Earth's landscapes.

3. Many of the Earth's most significant landscape features are under the oceans.

Vocabulary

mountain
plain
plateau
continental slope
abyssal plain
underwater delta
turbidity current

Objectives

Students will
—describe three major landscape features: mountains, plains, and plateaus.
—identify mountains, plains, and plateaus on a landscape map.
—construct models of various types of mountains and relate those models to specific places in the United States.
—identify, from observing illustrations of the Earth's sur face features, which of them were created by earthquakes.
—identify abyssal plains and underwater deltas, and model their formation.

Learning Links

Social Studies: Identifying land-scape regions of the United States and identifying ocean bottom features

Art: Constructing model of under-water landscape

Assessment

Choose mountains, plains, or plateaus, and describe what Earth activity may have caused their formation. Illustrate your ideas.

Activity One: Mountain, Plain, and Plateau

Materials for the teacher
- Transparency made from Master 25a, Landscape Regions
- Transparency made from Master 1b, U.S. Map (with states)
- Master 25b and 25c for reference
- Overhead projector
- A variety of scenic photographs showing major Earth features—mountains, plains, plateaus, and oceans

Materials for each student
- Crayons or colored pencils
- Class notebook
- Handout made from Master 25a, Landscape Regions Worksheet

moun • tain

A mountain is a portion of the landscape that is usually higher than surrounding areas and has steep slopes with faulted, folded, or tilted rocks.

plain

A plain is an area of horizontal rocks that is generally lower than surrounding regions.

plat • eau

A plateau is an area of horizontal rocks that is higher than surrounding areas and usually has some areas of steep slopes.

Procedure

1. Explain that landscape features related to earthquakes range from major features like mountains, plains, and plateaus to smaller features like cliffs and valleys, and very small features like crushed and scratched rock along faults. This unit deals with the major features.

2. Have class members suggest some examples of mountains, plains, and plateaus in the world, the United States, and their own locality.

3. Distribute copies of Master 25a. Landscape Regions Worksheet. Project the transparency of the same master. Ask students to use a purple pencil or crayon to color in every region on their worksheets that has a **1**. These are the mountain regions. Ask them to color the areas with **2**s, the plains regions, in green, and the **3**s, the plateau regions, in brown Direct the students to complete the key on Master 25a.

4. Project Master 1, U.S. Map, with labels. Help students locate their own state and the two or three neighboring states on their worksheet. Ask the class:

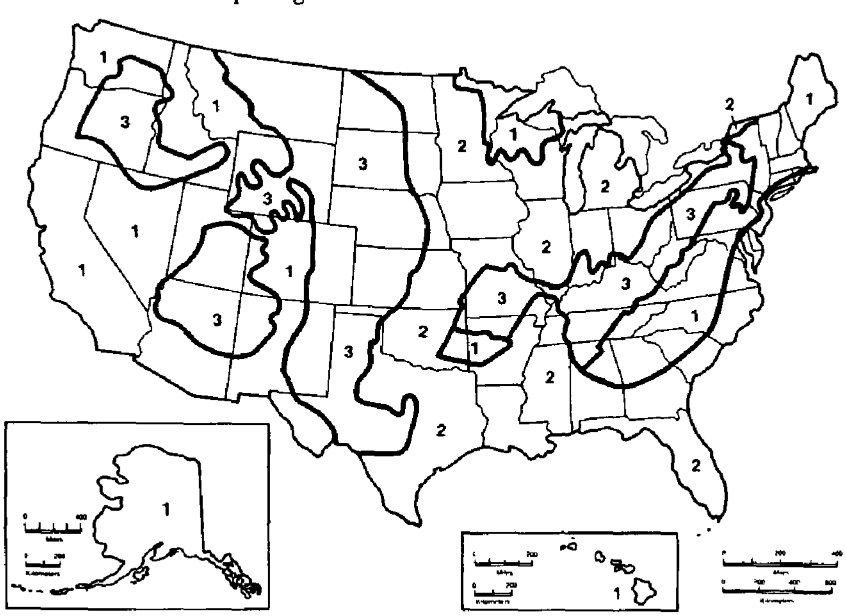
What kind of landscape region do you live in?

Where is the mountain landscape region nearest to your area?

Where is the nearest plains region? What about plateaus?

5. Allow students to discuss their answers until they arrive at a consensus.

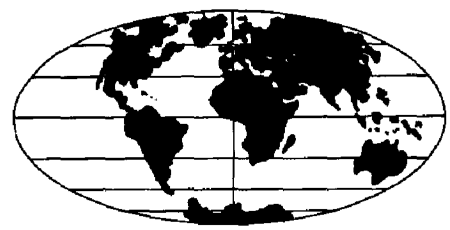
Master 25a. Landscape Regions Worksheet



Activity Two: The Folding Mountains Mystery

Materials for the teacher
- Transparency made from Master 25b, Landscape Regions of the U.S.
- Transparency made from Master 17, Plate Boundaries Map
- Transparency made from Master 19, Formation and Breakup of Pangaea
- Overhead Projector
- A classroom map of U.S.

