4th Grade Earth Science: Rocks & Minerals Unit

Developed for Chapel Hill Carrboro City Schools
Northside Elementary School Outdoor Wonder & Learning (OWL) Initiative

Unless otherwise noted, activities written by:
Lauren Greene, Sarah Yelton, Dana Haine, & Toni Stadelman
Center for Public Engagement with Science
UNC Institute for the Environment

In collaboration with 4th grade teachers at Northside Elementary School:
Meaghan Cole, Stephanie Jeffries, Ashley Quick-Hooker, & Rita Singh

ACKNOWLEDGEMENTS

Many thanks to Dan Schnitzer, Coretta Sharpless, Kirtisha Jones and the many wonderful teachers and support staff at Northside Elementary for their participation in and support of the Northside OWL Initiative. Randy Bechtel, NC Geological Survey, and Michelle Haskin, UNC Department of Geological Sciences, went above and beyond in contributing their time, creativity and advice in developing the hands-on activities for this unit. Thanks also to Shelby Brown for her invaluable assistance compiling, editing, and proofreading the curriculum.

Instructional materials and supplies to promote STEM-based outdoor learning were instrumental to the successful implementation of this curriculum. The purchase of these materials was made possible with funding provided by the Duke Energy Foundation to Chapel Hill-Carrboro City Schools.

Curriculum developed June 2018 – July 2019

For more information, contact:
Sarah Yelton, Environmental Education & Citizen Science Program Manager
UNC Institute for the Environment Center for Public Engagement with Science
sarah.yelton@unc.edu

Overarching Unit Question

How are rocks, minerals, and geohazards evidence of our dynamic Earth's surface, and how do we experience these in our communities?

Essential Questions

Arc 1: What can we learn by examining the properties of rocks and minerals?
Arc 2: How can we classify rocks and minerals?
Arc 3: How do rocks and landforms change under different circumstances?

Transfer Goals

- Use scientific approaches and methodologies to investigate phenomenon, claims, results and information.
- Use scientific thinking to understand the relationships and complexities of the world around them.

Enduring Understandings (Science)

- We can learn about objects by observing them.
- Matter exists in different forms and can change from one state to another.
- We can use our knowledge of matter and how it changes to solve real problems.
- Structures of the earth change over time and can be measured and compared through models and diagrams.

Target Science Essential Standards

4.P.2 **Understand** the composition and properties of matter before and after they undergo a change or interaction.

4.P.2.1 **Compare** the physical properties of samples of matter (strength, hardness, flexibility, ability to conduct heat, ability to conduct electricity, ability to be attracted by magnets, reactions to water and fire).

4.P.2.2 **Explain** how minerals are identified using tests for the physical properties of hardness, color, luster, cleavage and streak.

4.P.2.3 **Classify** rocks as metamorphic, sedimentary or igneous based on their composition, how they are formed and the processes that create them.

4.E.2.3 **Give examples** of how the surface of the earth changes due to slow processes such as erosion and weathering, and rapid processes such as landslides, volcanic eruptions, and earthquakes.

4.L1.3 **Explain** how humans can adapt their behavior to live in changing habitats (e.g., recycling wastes, establishing rain gardens, planting trees and shrubs to prevent flooding and erosion).

Secondary Target Standards (ELA, Math, Social Studies)

ELA

RI.4.2 Determine the main idea of a text and explain how it is supported by key details; summarize the text.

RI.4.4 Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade 4 topic or subject area.

W.4.2 Write informative /explanatory texts to examine a topic and convey ideas and information clearly.

W.4.3 Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.

SL.4.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.

Math

4.MD.1 Know relative sizes of measurement units. Solve problems involving metric measurement.

4.MD.4 Represent and interpret data using whole numbers.

Unit Overview

In this unit, students will learn about rocks and minerals as well as processes that shape the earth. Before the unit begins, students will collect a pet rock to use throughout the unit, especially in Arc 1 and 2, to learn about rocks and minerals.

Arc 1 focuses on learning about rocks and minerals and their properties. Students will conduct online research, as well as participate in hands-on activities. An investigation of the properties of rocks and minerals will use samples of multiple different rocks and minerals. During a rock wall scavenger hunt, students begin to explore rocks in an outside environment.

In Arc 2 students learn about the three types of rocks and how they move through the rock cycle. After learning about the different types of rocks, students will match descriptions with rocks to learn how the types of rocks vary. A more in-depth investigation of rock types occurs when students observe the rocks around the schoolyard during a rock walk. Students then simulate the rock cycle using a dice game in the classroom and try to determine which type of rock their pet rock is.

Arc 3 delves into how rocks and landforms change over time. Students complete two outdoor activities to make observations of erosion, deposition, and weathering around the schoolyard and surrounding areas. The final activity investigates the different types of geohazards, focusing on the most common ones in North Carolina.

Duration

12-15 days of 45 minute lessons (plus any additional collection days for Learning Activity 9)

Vocabulary*

Properties, shape, mineral, rock, magnetic, hardness, crystal, color, luster, cleavage, fracture, streak, geologist, igneous, sedimentary, metamorphic, rock cycle, erosion, deposition, weathering, earthquake, landslide

** Definitions of vocabulary words can be found on the Arc overview pages. Relevant vocabulary is also listed on each learning activity page.*

Go Outdoors! Tips & Tools

Taking your class outside for science or any lessons can be rewarding and challenging. Along with behavior and materials management tips with each lesson, this section is intended to help you have the tools you need to successfully take your class outside.

