EARTH SCIENCE GRADE 4

ASSESSMENT PACKET

Investigate the wild word of rocks and minerals by discovering igneous, sedimentary, and metamorphic rocks as well as quartz, calcite, feldspar, mica, hornblende and ore minerals using diagnostic experiments that real field scientists use!

Created by Aurora Lipper, Supercharged Science

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This curriculum is aligned with the National Standards and STEM for Science.

Educational Goals

You are about to become a real geologist as you explore the world of rocks, crystals, gems, fossils, and minerals by moving beyond just looking at pretty stones and really being able to identify, test, and classify samples and specimens you come across using techniques that real field experts use.

While most people might think of a rock as being fun to climb or toss into a pond, you will now be able to see the special meaning behind the naturally occurring material that is made out of minerals by understanding how the minerals are joined together, what their crystalline structure is like, and much more.

Here are the scientific concepts:

- Minerals are the building blocks of rocks.
- Rocks are usually composed of two or more minerals (once in a while, rocks can be made from just one, but usually it's two or more).
- Minerals are naturally occurring nonliving solids made from a single kind of material.
- Minerals have a regular internal arrangement of atoms and molecules (called crystals).
- Each mineral has its own unique combination of different chemical elements.
- When atoms and molecules combine to make a mineral, they form a type of crystal.
- Each mineral has a unique set of properties and can be identified using a series of standardized tests.

By the end of the labs in this unit, students will be able to:

- Identify and describe the physical properties of minerals.
- Differentiate igneous, sedimentary, and metamorphic rocks by their properties.
- Identify common minerals (including quartz, calcite, feldspar, mica, and hornblende) and ore minerals using a table of diagnostic properties.
- Practice common identification techniques that field scientists use on minerals.
- Identify and differentiate different classifications of rocks, including common sub-designations for certain types of rock.
- Measure and estimate the weight, length and volume of objects.
- Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.
- Follow a set of written instructions for a scientific investigation.

Earth Science Grade 4 Evaluation

Teacher Section

Overview Kids will demonstrate how well they understand important key concepts from this section.

Suggested Time 90 minutes

Objectives Students will be tested on the key concepts of geology:

- Minerals are the building blocks of rocks.
- Rocks are usually composed of two or more minerals (once in a while, rocks can be made from just one, but usually it's two or more).
- Minerals are naturally occurring nonliving solids made from a single kind of material.
- Minerals have a regular internal arrangement of atoms and molecules (called crystals).
- Each mineral has its own unique combination of different chemical elements.
- When atoms and molecules combine to make a mineral, they form a type of crystal.
- Each mineral has a unique set of properties and can be identified using a series of standardized tests.

Materials

- Coin
- Steel nail
- Plate glass
- Ceramic Tile (2)
- Handheld magnifier
- Scale
- Graduated cylinder or Pyrex glass 4-cup measuring cup
- Calculator
- Longwave UV light
- Shoebox
- Razor
- Tape
- Small bottle of acetic acid or distilled vinegar
- Disposable pie pan
- Disposable gloves
- Goggles

<u>Rock Samples</u>

- Talc
- Quartz
- Apatite
- Calcite
- Pyrite
- Hematite (red)
- Hematite (gray)
- Jasper
- Pumice
- Fluorescent minerals (3)
- Limestone
- Coquina
- Sandstone
- Optional: Meteorites (stony, iron)
- Optional: Tektite
- Optional: Magnet

Lab Preparation

1. Print out the student worksheets for the lab practical, homework assignment, and quiz
2. Prepare the lab stations for the lab practical. Refer to the student data worksheets for setup information.

Lesson: The students are taking two tests today: the quiz and the lab practical. The quiz takes about 20 minutes, and you'll find the answer key to make it easy to grade.

Lab Practical: Students will demonstrate that they know how to follow a set of written instructions for scientific investigation, identify and describe the physical properties of minerals, practice common identification techniques that field scientists use on minerals, Follow a set of written instructions for a scientific investigation, and measure or calculate the weight and volume of objects.