Materials for each small group
- Three to five hand towels or fabric scraps of approximately the same size.



From Master 19, Formation and Breakup of the Pangaea

Procedure

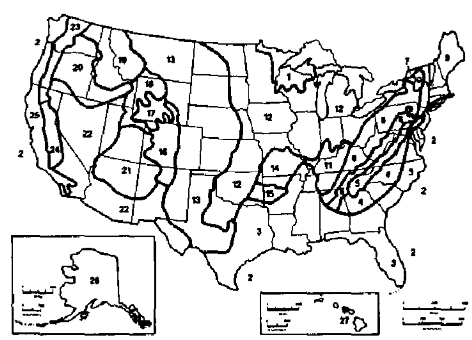
1. On a classroom map of the United States, and on Master 23b, locate the Folded Appalachians, the Ouachita Mountains, the Sierra Nevada Mountains, and the Basin Range regions of the United States. Explain that each of these regions has been molded by earthquakes or activity associated with earthquakes.

2. Tell students that the Folded Appalachians and the Ouachita Mountains were formed largely by a process called folding. Distribute three to five towels to each small group. Explain that the towels will represent rock layers of the lithosphere in the simulation they are about to do. Give these directions:

a. Stack the towels.

b. Hold the stack by its two ends and gently push the towels toward the center. What happened? (The towels folded into several ridges.)

If the sheets of towel were layers of rock, what would provide the push to fold them? (The pressure of earthquake movements and convergent plate movements, or the squeezing of rock layers from opposite sides)



Master 25b. Landscape Regions of the U.S. See Master 25c for a complete list of the regions numbered. The four mentioned in the text include (6) Folded Appalachians, (15) Ouachita Mountains, (22) Basin and Region, and (24) Sierra Nevadas

3. Project Master 17, Plate Boundaries Map, and ask: Do you see evidence of plates converging anywhere near either the Folded Appalachians or the Ouachitas? Challenge students: How could these layers have been folded? (Do not provide any answer yet.)

4. After some discussion, project Master 19, Formation and Breakup of Pangaea, and let students observe that plate boundaries were converging in those places hundreds of millions of years ago, when these old mountains were formed.

Activity Three: Mountain Modeling

Materials for each student or pair of students
- Dull table knife or scissors
- Rectangular block of plastic foam or furniture foam, at least 2" (10 cm) long and wide and 2" (8-10 cm) thick
- Newspapers to cover desks or work surfaces

Teacher Take Note: This procedure can be done with any of several kinds of material, but you'll want to experiment with whatever you select. You'll see what kind of cutting tool works best and know what to expect when you do the activity with your class.

Procedure

1. Distribute materials. Tell students that they are going to model another type of mountain building which formed the Sierra Nevadas and the Basin and Range areas of the United States. Give these directions:

a. Cut a wedge-shaped section out of the middle of the block, lift it out, and then replace it in its original position.

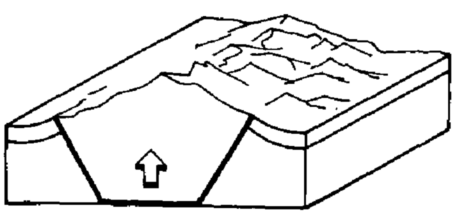
b. Hold the sides of the block in two hands and pull them apart slightly, allowing the inner wedge to drop.

What do the tops of the two cut surfaces represent? (faults)

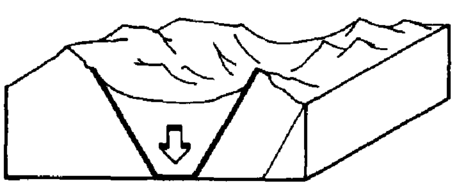
What do the slopes along which the wedge slipped represent? (fault cliffs)

What could cause something like this to happen to the Earth's lithosphere? (There are several possible answers. An earthquake could cause two portions of the lithosphere to separate. Plates could be diverging. Convergence could also cause this kind of movement, however, and is a likely explanation in the case of the Sierra Nevadas and the Basin and Range mountains.)

Examples of mountain building action



Uplifting (or upwarping) may be caused by convergence



Downdropping may be caused by convergence or divergence

2. Ask students to put the wedge back in its original position to prepare for another simulation. Direct them to hold the three sections together with their two hands and push on the outside, causing the wedge to move up. Ask:

What could happen in the lithosphere to cause this kind of movement? (compression resulting from the convergence of plates or convergence due to fault movement.)

How could a small movement like this result in mountains thousands of meters high? (Mountains would be formed by a series of earthquakes, or many series over many thousands of years.)

