Mineral and Rock Identification

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**Purpose:**

The purpose of this lab is for students to become familiar with the basic properties of rocks and minerals.

**Essential Learning Outcomes:**

Determine basic rock and mineral properties

Identify rocks and minerals based on properties

**Equipment supplied:**

Rock and mineral samples

Streak plate

Glass plate

Penny

Steel nail

Hand lens

**Instructor’s Notes:** This is a relatively basic lab exercise in which students are introduced to the some of the most common minerals and igneous, sedimentary, and metamorphic rocks. Tables could easily be modified to include a greater variety of minerals and rocks.

**Exercises:**

**Part 1 – Mineral Identification**

You will identify minerals based on their physical properties. A mineral is a naturally occurring substance with a definite chemical composition and characteristic structure. Minerals are composed of one or more elements (i.e., silicon, iron, copper, etc.). Minerals differ from each other in both chemical composition and physical properties. **Color** is the most obvious property, but is highly variable; descriptions include dominate color as well as additional colors. **Luster** is a description of how shiny the surface appears and is typically described as either metallic or non-metallic. **Hardness** is a measure of how solid the mineral is and is classified using the Mohs Hardness Scale (1 = softest, 10 = hardest). Hardness is determined by attempting to scratch the mineral with objects of known hardness. **Streak** is the color of the mineral powder left behind on a streak plate. **Other miscellaneous properties** include grain size, crystal size, feel, taste, magnetism, etc.

1. Use the physical properties of the samples, Table 1. Mohs Hardness Scale, and Table 2. Physical Properties of Minerals to identify the minerals.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Mineral** | **Color** | **Luster** | **Hardness** | **Streak Color** | **Other Misc.** | **Mineral Name** |
| 1 |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |
| 6 |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  |
| 9 |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |

***Table 1. Mohs Hardness Scale***

|  |  |
| --- | --- |
| **Hardness (Softest to Hardest)** | **Example Material** |
| 1 | Talc |
| 2 | Gypsum |
| 2.5 | Fingernail, pure gold, silver, aluminum |
| 3 | Calcite, penny |
| 4 | Fluorite |
| 4.5 | Platinum, iron |
| 5 | Apatite |
| 5.5 | Glass |
| 6 | Orthoclase, titanium |
| 6.5 | Steel nail |
| 7 | Quartz |
| 8 | Topaz, emerald |
| 9 | Corundum, ruby, sapphire |
| 10 | Diamond |

***Table 2. Physical Properties of Minerals.***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Mineral Name** | **Color** | **Luster** | **Hardness** | **Streak Color** | **Other Misc.** | **Chemical Composition** |
| Talc | Gray, white, green | NM | 1 | Green, gray, white | Feels greasy/soapy | Hydrous magnesium silicate |
| Hematite | Reddish brown, steel gray | M to NM | 1 – 6.5 | Red | Heavy | Iron oxide |
| Gypsum | Gray, colorless | NM | 2 | White to colorless |  | Hydrous calcium sulfate |
| Muscovite mica | White, colorless | NM | 2 – 3 | White to colorless | Thin flakes | Non-ferromagnesium silicate |
| Biotite mica | Black, brown, dark green | NM | 2 – 3  | White to colorless | Thin flakes | Ferromagnesium silicate |
| Galena | Silver gray | M | 2.5 | Grayish black | Heavy, cubic | Lead sulfide |
| Halite | Colorless, white, yellow, pink | NM | 2.5 | White to colorless | Tastes salty, cubic | Sodium chloride |
| Fluorite | Purple, blue, green | NM | 4 | White to colorless | Interlocking cubes | Calcium fluoride |
| Magnetite | Silver black | M | 6 | Black | Magnetic, heavy | Iron oxide |
| Pyrite | Brassy yellow | M | 6 – 6.5  | Greenish black | Gold-like, heavy | Iron sulfide |
| Quartz | Colorless, white, variable | NM | 7 | White to colorless | 6-sided crystals | Silicon oxide |

**Part 2 – Rock Identification**

Rocks are composed of two or more minerals and can be classified as igneous, sedimentary, or metamorphic based on origin. Igneous rocks form when magma rises from the mantle, cools, and hardens either below the Earth’s surface or on the surface. Sedimentary rocks are layered accumulations of mineral particles derived from weathering and erosion of preexisting rocks, chemical deposition, or accumulation of plant and animal remains. Metamorphic rocks form when igneous, sedimentary, or other metamorphic rocks are subjected to intense heat and pressure to form

### *Igneous Rock Identification*

Igneous rocks can be subdivided based on whether they formed above or below the Earth’s surface. Intrusive igneous rocks form by gradually cooling below the surface, which results in the formation of large crystal grains. Extrusive igneous rocks form by cooling rapidly at the Earth’s surface, which results in small crystal grains and often contain pockets of air.