Before You Go Outside

- Create **ground rules** with students for all outdoor lessons. Post the rules for students to be able to easily see.
- Ask for **parent volunteers**. Extra help can make an outdoor learning experience much more manageable.
- Teach students proper use, including safety, of the science tools they will be using.
- Set expectations before go. Give instructions both inside and repeat once outside.
- Have a clear **objective** for going outdoors. This will help focus students' attention.
- Be flexible. Structure lessons to take advantage of **opportunities and challenges**.
- Establish a meeting spot and emergency plan. Have a signal for emergency situations.
- Take students outside for short exercises to practice rules before longer outdoor lessons.
- Use **same door** to always go outside for learning. Emphasize this is different than going outside for recess.

While You Are Outside

- **Model** the activities and outdoor skills for students. Show them what you expect them to be doing.
- **Participate in the activity**. Get down on your students' level. Get your hands dirty.
- Model **respect for nature** with your students.
- The outdoors is full of **teachable moments**. Use "I wonder" statements to engage students in questioning the experience. Have students write down questions to be researched back in the classroom.
- Allow students to be **leaders** in the activity. Ask students to volunteer as teacher assistant or materials manager.
- Acknowledge that students want to explore and can do so once the assigned task is complete.

Safety First!

- Scout outdoor areas ahead of time if possible, to note **potential hazards** such as poison ivy.
- Students should **never be alone**. If a student needs to go back to the building, send 2 students.
- Take a **first aid kit and phone/walkie-talkie**. Consider bringing along staff trained in first aid/CPR.
- Let office staff know where you and your class are going if headed out on a walking field trip.
- **Stay on the trail/path**, unless otherwise directed. On the greenway, stay on the right side of path.
- **Do not eat wild plants**, unless harvesting in the garden with a teacher.
- Set **boundaries** for the students to stay within. You have to be able to see me and I have to be able to see you!

A Note on Nature Journaling

Nature journals that you use with your class should be small composition books or other blank books that students use to make outdoor observations, including writing, drawing, and painting. Students can use colored pencils, watercolor pencils, or other materials to remember details of plants, animals, and habitats they are investigating around the schoolyard. This is different from a science notebook. However, some teachers may choose to have students paste blank pages into their science notebook to use for nature journaling pages.

Essential Questions

What can we learn by examining the properties of rocks and minerals?

NC Science Essential Standards – Unpacked Content

4.P.2.1 Students know that samples of matter have many observable properties that can be measured. Students know that samples of matter can be described according to the characteristics of the materials they are made from. Students are familiar with, and can test for the following properties: strength, hardness, flexibility, ability to conduct heat, ability to conduct electricity, ability to be attracted by magnets, reactions to water (dissolve) and heat/fire (melt, evaporate).

4.P.2.2 Students know that minerals can be identified by using particular tests. Students know how to perform tests for hardness and streak. Students are able to describe the color, luster, and cleavage of a mineral.

Lessons in this Arc

- Engaging Activity: Pet Rocks
- Learning Activity 1: Properties of Minerals
- Learning Activity 2: Rocks & Minerals Stations
- Learning Activity 3: Rock Wall Scavenger Hunt
- Learning Activity 4: Comparing Cookies & Rocks

Go Outdoors!

- ✓ Engaging Activity: Pet Rocks
- ✓ Learning Activity 3: Rock Wall Scavenger Hunt

Nature Journal Connection

- Engaging Activity: Pet Rocks
- Learning Activity 3: Rock Wall Scavenger Hunt

Duration

5-6 days of 45 minute learning activities (with the exception of Learning Activity 2 which takes about 60 minutes)

Background Information

All matter has **properties** which can be measured or observed. Strength, hardness, flexibility, ability to conduct heat, ability to conduct electricity, ability to be attracted to magnets, and ability to react with water and fire are all properties of matter. Matter is any substance that takes up space by having volume and has mass. Matter can undergo physical and chemical changes but it cannot be destroyed. It can only change form.

Geologists are the earth scientists who study the earth, its composition, and the changes that occur over time. **Rocks** are naturally-occurring and made of at least one mineral. A **mineral** is also naturally-occurring and has a

characteristic internal atomic structure and a definite chemical composition. **Crystals** are solids formed by molecules connecting together in a repeated pattern.

Hardness, color, luster, cleavage, and streak are all physical properties used to identify minerals. Physical properties can be observed and measured without changing the composition of matter. The **shape** is the form of the rock or mineral. **Hardness** is the ability of an object to resist being scratched. The Moh's Hardness Scale is used to assess the hardness of a rock. **Color** is the appearance of the object caused by light either being reflected or emitted. **Luster** is how light is reflected off the surface of the mineral. If a mineral breaks and forms a smooth surface, it is called **cleavage**. If the mineral breaks unevenly it is **fractured**. When a mineral is scraped on a streak plate, the color of the powder left behind is a **streak**.

Vocabulary

- **Properties** are **c**haracteristics that can be observed or measured.
- **Shape** is something having a certain form.
- A **mineral** is a naturally-occurring, inorganic solid which possesses a characteristic internal atomic structure and a definite chemical composition.
- A **rock** is a naturally occurring solid made up of one or more minerals.
- **Magnetic** is an object surrounded by a magnetic field, causing iron or steel materials to be attracted to it.
- The **hardness** of a mineral is its ability to resist scratching.
- A **crystal** is a solid that forms by a regular repeated pattern of molecules connecting together.
- **Color** is the aspect of things that is caused by differing qualities of light being reflected or emitted by them.
- **Luster** is how light is reflected from the surface of a mineral.
- **Cleavage** is the ability of a mineral to break along preferred planes. Cleavage forms a smooth surface.
- **Fracture** is when a mineral breaks unevenly. Fractures result in chips and rough surfaces on minerals.
- **Streak** is the color of the powder left on a streak plate (piece of unglazed porcelain) when the mineral is scraped across it.
- A **geologist** is a scientist who studies the Earth, the materials of which it is made, the processes acting upon them, and how they have changed over time.