Activity Four: Underwater Avalanche

Materials for the teacher
- Transparency made from Master 26, Ocean Bottom
- Overhead projector

Materials for each small group
- A trough 50 cm to one meter long (This could be a section of PVC rain gutter or a shipping tube cut and lined with plastic. Halves of quart milk cartons would also work.)
- 2 liter container filled with water
- Trough supports (blocks of wood or old books)
- Sandy soil or mixture of sand and dry pottery clay (kaolin) to simulate sediment
- Plastic shoe box or baking pan to hold water and sediment
- Corrugated cardboard strips with the grooves exposed (Tear off the outer layer of paper.)
- Tape

Procedure

1. Project the transparency of the ocean bottom, Master 26, Ocean Bottom. Orient students by pointing out the eastern United States, the Mid-Atlantic Ridge in the Atlantic Ocean, and the abyssal areas in the underwater delta. Inform students that the abyssal areas are one of the largest landscape features of the Earth. Ask the class why they suppose there are such extensive flat areas on the ocean bottoms, and why the underwater deltas exist. Also ask why the deltas and abyssal areas are located where they are. (Accept various answers for now.)

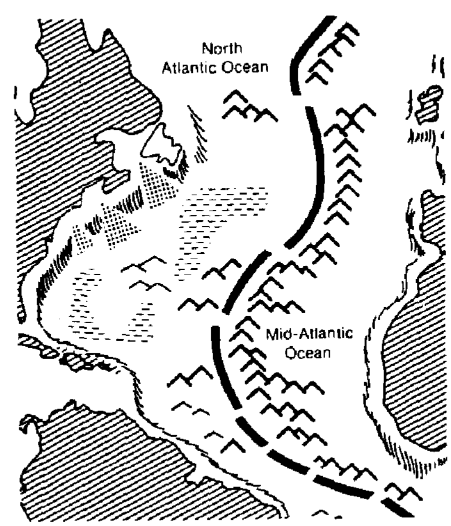
2. Point out the angled underwater landscape of the continental slope and the rough topography near the mid-ocean ridge. Explain that earthquakes under the continental slopes can cause sediment on the ocean bottom to loosen, mix with water, and slide down the slope at speeds up to 100 km an hour. We call this movement a turbidity current.

a • bys • sal plain

An abyssal plain is a plain under the ocean between a continent and a mid-ocean ridge.

tur • bid • i • ty cur • rent

A turbidity current is a downward flow of water and sediments such as mud or sand along the ocean bottom. These swirling currents may be caused by earthquakes.

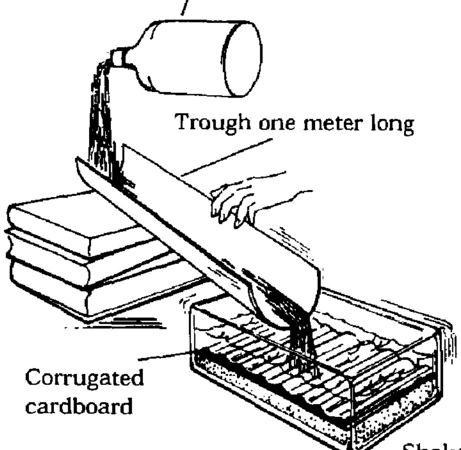


Extensions

1. Use a stopwatch to calculate the speed of the turbidity currents.

2. Tie string across the trough to represent underwater communication cables, then observe and record what happens to these model cables in a turbidity current.

3. Show some other diagrams or maps of ocean bottoms, and discuss several other features and how their origin is related to earthquakes. (Other ocean features related to earthquakes include ocean trenches, rift valleys, mid-ocean ridges, island arcs, lava flows, and volcanoes of the mid-ocean ridges.)



3. Tell the class that they are going to build a model to demonstrate turbidity currents and their effects on the features of the ocean bottom. Give these directions:

a. Set up the trough, making sure it can hold water.

b. Place one end of the trough so that it overhangs the collecting pan.

c. Prop up the high end with books or blocks of wood, so that there is about a 10- to 20-degree slope to the trough, representing the topography of the ocean slope.

d. Place some corrugated cardboard in the collecting pan and tape it in place. If necessary, hold the cardboard in place during the next steps. It represents the rough landscape east of the abyssal areas on the ocean bottom. Cover the bottom of the trough with soil or sand and clay.

e. Slowly and continuously pour water into the upper end of the trough. While one student is pouring, another will shake the trough.

4. Have students create different kinds of turbidity currents by repeating step e above, possibly pouring at different speeds and shaking with different intensities. Ask:

What does the shaking of the trough represent? (an earthquake)

What has happened to the rough surface (corrugated cardboard) of the ocean bottom? (It has become smoother because sediments have filled it in.)

What has been produced? (An abyssal plain is produced by the deposition of sediment from the turbidity current.)

What has been formed where the trough overhangs the collecting pan? (An underwater delta has been formed. If students don't know what a delta is on land—a more or less fan-shaped land area where sediments are deposited at the mouth of a river—explain and give examples. The Nile Delta, the Mississippi Delta are good ones.)

