

## Targeted Age:

Middle to High School

## Activity Structure:

Individual assignment

## Indiana Standards and Objectives:

7.ESS.3, 7.ESS.4,  
ES.6.7, ES.5.6, ES.6.5, ES.6.7

## MATERIALS NEEDED

- Colored pencils or crayons
- Scissors
- Tape
- Printed copies of foldable fault block activity

## Introduction

In this lesson, students will create three-dimensional (3-D) blocks out of paper to learn about the types of faulting that occur at the Earth's surface and its interior. Students will manipulate three fault blocks to demonstrate a normal fault, reverse fault, and strike-slip fault, and explain how movement along a fault generates earthquakes because of the sudden release of energy in the Earth's crust.

## Background Information

The outer crust of the Earth is divided into huge plates, much like a cracked eggshell. Driven by convection currents that permit heat to escape from the Earth's interior, the plates move at a rate of about a ½ inch to 4 inches per year, displacing continental land masses and ocean floor alike. The forces that move the plates create stresses within the Earth's crust, and can cause the crust to suddenly fracture. The area of contact between the two fractured crustal masses is called a fault. Earthquakes result from sudden movements along faults, creating a release of energy. Movement along a fault can be horizontal, vertical, or both.

Studies show that the crust under the central United States was torn apart, or rifted, about 600 million years ago. This rift did not completely separate the crust into individual plates, but it did create zones of faulting in the Mississippi River Valley region. Indiana earthquakes that have occurred in the last 200 years are related to these now-deeply buried faults. Many of the mapped faults in Indiana are in the southwestern corner of the state. These faults extend into Illinois and northern Kentucky and are collectively known as the Wabash Valley Fault System. Because the crust is weak in this area, the faults are likely candidates for future movement.

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The point on the Earth's surface directly above the center of an earthquake is called the epicenter. During the last two centuries, earthquakes having epicenters that originate in Indiana have been relatively minor events. However, this has not always been the case. Researchers have found dozens of ancient sandblows, which give evidence that at least six major earthquakes with epicenters in Indiana happened in the last 12,000 years. The largest of these appears to have had an epicenter at or near Vincennes; this event is estimated as having been more powerful than the Northridge earthquake that struck the Los Angeles area in January 1994.

## Vocabulary

**Compression** – a stress that squeezes rocks together resulting from forces applied perpendicular to a fault plane

**Hanging Wall** – a block of crust that lies beneath the fault plane

**Hypocenter** – the point within the Earth's crust where an earthquake begins; also commonly termed the focus

**Earthquake** – the shaking or vibration of the ground surface in response to the sudden release of energy caused by fault movement

**Epicenter** – the point on the Earth's surface vertically above the hypocenter

**Fault** – a fracture in the Earth's crust where one side moves relative to the other

**Fault Plane** – the flat (planar) surface along which there is movement during an earthquake

**Foot Wall** – a block of crust that is located above the fault plane

**Normal Fault** – a fracture in the Earth's crust where the hanging wall moves down relative to the foot wall

**Reverse Fault** – a fracture in the Earth's crust where the hanging wall moves up relative to the foot wall

**Shear** – a stress that moves rock in opposite directions resulting from forces applied parallel to a fault plane

**Strike-Slip Fault** – a fracture in the Earth's crust where two blocks of crust move laterally relative to one another

**Tectonic Plates** – the rigid, thin, irregularly-shaped slabs of solid rock that move relative to one another on the outer surface of the Earth

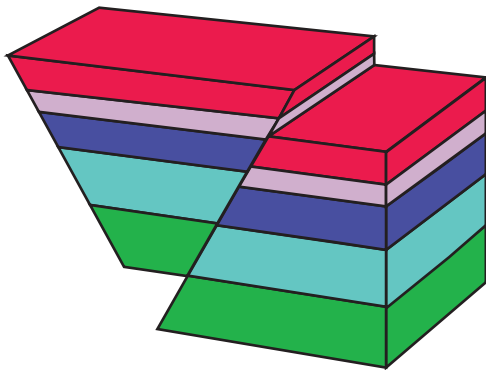
**Tension** – a stress that pulls rocks apart resulting from forces applied perpendicular to a fault plane

## Teacher Reference Page

### Fault

A fracture in the Earth's crust where one side moves relative to the other. Sudden movements in faults cause earthquakes.