Literature Connections

Books

- *Everybody Needs a Rock* by Byrd Baylor (E BAY)*
- *These Rocks Count* by Alison Formento (E FRO)*
- *If You Find a Rock* by Peggy Christian (552 CHR)*
- *A Rock is Lively* by Diannna Hutts Aston (552 AST)*

Book sets

- *Minerals, Rocks, and Soil* by Barbara Davis*

*currently available in Northside Elementary's media center

Engaging Activity
Pet Rocks

Lesson Prep

- ✓ Assign students to collect a pet rock prior to starting the rocks and minerals unit.
- ✓ Preview the book you have chosen to read to the class.
- ✓ Collect a spare pet rock or two for student use.

Vocabulary

Rock

Procedure

Pre-assignment

- Students should be given the assignment to find a rock to bring in for study during the rock unit.
- This will be **their pet rock** and study subject for the duration of the unit.
- Ideally, the students will have at least a weekend to collect their rock.
- The rock needs to be big enough to study and small enough to easily bring to school. You may want to give specific parameters like it needs to be between the size of a nickel and an apple.
- **They should collect the following information when they find their rock: location rock was found, surrounding environment, and date collected.** This can be recorded on a notecard or other small piece of paper, and should come back to school with their rock.

Independent Work

- Students will use the **Nature Journaling Prompt**: 
  - Describe your pet rock by telling the story of finding it and why you chose it. Be sure to include where you found your rock and a detailed description of your rock using your sense of touch, sight, hearing, and smell. Sketch your rock.
- Students could take their pet rocks to an area **outside** such as the green roof, the school garden, or the rock wall next to the black top to complete the Nature Journaling Prompt. 

Mini-Lesson

- **After** students have found a rock and written their descriptive stories, then read a book about rocks.
- Read "Everybody Needs a Rock" by Byrd Baylor (E BAY). This story gives rules for finding a pet rock.

Learning Objectives:
Students will be able to use their observation skills to describe a rock.

Nutshell/Skills:
Students can make observations about a rock.

Science Essential Standards:
4.P.2.1, 4.P.2.2

Math Essential Standards:
NC.4.MD.1 (Extensions)

Time:
45 minutes

Teacher Materials:
One of the below books:
- "Everybody Needs a Rock" by Byrd Baylor (E BAY)
- "These Rocks Count" by Alison Formento (E FRO)
- "If You Find a Rock" by Peggy Christian (552 CHR)
- "A Rock is Lively" by Diannna Hutts Aston (552 AST)

Student Materials:
- Private Eyes (or other magnifiers)
- Nature Journals
- Writing utensils
- Pet rocks

- Throughout the story you could use a silent signal, such as a thumbs up, for when they have a connection between their story and the book.
- Alternate books that could be read include "These Rocks Count" by Alison Formento (E FRO), "If You Find a Rock" by Peggy Christian (552 CHR), or "A Rock is Lively" by Diannna Hutts Aston (552 AST).

Opportunities for Extended Learning

1. Have students find the mass and other measurements of their pet rocks.
2. Discuss how they could find the density of their pet rocks.

Behavior & Materials Management Tips

- Have students describe proper ways to handle their pet rock before they begin. Include in your discussion where they will keep their pet rocks when they are not using them for science.
- You could discuss proper treatment of a living pet and compare that to how they should handle their pet rocks.
- Emphasize that their pet rocks are a way to help the students learn about rocks and minerals.
- Remind students how to properly use The Private Eyes (or other magnifiers). Be sure to include in your instructions the fact that their rocks can scratch the lenses of The Private Eyes.

Pet Rock Nature Journaling Prompt

Describe your pet rock by telling the story of finding it and why you chose it. Be sure to include where you found your rock and a detailed description of your rock using your sense of touch, sight, hearing, and smell. Sketch your rock.

Pet Rock Nature Journaling Prompt

Describe your pet rock by telling the story of finding it and why you chose it. Be sure to include where you found your rock and a detailed description of your rock using your sense of touch, sight, hearing, and smell. Sketch your rock.

Pet Rock Nature Journaling Prompt

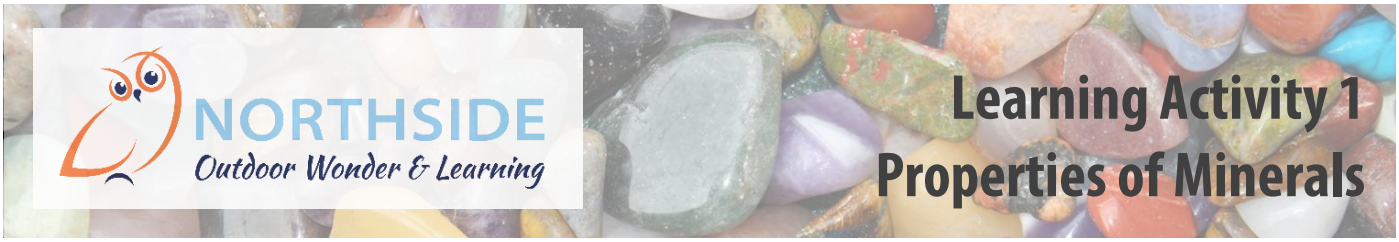
Describe your pet rock by telling the story of finding it and why you chose it. Be sure to include where you found your rock and a detailed description of your rock using your sense of touch, sight, hearing, and smell. Sketch your rock.