5. To sum up, project the transparency of the ocean bottom again and reinforce the meaning and origin of abyssal plains and underwater deltas, and how they are produced (at least in part) by turbidity currents generated by earthquakes.

Unit III. Physical Results of Earthquakes

Materials List

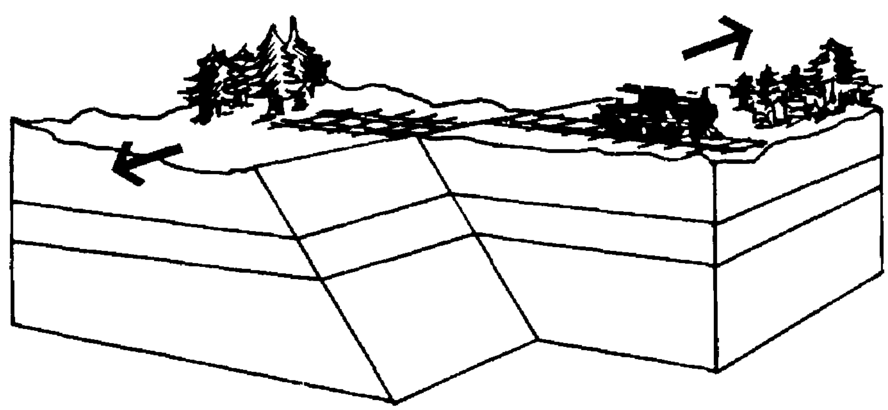
Grades K-2
empty milk cartons
colored pencils
markers
crayons
drawing paper
masking tape
overhead projector
scissors
rubber bands

Grades 3-4
scissors
colored pencils
unlined paper
paper clips
light cardboard
glue stick
metric measuring cup/beaker
small plastic tub
sand
newspapers
foam tray
soil
overhead projector
gravel
aluminum foil
metal or glass baking pan
  or plastic shoebox
plastic margarine lid
punching tool
string
metric ruler

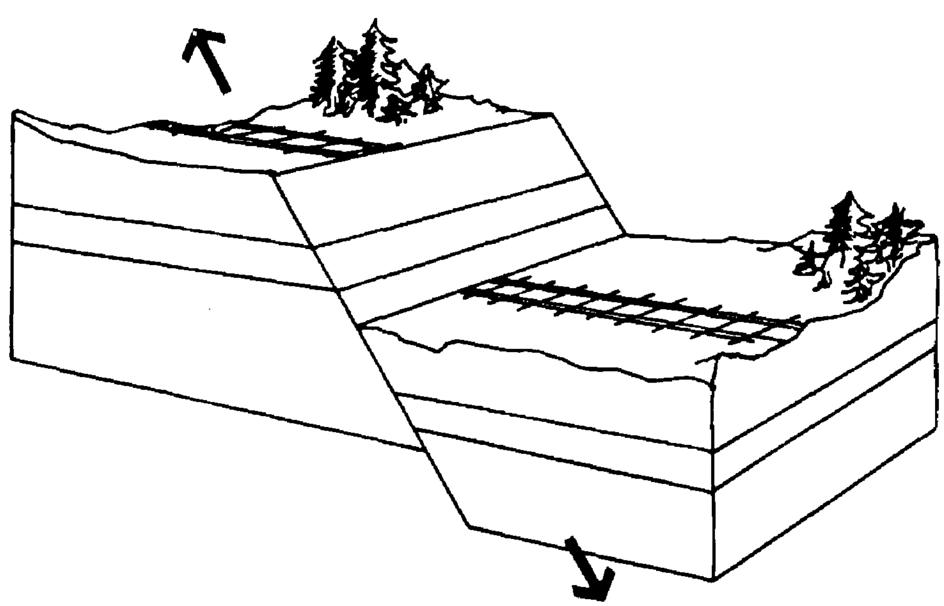
Grades 5-6
photographs
crayons
colored pencils
construction paper
2-liter soda bottle
foam block
furniture foam
newspapers
permanent markers
PVC rain gutter, shipping
  tube, or milk carton
plastic shoe box
blocks of wood
sandy soil, or sand, or clay
  (kaolin)
corrugated cardboard
dull table knife or scissors
overhead projector
notebook
tape

