Properties of Minerals

What Is a Mineral?

1a. SUMMARIZE All minerals must be able to form from (organic/inorganic) processes.

b. EXPLAIN What, specifically, makes a process inorganic?

c. CLASSIFY Amber is a material used in jewelry. It forms only by the process of pine tree resin hardening into stone. Is amber a mineral? Explain.

got it? .................................................................

○ I get it! Now I know that to be classified as a mineral, a substance must be __________________

○ I need extra help with __________________

How Are Minerals Identified?

2a. SUMMARIZE Geologists identify minerals by examining their __________________

b. DESIGN EXPERIMENTS Lodestone is magnetic. How might you identify whether a mineral sample might be lodestone?

Properties of Minerals

got it? .................................................................
○ I get it! Now I know that the characteristic properties used to identify minerals are

........................................................................

........................................................................

........................................................................

○ I need extra help with ...........................................

........................................................................

How Do Minerals Form?

3a. REVIEW Magma below Earth's surface cools (slowly/quickly).
   b. PREDICT Slow cooling of magma leads to what size mineral crystals?

........................................................................

........................................................................

........................................................................

got it? .................................................................
○ I get it! Now I know that the three general ways minerals form are when

........................................................................

........................................................................

........................................................................

○ I need extra help with ...........................................

........................................................................
Properties of Minerals

Understanding Main Ideas
Answer the following questions on a separate sheet of paper.

1. List the five characteristics necessary for a substance to be a mineral.
2. In general, what are three ways in which minerals form?

Fill in the missing properties in the table below.

<table>
<thead>
<tr>
<th>Mineral Property</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>Perform scratch test</td>
</tr>
<tr>
<td>Color</td>
<td>Observe surface of mineral</td>
</tr>
<tr>
<td>4.</td>
<td>Observe color of mineral’s powder</td>
</tr>
<tr>
<td>Luster</td>
<td>Observe how mineral reflects light</td>
</tr>
<tr>
<td>5.</td>
<td>Find mass per unit volume</td>
</tr>
<tr>
<td>6.</td>
<td>Observe number and angle of crystal faces</td>
</tr>
<tr>
<td>Cleavage and Fracture</td>
<td>Break mineral apart to see if it splits along flat surfaces</td>
</tr>
</tbody>
</table>

Building Vocabulary
Match each term with its definition by writing the letter of the correct definition in the right column on the line beside the term in the left column.

7. ___ streak
   a. formed from materials that were not a part of living things

8. ___ fracture
   b. the property of splitting easily along flat surfaces

9. ___ Mohs hardness scale
   c. how a mineral breaks apart in an irregular way

10. ___ crystal
    d. the repeating pattern of a mineral’s particles in a solid

11. ___ cleavage
    e. the color of a mineral’s powder

12. ___ inorganic
    f. a ranking of minerals from softest to hardest

13. ___ solution
    g. a mixture in which one substance is dissolved in another
Properties of Minerals

Geologists classify crystals into six groups according to the number and angle of the crystal faces. Follow the steps below to make models of two of those crystal shapes by using the patterns shown.

Crystal Shapes

Procedure
1. Cut out each pattern by cutting only along the solid lines.
2. Fold the first pattern along each of the dashed lines. Make each fold so that the dashed line is on the outside edge of the fold. Side A should be opposite side AA, side B opposite side BB, and so on.
3. To hold the model together, use clear tape to attach each tab to the side it now overlaps.
4. Repeat Steps 2 and 3 with the second pattern.
5. Try to make your own paper models for the four other types of crystals.

Cubic

Hexagonal
## Properties of Minerals

### What Is a Mineral?

A mineral is a naturally occurring solid that can form by inorganic processes and that has a crystal structure and a definite chemical composition. For a substance to be a mineral, it must have all five of these characteristics.

The repeating pattern of a mineral’s particles forms a solid called a crystal. All minerals must be able to form by inorganic processes, meaning from materials that were not a part of living things.