Pet Rock Nature Journaling Prompt

Describe your pet rock by telling the story of finding it and why you chose it. Be sure to include where you found your rock and a detailed description of your rock using your sense of touch, sight, hearing, and smell. Sketch your rock.

Pet Rock Nature Journaling Prompt

Describe your pet rock by telling the story of finding it and why you chose it. Be sure to include where you found your rock and a detailed description of your rock using your sense of touch, sight, hearing, and smell. Sketch your rock.



Learning Activity 1
Properties of Minerals

Lesson Prep

- ✓ Students can complete all work on computers, if you choose.
- ✓ Preview the *Flocabulary on Minerals*, *Mineralogy4Kids Minerals*, and *Mineralology4Kids Crystals.*

Vocabulary

Mineral, properties, color, luster, cleavage, streak, hardness, crystal

Procedure

Independent Work

- Students will create a KWL chart about their pet rocks.
  - Students should add at least **3** things they **know** and **3** things they **wonder** to their KWL chart for their pet rocks.
  - As they learn about the properties of minerals, they should be able to add at least **3** things they **learned** to the chart.
- *Flocabulary on Minerals* which goes over the vocabulary used to describe the properties of minerals.
- Have students use *Mineralogy4Kids Minerals* website to write a definition of each **vocabulary word: mineral, color, luster, cleavage, streak, hardness, crystal.** To define the term **crystal**, use *Mineralology4Kids Crystals*.
- Have students write a sentence about a connection between their **pet rock** and 5 of the vocabulary words, for a total of 5 sentences.

Assessment

- Vocabulary sentences which connect to their pet rocks can serve as an assessment.

Learning Objectives:
Students will be able to identify and describe the properties of minerals that are used to identify them.

Nutshell/Skills:
Students can describe the properties of minerals.

Science Essential Standards:
4.P.2.1, 4.P.2.2

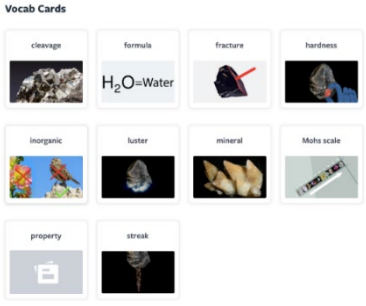
ELA Essential Standards:
RI.4.4

Time:
45 minutes

Student Materials:
- Chromebooks or iPads
- Pet rocks
- *Flocabulary on Minerals*
- *Mineralogy4Kids Minerals*
- *Mineralology4Kids Crystals*

Opportunities for Extended Learning

1. Watch the BrainPop video on "*Crystals*" (2:33).
2. *Mini Me Geology* has resources to help you teach about the properties of minerals as well as resources for students. Be aware that the video explaining the streak test does use a mineral that students will be trying to identify in the next activity, so you may want to save showing that video to students until after they have completed Learning Activity 2: Rocks and Minerals Stations.
3. *Padlet for Identifying Minerals* created by Ashley Quick-Hooker.



Learning Activity 2
Rocks and Minerals

Adapted from NC Geological Survey's *Rock and Mineral Stations Activity* by Randy Bechtel.

Lesson Prep

- ✓ Set up the 6 stations with station instructions as well as rock and mineral samples and other materials:
  - ✓ Station #1 needs quartz, calcite, and gypsum.
  - ✓ Station #2 needs magnetite, obsidian, and coal plus a magnet.
  - ✓ Station #3 needs limestone, hematite, and pumice plus a streak plate, container of water, and paper towels.
  - ✓ Station #4 needs talc, graphite, galena, and sulphur.
  - ✓ Station #5 needs feldspar, halite, and mica.
  - ✓ Station #6 needs amethyst, citrine, milky quartz, rose quartz, tiger-eye, agate, and aventurine.
  - ✓ **Note**: Each station needs **ONLY 1** sample of each type of rock or mineral.
- ✓ Make copies of the "Answer Sheet for the Rocks and Minerals Station Activities", one per student.
- ✓ Read over **all** the station instructions.

Vocabulary

Property, shape, mineral, rock, magnetic, hardness, crystal, color, luster, cleavage, fracture, streak, geologist

Procedure

Mini-Lesson (15 minutes)

- Tell students that a **geologist** is a scientist that studies the Earth, what the Earth is made of, and how the Earth was formed. Today we are going to be geologists. What sort of things might we study?
  - Student answers could include rocks, minerals, climate change, earthquakes, volcanoes, landslides, erosion, deposition, weathering, floods, fossil fuels, ground water, or metals.
  - Telling students that they will be geologists today empowers them to think and act like a scientist **and** gives you a way to refocus their off-task behavior.
- Ask students to tell you about the different **properties of minerals**. How could they, like geologists, use these properties **to identify** a particular rock or mineral?
  - Properties of minerals include hardness, luster, streak, color, crystal shape, and cleavage.

Learning Objectives:
Students will be able to demonstrate how to use the properties of minerals to identify the type of mineral.

Nutshell/Skills:
Students can identify minerals by applying their knowledge of the properties of minerals.