Fault Movements

Horizontal Fault Movement

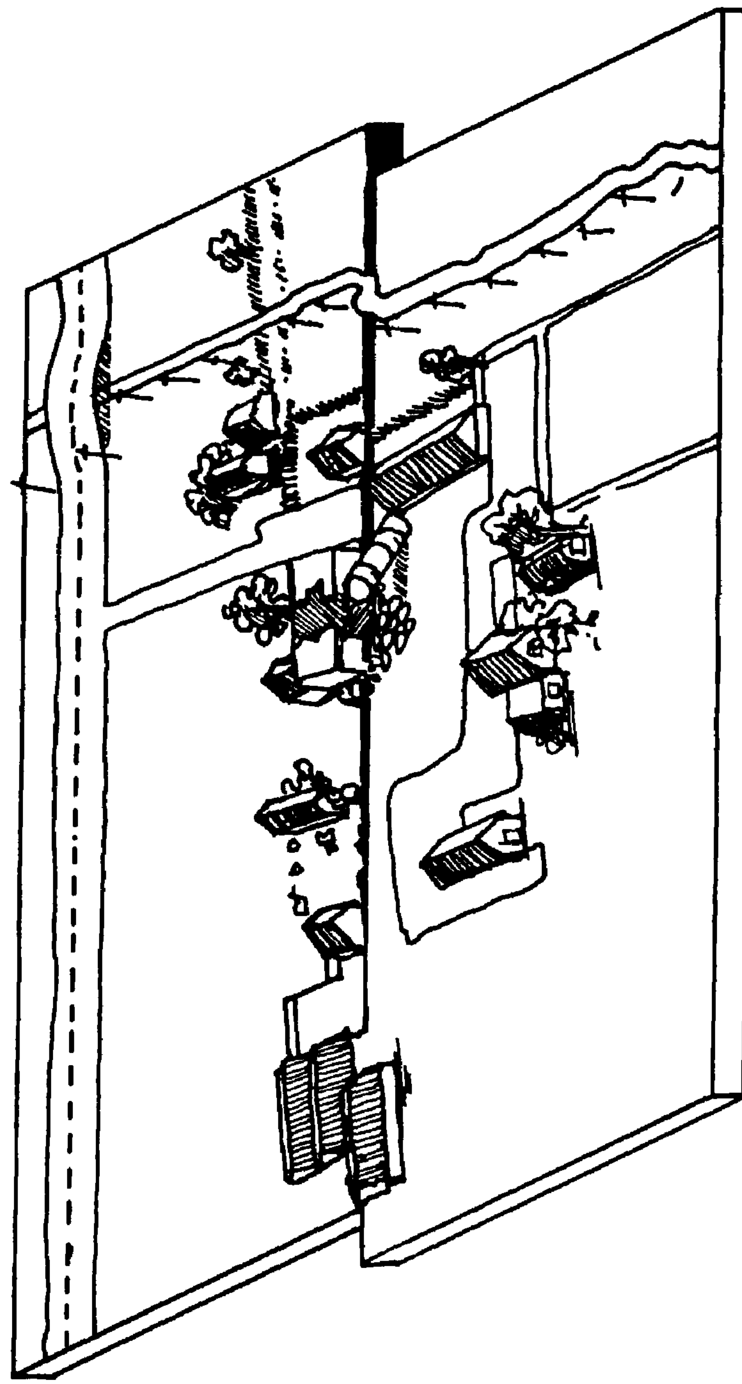


Vertical Fault Movement

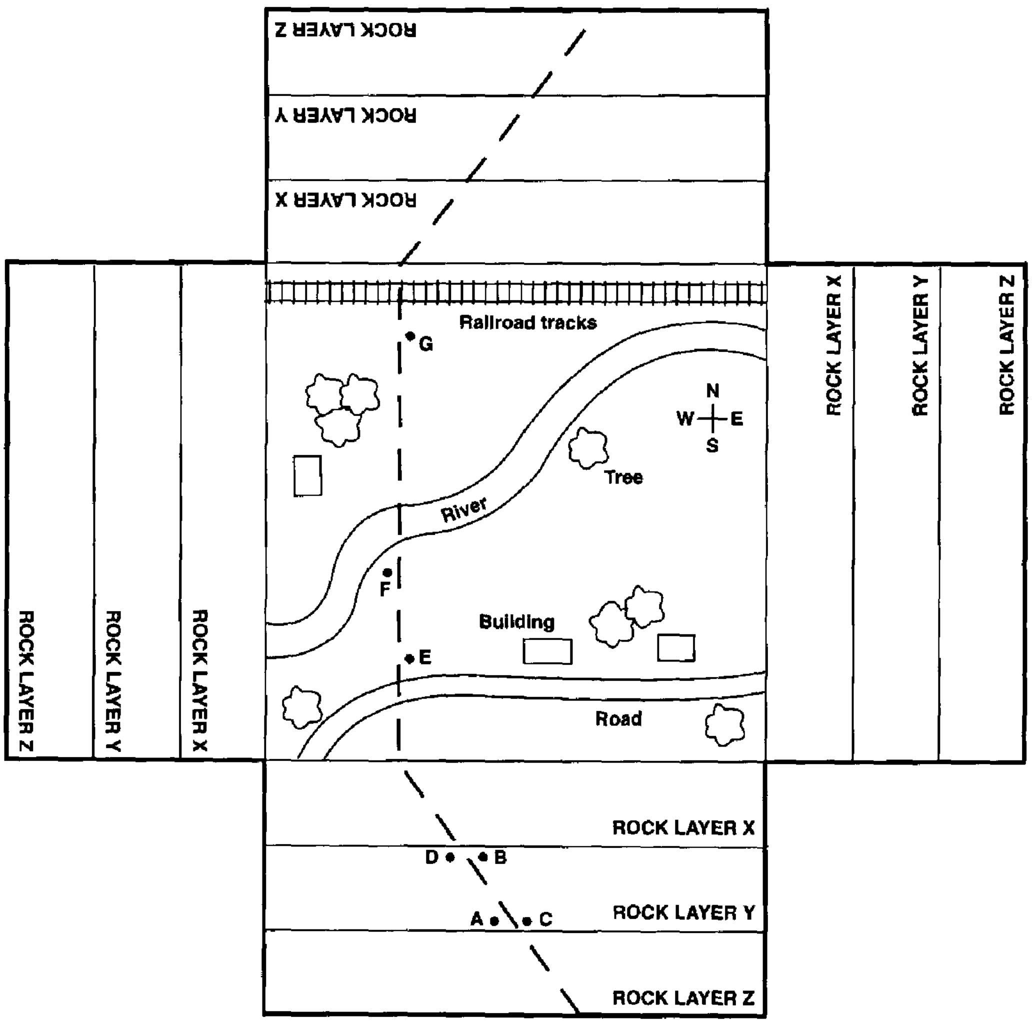


Rural Community After an Earthquake

Name ______________



Fault Model


ROCK LAYER Z
ROCK LAYER Y
ROCK LAYER X
Railroad tracks
G
N
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Tree
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Building
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ROCK LAYER X
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Tsunami Facts

Tsunami
- ◆ Japanese word
- ◆ pronounced: soo • nah • me
- ◆ means "wave in the harbor"
- ◆ misnamed as "tidal waves"

Caused by:
- ◆ earthquake
- ◆ other movements on the ocean floor

Travel at speeds up to 600 miles per hour

Tsunami traveling in deep water and open ocean cause no damage and are hardly noticeable.

