

## SECTION 2 Relative Dating: Which Came First?

### BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- What is relative dating?
- How can rock layers be disturbed?

National Science Education Standards  
ES 2b

### What Is Relative Dating?

Imagine that you get a newspaper every day. At the end of the day, you stack the day's paper on top of the paper from yesterday. In time, you build up a large stack of newspapers. Where are the oldest newspapers in the pile? Where are the newest ones? The oldest papers are at the bottom of the pile, and the newest ones are at the top.

Layers of rock are similar to your stack of newspapers. In most cases, the oldest layers of rock are found below the youngest layers. The idea that younger rocks lie above older rocks is called **superposition**.

The idea of superposition can help geologists learn the order in which different rock layers formed. In general, rock layers near the top of a rock sequence formed after layers of rock lower in the sequence. Therefore, the layers at the top of the sequence are younger than the layers lower down. Figuring out whether a rock layer is older or younger than the layers around it is called **relative dating**. ✓

### STUDY TIP

**Compare** In your notebook, make a chart explaining different ways that rock layers can be changed after they form.

### READING CHECK

**1. Define** What is relative dating?

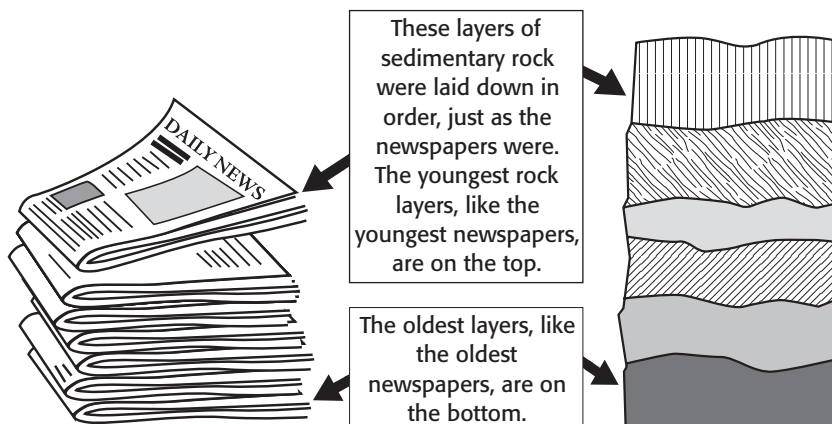
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The idea of \_\_\_\_\_ says that rock layers at the bottom of a body of rock are older than layers at the top. Geologists can use this idea to determine the relative age of different rock layers.

### TAKE A LOOK

**2. Identify** Fill in the blank line in the figure.

**SECTION 2** Relative Dating: Which Came First? *continued*

 **Say It**

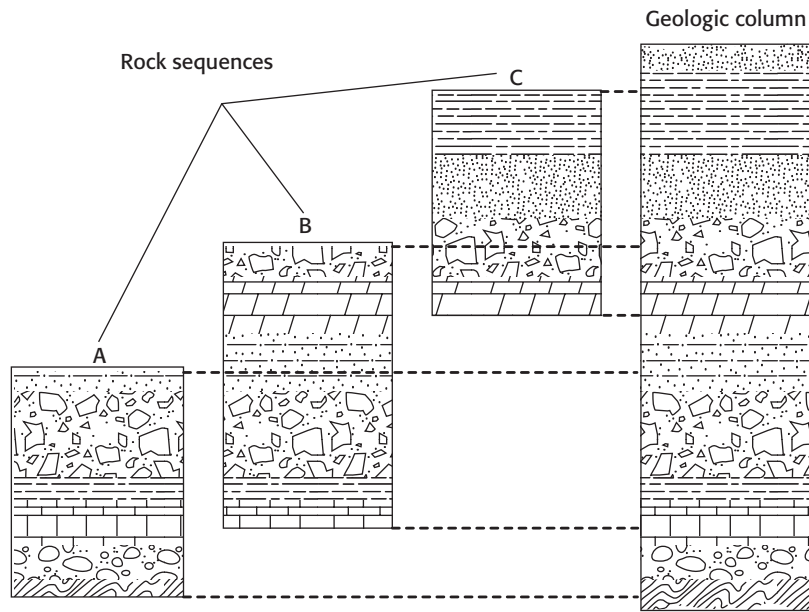
**Share Experiences** Have you ever been to a place where you could see many rock layers stacked up? In a group, talk about what you observed.

**THE GEOLOGIC COLUMN**

The idea of superposition only applies to rock layers that have not been changed after they formed. However, not all rock layers are undisturbed. Forces from inside the Earth and processes on the Earth’s surface can affect rock layers. These forces and processes can break rock layers apart or cause them to bend or tilt. Sometimes, the forces can even turn the rock layers upside down!