Science Essential Standards:
4.P.2.1, 4.P.2.2

Time
60 minutes (can be divided into two 30 minutes sessions)

Teacher Materials
- Teacher Answer Key for the Rocks and Minerals Station Activities

Student Materials
- Copies of student answer sheet
- Station instruction sheets
- Rock and mineral samples: quartz, calcite, gypsum, magnetite, obsidian, coal, limestone, hematite, pumice, talc, graphite, galena, sulphur, feldspar, halite, mica, amethyst, citrine, milky quartz, rose quartz, tiger-eye, agate, aventurine
- Streak plates
- Container of water big enough to float the pumice, about half full of water
- Paper towels
- Magnet
- Pencils
- Pet rocks (optional)

- If you have not done a lesson on the properties of minerals, you will need to teach about hardness and streak before completing this lab.
- With students at their seats, walk around to each station **reading** the directions out loud and **modeling** how to handle the samples. Tell students that **the goal of this lab is for them to use the properties of minerals to identify the samples, just like a geologist does**.
  - For Station #3, when testing which sample **floats**, instruct the students to gently place the samples one at a time in the container so as not to splash or spill the water. Streak plates have a hardness of about a 7, therefore, minerals that have a hardness of greater than 7 won't streak. Place the streak plate flat on the table and scratch the mineral on the plate. Students may have to press hard to see the streak.
- **Emphasize** that they will need to carefully **follow the directions** at each station to be able to **identify** each of the rocks and minerals. They will need to **work together** as a team to complete this lab.
- Explain that **scientists** often do things in a **certain order** to find the answers.
- Let students know that there are **6 different stations** that each group will be visiting. They will have about **5 minutes at each station**. Typically, the first rotation may take the longest as they get a feel for what to do.
- Students should **follow the directions** at each station and then answer the question on their paper. You will tell them when it is time to rotate and how to rotate, i.e. clockwise.
- **Remind** students to handle the samples **carefully** as some may have sharp edges and are heavy. As with any science lab, **safety is important**.

Independent Work (35 minutes)

- Have students complete Stations #1-6 in groups. Stations #1-5 have students performing mineral identification tests while Station #6 demonstrates that color is not a reliable way to identify a rock or mineral.
- Student groups will rotate to each station to perform the different tests that geologists use to identify rocks and minerals, as well as read more about the samples.
- Tell the groups to rotate about every 5 minutes.
- While at each station, students should complete the corresponding questions on their answer sheet.
- Students can also test their **pet rocks** at each station **after** the samples have been identified and answers recorded.
- Students should stay focused on the particular tests for each station. The properties of minerals focused on at each station correspond specifically with the samples chosen for that station.

Assessment (10 minutes)

- Have students turn in their "Answer Sheet for the Rocks and Minerals Station Activities" to be graded using the answer key.
- As a class, discuss the lab.
  - Have volunteers **identify** each sample.
  - As each sample is identified, hold up the sample and have students give a thumbs up or thumbs down if they agree or disagree with the identification.
  - Ask students about which samples were **hardest** to identify and why as well as which were **easiest**.
  - For Station #6, ask students about what clues lead them to determine that all samples are the same mineral.
  - As you are discussing the samples, either collect the materials to a central location where you can handle the samples and refer to the directions/information sheets or rotate around the room as you discuss each station.
  - Ask students about what properties of minerals they didn't use and how those properties might have helped them in identification of the samples.

Opportunities for Extended Learning

1. Mystery Doug video "*Why does this rock look like a sponge?*" (5:42) about pumice and how it is formed.
2. Ward Science has *printable information cards* about the different rock and mineral specimens at
3. Have students complete a writing assignment about their **pet rock** in connection to the lab, such as "I learned my pet rock…".
4. Have students complete a writing assignment describing what they did in story format using the prompt "As a geologist, today I…".

Behavior & Materials Management Tips

- When giving directions about each station, instruct students what to do with their hands, i.e. place hands flat on the table, on top of their head, or in their lap.
- Have students describe **proper ways to handle** the rock samples before they begin.
- Emphasize that the materials provided are there to help the students learn about rocks and minerals.
- Have the samples on a tray or paper plate or even a piece of paper to give students a target for where materials should be located.
- Have **ONLY 1** sample of each type of rock or mineral at each station. As students are trying to identify each sample, multiple samples of the same type may lead to confusion. Having only 1 sample lends itself to more **collaboration** and **focus**.
- **Before** students begin the independent portion have students decide within each group how they are dividing the work at each station or if each member will be in charge at a particular station.
- Start your timer when students begin to rotate between stations to encourage them to get started quickly.
- To clean your streak plates, you can wipe clean with a damp paper towel in between groups if needed. After you have completed the lab, soak them in soapy water and scrub with a sponge. If there is still residue on the streak plates, cleaning with a Magic Eraser or similar fine abrasive will remove it.
- Be ready with key phrases to help students stay on track. "Do you think a geologist would do that?".

Station #1 - Quartz, Calcite, Gypsum

Crystal Shape and Hardness

Directions:

- Use the 2 tests below to identify the minerals at this station.
- After you have done **both** tests, look on the back of this sheet for more information to help you identify the name of each mineral.

Test #1: Crystal Shape

- Do the minerals have the same shape? **Describe** the shape of each crystal.

Test #2: Hardness Test

- **Scratch** each mineral with your **fingernail**.
- The softest mineral can easily be scratched with your fingernail, the hardest mineral cannot be scratched by your fingernail.
- Place the softest mineral to the side.
- **Scratch** the remaining two minerals on **each other**, the hardest mineral will scratch the other mineral.

Turn the page over for more information to help you name these minerals.

Hardness		*Crystal Shape*
Quartz (SiO_2) is a very hard mineral (**hardness of 7** on Moh's scale).		**Quartz** grows in **pencil shape crystals**.
The mineral **Calcite** ($CaCO_3$) has a **hardness of 3** on Moh's scale.		**Calcite** grows in **rhombohedron (leaning cube) shape crystals**.
Gypsum ($CaSO_4*2H_2O$) is a very soft mineral (**hardness of 2** on Moh's scale).		**Gypsum** grows in **tabular shape crystals**.