### How Are Minerals Identified?

Each mineral has characteristic properties that can be used to identify it. They include color, streak, luster, hardness, density, crystal structure, cleavage, fracture, and special properties. The **streak** of a mineral is the color of its powder. **Luster** is the term used to describe how light is reflected from a mineral’s surface. The **Mohs hardness scale** is used to rank the hardness of minerals. The repeating pattern of a mineral’s atoms forms a mineral’s crystal structure. Each mineral has a characteristic density.

A mineral that splits easily along flat surfaces has the property called cleavage. Fracture describes how a mineral looks when it breaks apart in an irregular way.

### How Do Minerals Form?

- **A geode** is a rounded, hollow rock that is often lined with mineral crystals. **Crystallization** is the process by which atoms are arranged to form a material that has a crystal structure. **In general, minerals can form in three ways.** Some minerals form from organic processes. Other minerals can crystallize from materials that are dissolved in solutions. Finally, many minerals crystallize as magma and lava cools. All minerals can form by inorganic processes. However, some minerals can also form by organic processes.

- **A solution** is a mixture in which one substance is dissolved in another. When elements and compounds that are dissolved in water leave a solution, crystallization occurs.

- Minerals form as hot magma cools inside the crust, or as lava hardens on the surface. When these liquids cool to a solid state, they form crystals. A vein is a narrow channel or slab of a mineral that is different from the surrounding rock.

On a separate sheet of paper, explain how one mineral differs from another.
Classifying Rocks

How Do Geologists Classify Rocks?

1a. REVIEW Geologists classify rocks according to their ____________

b. EXPLAIN How do igneous rocks form?

c. CLASSIFY Pumice is a type of rock that forms from molten material that erupts violently from a volcano. To what group of rock does pumice belong?

got it? .................................................................

○ I get it! Now I know that geologists classify rocks into three major groups called ____________

○ I need extra help with ____________

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## Classifying Rocks

### How Do Geologists Classify Rocks?

<table>
<thead>
<tr>
<th>To study a rock sample, geologists observe the rock's mineral composition, color, and texture.</th>
<th>Geologists use terms that are based on size, shape, and pattern of the grains.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rocks are made of mixtures of minerals and other materials. About 20 minerals make up most of the rocks of Earth's crust. These minerals are known as rock-forming minerals.</td>
<td>Geologists have classified rocks into three major groups: igneous rock, sedimentary rock, and metamorphic rock. Each of these groups of rocks forms in a different way.</td>
</tr>
<tr>
<td>A rock's color provides clues to the rock's mineral composition. For example, granite is generally a light-colored rock that has high silica content. That is, it is rich in the elements silicon and oxygen. Basalt is a dark-colored rock that has a lower silica content than granite has. But unlike granite, basalt has mineral crystals that are too small to be seen with the naked eye.</td>
<td>Igneous rock forms from the cooling of magma or lava. The magma hardens underground to form rock. The lava erupts, cools, and hardens to form rock on Earth's surface. Most sedimentary rock forms when small particles of rocks or the remains of plants and animals are pressed and cemented together. Sedimentary rock forms in layers that are buried below the surface. Metamorphic rock forms when a rock is changed by heat or pressure, or by chemical reactions. Most metamorphic rock forms deep underground.</td>
</tr>
</tbody>
</table>

On a separate sheet of paper, describe the characteristics that geologists used to classify rocks.
Classifying Rocks

Understanding Main Ideas
Answer the following questions on a separate sheet of paper.

1. What characteristics do geologists observe when studying a rock sample?
2. Name the three major groups of rocks and describe how each forms.

Fill in the missing information in the table below.

<table>
<thead>
<tr>
<th>Grain Property</th>
<th>Description</th>
<th>Texture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>Large, easy to see</td>
<td>3.</td>
</tr>
<tr>
<td>Size</td>
<td>4.</td>
<td>Fine-grained</td>
</tr>
<tr>
<td>Shape</td>
<td>Mineral crystals</td>
<td>Crystalline</td>
</tr>
<tr>
<td>5.</td>
<td>Rock fragments</td>
<td>Rounded or jagged</td>
</tr>
<tr>
<td>6.</td>
<td>Layered or random grains</td>
<td>Banded or nonbanded</td>
</tr>
</tbody>
</table>

Building Vocabulary
Fill in the blank to complete each statement.

