

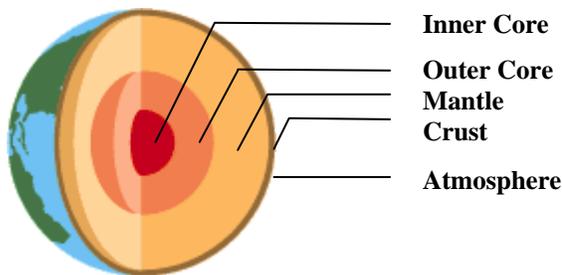
ARIZONA ROCKS!

INTRODUCTION

- A. What are the differences between rocks and minerals? (minerals are composed of elements and rocks are composed of mineral compounds.)
- B. How are minerals formed? (gases, magma, precipitation from H₂O)
- C. What are the 3 types of rocks? (metamorphic, sedimentary, igneous.)
- D. What methods are used to identify rocks and minerals? (luster, color, streak, hardness.)

EARTH FORMATION

A. Explain the Formation of the Earth: The Earth was formed 18 billion years ago from spinning particles of dust. The result of compressing and spinning was the formation of a nearly circular planet. These particles combined to form the 109 different elements that make up the 5 different layers of the earth.



ELEMENTS

- A. Explain what elements are: Elements are the building blocks of Earth materials. Of the 109 different elements, 8 make up nearly 99 percent of the Earth's crust. Elements are The remaining 1% is considered rare elements for example carbon. Elements combine to form naturally occurring minerals.
- B. The 8 most abundant elements in the Earth's crust are:

- 46.6% Oxygen (O)
- 27.7% Silicon (Si)
- 8.1% Aluminum (Al)
- 5.0% Iron (Fe)
- 3.6% Calcium (Ca)
- 2.8% Sodium (Na)
- 2.6% Potassium (K)
- 2.1% Magnesium (Mg)

Note: Hydrogen is the most common element on the periodic table of elements but not in the Earth's surface. Found more in air and water. Oxygen is part of a mineral.

MINERALS

- A. Define what minerals are.
 - Minerals are inorganic (nonliving) crystalline solids, found in nature and composed of one or more elements. For example: oxygen + silicon= quartz.

- The Earth's crust holds about 2000 kinds of minerals. A few (including gold) occur as just one element; most are comprised of two or more elements (called compounds).

B. Display different examples of minerals and explain how they are used industrially:

1. **Malachite and Azurite:** Copper ore is an element that can be extracted from either of these minerals. Copper is a good conductor of electricity and heat and is one of Arizona's primary resources. The element copper is removed from these minerals and used to produce electrical wire and copper piping. The blue color found in Azurite is also used by early people for facial paint and dye and is still used as a paint pigment.
2. **Mica/Muscovite:** Toasters, sparkly eye shadow and lip gloss.
3. **Chalk:** This is a limestone, which is formed from the skeletons of tiny sea animals that are too small to see with the naked eye.
4. **Bauxite:** Show aluminum foil. Bauxite is the principal ore of aluminum.
5. **Quartz:** Light bulb, glass, fiberglass, gemstones, watches, and radio transmitters.
6. **Halite:** Table salt and contains sodium and chlorine used in the chemical industry to make bleach and baking soda.
7. **Fluorite:** minerals are used to make one's teeth resistant to decay. Show the students an example of fluorite.
8. **Lead:** Primarily used in the construction of batteries and steel manufacturing of tire weights and fish weights.
9. **Pyrite:** Used to make brown glass.
10. **Gypsum:** used to make over 30 billion square feet of drywall each year; cement; agriculturally used to break soil compaction;
11. **Cinnabar:** Mercury Ore –The poisonous mercury ore cinnabar, is used in the manufacturing of drugs, pigments, insecticides and scientific instruments, as well as in dentistry.
12. **Talc:** Used to make baby powder
13. **Calcite**

DIFFERENT KINDS OF MINERALS

A. The Earth consists of more than 4300 different minerals that are grouped into 2 classes:

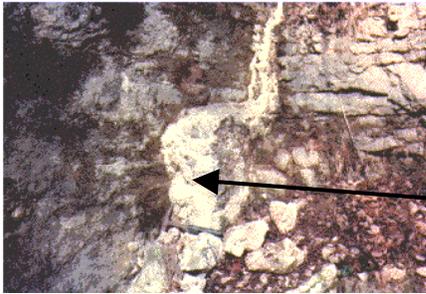
1. **Metallic Minerals** – Familiar metals include copper, gold, and silver. Other non-native minerals include iron and aluminum. Minerals are called metallic based on the luster that is seen.
 - Metals, and other elements, are often obtained from rocks called Ores.
 - Ores contain high concentrations of one or more metals able to be profitably mined.
 - Metals are primarily found in combinations with other minerals. For example: Copper is found in azurite, malachite and bornite; lead is found in galena
 - Metallic minerals are used to produce steel products. Manufactured products, such as steel, are not minerals.
 - Precious metallic minerals such as gold and silver are valued according to the amount of karats they possess. This is a unit of measurement based on a fineness scale from 1 to 24. A 14 karat gold ring contains 14/24 or 58% gold a 24 karat gold ring contains 24/24 or 100% gold (not quite 100%...even 24 karat gold contains a small amount of copper for strength).

2. **Nonmetallic Minerals** – i.e. sulfur, gypsum, borax, quartz. These minerals do not contain the metallic luster.

HOW ARE MINERALS FORMED?