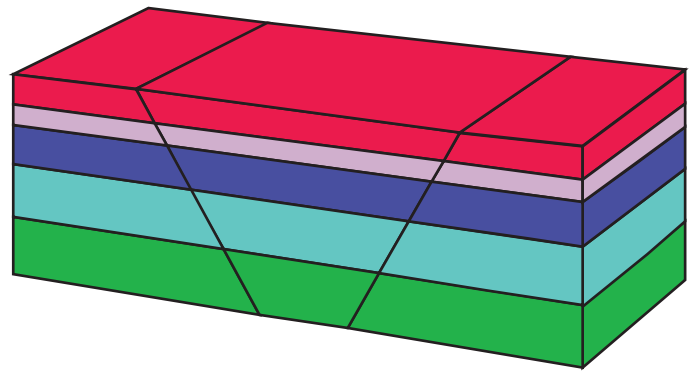
The fault plane in this diagram is the area of contact between the two fault blocks. Fault planes may contain striations or slickensides that can indicate the direction of fault motion.



### Fault Blocks

Fault blocks represent blocks of the Earth's crust. Each color represents a layer of the Earth, while the diagonal black lines represent faults in the Earth's crust.

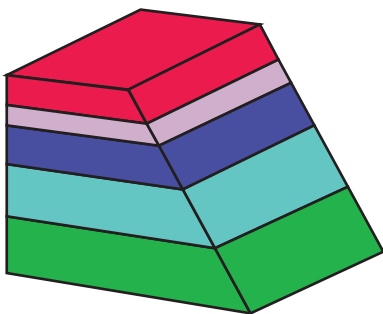
In this position, the fault blocks represent unfaulted, or unmoved, crust.



### Foot Wall

A foot wall is a block of crust that lies underneath a fault plane.

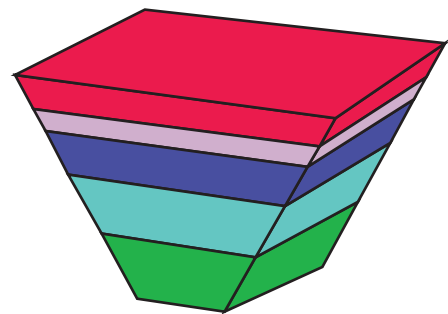
*Hint for Identification:* If a person were able to stand on the fault plane, their feet would be on the foot wall.



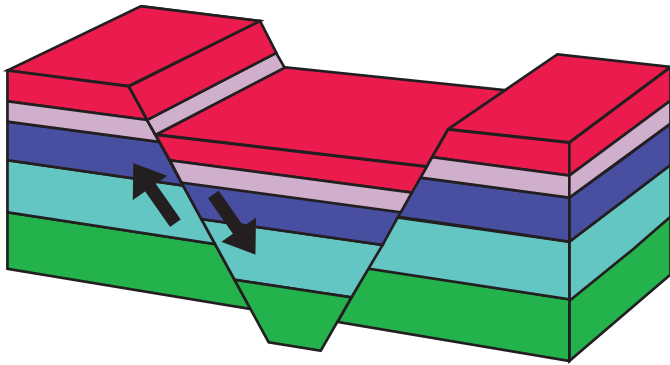
### Hanging Wall

A hanging wall is a block of crust that is located above a fault plane. Its shape rests or hangs on the foot wall.

*Hint for Identification:* If a person were able to stand on the fault plane, they could hang onto the hanging wall.



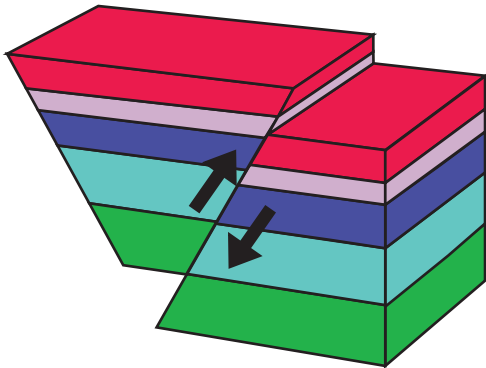
## Teacher Reference Page – Types of Faults