7. ______________ is a dark-colored rock with a relatively low silica content.
8. The look and feel of a rock's surface is its ______________.
9. The particles of minerals or other rocks that make up a rock are called ______________.
10. The 20 minerals make up most of the rocks of Earth's crust are known as ______________.
11. ______________ is generally a light-colored rock with a high silica content.
12. ______________ rock forms when rock particles get pressed and cemented together.
13. ______________ rock forms when a rock is changed by heat or pressure.
14. ______________ rock forms when magma or lava cools and hardens.
Classifying Rocks

The Earth’s crust is made up of different kinds of rocks that have different characteristics. Read the passage and study the graphs below. Then answer the questions that follow on a separate sheet of paper.

A Crust Full of Rocks

The three major groups of rocks make up Earth’s crust. But these groups of rocks are not found in equal amounts. The circle graph in the center below shows each group’s percentage of the crust. The three circle graphs that surround the central one show the percentage of rocks that make up each group. You’ll learn about many of these rocks as you read the rest of the chapter.

1. Which rock group makes up most of Earth’s crust, and what is its percentage?
2. How do rocks in that rock group form?
3. What kind of rocks make up most of the igneous rock? From your knowledge of Earth’s crust, where would you most likely find such rocks?
4. Which rock group makes up least of Earth’s crust, and what is its percentage?
5. How do rocks in that rock group form?
6. What rock makes up the greatest part of metamorphic rocks, and what percentage?
7. How do metamorphic rocks form?
Igneous Rocks

How Do Geologists Classify Igneous Rocks?

1a. IDENTIFY Rhyolite is an (intrusive/extrusive) igneous rock.

b. SUMMARIZE How does rhyolite form?

________________________________________

________________________________________

c. COMPARE AND CONTRAST Rhyolite has a similar composition to granite.
Why is the texture of rhyolite different from the texture of granite?
________________________________________

________________________________________

______________

I get it! Now I know that igneous rocks are classified according to their __________________________

________________________________________

I need extra help with __________________________

________________________________________

How Are Igneous Rocks Used?

______________

I get it! Now I know that throughout history, people have used igneous rocks for __________________________

________________________________________

I need extra help with __________________________

________________________________________
Igneous Rocks

How Do Geologists Classify Igneous Rocks?

Even though all igneous rocks form from magma or lava, igneous rocks can look vastly different from each other. Igneous rocks are classified by their origin, texture, and mineral composition. The texture of an igneous rock depends on the size and shape of its mineral crystals. Rapidly cooling lava forms fine-grained igneous rocks with small crystals or no crystals at all. Slowly cooling magma forms coarse-grained rocks, such as granite, with large crystals. Intrusive rocks have larger grains than extrusive rocks. Extrusive rocks have a fine-grained or glassy texture.

Igneous rock may form on or beneath Earth's surface. Extrusive rock is igneous rock formed from lava that erupted onto Earth's surface. Basalt is the most common extrusive rock. Igneous rock that formed when magma hardened beneath the surface of Earth is called intrusive rock. The most abundant type of intrusive rock in continental crust is granite. Lava that is low in silica usually forms dark-colored rocks such as basalt. Magma that is high in silica usually forms light-colored rocks, such as granite.

How Are Igneous Rocks Used?

People throughout history have used igneous rock for tools and building materials. Granite has been used to build statues, fortresses, bridges, and public buildings. Today, thin polished sheets of granite are used in curbstones and floors. Basalt is used for cobblestones and as a material in landscaping and roads. Pumice is a good abrasive for cleaning and polishing. Obsidian was used to make sharp tools for cutting and scraping. Perlite is mixed with soil and used for starting vegetable seeds.