- **Quartz** is very common mineral on the Earth's surface. It forms in a variety of environments and can be found in igneous, metamorphic, and sedimentary rocks.
- **Calcite** is the main mineral in limestone (sedimentary rock) and marble (metamorphic rock). It is also found some other sedimentary rocks. Present in some igneous rocks (basalt cavities).
- **Gypsum** ($CaSO_4*2H_2O$) is a type of mineral called an evaporite. It is found in sedimentary rocks (similar to salt crystals when saltwater evaporates). *Origin* – When seawater evaporates salt and gypsum and other evaporates crystallize as the water evaporates away.

Station #2 – Magnetite, Obsidian, Coal

Goldilocks Test and Magnetism

Directions:

- ❖ Be careful, one of these samples has sharp edges!
- ❖ Use tests below to identify the rocks and minerals at this station.
- ❖ After you have done **both** tests, look on the back of this sheet for more information to help you identify the name of each rock and mineral.

Test #1: Goldilocks Test

- ♦ How heavy is it? Pick up each sample and use the Goldilocks Test – too heavy, too light, just right.
- ♦ When you pick it up is it lighter or heavier than you thought it would be?
- ♦ Put them in order from **lightest to heaviest**.

Test #2: Magnetism

- ♦ How do we tell the difference between the two heaviest pieces?
- ♦ Use the magnet to see which sample is **magnetic**.
- ♦ What **other differences** are there between the two? How would you tell them apart if you did not have a magnet?

Turn the page over for more information to help you name these rocks & minerals.

More Information:

Magnetite (Fe_3O_4) is a **mineral**. It will attract a magnet. You can see little sparkles/flashes on some pieces of magnetite – those are little magnetite crystals. *Origin* – Can be formed in igneous, sedimentary and metamorphic rocks. If enough is in a rock, it can be mined as iron ore.

Obsidian is an **extrusive igneous rock.** It was erupted from a volcano! Obsidian is shiny, like glass, and can be very sharp (so be careful). Native Americans used obsidian for arrowheads, and today, surgeons use obsidian tips on surgical instruments. *Origin* - Molten rock that was exploded out of a volcano which cooled so quickly that no crystals grew, and it hardened as glass.

Coal is the lightest sample at this station. It's a **sedimentary rock.** *Origin* – Basically, coal is just very squished and slightly baked dead plants. As plants die in a swamp, they fall to the bottom of the water. More plants and sediment pile on top and squish the stuff at the bottom. The stuff at the bottom is compressed and heated to make it harder and harder until you get coal.

Station #3 – Hematite, Pumice, Limestone

Goldilocks Test, Floating, Streak, Observation

Directions:

- Be careful to not spill the container of water.
- Use tests below to identify the rocks and minerals at this station.
- The square piece of tile is not a rock; it is a streak plate for one of your tests.
- After you have done **both** tests, look on the back of this sheet for more information to help you identify the name of each rock and mineral.

Test #1: Goldilocks Test & Floating

- How **heavy** is it? Pick up each sample and use the Goldilocks Test – too heavy, too light, just right.
- Hard to tell which one is lightest? See if they float.
- The **lightest** one will float. Set it aside.

Test #2: Streak

- How do we tell the difference between the **2** heaviest pieces?
- We use the streak test and observe!
- Directions for the Streak Test: Place the square tile streak plate flat on the table and scratch the **2** heaviest samples on the plate.
- What **color** is the streak of each sample?
- Are there **other differences** between the two heaviest samples?

Turn the page over for more information to help you name these rocks & minerals.

More Information:

Pumice is the **lightest** sample at this station and floats in water. It is an **extrusive igneous rock.** It was erupted from a volcano! It is light, because it is full of holes. The holes used to be bubbles of volcanic gases. *Origin* - frothy stuff in a volcanic eruption that hardens. (Picture gas bubbles in shaken up soda –> hardens into a rock = pumice).

Hematite (Fe_2O_3) is a **mineral** and has a **reddish-brown streak.** It has a hardness of 5 to 6.5 on Moh's scale, which is why you have to scratch it very hard on the streak plate. *Origin* - Iron ore in sedimentary and metamorphic rocks.

Limestone is a **sedimentary rock** made of the mineral calcite ($CaCO_3$). The rock also contains small amounts of sand, clay and **fossils**. Calcite fizzes in an acid, like vinegar. (A property demonstrated by putting a drop of vinegar on the sample which produces bubbles of carbon dioxide (CO_2), similar to bubbles in soda). *Origin* - The limestone formed when layers of seashells and mud accumulated in a tropical ocean. This rock is now found on land in the Coastal Plain of North Carolina! Groundwater traveling through the limestone dissolved away the **fossils** forming its current "holey" texture.

Station #4 – Talc, Graphite, Galena, Sulfur

Luster

Directions:

- ❖ Use the information and tests below to identify the minerals at this station.
- ❖ Each person in the group takes a turn **reading** one mineral description and matching the mineral with its description.
- ❖ After you have done **both** tests, look on the back of this sheet for more information to help you identify the name of each mineral.

Test #1: Luster

- ♦ Do the minerals have the same luster? **Describe** the luster of each mineral.

Mineral Descriptions:

- ◘ **Talc** is the **softest** mineral and is a 1 on the Moh's hardness scale**.** Talc can be white, gray, green, clear, or brown. It is used in making many products, including **talc**um powder. You may know **talc**um powder as baby powder.
- ◘ **Sulfur** is a **yellow** mineral and also is an element (S) on the periodic table. It has a hardness of 1.5 to 2.5 on Moh's scale. Sulfur is very abundant but rarely is found in its pure form. Sulfur has a very distinct **smell** and is part of many strong odors like the smell of skunks and rotten eggs.
- ◘ **Graphite** is gray or black with a hardness of 1 to 2 on the Moh's scale. The "lead" in your **pencil** is actually graphite. Graphite is a form of carbon (C) that is created by high heat and pressure. It is usually found in metamorphic rocks that formed from sedimentary rocks.
- ◘ **Galena** is silver, gray, or black with about a 2.5 on the Moh's hardness scale. Galena cleaves, or breaks, into **cubes**. Galena is made of sulphur and lead and can contain silver. Lead and silver are mined from galena.