A. Describe the 3 ways minerals are formed:

- Minerals come from magma, the molten rock beneath the Earth's surface. When magma cools, mineral crystals are formed.
- When magma cools slowly beneath the Earth's crust, large crystals form. When magma cools rapidly no crystals form.
- Minerals also form from compounds dissolved in a liquid such as water. When the liquid evaporates it leaves behind the minerals as crystals.



Mineral
formation

WHAT ARE ROCKS?

A. Talk about what rocks are.

- Rocks are a mixture of minerals. Minerals are the ingredients that make up rocks.
- Get three balls of different colors of clay. Individual balls represent a red mineral, blue mineral, and yellow mineral. If you took some of the red, blue, and yellow ball of clay, you would have a rock.

B. Explain how rocks are separated into 3 groups:

1. **Igneous Rocks** – The parent of all rocks. What words sounds like or starts with “ig” like igneous, ignite, ignition, iguana, ignorant, or igloo. Which of these words have something to do with fire? Ignite and ignition. “Ig” comes from the Latin word for fire.
 - Name and explain the two types of igneous rocks.
 - **Intrusive rocks** (also known as plutonic rocks) solidify (harden) within the Earth's crust and only appear at the surface after the rocks above them have eroded away. Because these rocks cool very slowly they have observable crystals.
 - **Extrusive rocks** (also known as volcanic rocks) are formed when **magma** erupts from a volcano as **lava**, then cools at the surface. Because these rocks cool so quickly they have few or no observable crystals.
 - **What causes a volcano to explode?** When the gas pressure of magma gets too high, the rocks that make up the volcano break, and the magma escapes to the surface to erupt (like the bubbles that build up in a bottle of soda). Carbon dioxide is the most common of these gasses.
 - **Pāhoehoe and Aa** – Hawaiian term used to describe the textures of volcanic rocks. **Pāhoehoe** is a formation of smooth rocks and **aa** is a formation of rough rocks.

- As magma/lava cools elements chemically combine or crystallize.
2. **Metamorphic Rocks –**
 - Metamorphic rocks are changed rocks.
 - Metamorphism is the result of pressure, temperature or chemical forces that cause pre-existing rocks to change in appearance and mineral composition.
 - These are igneous, sedimentary, or other metamorphic rocks that were squish squashed together inside Mother Earth while undergoing hot temperatures. The temperatures are not hot enough to melt the rock, otherwise it would be igneous.
 3. **Sedimentary Rocks –** When rocks are weathered and eroded they break down into smaller pieces of rocks and minerals called sediment. The sediments are compacted (pressed down). In time the particles are cemented together to form new rocks, known as sedimentary rocks.

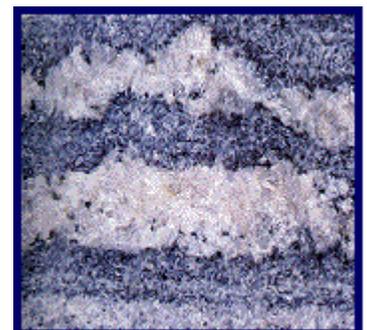
Show Samples of Different Types of Rocks

A. Igneous

- Illustrate the cooling of igneous rocks through the following three examples:
 1. **Granite** – This is an intrusive igneous rock that cools very slow. We know it cooled slow because the minerals in granite are very large. When rocks cool slowly the minerals have enough time to grow visibly large.
 2. **Basalt/Volcanic Bomb (AA)** – This is an extrusive rock that cools quicker than granite. Geologists know this minerals are not visible with the naked eye, but with a specialized microscope.
 3. **Obsidian/Volcanic Glass (Pahoehoe)** - This is an extrusive igneous rock cooling very quickly giving the minerals no time to grow. This is a natural glass.
- **Pumice** – Another example of igneous rock that is formed when lava is ejected into the air as a froth containing masses of gas bubbles. As the lava solidifies the gas bubbles are frozen into the rock.

B. Metamorphic

- The word metamorphic comes from a Latin word meaning to change in form
- **Schist** – This is a metamorphic rock formed mainly from sedimentary clay, shale, meta, slate, phyllite.
- **Marble** – Marble is limestone that has been recrystallized due to metamorphism.
- **Gneiss** – A metamorphic rock is formed when the parent rock is nearly melted. i.e. granite (or conglomerate) to gneiss. Gneiss is a metamorphic-conglomerate.



C. Sedimentary

- **Fossiliferous limestone** – Formed from the remains of shells, teeth and bones.
- **Coal** – Sedimentary rock made from deceased animals (some) and plants (mostly) which get covered by other sediments. This rock produces 56% of our nation's energy.

- **Fossil Dung/Coprolite** – Sedimentary.
- **Conglomerate** – Sedimentary rock formed of pebbles, sand & clay.
- **Shale** – Found in horizontal layers. Shale is originally clay and mud that is compacted.
- **Petrified Wood** – Petrified wood found in Arizona is said to date up to 220 million years ago. Minerals substitute the organic material sometimes resulting in the formation of nearly perfect replica of the original organism. The Color of the petrified wood can be attributed to the impurities that replace the organic material.

SO WHAT ARE THE DIFFERENCES BETWEEN ROCKS AND MINERALS?

A. Describe these differences:

1. Minerals may exhibit a definite shape as a result of crystal structure.
2. **Rocks are mixtures of minerals and minerals are mixtures of elements.**
3. The chemical composition (SiO_2 - Quartz) of minerals is definite or varies within limits; the chemical compositions of rocks differ because the combination of minerals is highly variable.

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