These disruptions can make it difficult for a geologist to determine the relative ages of different rocks. However, geologists have an important tool that can help them in relative dating: the geologic column.

The **geologic column** is a detailed series of rock layers. It contains all the known fossils and rock formations on Earth, ordered from oldest to youngest. Geologists have created the geologic column by combining information from all over the world.



**TAKE A LOOK**

**3. Explain** How do geologists construct the geologic column?

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The three rock sequences (A, B, and C) are from three different places on Earth. Some of the rock layers are found in more than one rock sequence. Geologists construct the geologic column by combining information from rock sequences around the world.

Geologists use the geologic column to help them interpret rock sequences. They also use it to help them identify rock layers in complicated rock sequences.

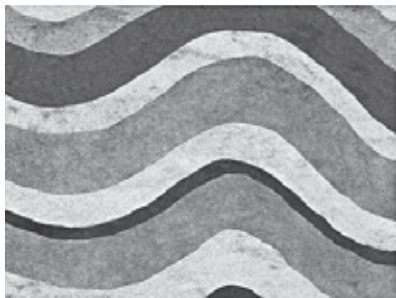
**SECTION 2** Relative Dating: Which Came First? *continued*

**How Can Rock Layers Be Disturbed?**

Gravity causes sediment to be deposited in flat, horizontal layers. Flat, horizontal layers of sediment should form flat, horizontal layers of rock. If rock layers are not horizontal, then some force must have disturbed them after they were formed. ✓

**CHANGED ROCK LAYERS**

Folding and tilting are two ways that rock layers can be disturbed. *Folding* happens when rock layers are bent because of pressure. *Tilting* happens when forces from inside Earth move rock layers so that they are slanted.

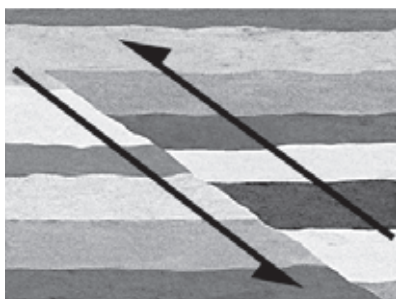


Folding happens when rock layers bend and buckle under pressure.

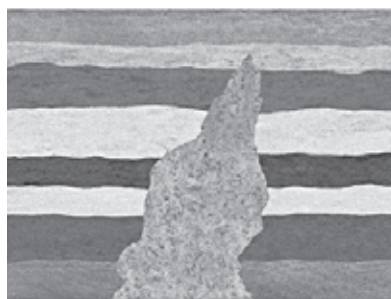


Tilting happens when forces from inside Earth cause rock layers to become slanted.

Faults and intrusions can cut across many rock layers. A *fault* is a break or crack in Earth's crust. Large pieces of rock can move or slide along a fault. An *intrusion* forms when melted rock moves into cracks in rock layers and then cools. ✓



A fault is a break in Earth's crust. Rock can slide along a fault and disturb rock layers.



Intrusions form when melted rock moves through cracks in rock layers. The melted rock cools and hardens to form igneous rock.

**READING CHECK**

**4. Describe** What is one thing that tells a geologist that rock layers have been disturbed?

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**TAKE A LOOK**

**5. Compare** How is folding different from tilting?

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**READING CHECK**

**6. Identify** What kind of rock is an intrusion made of?

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**TAKE A LOOK**

**7. Define** What is a fault?

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**SECTION 2** Relative Dating: Which Came First? *continued*

### Critical Thinking

**8. Infer** Imagine that you are a geologist and you find an unconformity between two rock layers. What can you guess about the environment at the time the unconformity was forming?

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### TAKE A LOOK

**9. Identify** Give two ways that an unconformity can form.

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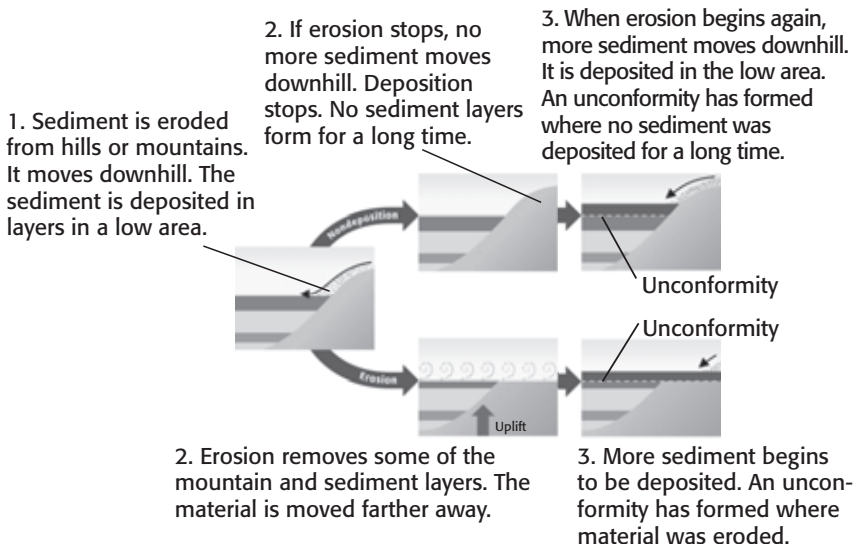
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### MISSING ROCK LAYERS