### Normal Fault

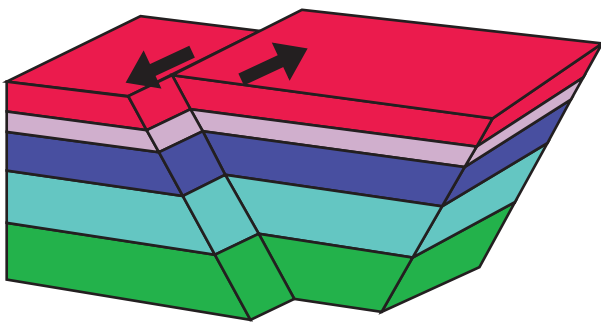
In this position, the hanging wall moved down relative to the foot wall, indicating normal fault activity. This picture shows that the central hanging wall moved down relative to the other foot walls. When a hanging wall moves down, a cliff face is formed, called a “fault scarp.”

All of the known faults in Indiana are normal faults.



### Reverse Fault

In this position, the hanging wall moved up relative to the foot wall, indicating reverse fault activity. This picture shows that the central hanging wall was pushed up relative to the foot wall.



### Strike-Slip Fault

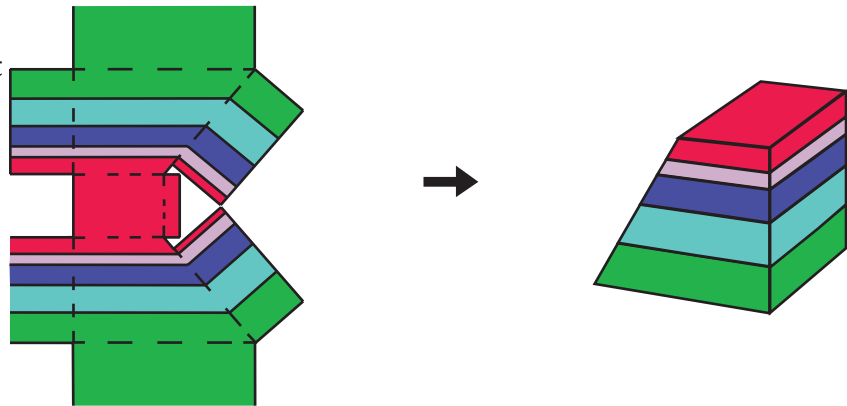
In this position, the blocks of crust have laterally moved relative to each other, indicating strike-slip fault activity. Lateral, or side-to-side, motion does not produce a fault scarp but can create weaker areas of rock where fault blocks slide past one another.

The Earth is complex! In real life, faults can combine several of these movements. For example, the famous San Andreas Fault in California has a strike-slip motion 95 percent of the time and a reverse fault motion 5 percent of the time.

## Procedure

1. Distribute the printable fault blocks and student data sheets to each student. Review the vocabulary terms and earthquake history of Indiana prior to beginning the activity.
2. Instruct students to color the blocks. Each block has five layers with numbers to guide coloring. Students should color each numbered layer the same color on each block; for example, layer 1 is red on all blocks, layer 2 is green on all blocks, and so forth.

3. Instruct students to carefully cut out the fault block along the outer solid black lines. Once cut out, students should fold on the dotted lines to form the blocks. Tape the flaps together to create a 3-D fault block. Repeat until all three fault blocks are assembled.



4. Once the fault blocks are assembled, students should manipulate the blocks and locate the footwall, hanging wall, fault, and epicenter.
5. Once students have observed the fault blocks, compare and contrast the types of faulting. Instruct students to use their reference sheet and simulate each type of fault with the 3-D fault blocks, emphasizing the relative motions of the footwall and hanging wall.
6. Ask the class what relationship exists between faulting and earthquakes. Discuss compressional forces along tectonic plate boundaries.
7. Allow students to review the activity through the reflection questions.