Tsunami traveling in shallow water can batter coastlines with waves as high as 100 feet, causing considerable damage.

Tsunami Warning Centers

Post warnings when earthquake of tsunami potential occurs.

Notable Tsunami

November 1, 1755. A Lisbon, Portugal earthquake generated tsunamis that hit the west coasts of Spain, Portugal, and Morocco.

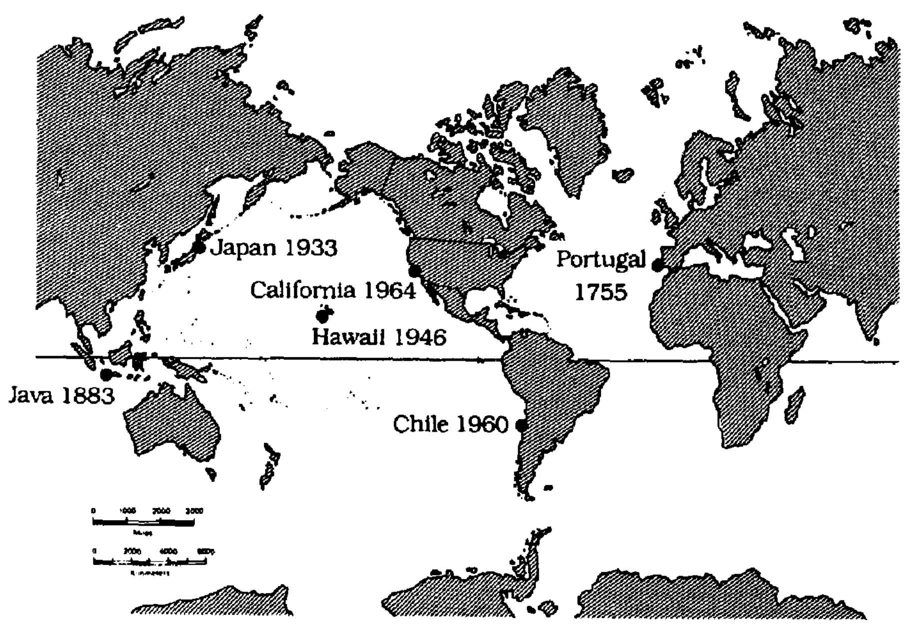
August 27, 1883. The volcanic eruption and explosion on the island of Krakatoa (west of Java in the East Indies) generated a tsunami that sent 100-foot (about 30 meters) waves crashing into Java and Sumatra, drowning 36,500 people.

March 2, 1933. An earthquake along a submarine fault in the Japan trench (subduction zone) generated a tsunami that struck the Japanese coast with wave crests as high as 25 meters, killing 3,000 people.

April 1, 1946. An earthquake on the sea bottom near the Aleutian Islands generated a tsunami that struck Hilo, Hawaii, killing 159 people.