1. Use the physical properties of the samples and Table 3. Physical Properties of Igneous Rocks to identify the **igneous rocks**.
2.
3.
4.
5.
6.
7.
8.
9.

***Table 3. Physical Properties of Igneous Rocks***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **COMPOSITION** | **Minerals** | Orthoclase, quartz, muscovite, biotite, plagioclase, hornblende | Plagioclase, biotite, hornblende, augite | Plagioclase, olivine, augite |
| **Appearance** | Light colored | Intermediate colored | Dark colored |
| **INTRUSIVE** | Coarse grained | ***Granite*** | ***Diorite*** | ***Gabbro*** |
| **EXTRUSIVE** | Fine grained | ***Rhyolite*** | ***Andesite*** | ***Basalt*** |
| Vesicular | ***Pumice*** | ***Scoria*** |
| Glassy | ***Obsidian*** |
| Pyroclastic | Coarse | ***Volcanic breccias*** |
| Fine | ***Tuff*** |

### *Sedimentary Rock Identification*

Sedimentary rocks can be subdivided based on the source of minerals. Clastic sedimentary rocks, the most common sedimentary rocks, form from the accumulation of mineral grains weathered from other rocks (e.g., sandstone). Chemically-precipitated sedimentary rocks form from minerals precipitated from solution or from organism that build shells from minerals dissolved in solution (e.g., limestone). Organic sedimentary rocks form from the accumulation of organic material; coal, asphalt/bitumen, lignite, and oil shale are examples of organic sedimentary rocks.

1. Use the physical properties of the samples and Table 4. Physical Properties of Sedimentary Rocks to identify the **sedimentary rocks**.
2.
3.
4.
5.
6.
7.

***Table 4. Physical Properties of Sedimentary Rocks***

|  |  |  |  |
| --- | --- | --- | --- |
| **Texture** | **Composition** | **Description** | **Name** |
| **Clastic** | Gravel | Predominantly quartz | Contains large rounded rock fragments | ***Conglomerate*** |
| Sand | Cemented sand-sized grains | ***Sandstone*** |
| Silt | Cemented fine-grained fragments | ***Siltstone*** |
| Clay | Cemented very fine-grained fragments | ***Shale*** |
| **Chemically Precipitated** | Quartz | White to gray | ***Chert*** |
| Dark gray to black | ***Flint*** |
| Calcite | Light brown, hard, dense, smooth surfaces | ***Lithographic Limestone*** |
| Light colored, most shell fragments | ***Coquina*** |
| Chalky color, gritty feel, microscopic organisms | ***Chalk*** |
| **Organic** | Carbon | Plant remains, black, light-weight | ***Bituminous coal*** |

### *Metamorphic Rock Identification*

All rocks can be subjected to metamorphic processes, so a wide variety of metamorphic rocks exist. Metamorphic rocks form when a pre-existing rock is subjected to intense heat and pressure to chemically and/or physically alter the rock into a new rock type (e.g., limestone being metamorphosed into marble). Metamorphosis occurs when rocks are deeply buried and compressed by overlying material, along plate boundaries and fault lines, during mountain uplift, and near volcanoes and other regions of invading magma. Metamorphic rocks are often smoother, harder, and have more banding compared to their parent rocks.

1. Use the physical properties of the samples and Table 5. Physical Properties of Metamorphic Rocks to identify the **metamorphic rocks**.
2.
3.
4.
5.
6.
7.

***Table 5. Physical Properties of Metamorphic Rocks***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Texture** | **Rock** | **Composition** | **Description** | **Derived from** |
| **Foliated** | Fine-grained | **Slate** | Quartz | Flat, red to dark grey, breaks in smooth plates | Shale |
| Coarse-grained | **Schist** | Mica, garnet, quartz, hornblende | Conspicuous mica, silvery black, shiny | Shale, siltstone, basalt |
| Large crystals | **Gneiss** | Feldspar, quartz, mica, hornblende, augite | Banded, breaks in blocks | Granite and igneous rocks |
| **Non-foliated** | Fine-grained | **Anthracite** | Carbon | Black, shiny, light | Bituminous coal |
| Medium-grained | **Quartzite** | Quartz | Interlocking grains, green to red to purple colors | Sandstone |
| Coarse-grained | **Marble** | Calcite | Crystalline masses, effervesces | Limestone |

1. Which of the following can be scratched by a nail? How did you determine that?
	1. quartz
	2. sapphire
	3. gypsum
	4. diamond
2. Why do you do streak and hardness tests to identify minerals but you do not typically do those tests to identify rocks?
3. What is the most obvious property of a rock or mineral?
4. How are igneous rocks subdivided?
5. How are sedimentary rocks subdivided?
6. How do metamorphic rocks typically compare to their parent rocks?