**What is the relationship between faults and earthquakes? Ask students to demonstrate the types of faulting that form from compressional forces.**

Name:

\_\_\_\_\_

Class Period:

\_\_\_\_\_

Vocabulary:

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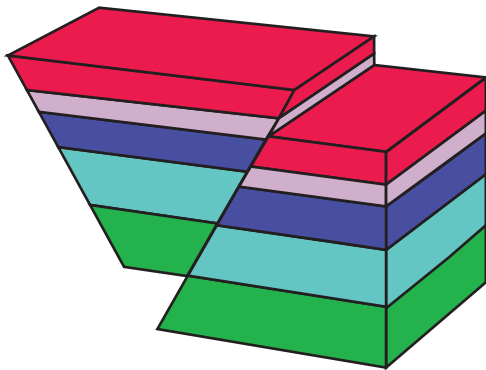
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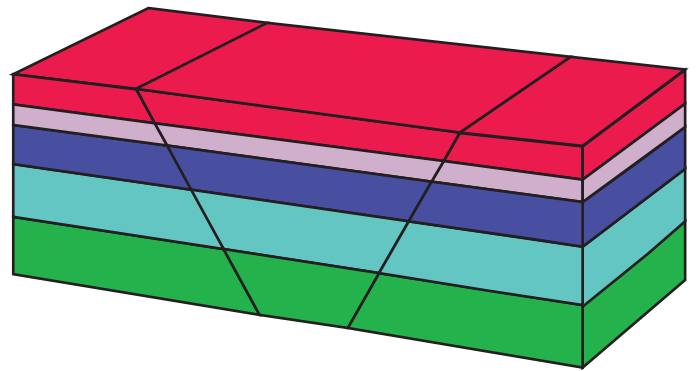
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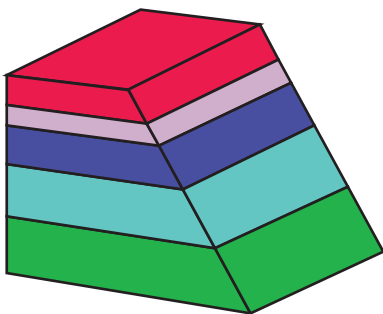
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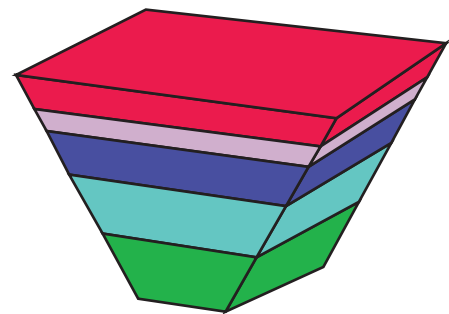
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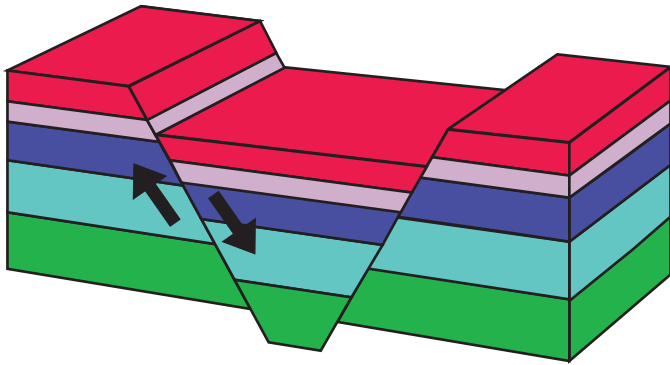
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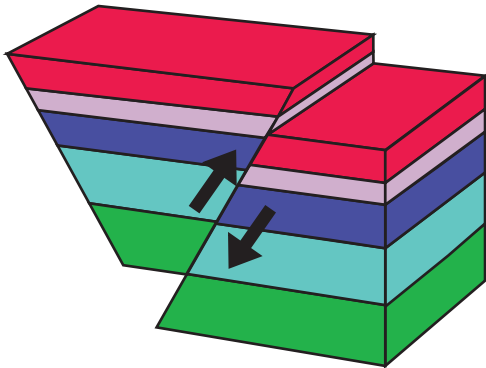
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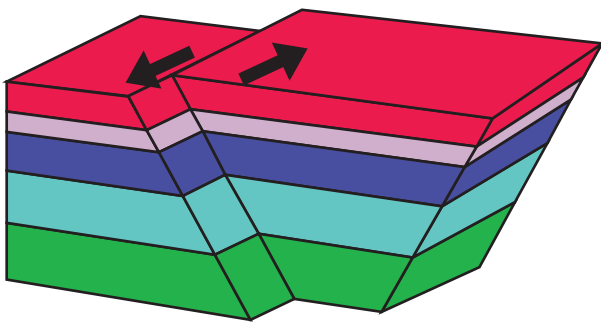
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## Reflection Questions