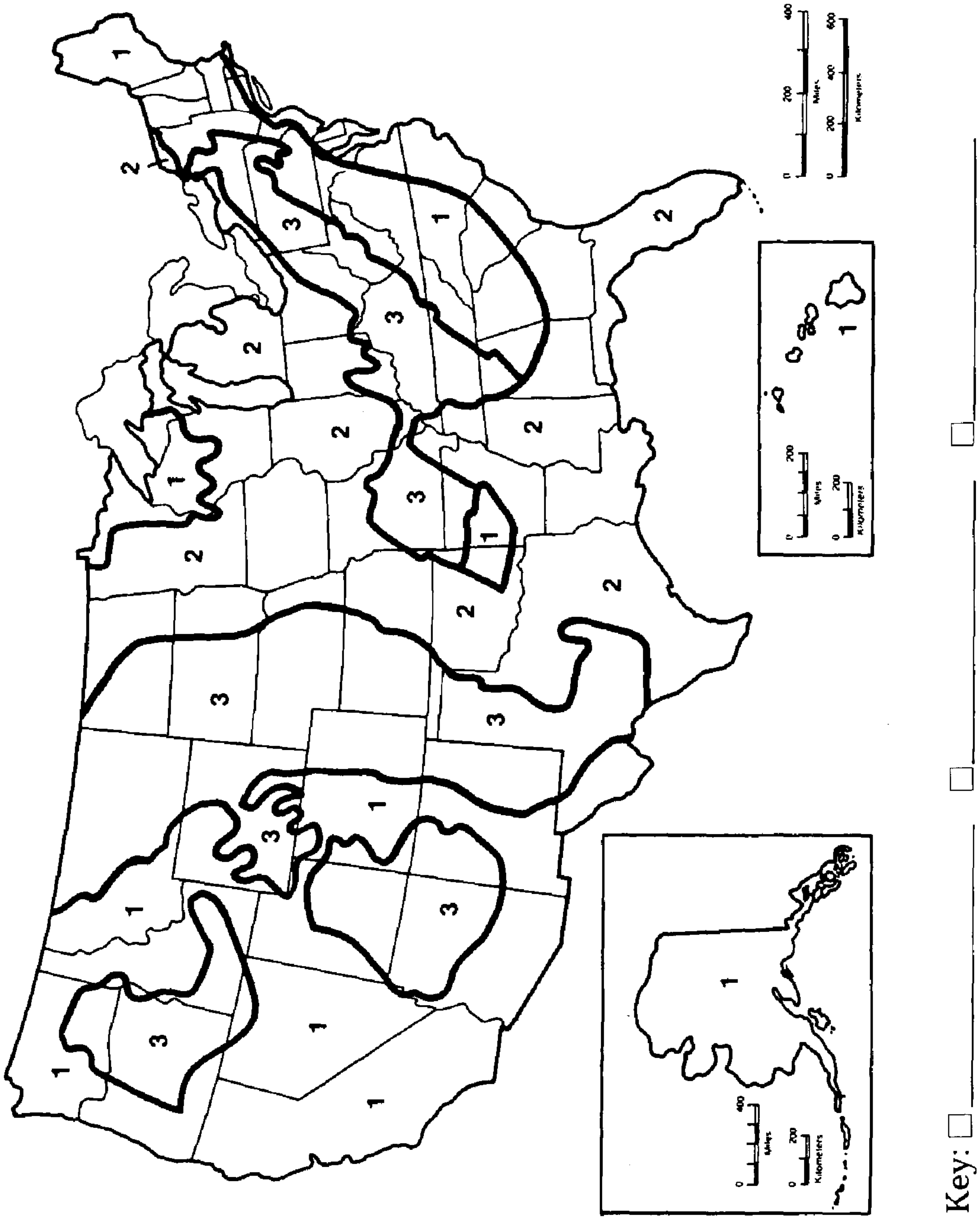
May 22, 1960. An earthquake in Chile generated a tsunami, killing 1,000 people in Chile, Hawaii, the Philippines, and Japan.

March 28, 1964. The powerful Alaskan earthquake caused a tsunami that came ashore in many places, including Cresent City, California. It caused a total of 122 deaths and $104,000,000 in damage, overall. Waves were 52 meters (about 170 feet) high in Valdez, Alaska.