Earth Science Grade 4 Evaluation

Student Worksheet

Overview: Today, you're going to take two different tests: the quiz and the lab practical. You're going to take the written quiz first, and the lab practical at the end of this lab. The lab practical isn't a paper test – it's where you get to show your teacher that you know how to do something.

Lab Test & Homework

1. Your teacher will ask you to share how much you understand about Earth Science. Since science is so much more than just reading a book or circling the right answer, this is an important part of the test to find out what you really understand.
2. While you are waiting to show how much of this stuff you already know, you get to choose which homework assignment you want to complete. The assignment is due tomorrow, and half the credit is for creativity and the other half is for content, so really let your imagination fly as you work through it. Choose one:
    a. Write a short story or skit about minerals from the perspective of the rock itself (like marble or granite). You'll read this aloud to your class.
    b. Make a poster that teaches one of the main concepts of geology you enjoyed most. When you're finished, you'll use it to teach to a class to younger students and demonstrate the principles that you've learned.
    c. Write and perform a poem or song about your favorite type of rock (fluorite, gypsum, conglomerate…). This will be performed for your class.

Earth Science Grade 4 Quiz

Teacher's Answer Key

1. What is the definition of a rock? (Something that is made of two or more minerals.)
2. What does it mean if there's no streak left on the streak plate? (The mineral is harder than the streak plate, which means it has a hardness of above 7.)
3. Give an example of a kind of rock that leaves a streak a different color than its surface color. (Pyrite is gold, but its streak is green-black.)
4. If a mineral scratches a penny but doesn't get scratched by a nail, can you approximate its hardness? (Over 5.5)
5. Give examples of the hardest and softest minerals on the Mohs' Scale. (Diamond = 10, Talc = 1)
6. Name three properties geologists look for when they try to categorize a mineral. (Color, hardness, fluorescence, magnetism, luster, how they break, if they react to acid, etc.)
7. If you break a sample of quartz and find that it has no clean surfaces of separation, what kind of cleavage does it show? (none)
8. What are two things we use coal for? (heating water and generating electricity)
9. What is the equation for finding density? ($\rho = m/V$)
10. How is fluorescence different from phosphorescence? (Minerals that are fluorescent glow when exposed to a UV light. Minerals that continue to emit light even after the UV light has been switched off are phosphorescent.)
11. Is lodestone the same as magnetite? (Lodestone is the magnetic version of magnetite.)
12. Name three characteristics of pumice. (light-colored, floats on water, and is porous.)
13. What is a crystal, and how is it different from a mineral and a rock? (Crystals are a structure of a regular pattern of atoms within a solid. A mineral is an inorganic substance. All minerals are crystalline. Rocks are composed of two or more minerals. Not all crystals are minerals.)

Earth Science Grade 4 Quiz

Student Quiz Sheet

Name_____

1. What is the definition of a rock?

2. What does it mean if there's no streak left on the streak plate?

3. Give an example of a kind of rock that leaves a streak a different color than its surface color.

4. If a mineral scratches a penny but doesn't get scratched by a nail, can you approximate its hardness?

5. Give examples of the hardest and softest minerals on the Mohs' Scale of Hardness.

6. Name three properties geologists look for when they try to categorize a mineral.

7. If you break a sample of quartz and find that it has no clean surfaces of separation, what kind of cleavage does it show?

8. What are two things we use coal for?

9. What is the equation for finding density?

10. How is fluorescence different from phosphorescence?

11. Is lodestone the same as magnetite?

12. Name three characteristics of pumice.

13. What is a crystal, and how is it different from a mineral and a rock?

Earth Science Grade 4 Lab Practical

Teacher's Answer Key

This is your chance to see how well your students have picked up on important key concepts, and if there are any holes. Your students also will be working on their homework assignment as you do this test individually with the students.