Turn the page over for more information to help you name these minerals.

More Information:

Luster is the how a mineral looks when light reflects off its surface. Minerals are categorized as either having a metallic or nonmetallic luster. Within nonmetallic, there are several ways to categorize a mineral's luster. There is no scientific method to determine luster, so it is not the best way to identify a mineral. You may have found it hard to agree on the luster of these minerals.

- **Metallic** luster is shiny and reflective like metal.
- **Vitreous** is also known as glassy.
- **Adamantine** is also known as brilliant.
- **Resinous** luster looks like resin or plastic.
- **Silky** luster looks like fibers of silk.
- **Pearly** luster looks like a pearl and can be iridescent.
- **Greasy** luster looks like it has a layer of oil or grease on it.
- **Waxy** luster looks like the mineral has a layer of wax on it.
- **Dull** is also known as earthy.

Talc has a **pearly** luster.

Graphite usually has a **metallic** luster but can have a **dull** luster. You may notice that graphite easily rubs off on your hands and paper.

Galena has a **metallic** luster but can have a **dull** luster. Lead is very heavy which makes galena the heaviest of these four samples.

Sulfur has a **resinous** to **greasy** luster.

Station #5 – Feldspar, Halite, Mica

Cleavage, Hardness

Directions:

- ❖ Use tests below to identify the rocks and minerals at this station.
- ❖ After you have done **both** tests, look on the back of this sheet for more information to help you identify the name of each rock and mineral.

Test #1: Cleavage

- ♦ Look at the **smooth, flat sides** of each mineral.
- ♦ These smooth surfaces have to do with how that mineral cleaves, or breaks, apart.
- ♦ One of these minerals easily cleaves into **flat sheets**. Set it aside.

Test #2: Hardness Test

- ♦ Scratch the remaining **2** minerals with your fingernail.
- ♦ The softer mineral can easily be scratched with your fingernail, the harder mineral cannot be scratched by your fingernail.

Turn the page over for more information to help you name these rocks & minerals.

More Information:

Mica is a mineral found in different forms such as **biotite** and **muscovite**. Mica easily cleaves into thin sheets. It has a hardness of 2.5 to 3 on the Moh's scale. It can be black, dark green, brown, or silver and has a vitreous or pearly luster. Mica can appear a metallic gold in sunlight which has caused it to be mistaken for gold.

Feldspar has perfect cleavage in 2 directions at about right angles. It has a hardness of 6 to 6.5 on Moh's scale, which is why you can't scratch it with your fingernail. Feldspar is usually white, gray, pink, or brown with vitreous or pearly luster. It is a common mineral found in many igneous, sedimentary, and metamorphic rocks.

Halite has perfect, cubic cleavage in 3 directions at right angles. It is a 2.5 on the Moh's hardness scale. If free of impurities, it is colorless or white and has a vitreous luster. Halite (NaCl) is salt in its mineral form.

*Remember it is **not** safe to taste anything during science unless specifically told to do so. Do **not** taste or lick this mineral.*

Station #6 – Mineral Colors

All the Same or All Different?

Directions:

- ❖ Each person in the group takes a turn **reading** one mineral description and matching the mineral with its description.
- ❖ After you have matched **all** the minerals with their descriptions, answer the question at the bottom.

Mineral Descriptions:

- ◘ **Amethyst:** lilac or purple quartz which gets its color from an iron impurity (Fe+3) and is the most valuable of the quartz gemstones. The best quality is dark purple with a red-flash. A lot of amethyst comes from Brazil.
- ◘ **Citrine:** yellow to orange quartz which gets its color from an iron impurity too. Also, heating amethyst to 550 degrees C (1,022 degrees F) converts it to citrine. Subjecting citrine to radiation can change it back to amethyst.
- ◘ **Milky Quartz:** the white, cloudy look of this quartz is caused by tiny, microscopic, areas of fluid that were encased by the quartz as it grew.
- ◘ **Rose Quartz:** this is one of the more rare types of quartz and is unlike any other pink mineral. The color is caused by iron and titanium impurities.
- ◘ **Tiger-eye**: composed of a compact mass of quartz fibers and is the result of silica replacing the original particles of crocidolite (asbestos).
- ◘ **Agate:** usually a banded quartz that is translucent (you can partially see through it) and may contain any number of colors or combinations. It may also include members that are non-banded.
- ◘ **Aventurine:** greenish quartz with chromium mica or other metallic looking inclusions that make the material "sparkle".

- ♦ **Are all of these the same mineral or different minerals?**

Name _____ **Date** _____

Answer Sheet for the Rocks and Minerals Station Activities

Station #1 - Quartz, Calcite, Gypsum (*Crystal shape and hardness*)

1. Which mineral has a crystal shape like a pencil and is very hard?

   _____

2. Which mineral is shaped like a cube and can make you see double?

   _____

3. Which mineral is soft and has a tabular shape? _____

Station #2 - Magnetite, Obsidian, Coal (*Goldilocks test and magnetism*)

1. Which mineral is very heavy and magnetic? _____
2. Which mineral is sharp, used for surgical instruments and was blown out of a volcano? _____
3. Which mineral is very light and made of squished and baked plants?