On a separate sheet of paper, tell how geologists classify igneous rocks. Then explain how a geologist would go about classifying a sample of granite.
Igneous Rocks

Understanding Main Ideas
Answer the following questions on a separate sheet of paper.

1. How are igneous rocks classified?
2. What is the most common type of extrusive rock?
3. What is the most common type of intrusive rock?
4. Explain how the silica content of molten material affects the color of igneous rocks.
5. What qualities of igneous rocks have long made them useful for tools and building materials?
6. Describe one use each for the igneous rocks granite, obsidian, and pumice.

Fill in the missing textures in the table below.

<table>
<thead>
<tr>
<th>Origin of Igneous Rock</th>
<th>Resulting Texture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slow cooling of magma far beneath Earth’s surface</td>
<td>7.</td>
</tr>
<tr>
<td>Rapid cooling of lava in which tiny crystals form</td>
<td>8.</td>
</tr>
<tr>
<td>Extremely rapid cooling of lava in which no crystals form</td>
<td>9.</td>
</tr>
</tbody>
</table>

Building Vocabulary
Fill in the blank to complete each statement.

10. Igneous rock formed from lava that erupted onto Earth’s surface is called ___________ rock.

11. Igneous rock that formed when magma hardened beneath the surface of Earth is called ___________ rock.
Igneous Rocks

It's possible for a single mixture of minerals to produce more than one type of rock. Read the passage and study the table below. Then answer the questions that follow on a separate sheet of paper.

The Same But Different
Can two different rocks with different names have the same mineral composition? The answer is yes. There are six major kinds of igneous rocks: granite, diorite, gabbro, rhyolite, andesite, and basalt. Geologists usually group these six kinds of igneous rocks in pairs, because each pair generally contains the same minerals. Study the table below to see which igneous rocks are the same but different.

<table>
<thead>
<tr>
<th>Common Igneous Rocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intrusive rocks (Coarse-grained)</td>
</tr>
<tr>
<td>Extrusive rocks (Fine-grained)</td>
</tr>
<tr>
<td>Minerals</td>
</tr>
<tr>
<td>Color</td>
</tr>
</tbody>
</table>

1. Which of the six major kinds of rock are intrusive and which are extrusive?
2. Compare granite with rhyolite. How are they similar? How are they different?
3. Compare the mineral composition of diorite with the mineral composition of andesite.
4. In what way is gabbro different from basalt? What can you infer from this about how these two kinds of igneous rocks form?
5. How is granite like gabbro?
6. Which rock has more silica in it, granite or basalt?
7. Is a rock with more silica in it more likely to be lighter or darker than a rock with less silica in it?
Sedimentary Rocks

How Do Sedimentary Rocks Form?

got it?

○ I get it! Now I know that most sedimentary rocks are formed through the processes of _________________________________

○ I need extra help with _________________________________

What Are the Three Major Types of Sedimentary Rocks?

1a. REVIEW Shale forms from tiny particles of (clay/sand/mica).

b. DESCRIBE How is clay deposited to form shale?

c. INFERENCE You come across a thick deposit of shale that forms a layer in the ground. What can you infer about the area's past environment?


got it?

○ I get it! Now I know that the three major types of sedimentary rocks are _________________________________

○ I need extra help with _________________________________
Sedimentary Rocks

How Are Sedimentary Rocks Used?

**got it?**

- I get it! Now I know that throughout history, people have used sedimentary rocks for ________________________________
  ________________________________
  ________________________________

- I need extra help with ________________________________
  ________________________________
  ________________________________
Sedimentary Rocks

How Do Sedimentary Rocks Form?

- **Sediment** is small, solid pieces of material that come from rocks or living things. Sedimentary rocks form when sediment is deposited by water and wind.
- Most sedimentary rocks are formed through a sequenced of processes: weathering, erosion, deposition, compaction, and cementation.
- Rock on Earth’s surface is constantly broken up by weathering—the effects of freezing and thawing, plant roots, acid, and other forces on rock. After the rock is broken up, the fragments are carried away as a result of erosion—the process by which running water, wind, or ice carry away bits of broken-up rock.
- Deposition is the process by which sediment settles out of the water or wind carrying it. The process that presses sediments together is compaction.
- Cementation is the process in which dissolved minerals crystallize and glue particles of sediment together.