Materials

- Coin
- Steel nail
- Plate glass
- Ceramic Tile (2)
- Handheld magnifier
- Scale
- Graduated cylinder or Pyrex glass 4-cup measuring cup
- Calculator
- Longwave UV light
- Shoebox
- Razor
- Tape
- Small bottle of acetic acid or distilled vinegar
- Disposable pie pan
- Disposable gloves
- Goggles

<u>Rock Samples</u>

- Talc
- Quartz
- Apatite
- Calcite
- Pyrite
- Hematite (red)
- Hematite (gray)
- Jasper
- Pumice
- Fluorescent minerals (3)
- Limestone
- Coquina
- Sandstone
- Optional: Meteorites (stony, iron)
- Optional: Tektite
- Optional: Magnet

Lab Practical: Each student will need a complete copy of their evaluation packet so they can move from station to station and answer the questions. Set up the stations ahead of time and run through them once to be sure everything is set up correctly. (You'll need to put together the fluorescent box, for example.)

If you don't have certain rock specimens, feel free to substitute with what you have. The rocks in this packet reuse the materials from the accompanying experiments in the main part of the program.

Earth Science Grade 4 Lab Practical

Student Worksheet

LAB STATION PACKET

This is your chance to show how much you have picked up on important key concepts, and if there are any holes. You also will be working on a lab assignment individually at different stations. Your teacher will let you know what to do and how long to spend at each station.

Lab Practical:

- You will be visiting several different stations that have been set up already for you. Your job is to figure out which rock is which and complete the data sheet in this packet for each station you visit.

Station #1: Hardness

Find four rocks at this station along with a coin, nail, and piece of glass. You're going to figure out which mineral is which, and also estimate their hardness. We're looking for the hardest mineral. Here's how you do it:

1. You'll be able to scratch the talc rock with not only your fingernail and also a coin. Since your fingernail and the coin both have a hardness of 2, this rock has a harness of less than 2. What number rock do you think talc is, and what is the hardness? Write it here:

   Talc is rock number _____ and has a hardness of about _____.

2. Now find the rock that can't be scratched by the steel nail, and can also scratch a piece of glass. This is quartz. Minerals that can scratch glass have a hardness of 7 (or higher).

   Quartz is rock number _____ and has a hardness of about _____.

3. Both Calcite and Apatite can be scratched by the steel nail, but not by your fingernail or the coin. Apatite harder than Calcite because you can use Apatite to make a scratch on Calcite, but Calcite can't scratch Apatite.

   Apatite is rock number _____ and has a hardness of about _____.

   Calcite is rock number _____ and has a hardness of about _____.

4. Which rock is the hardest?_____

Station #2: Color & Streak

Find four rocks: two that are red, one is shiny gray, and one that is shiny gold. You'll also have a small white piece of ceramic tile, called a streak plate. We're going to use a streak test to figure out the names of these rocks. We're looking for the two that are actually the very same mineral. Here's how you do it:

1. Take a rock and use it like a pencil to make a scratch across the surface of the ceramic tile. The mineral will make a color that is unique for that mineral. This works because when the mineral, when scratched, is ground into a powder. All varieties of a given mineral have the same color streak, even if their surface colors vary.

2. Record what you find in the data table below:

Sample Number	Surface Color of Rock	Color of the Streak	What Mineral Is It?

3. In your data table above, circle the two rocks that are actually the very same rock.

Hematite will leave a red streak. Pyrite, which looks a lot like real gold, leaves a black streak, while gold will leave a golden streak. Some minerals are harder than the mineral plate, like jasper, and you'll just get a scratch on the plate, not a streak.

Station #3: Density

You'll find a large, lightweight rock next to a measuring scale and a tub of water. We're going to measure the density of the pumice rock. Density is a measure of how heavy something is for its size. Foam is not very dense compared to a typical rock, meaning that if you had a rock and a piece of foam exactly the same size, you'd expect the rock to weigh more. However, this rock is lighter than usual. Let's find out how dense it is. Here's how you do it:

1. Weight the rock using a scale. Make sure you are measuring in grams, and record your weight here:

   Mass = _____ grams

2. Record the water level in milliliters (mL). You can add more water if you need to to bring it up to a number that's easier to read.

