Mystery Minerals Lab

Exploring Earth Sciences through Mineral Identification

Rucker Family Science Teacher Program

Science supplies for Every Student Initiative Teachers

PEORIA RIVERFRONT MUSEUM

Amethyst Gallery of Minerals - Mystery Minerals Lab

Table of Contents

Activity Overview	1
Teacher Resource Document	2-3
Student Resource Lab Document: Mineral Background	4-5
Student Resource Lab Document: Identification Worksheet	6-7
Student Resource Lab Document: Identification Worksheet Key	8-9
Additional Optional Activities: Mini Amethyst Lesson	10-11
Additional Optional Activities: Backyard Geologist Bring from Home Classroom Museum	12
Additional Optional Activities: Create a Classroom Fossil Collection	13-14

Lesson plan developed by the Peoria Riverfront Museum in conjunction with *Amethyst Gallery of Minerals* exhibition. This resource was made possible thanks to the Rucker Family Science Grant Fund.

Rucker Science Fund
Amethyst Gallery of Minerals - Mystery Minerals Lab

Activity Overview

Student Objectives:

- Students can identify minerals by observing and testing the physical properties of each mineral
- Students will conduct their own guided investigation focused on geology and earth science.

Learning Standards aligning with NGSS

- MS-ESS1-4
- MS-ESS2-2
- MS-ESS2-3
- HS-ESS2-2

Student Background Knowledge

Students should understand that everything is made of matter, and that matter has specific properties by which it can be identified.
Students should know that substances can be identified by looking at patterns of their properties.

Customize to Classroom

- The activities outlined in this guide are catered towards a medium-large classroom size. The Original GeoScience Industries Laboratory Manual is also included. This is a great resource and provides a more lecture/demonstration style of lessons including burner and hood required lab tests. Feel free to mix and match based on the needs of your classroom.

Lesson Activities

In this lesson, students will carry out an investigation to identify substances based on patterns of their properties.

Resources

- For Teachers Resource Document
- Student Activity Handout
    - Background Sheet
    - Identification Worksheet
    - Mineral Identification Key
- Original GeoScience Industries Mineral Identification Laboratory Manual
- Additional optional activities:
    - Mini Amethyst Lesson
    - Homework Activity
- Amethyst Gallery of Minerals tour at Peoria Riverfront Museum
    - https://youtu.be/YbhuOSRGJuY?si=wqF07_E-xrpiSRsq

Mystery Minerals | Teacher Resource Document

Lesson Objectives:

Students will investigate and run a variety of geologic tests to identify a selection of minerals. They will observe the surface color, power color by using a streak plate, luster, and magnetism using a magnet to the mineral. Students will also measure the hardness using the scratching technique.

Time needed:

1 hour class period.

Lesson Process Overview

Part One: Introduction to minerals as a class
Part Two: Explore identification testing as a class
Part Three: Investigation stations in small groups or pairs

Materials included in Mystery Mineral Kit

- Minerals (listed in key order. Do not show order to students; minerals are numerically labeled.
    1) Milky Quartz
    2) Microcline Feldspar
    3) Muscovite Mica
    4) Biotite Mica
    5) Calcite
    6) Hornblende
    7) Gypsum variety Selenite
    8) Talc
    9) Graphite
    10) Hematite
    11) Fluorite
    12) Sulfur
    13) Limonite
    14) Nepheline
    15) Rose Quartz
    16) Barite
    17) Chalcopyrite
    18) Galena
    19) Pyrite
    20) Magnetite
    - One for each group (This kit contains enough materials for 5 groups)
        - Magnets
        - Magnifying Glass
        - Nail
        - Scratch plate
        - Copper penny (optional)
    - Selection of Mazon Creek Fossil with identification information
    - *Illustrated Guide to Rocks and Minerals*
    - *Illustrated Guide to Fossil and Fossil Collecting*

