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## STUDY GUIDE: GEOLOGY: ROCKS AND MINERALS

This study guide will introduce the three basic types of rocks and will give examples of each kind. It will define a mineral, tell the basic properties of minerals, give examples, and tell ways to identify one mineral from another.

The study of rocks and the earth is called **geology**, and the person who studies these topics is a **geologist**.

The study of minerals is called **mineralogy**, and the scientist who specialized in the study of minerals is called a **mineralogist**.

### ROCKS

Geologists divide all rocks into three types or groups, based upon how they were formed. The three basic rock types are:

1. Sedimentary Rocks
2. Igneous Rocks
3. Metamorphic Rocks

**Sedimentary rocks** are formed when dirt, dust, pebbles, and other sediments are deposited by either wind or by water. These rocks often form under water. One layer of sediment drops to the bottom of the lake or river. Another layer is deposited on top of the first. Pressure from the layers above causes heat, which causes the particles to merge to form sedimentary rocks. Minerals found in the water also help to cement the particles together. When animal remains are trapped between the layers, **fossils** are often formed, as the particles harden into rocks. Because most sedimentary rocks are formed under a body of water, **fossils are commonly found in sedimentary rock layers**. Layers are usually visible in this type of rock.

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**Igneous rocks** are formed by the eruption of a volcano. They were all originally hot, liquid magma beneath the Earth's surface. Once the magma reaches the earth's surface, it is called **lava**. If an igneous rock is formed when hot magma reaches the Earth's surface, and then hardens into a rock as it cools on the surface of the earth, it is called an **extrusive rock**.

If the magma becomes trapped **below** the earth's surface, and the igneous rock is formed in a pocket deep within the earth, the rock is called an **intrusive rock**.

**Metamorphic rocks** were all either sedimentary rocks or igneous rocks at first. Then something happened to these rocks to change them. In most cases, the sedimentary or igneous rocks were subjected to heat or pressure for long periods of time. The heat and pressure caused the rocks to change to a different rock, which is then classified as a metamorphic rock.

### Types of Sedimentary Rocks

#### Name of the Rock

#### The Material that has been Cemented Together to Create the Rock

1. **Sandstone**

**Small Pieces of Sand**

(This rock feels gritty to touch. Particles of sand can often be rubbed off the rock.)

2. **Shale**

**Dirt and Mud**

(This rock is usually brown, black, tan, or reddish-brown in color, depending upon the type of dirt or mud that was deposited. If you wet the rock and smell it, the rock will smell just like mud.)

3. **Conglomerate**

**Tiny Pebbles**

4. **Limestone**

**Shells and Bones of Sea Animals**

(Limestone is often light gray in color. If a drop of vinegar is put on a piece of the limestone, the acid in the vinegar will cause a bubbling and slight popping sound. In regular limestone, the bones and shells have been ground up so fine that they are not visible. All limestones have a large quantity of the mineral calcite in them because this mineral is found within the shells and bones.)

5. **Coquina**

**Shells of Animals**

(Coquina is a special type of limestone. The shells **have not been ground up into fine pieces**. You can actually see shells that have been cemented together by minerals in the water.)

6. **Chalk**

**Shells of Sea Animals**

(Chalk is another type of limestone. The shells have been broken up into fine pieces cemented together loosely.)

7. Rock Salt

The Mineral, Halite

8. Coal

Plant Materials Such as Mosses, Ferns, or Parts of Trees.

(All coal contains the elements **carbon, hydrogen, and oxygen**. When the plant materials are buried under mud or other sediment, most of the hydrogen and oxygen escape, leaving the black carbon. There are four types of coal, based upon how long the materials were pressed together.

**Peat** is coal in which the twigs and remains can still be seen. It has only been pressed slightly.

**Lignite** is soft brown coal that is formed when peat is heated and pressed. It is only about 40% carbon. It is not a good energy source because it burns too rapidly.

**Bituminous coal is called soft coal**. It has been compressed longer than lignite, and contains about 85% carbon. It burns easily but creates much smoke.

**Anthracite is the hardest type of coal**. It is about 95% carbon and has been pressed into a hard rock. It burns for a long time, and it provides the best type of energy. However, it is the most expensive type.)

**Other examples of sedimentary rocks that are less common include the following:** flint, chert, breccia, stalactites, and potash ore

### Types of Igneous Rocks

1. **Basalt:** This extrusive rock is formed on the surface of the earth. It makes up many of the volcanic cones, and it is dark gray or dull black in color. It has very fine grains that are hard to distinguish. The Hawaiian Islands and much of Iceland have been formed from basalt.
2. **Gabbro:** This intrusive rock was formed under the surface of the earth. It cooled more slowly than basalt, and thus has larger grains or crystals. It is also very dark in color.
3. **Obsidian:** This is a very shiny black or dark brown rock, and it appears to look like black glass. It is hard and brittle and often has lava swirl marks on its surface.
4. **Granite:** This is the most common intrusive rock. It is made of three minerals: feldspar, mica, and quartz. It is usually pink or gray in color, with black specks and white shiny crystals. Granite is usually used for buildings and tombstones.

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5. **Pumice:** The steam and gases that come from the volcano cool to form pumice, which resembles a sponge because of all its air holes. Pumice is sometimes light enough to float in water.
6. **Scoria:** Scoria is a piece of basalt that hardened so quickly that it hardened right around the air bubbles. It has more holes than a piece of Swiss cheese, but is much heavier and darker in color than pumice.
7. **Tuff:** Tuff is similar to pumice, but is usually darker in color because particles of dust and dirt were trapped in the steam and lava when it hardened.