   Water level = _____ mL

3. Place the pumice sample in the water and record the new water height. Make sure the rock is completely submerged. Use a fingertip to push it completely underwater if you need to.

   New water level = _____ mL

4. What is the difference in the water levels? You can use a calculator.

   Water level difference = _____ mL

5. Now use the calculator to divide the mass by the water level difference. This is your density.

   Density = mass ÷ water level difference = _____ (units?)

6. Is pumice lighter or heavier than water? _____

The density of water is 1 g/mL. The specific gravity (also called the "s.g." or "SG") of a mineral or rock is how we compare the weight of the sample with the weight of an equal volume of water. Low specific gravity substances, like pumice (0.9), are not very dense. High specific gravity substances, like for gold (19.3), are very dense. If the specific gravity is less than 1, it will float on water.

Station #4: Fluorescence

Find a black box with a black light inside along with several different rocks. Some minerals fluoresce (glow) when exposed to this type of light, but you need a dark space to be able to see it. Let's find out what happens to these rocks when you exposed them to a UV light.

1. Play with the rocks in the UV light. Find the best three out of the pile.

2. Record the most amazing three rocks in the data table below:

Rock Sample Number	What color(s) is it in daylight?	What color(s) is it in UV light?

There are two different types of UV wavelengths: longwave and shortwave. Some minerals fluoresce the same color when exposed to both wavelengths, while others only fluoresce with one type, and still others fluoresce a different color depending on which it's exposed to. Minerals fluoresce more notably with shortwave UV lamps, but these are more dangerous than longwave since they operate at a wavelength that also kills living tissue.

Station #5: Acid Test

Wear gloves when doing this lab!

Find three rocks and a small bottle of acid. Two if the rocks chemically react with acid and one does not. The rock that doesn't react is called a clastic rock, and that's the one we're looking for.

1. **Put your gloves on. No exceptions.** This acid is the same kind that's found in your stomach and will dissolve living tissue.
2. Place the three rocks in the metal pie tin, spacing them apart.
3. Place a single drop of acid on each rock and watch for a reaction.
4. Record your observations in the data table below.

Rock Sample Number	Did it fizz?	Mineral Name

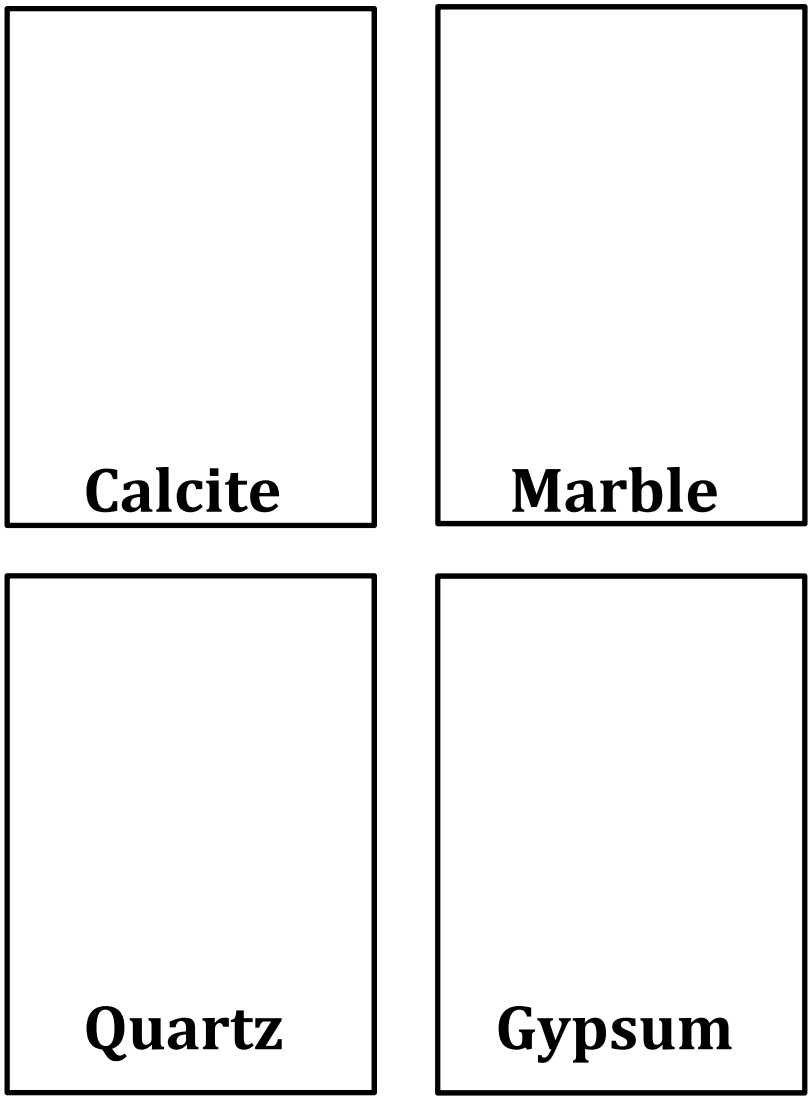
5. IMPORTANT: Use the damp cloth to carefully wipe off each rock. Don't get the rock too wet – just wipe off the surface.
6. Throw your gloves in the trash.
7. In your data table, circle the one that is the clastic (non-reactive) rock.