Procedure

Mystery Minerals Identification Stations

1) Set up mineral stations for each mineral the students are to identify. Some stations may have two minerals to identify. Ensure names of minerals are unidentified at set-up; label the mineral with a number instead.
2) Each station should be equipped with one each of the following items:
    a) Streak plate (white unglazed porcelain)
    b) Magnet
    c) Water in large enough graduated cylinder to hold water and all mineral samples
    d) Steel Nail
3) Divide students into equal groups. Have the number of student groups match the number of mineral stations.
4) Distribute an **Identification Worksheet** and **Mineral Background sheet** to each student. Have students read the Mineral Background sheet.
5) Assign each group to a mineral station and have students move to their assigned station to begin testing. Have the students perform the physical property tests listed on the Mineral Background sheet. Have students record the test results on the Mineral Worksheet.
6) Rotate the student groups through each of the workstations, performing the tests at each station. Allow 5 to 10 minutes per mineral per station.
7) Hand out Mineral Identification Sheets. (These sheets will be prepared by the teacher depending on the minerals available to use in the class. The sheets should include the name of the minerals and their physical properties).
8) Have students compare their test results with the Mineral Identification Sheet. Write the name of the mineral on the Mineral Worksheet.
9) Once the groups are finished, check their identifications. Send them back to re-deo tests if any are incorrect.

Mystery Minerals | Student Resource Lab Document: Mineral Background

Part One: Introduction

Minerals v. Rocks
Minerals are naturally occurring inorganic, pure substances. Minerals have an orderly structure that is often seen in the form of crystals. There are more than 3000 known minerals on Earth. Rocks are made up of combinations of different minerals.

Geologists, people who study Earth's structure, categorize minerals based on specific properties: chemical composition, color, luster, density, crystal form, hardness, and transparency. Minerals have many different uses that are usually dependent on their properties.

The terms mineral and rock are often confused. They are frequently used together and the materials they describe are closely related. In general, a mineral is a naturally occurring chemical element or compound formed by inorganic processes, whereas a rock is a mixture of particles or grains of several minerals.

Illinois has a surprising wealth of rock and mineral resources, not only to be collected as interesting specimens but to be put to practical and profitable use. Illinois is rich in many minerals, most notably our state mineral: fluorite.

Part Two: How to Test Minerals for Identification
You and your group will use the information below to identify Mystery Minerals!

Type of Test	**Procedure**
Color	Examine the mineral with all the lights on in the room. Many minerals have multiple colors. Record the color
Streak- The color of the powder of the mineral	Rub the mineral across a ceramic plate. The mineral may leave a colored streak of powder. Record the color of the powder. *If the mineral does not leave a streak, it has a hardness greater than 6.5.
Luster – The appearance of the surface of the mineral in reflected light.	Metallic – The luster resembles or somewhat resembles metal. Nonmetallic: - Vitreous: glassy - Pearly: pearl-like - Dull or Earthy: not shiny, clay like - Adamantine: Dimond- like - Resinous or Greasy: resin or grease-like - Silky: resembles silk fabric on the surface, often look fibrous
Magnetism	Hold a magnet to the mineral. If the mineral is attracted to the magnet, it has magnetic properties.
Hardness – The resistance a mineral offers to scratching.	Hold the mineral firmly and drag the nail across it. Use your magnifying glass to look for a scratch. The nail has a hardness of 5. If the mineral shows a scratch from the nail, it has a hardness of less than 5. Other materials you can use to test hardness: - Copper penny - hardness level 3 - Fingernail - hardness level 2.5 - Steel nail- hardness level 6

Explain the patterns you will test and how they will help you identify the mineral:

Mystery Minerals | Identification Worksheet

Part Three: Investigate

You have been split into teams of geologists given the challenge to identify 20 unknown minerals. Use the previous table to begin your investigation. As a team, agree on what tests you will begin with.

Each station should have one porcelain streak plate, one magnet, one copper penny, one steal nail, and at least one mineral. Fill out the following worksheet table as you and your group run each identifying test. Leave "Final Identification" blank.

Record your observations from your investigation in the following table.

Sample #	Color	Streak Color	Luster	Magnetic (yes/no)	Hardness	Specific Gravity (estimated)	Final Identification

Sample #	Color	Streak Color	Luster	Magnetic (yes/no)	Hardness	Specific Gravity (estimated)	Final Identification

Geologist Questions

What was your process in identifying these minerals? Which characteristics did you start with? How did this process change from the first to the last station you visited?