Think back to your stack of newspapers. Imagine that you want to read something in the paper from Valentine’s Day, February 14. However, when you look, the paper from February 14 is not there. The papers go from February 13 to February 15. What happened? Maybe you didn’t put that day’s newspaper on the stack. Maybe someone took that paper out of the stack.

The same ideas that apply to a missing newspaper apply to a missing rock layer. An **unconformity** is a break in, or a missing part of, the geologic record. Unconformities can form when sediment is not deposited in an area for a long time. If sediment is not deposited, no new layer of rock can form. This is like your forgetting to put a newspaper onto the stack.

Unconformities can also form when erosion removes a layer of rock after it formed. This is like someone taking a paper out of the stack.

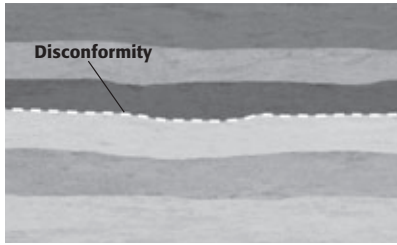


Geologists put all unconformities into three main groups: disconformities, nonconformities, and angular unconformities.

### DISCONFORMITIES

A *disconformity* is a place where part of a sequence of parallel rock layers is missing. Disconformities can form when a sequence of rock layers is pushed up because of forces inside the Earth. Erosion removes the younger layers of rock at the top of the sequence, forming an *erosion surface*. Later, deposition starts happening again, and sediment buries the erosion surface.

**SECTION 2** Relative Dating: Which Came First? *continued*



Disconformities are the most common kind of unconformity. The rock layers above the disconformity may be thousands to many millions of years younger than those below it.

**TAKE A LOOK**

**10. Define** What is a disconformity?

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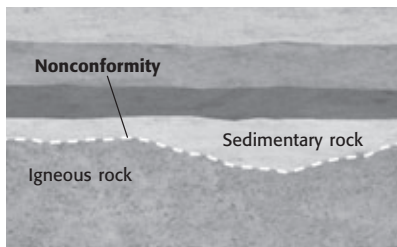
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**NONCONFORMITIES**

A *nonconformity* is a place where sedimentary rocks are found on top of eroded igneous or metamorphic rocks. The igneous or metamorphic rocks can be pushed up by forces inside the Earth. Then, erosion can remove some of the rock. Later, sediment may be deposited on top of the eroded rock. ✓



The rock layers above a nonconformity may be millions of years younger than those below it.

**READING CHECK**

**11. Explain** How do nonconformities form?

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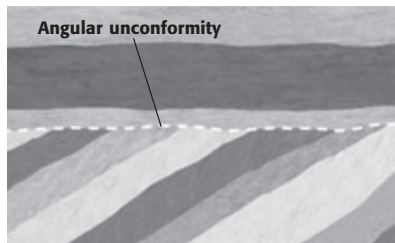
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**ANGULAR UNCONFORMITIES**

An *angular unconformity* is a place where horizontal rock layers lie on top of tilted or folded rock layers. The tilted or folded layers were eroded before the horizontal layers formed above them.



The rock layers above an angular unconformity may be millions of years younger than those below it.

**TAKE A LOOK**

**12. Compare** How is a nonconformity different from an angular unconformity?

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Folding, tilting, faults, intrusions, and unconformities all disturb rock layers. Sometimes, a single rock body may have been disturbed many times. Geologists must use their knowledge of the things that disturb rock layers to piece together the Earth's history.

# Section 2 Review

## SECTION VOCABULARY

**geologic column** an ordered arrangement of rock layers that is based on the relative ages of the rocks and in which the oldest rocks are at the bottom

**relative dating** any method of determining whether an event or object is older or younger than other events or objects

**superposition** a principle that states that younger rocks lie above older rocks if the layers have not been disturbed

**unconformity** a break in the geologic record created when rock layers are eroded or when sediment is not deposited for a long period of time

1. **Identify** Give two ways that an unconformity can form.

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2. **Apply Concepts** If the tops of the rock layers in the figure below were eroded and then deposition started happening again, what kind of unconformity would have formed?




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3. **Describe** What does the idea of superposition say about rock layers that have not been disturbed?

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4. **Identify** Give two ways in which geologists use the geologic column.

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5. **Explain** How does a disconformity form?

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