What Are the Three Major Types of Sedimentary Rocks?

- Geologists classify sedimentary rocks according to the type of sediments that make up the rock. The three major groups of sedimentary rocks are clastic rocks, organic rocks, and chemical rocks.
- A clastic rock is a sedimentary rock formed when rock fragments are squeezed together. Some common clastic rocks are shale, sandstone, conglomerate, and breccia. Organic rock forms where the remains of plants and animals are deposited in layers. Organic rocks include coal and limestone. Chemical rock forms when minerals dissolved in a water solution crystallize. Chemical rocks include limestone and rock salt.

How Are Sedimentary Rocks Used?

- People have used sedimentary rocks throughout history for many different purposes, including for tools and building materials. Chert and flint were used to make spearheads and arrowheads. Sandstone and limestone are used as building materials. Limestone is used to make cement and steel.

On a separate sheet of paper, explain the sequence of processes through which most sedimentary rocks are formed.
Sedimentary Rocks

Understanding Main Ideas
Answer the following question on a separate sheet of paper.

1. In order, list the sequence of processes through which sedimentary rocks form.

Classify each of the following sedimentary rocks by writing clastic, organic, or chemical in the blank beside it.

2. _______ sandstone 6. _______ breccia
3. _______ limestone made from shells 7. _______ limestone made from precipitated calcite
4. _______ conglomerate 8. _______ rock salt
5. _______ coal 9. _______ shale

Building Vocabulary
Match each term with its definition by writing the letter of the correct definition in the right column on the line beside the term in the left column.

10. ___ clastic rock
11. ___ sediment
12. ___ cementation
13. ___ organic rock
14. ___ compaction
15. ___ chemical rock
16. ___ deposition
17. ___ erosion

a. small, solid pieces of material from rocks or living things
b. the process that presses sediments together
c. sedimentary rock formed from remains of plants and animals
d. the process by which running water, wind, or ice carry away bits of broken-up rock
e. the process in which dissolved minerals crystallize and glue sediment together
f. sedimentary rock that forms when rock fragments are squeezed together
g. the process by which sediment settles out of water or wind
h. sedimentary rock that forms when minerals dissolved in a water solution crystallize
Sedimentary Rocks

The Formation of Coal

Coal is an organic sedimentary rock. One of its properties is that it burns. Coal provides energy for industries and for the production of electricity.

Much of the country’s best coal is found in Pennsylvania, Ohio, West Virginia, Kentucky, Tennessee, and Alabama. The formation of this large coalfield began about 300 million years ago during a time geologists call the Carboniferous Period. During that period, vast tropical swamp forests covered much of North America. When these ancient trees died, they fell into the swamp water, which was low in oxygen. Instead of rotting—as they would in an oxygen-rich environment—the dead vegetation piled up. The sequence of pictures below tells the rest of the story of how this plant matter became coal.

1. What is coal?
2. When did the coal deposits of the eastern United States begin to form? What were environmental conditions like at that time?
3. What is peat?
4. What process caused the peat to become coal?
5. A type of coal called anthracite is classified by geologists as a metamorphic rock. It is much harder than sedimentary coal. Describe how you think anthracite forms.
Metamorphic Rocks

What Are Metamorphic Rocks?

1a. DEFINE What is a metamorphic rock?

b. IDENTIFY FAULTY REASONING Suppose great heat completely melts a certain deposit of rock, which then hardens into new rock. You might think that the new rock is metamorphic. But it isn't. Why not?

Got it?