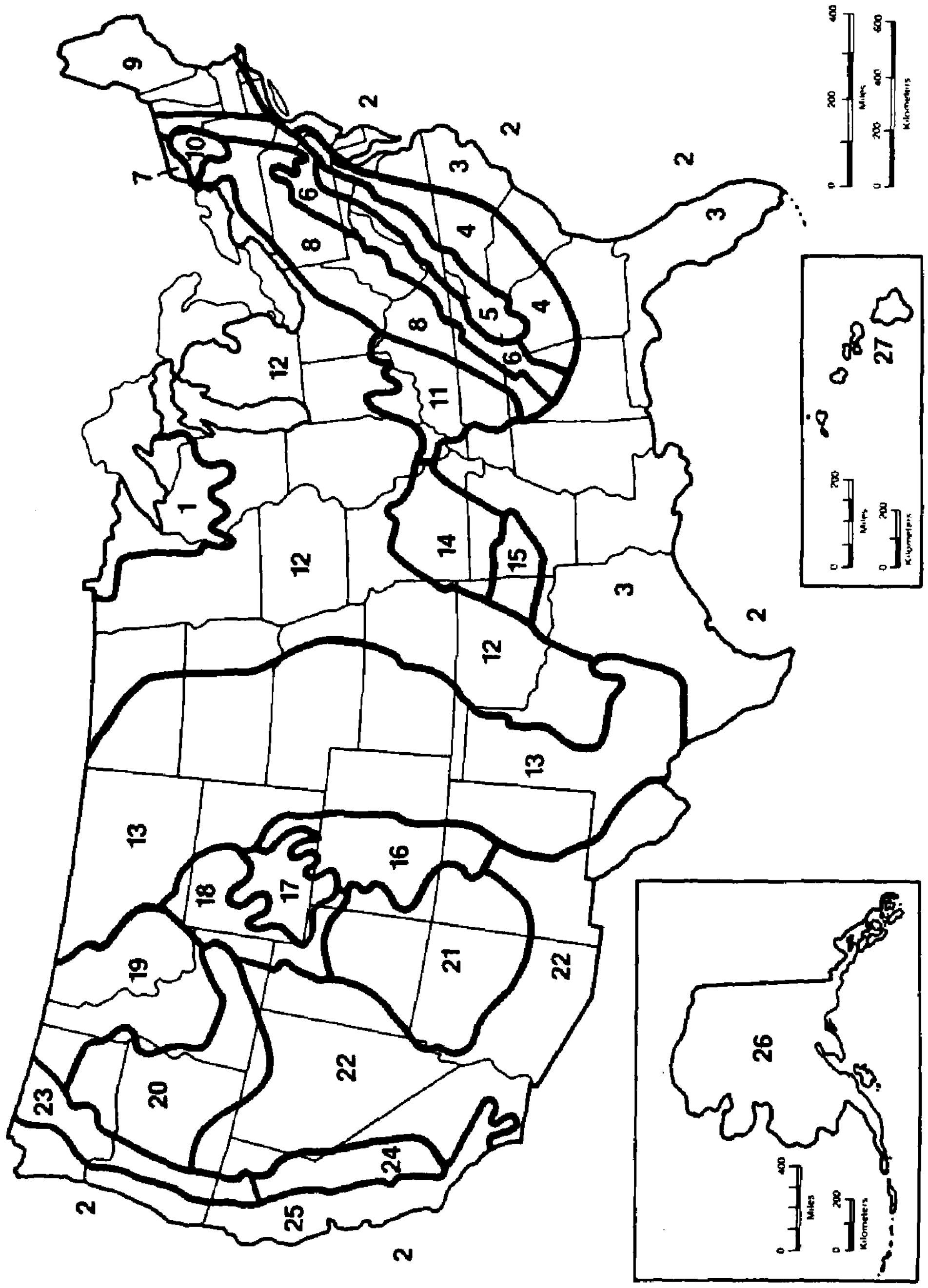


Landscape Regions Worksheet

Name ______________________________



Landscape Regions of U.S.



Landscape Regions Key

1. Superior Uplands - mountains **(1)**
2. Continental Shelf - plains **(2)**
3. Coastal Plain - plain **(2)**
4. Appalachian Piedmont - mountains **(1)**
5. Blue Ridge Appalachians - mountains **(1)**
6. Folded Appalachians - mountains (folded) **(1)**
7. St. Lawrence Valley - plain **(2)**
8. Appalachian Plateaus - plateau **(3)**
9. New England Uplands - mountains **(1)**
10. Adirondack Mountains - mountains **(1)**
11. Interior Low Plateaus - plateau **(3)**
12. Central Lowlands - plateau **(3)**
13. Great "Plains" - plateau **(3)**
14. Ozark Plateau - plateau **(3)**
15. Ouachita Mountains - mountains (folded) **(1)**
16. Southern Rocky Mountains - mountains **(1)**
17. Wyoming Basin - plateau **(3)**
18. Middle Rocky Mountains - mountains **(1)**
19. Northern Rocky Mountains - mountains **(1)**
20. Columbia Plateau - plateau **(3)**
21. Colorado Plateau - plateau **(3)**
22. Basin and Range - mountains (fault block) **(1)**
23. Cascade Mountains - mountains **(1)**
24. Sierra Nevada Mountains - mountains **(1)**
25. Pacific Coastal Ranges - mountains **(1)**
26. Alaska (mostly mountains) - mountains **(1)**
27. Hawaii (composed of volcanos) - mountains **(1)**

Ocean Bottom