**Other less common types of igneous rocks are the following:**  
diorite, pegmatite, dolerite, and syenite

**Types of Metamorphic Rocks**

Remember that metamorphic rocks are rocks that began as either sedimentary or igneous and were changed into a new and different rock.

<u>Metamorphic Rock Name</u>	<u>Type of Rock That was Changed to Create This New Rock</u>
1. <b>Slate</b>	<b>Shale</b> (sedimentary rock made from mud and dirt.)
2. <b>Marble</b>	<b>Limestone</b> (sedimentary rock made from shells and bones of sea animals.)
3. <b>Gneiss (pronounced NICE)</b>	<b>Granite</b> (igneous rock which was pressed so much that the black mica specks lines up in nice straight lines.)
4. <b>Quartzite</b>	<b>Sandstone</b> (sedimentary rock made from sand grains.)

## MINERALS

A mineral is defined as a “naturally occurring, inorganic solid that has a definite chemical composition and crystal shape.” Let’s look at these four characteristics of all minerals more closely.

1. A mineral must occur naturally in nature. Cement is **not** a mineral because it has been created by man.
2. A mineral must be **inorganic**. This means that it is **not made from living things or from the remains of living things**. Quartz is a mineral, but coal is not a mineral because coal was made from decaying plants.
3. A mineral has a definite chemical composition. This means that it is made from one or more elements that have been joined together to form a compound.
4. The atoms of a mineral are arranged into a definite pattern called **crystals**. Every mineral has a specific crystal shape.

There are so many different kinds of minerals that it is hard to tell them apart. Mineralogists use eight main properties of minerals to help in identification. Below is a list of the eight main properties used in mineral identification.

1. Color
2. Luster
3. Hardness
4. Streak
5. Crystal Shape
6. Density
7. Cleavage or Fracture
8. Specific Gravity

Some minerals are easily identified by their colors. **Cinnabar**, which contains the ore of mercury, is red. **Malachite**, which contains the ore of copper, is green. **Azurite** is blue, and often occurs with Malachite. **Quartz** can be different colors. **Pure quartz** is clear or white in color. Quartz with a grey cast is called **smoky quartz**. Purple quartz is called **amethyst**, which is February’s birthstone. Yellow quartz is called **citrine**. Pink quartz is called **rose quartz**. **Topaz** is usually yellow.

Luster refers to the mineral’s shine, or how it reflects light. Certain minerals, such as silver, copper, gold, and pyrite shine brightly when light hits them. We say they have a **metallic luster**. Nonmetals appear to be glassy, pearly, or dull. They have little luster.

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Hardness is a valuable way to identify minerals. Fredrich Mohs, a German mineralogist, developed a scale of hardness for minerals. He took ten minerals and arranged them in order from softest to hardest. Number 1 was assigned to the softest mineral, Talc, and number 10 was assigned to the hardest mineral, the Diamond. A mineral will scratch any other mineral having a lower number. Here is a list of the minerals on Moh's Scale of Hardness with their accompanying numbers.

1. Talc
2. Gypsum
3. Calcite
4. Fluorite
5. Apatite
6. Feldspar
7. Quartz
8. Topaz
9. Corundum
10. Diamond

The streak test is also used to identify minerals. A mineral sample is rubbed across a small glazed piece of porcelain called a "streak plate." A color is rubbed from the rock onto the plate, which has a hardness of about 7, and can thus be used to test any mineral that is softer than a 7 on the hardness scale. Each mineral makes a particular color streak when rubbed on the plate. All nonmetallic minerals produce a white or colorless streak. Hematite, which contains iron, always has a reddish-brown streak. Iron pyrite's streak is greenish-black in color.

Crystal shape can sometimes help identify a mineral. There are six basic types of crystal shapes that most minerals can have. You will be given a list of these six basic crystal shapes, and the name of a mineral that has this particular shape.

### Basic Crystal Shape

1. Cubic
2. Hexagonal
3. Orthorhombic
4. Monoclinic
5. Tetragonal
6. Triclinic

### Mineral Example

Fluorite  
Tourmaline  
Topaz  
Malachite  
Wulfenite  
Amazonite

The exact characteristics of these crystals shapes will be covered more thoroughly in upcoming guides.

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Density is the "amount of matter in a given space." It can also be expressed as "mass per unit volume." The density of any mineral is the same, regardless of how big the piece of mineral is. Every mineral has a specific density. You can determine the density of a mineral by finding its mass on a balance scale and dividing this mass by its volume.

Cleavage is the way a mineral breaks. If it breaks along smooth, definite lines, it has cleavage. Halite always breaks into neat cubes. Mica always breaks into thin sheets. In fact, you can peel off layers of mica that are so thin you can read through them!

Fracture also refers to the way a mineral breaks. However, it is just the opposite from cleavage. If a mineral does not break along visible lines, it fractures. The majority of all minerals tend to fracture.

Specific gravity is another property that can be helpful in naming a mineral. Specific gravity is "the ratio of the weight of a mineral to the weight of an equal volume of water." It tells us how many times denser the mineral is than water. Most minerals are denser than water and will sink when emerged in the same volume of water. For example, feldspar has a specific gravity of 3. This means it is 3 times denser than water. Many metallic elements have a specific gravity of about 5. Pure gold is 19.3 times denser than an equal volume of water.

Here are a few other hints to help you identify particular minerals:

1. Sulfur is a soft, yellow rock. It smells like rotten eggs!
2. Magnetite is a fairly heavy rock. It is magnetic!
3. Halite always breaks into cubes. It tastes salty, and looks clear or slightly foggy square ice cubes.
4. Talc feels soapy and will easily rub off on your hands.
5. Galena is a very bright, shiny, silver rock, which feels quite heavy when held in your hand.