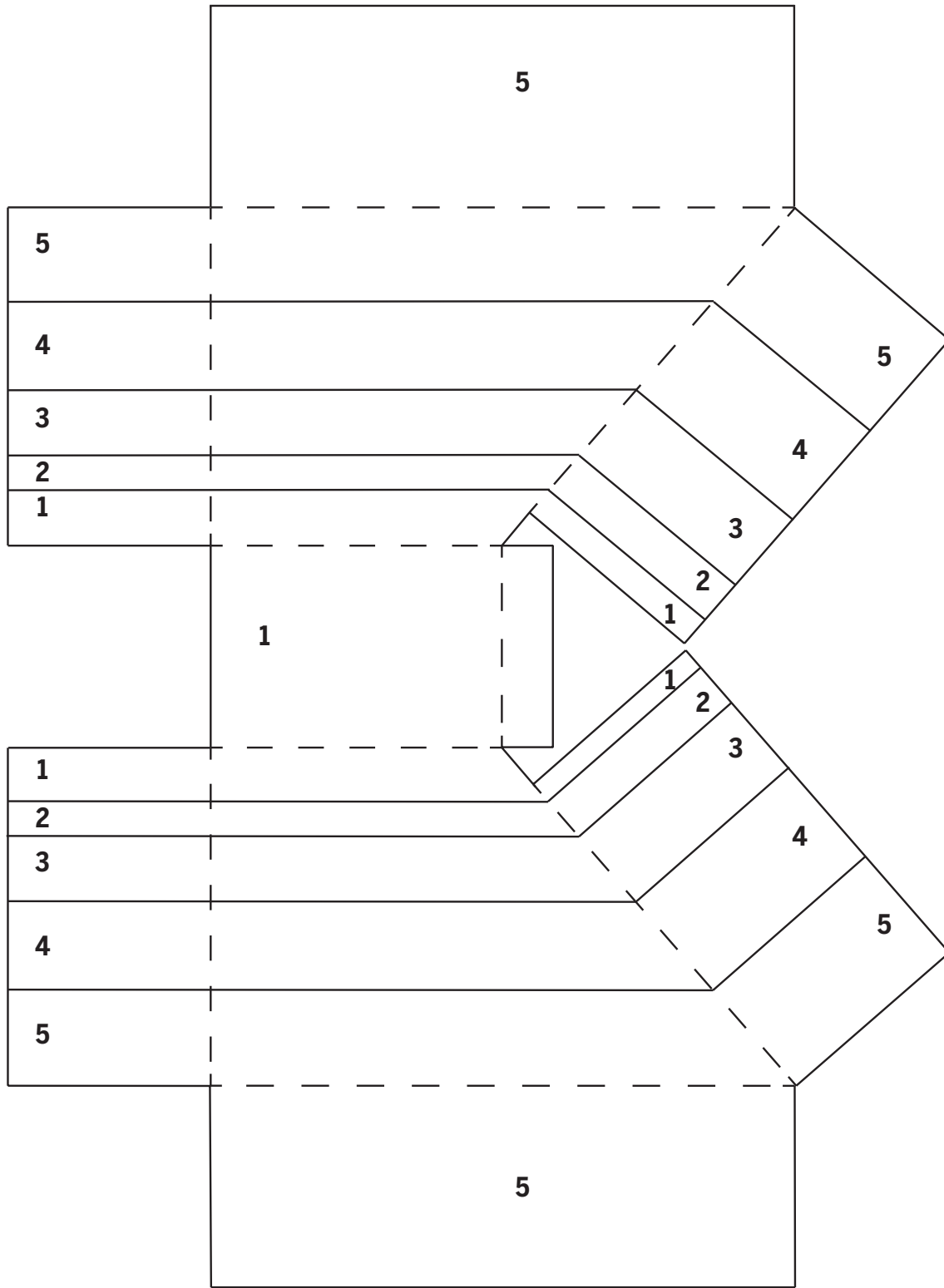
1. Draw a cross-section of a normal fault in the space below. Label the following vocabulary terms on your drawing: fault, foot wall, hanging wall, epicenter, hypocenter
2. What are the three types of faults generated in the Earth's crust? Use vocabulary terms, such as "hanging wall" and "foot wall," to describe each fault.
3. Match each type of stress to its corresponding type of fault. Explain your choices.