The two that fizzed are varieties of *limestone*. The one that looks like it's a bunch of smashed shells stuck together is called *shell limestone*, or *coquina* (pronounced "koh-KEE-nuh"). The one that doesn't fizz at all is called sandstone.

Station #6: Luster, Cleavage and Fracture

Find four white rocks. Which rock is which? Place them in the boxes below as you read the clues to figure it out. Also write the rock sample number in each box.

1. Quartz has no cleavage, only fracture.
2. Calcite has no fracture, only cleavage. Looks like a rhombus, and none of the angles are 90 degrees.
3. Gypsum is soft-looking and can be scratched by calcite.
4. Marble is sparkly in sunlight and has small, reflective planes like crumpled tinfoil.



BONUS STATION: Meteorites

Find several rocks, a magnet, a ceramic tile, and a magnifier. Some of the rocks are real meteorites, and others are not. Let's figure out which ones are meteorites and which are "meteor-wrongs". Here's how you do it: as you read through these clues, look at the pile of rocks and get rid of the ones you think are not meteorites.

1. Meteorites are space rocks that make it through the Earth's atmosphere. As they come through the atmosphere, they travel *really* fast. Most small, porous rocks will either explode or vaporize when they hit the atmosphere before they hit the ground. Only strong rocks without lots of holes make it to the ground.

2. Some meteorites get a dark crust or look like dark splashed metal on the outside.

3. Meteorites contain iron, and iron is heavy. A meteorite is usually heavier than an Earth rock the same size.

4. Since almost all meteorites have lots of iron in them, they are also magnetic.

5. There's one Earth rock called *lodestone* which is dark, heavy, and magnetic, but it's not a meteorite because it leaves a dark streak when scratched on a ceramic tile. A real meteorite will not leave a streak.

6. Which ones are real meteorites?

   Sample numbers:_____

7. Use your best guess to fill in the boxes below:

   Sample Number: Description:

   ☐ *Stony Meteorites* (there are two of these, one is the unmarked slice) are a mix of metal and stone, and this one was found in Arizona. 94% of all meteorites that fall to Earth are this kind.

   ☐ *Iron Meteorites* make up only 5% of meteorites that hit the Earth are this kind. This one came from the Asteroid Belt and was later found in Russia.

   ☐ *Tektite* is actually not a meteorite, but is the glass that formed from the sand that got so hot when the meteorite hit that it turned the sand into glass. This tektite was ejected out of our atmosphere and when it landed, it was a piece of glass.