What mineral(s) did you have the most difficult time identifying? Why do you think they were so difficult?

Mystery Minerals | Identification Worksheet Key

Give students these pages after they complete their initial tests to check the identification.

Mineral	Color	Streak Color	Luster	Magnetic (yes/no)	Hardness
Barite	White, brown	White	Vitreous	No	3.0-3.5
Biotite Mica	Black, brown, sometimes green-ish	White, grey	Vitreous, pearly, splendent	No	2.0-3.0
Calcite	White, colorless	White	Vitreous, earthy	No	2.5-3.0
Chalcopyrite	Brass yellow, bronze or green tarnish	Greenish black	Metallic	No	3.5-4.0
Fluorite	Colorless, white, yellow, green, blue, purple, pink, red, brown	White	Vitreous	No	4.0
Galena	Lead grey	Lead Grey	Metallic	No	2.5
Graphite	Black	Black	Dull metallic	No	1-2
Gypsum Variety Selenite	Colorless, white, pale grey, occasionally tinted brown, red or yellow	White	Vitreous, dull, silky	No	2.0
Hematite	Silver, black, brownish red	Reddish brown	metallic	Weakly	5-6.5
Hornblende	Dark green, black	White, grey, green	Vitreous	No	5-6

Give students these pages after they complete their initial tests to check the identification.

Sample #	Color	Streak Color	Luster	Magnetic (yes/no)	Hardness
Limonite	Brown, yellow	Yellowish brown	Earthy	No	4.0-5.5
Magnetite	Black	Black	Metallic	Yes	6.0
Microcline Feldspar	White, tan, salmon pink	White	Vitreous	No	6-6.5
Milky Quartz	Colorless, white, tan	White	Vitreous, dull	No	7.0
Muscovite Mica	Colorless, light shades of yellow, brown, or green	White	Vitreous, pearly	No	2.5-3.0
Nepheline	White, grey, brown	White	Vitreous, greasy	No	5.5-6.0
Pyrite	Pale brass yellow	Black	Metallic	No	6.0-6.5
Rose Quartz	Light pink	White	Vitreous	No	7.0
Sulfur	Yellow	Pale yellow	Resinous, greasy	No	1.5-2.5
Talc	Green, brown, grey, rarely pink	White, Green	Greasy, pearly	No	1.0-1.5

Mystery Minerals | Additional Optional Activities
Mini Amethyst Lesson

This outline provides supplemental information to prepare and impower all educators to engage with any student using the materials of the Rucker Family Science Teacher Kit.
Pair this lesson with the provided quartz and amethyst example. Pass both minerals around or ask students to come up to look at them closer and feel them both.

Educators should use the provided amethysts to allow a tactile element for the lesson. Use milky quartz provided by the kit, or optional self-supplied clear quartz.

Introduction
Introduce Amethyst without naming it:
- What color is this?
- Does anyone know what mineral this is?

Connect to PRM's Amethyst Geode that your class has or will see on their ESI field trip.
- What is a Geode?
  - Geodes are hollow rock formations with minerals, often quartz crystals, clustered inside. A geode forms when minerals settle into a hollow in the earth (like an animal burrow) or inside volcanic rock bubbles.

Introduce Quartz without naming it:
- What color is this?
- Does anyone know what mineral this is?
- How does it feel? Does it feel different from amethysts?
- Would you believe me if I told you that BOTH minerals are made from the same two ingredients?

Scientific Explanation
Point out specific visual elements or details:
- Most of the crystal lattice is this deep rich purple color. How does this crystal get so pretty? - SCIENCE!
- Amethysts are quartz. The other mineral we have here is called Quartz.
- Quartz – Silicon Dioxide
  - Magma contains various minerals, and those minerals also include oxygen and silicon. This magma can break through the earth's crust as tectonic plates shift. As this magma slowly cools down and solidifies over thousands of years, these two ingredients interlock and crystallize. Silicon and oxygen atoms form tetrahedral structures, thus creating the framework of quartz crystals... Did I lose anyone?
  - Basically, as the Earth shifts, aka the ground moves, bubbles form in lava containing all the ingredients for this crystal structure to form after many years. We all feel like scientists now?