○ I get it! Now I know that certain metamorphic rocks are used for __________________________

○ I need extra help with __________________________
**Key Concept Summary**

# Metamorphic Rocks

**What Are Metamorphic Rocks?**

<table>
<thead>
<tr>
<th>When great heat and pressure are applied to rock, the rock can change both its shape and its composition. Any rock that forms from another rock as a result of changes in heat or pressure (or both heat and pressure) is a metamorphic rock.</th>
<th>Geologists classify metamorphic rocks according to the arrangement of the grains making up the rocks. Metamorphic rocks that have their grains arranged either in parallel layers or bands are said to be foliated. Foliated describes the thin, flat layering found in most metamorphic rocks. Crystals in granite can be flattened to create the foliated texture of gneiss. Heat and pressure change the sedimentary rock slate into slate. As shale changes into slate, the mineral composition of the shale can change.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pockets of magma can rise through the crust. The high temperatures of these pockets can change rock into metamorphic rock. Collisions between Earth's plates can also push rock down toward the heat of the mantle. Plate collisions cause great pressure to be applied to rock while mountains are being formed.</td>
<td>Some metamorphic rocks are nonfoliated. The mineral grains in these rocks are arranged randomly. The pressure can deform, or change the physical shape of, the rock. Under very high temperature or pressure (or both), the minerals in a rock can be changed into other minerals. The appearance, texture, and crystal structure of the minerals in the rock change. Marble and quartzite are metamorphic rocks that have a nonfoliated texture. Quartzite forms out of quartz sandstone. Marble usually forms when limestone is subjected to heat and pressure deep beneath the surface. The metamorphic rocks marble and slate are important materials for building and sculpture.</td>
</tr>
</tbody>
</table>

On a separate sheet of paper, describe how metamorphic rocks form.
Metamorphic Rocks

Understanding Main Ideas
Fill in the blanks to complete each step in the formation of metamorphic rock.

1. Collisions between Earth’s plates push rock down toward the heat of Earth’s ________________

2. As the rock is buried deeper in the crust, ________________ as well as heat increases on the rock.

3. The rock is squeezed so tightly that the appearance, ________________, and crystal structure of the rock’s minerals change, creating metamorphic rock.

Answer the following questions on a separate sheet of paper.

4. Describe what a metamorphic rock is.

5. Describe a situation in which heat can change rock to metamorphic rock.

6. What characteristics do geologists use to classify metamorphic rocks?

7. Give examples of how two different metamorphic rocks are used.

Building Vocabulary
Fill in the blank to complete the statement.

8. ______________ describes the thin, flat layering found in most metamorphic rocks.
Metamorphic Rocks

Every metamorphic rock is a rock that has changed in form. Read the passage and examine the diagrams below. Then answer the questions that follow on a separate paper.

The Metamorphic Rocks
Tremendous pressure and high temperatures can change any rock into metamorphic rock. This process often occurs near plate boundaries. There, pressure builds as one plate collides with another. In addition, hot magma flows upward into rock near these boundaries. Such intense conditions change one kind of rock into another, such as shale, a sedimentary rock into slate, a metamorphic rock. But what happens if the pressure and temperature continue to increase after slate becomes slate? Look at Figure 1 below. Slate changes into schist, and schist changes into gneiss.

![Figure 1](image)

Gneiss and schist are the most common metamorphic rocks. Gneiss is a foliated rock usually composed of quartz and feldspar. Schist is also foliated, but its mineral composition varies. The terms gneiss and schist actually describe certain textures of metamorphic rock. That's why both shale and granite can change into gneiss, and both granite and basalt can change into schist. Figure 2 shows common metamorphic rocks to the right. The rocks on the left are igneous and sedimentary rocks. The arrows represent pressure and temperatures.

1. What causes shale to change into slate?
2. What are gneiss and schist?
3. What happens to the slate if these conditions increase?
4. How do tremendous pressures and high temperatures affect limestone?
5. How does metamorphism affect basalt?
6. What rocks can change into schist?
7. How does increased metamorphism affect schist?
The Rock Cycle

What Is the Rock Cycle?

1a. NAME The rock cycle builds, destroys, and changes the rock in Earth’s (crust/core).

b. ANSWER 🌋 DESCRIBE How do rocks form?

 got it?