*Hint: think about the direction of movement caused by the stress*

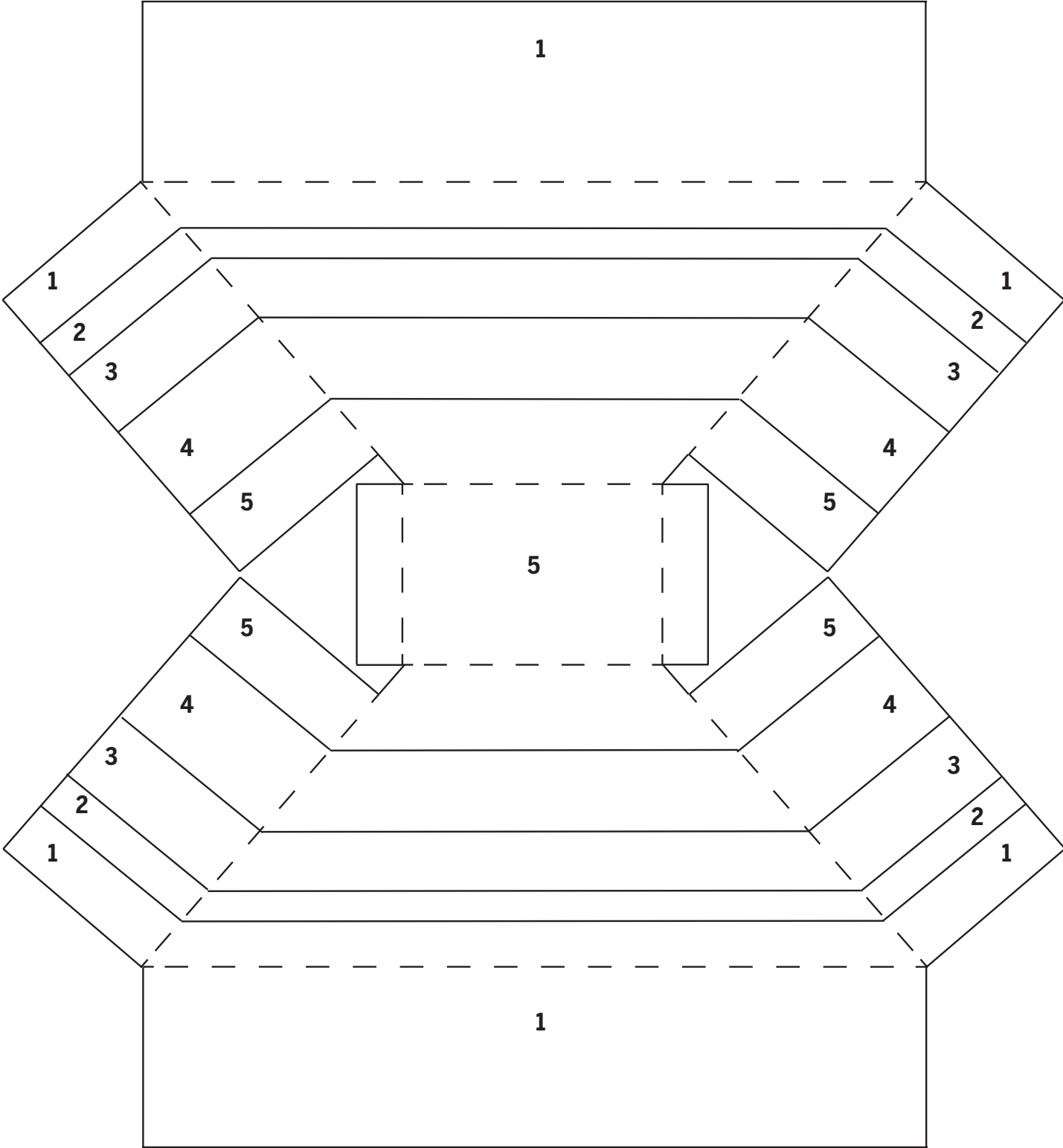
Type of Stress	Fault Produced? NF – Normal Fault RF – Reverse fault SF – Strike-slip fault	Justification
Compression		
Tension		
Shear		

4. What is the relationship between faults and earthquakes?

# Foldable Fault Block Activity



# Foldable Fault Block Activity



# Foldable Fault Block Activity