So, how does amethyst get its purple color?

Purple coloration comes from **Iron** “imperfections” trapped or built into its crystal lattice and exposed to radiation. This formation takes millions of years.

Where do the gamma rays come from?

Naturally, radioactive elements like uranium, thorium, and potassium-40 decay within the Earth, emitting gamma rays. Additionally, cosmic rays from outer space can also interact with minerals and cause exposure.

Compare and contrast:

Pair and share

Compare and contrast these two minerals, they are in similar shapes, but completely different colors!

The only difference here is that there is a whole lot of iron in the amethyst. Simply said, everything else is “the same”!

Mystery Minerals | Additional Optional Activities
Backyard Geologist Bring from Home Classroom Museum

Have students bring a mineral or rock from either their collection or outside their home. Do the same tests you did in this activity. See if as individuals or as a class students can identify their object.
Next, provide students with index cards to write out their own object label. Display objects in the classroom as your very own classroom natural history exhibit.
If they are unidentifiable based on the resources provided, not a problem! Either put as much information as you can on the label, or label it as unidentified!

Use the following template to write the "museum labels":

Mineral Name
Where it was found
Who found it or owns it Year found or added to collection

Example:

Amethyst
Guanajuato, Mexico
Peoria Riverfront Museum 2024

Mystery Minerals | Additional Optional Activities
Create a Classroom Fossil Collection

Included in your Mystery Mineral Kit is a small sampling of Mazon Creek Fossils. Mazon Creek fossils are unique and important to understanding the biodiversity of this area 300 million years ago. This can be the start of a classroom fossil collection!

Background information:

Illinois has a special trove of fossils, in the Mazon Creek area of Grundy, Will, Kankakee, and Livingston counties. These ironstone concertation fossils are special because both the hard and softer parts of the organism was preserved in many cases. Soft bodied creatures like worms, anemones, and sea jellies have been found in Mazon Creek fossils – creatures that normally are not preserved. Mazon Creek fossils are important worldwide for these factors. They provide scientists with an extraordinary view of biodiversity 300 million years ago.

These fossils are also neat due to their satisfying shapes. They are smooth round nodules, and can often be cracked in half, so the two pieces of rock open to reveal the fossilized treasure inside. They formed during the Pennsylvanian Period, about 300 million years ago. The climate was tropical, and the area that is now northern Illinois was a mixture of swampy lowlands and shallow marine bays. Mud from nearby river systems was deposited in deltas and bays, and turned into the shale where the fossils are found.

Plants and animals that died and fell to the bottom of the bays were rapidly buried by mud washing in from rivers, which protected the remains from being destroyed. Bacteria began to decompose the remains in the mud, which created carbon dioxide. This combined with iron to form a type of rock called siderite, which protected the remains from further damage. The combination of rapid burial and rapid formation of siderite resulted in excellent preservation of the many animals and plants from the Mazon Creek area.

The fossils were found as a result of coal mining. Concretions containing fossils are found in the shale that was deposited right above the coal seams. Shale was deposited in large spoil hills in strip mine areas. Once the shale erodes, the concretions are exposed. Fossils are also found along creek and river banks in the area.

Where to look?

Quarries, retired strip mine sites, cliffs, and bluffs along our major rivers, the Mississippi, Illinois, Ohio, and Wabash Rivers are excellent places to find fossils. If you want to collect fossils, always get permission from the landowner before entering the property. You actually can find fossils almost anywhere! They can be found in the gravel and crushed stone of your driveway or in stone walls and foundation.

Some tips and tricks:

- Sit down or get on your hands and knees and look carefully. Spend some time in one spot before you move on to another. Bring magnifying glasses for extra assistance.

- If you find a well-preserved fossil embedded in rock and you are not certain that you can get it without breaking or destroying it, let nature help you. If you leave it, the wind and weather may help loosen the fossil from the rock, and you can collect it on your next visit.
- Wear gloves to protect your hands and saftey goggles to protect your eyes
- Consider bringing a separate bag or box with newspaper or other material to protect fragile specimens.