○ I get it! Now I know that the rock cycle is

○ I need extra help with
# The Rock Cycle

## What Is the Rock Cycle?

<table>
<thead>
<tr>
<th>Forces deep inside Earth and at the surface produce a slow cycle that builds, destroys, and changes the rocks in the crust. The rock cycle is a series of processes that occur on Earth's surface and in the crust and mantle that slowly change rocks from one kind to another.</th>
<th>holding the rock together. The rock's texture will change, and the metamorphic rock quartzite will form.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The changes of the rock cycle are closely related to plate tectonics. Plate movements help drive the rock cycle by helping to form magma, the source of igneous rocks. Sedimentary rock can also result from plate movement. The collision of continental plates can be strong enough to push up a mountain range. Then, weathering and erosion begin. The mountains are worn away. This process leads to the formation of sedimentary rock. A collision between continental plates can push rocks down deep beneath the surface. Here, heat and pressure could change the rocks to metamorphic rock.</td>
<td></td>
</tr>
<tr>
<td>For example, the forces of mountain building slowly push granite upward. Over millions of years, weathering and erosion begin to wear away the granite to form sand. Streams carry the sand to the ocean. Layers of sediment pile up on the ocean floor. Calcite dissolved in the ocean water may cement the particles together, and sandstone forms. Eventually pressure may compact the sandstone particles further. Silica will replace the calcite as the cement.</td>
<td>Constructive and destructive forces build up and destroy Earth's landmasses. But as the rock in Earth's crust moves through the rock cycle, material is not lost or gained.</td>
</tr>
</tbody>
</table>

On a separate sheet of paper, explain how rocks are not lost or gained but recycled through the rock cycle.
The Rock Cycle

Understanding Main Ideas
Use these terms to fill in the blanks in the figure below: metamorphic rock, sedimentary rock, magma and lava, igneous rock, sediment.

Answer the following questions on a separate sheet of paper.

6. Describe how the granite of a mountain could change first into sandstone and then into quartzite.

7. Describe how a collision between continental plates can result in the formation of metamorphic rock.

Building Vocabulary
On a separate sheet of paper, write a definition for the term below.

8. rock cycle
The Rock Cycle

Rock can follow many different pathways through the rock cycle. Read the two examples below. Then answer the questions that follow on a separate sheet of paper.

Alternate Pathways
Pathway 1
Between New Zealand and South America, at the bottom of the Pacific Ocean, molten material from the mantle erupts from the mid-ocean ridge. As the material comes into contact with the very cold ocean water, it cools quickly to become rock. Over time, this rock ever so slowly moves away from the mid-ocean ridge, as sea-floor spreading makes changes in the ocean floor. About 200 million years later, the rock is subducted at a deep-ocean trench. As the rock moves downward, it melts to become part of the mantle. Eventually this melted material moves back up through the mid-ocean ridge to become rock again.

Pathway 2
Deep underground, a new rock forms as heat and pressure change its crystals and cause its grains to become foliated. Over millions of years, this rock is uplifted to become part of a mountain. Then, layers of rock above the foliated rock wear away, until it becomes exposed at the surface. Destructive forces wear it down, and its fragments are carried away by a river’s swift-flowing water. Eventually, these fragments flow into the ocean. Ocean water carries the rock fragments away from the river, and they are deposited on a beach. Over time, more and more sediment is deposited there, until the fragments that came from the foliated rock become cemented into a new rock. Then more and more rock forms about this rock, until the heat and pressure change its crystals and cause its grains to become foliated.

1. Which major group or groups of rocks are involved in the description of Pathway 1?
2. Make a flowchart that describes what occurs in Pathway 1.
3. Which major group or groups of rocks are involved in the description of Pathway 2?
4. Make a flowchart that describes what occurs in Pathway 2.
5. Write a description of another pathway through the rock cycle. In your description, tell how igneous rock changes to metamorphic rock, which then changes to sedimentary rock.