   _____

Station # 3 - Hematite, Pumice, Limestone (*Goldilocks test, streak, floating*)

1. Which sample is dull gray, contains remains of fossils, and fizzes?

   _____

2. Which sample is shiny gray and has a reddish-brown streak? _____
3. Which sample is dull gray, very light, filled with holes and was blown out of a volcano? _____

Name _____ **Date** _____

Station # 4 - Talc, Graphite, Galena, Sulfur *(Luster)*

1. Which sample has a pearly luster and is the softest mineral?

   _____

2. Which sample is yellow and has a resinous luster? _____
3. Which sample is gray with a metallic or dull luster and easily rubs off on objects?

   _____

4. Which sample is silver with a metallic luster and is the heaviest sample?

   _____

Station # 5 **-** Feldspar, Halite, Mica (*Cleavage)*

1. Which sample cleaves into thin sheets? _____
2. Which sample cleaves on 2 sides and is harder than your fingernail?

   _____

3. Which sample cleaves into cubes and is the mineral form of salt?

   _____

Station # 6 - Mineral Colors (*all the same or all different?)*

1. Are all the different color minerals at this station one mineral or many different minerals? _____

Teacher Answer Key for the Rocks and Minerals Station Activities

Station #1 - Quartz, Calcite, Gypsum (*crystal shape and hardness*)

1. Which mineral has a crystal shape like a pencil and is very hard? Quartz
2. Which mineral is shaped like a cube and can make you see double? Calcite
3. Which mineral is soft and has a tabular shape? Gypsum

Station #2 - Magnetite, Obsidian, Coal (*Goldilocks test and magnetism*)

1. Which mineral is very heavy and magnetic? Magnetite
2. Which mineral is sharp, used for surgical instruments and was blown out of a volcano? Obsidian
3. Which mineral is very light and made of squished and baked plants? Coal

Station # 3 - Hematite, Pumice, Limestone (*Goldilocks test, streak, floating*)

1. Which sample is dull gray, contains remains of fossils, and fizzes? Limestone
2. Which sample is shiny gray and has a reddish brown streak? Hematite
3. Which sample is dull gray, very light, filled with holes and was blown out of a volcano? Pumice

Teacher Answer Key for the Rocks and Minerals Station Activities

Station # 4 - Talc, Graphite, Galena, Sulfur *(Luster)*

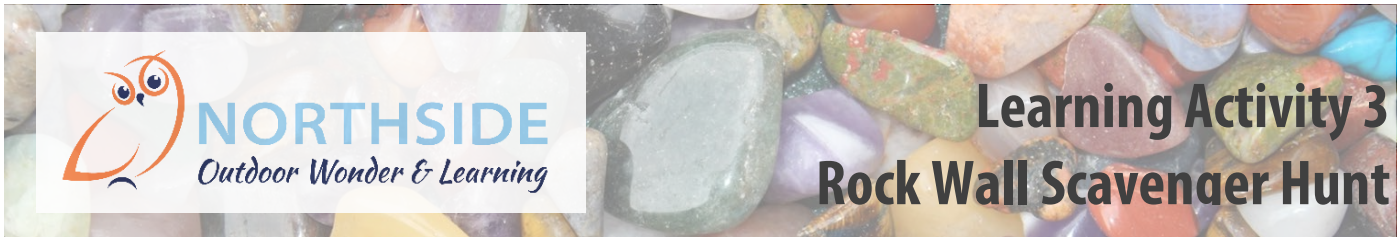
1. Which sample has a pearly luster and is the softest mineral? Talc
2. Which sample is yellow and has a resinous luster? Sulfur
3. Which sample is gray with a metallic or dull luster and easily rubs off on objects? Graphite
4. Which sample is silver with a metallic luster and is the heaviest sample? Galena

Station # 5 – Feldspar, Halite, Mica (*Cleavage)*

4. Which sample cleaves into thin sheets? Mica
5. Which sample cleaves on 2 sides and is harder than your fingernail? Feldspar
6. Which sample cleaves into cubes and is the mineral form of salt? Halite

Station # 6 - Mineral Colors (*all the same or all different?)*

1. Are all the different color minerals at this station one mineral or many different minerals? Same – all are types of quartz



Learning Activity 3
Rock Wall Scavenger Hunt

Lesson Prep

- ✓ Make copies of the "Rock Wall Scavenger Hunt" graphic organizer, 1 per student, for students to paste in their nature journals.
- ✓ Determine where you will take your class.

Vocabulary

Property, shape, mineral, rock, hardness, crystal, color, luster, cleavage, fracture

Procedure

Independent Work

- Have students glue their **Nature Journal Prompts** into their Nature Journals before going outside.
- Go outside to a rock wall (or other location with multiple rocks) on your school grounds.
- Using their Private Eyes, students will make close observations of the rock wall looking for different properties of rocks and minerals.
- Students should record their observations in their **Nature Journals** using the "Rock Wall Scavenger Hunt" graphic organizer on the following page.

Assessment

- Discuss the students' observations of the rock wall.
- **Exit ticket:** Describe one observation you made of the rock wall.

Opportunities for Extended Learning

1. Watch the Mystery Doug video "*Where does metal come from?*".

Behavior & Materials Management Tips

- ♦ Remind students how to use The Private Eyes by modeling how to look closely at something. Explain that rocks can scratch The Private Eyes which makes them less useful.
- ♦ Emphasize that the materials provided are there to help the students learn about rocks and minerals.
- ♦ Help students stay on task by reminding them that we are focusing on rocks right now.
- ♦ Ask students to remind you of the expectations for outdoor learning.

Learning Objectives:
Students will be able to observe properties of minerals and rocks in the rock wall around school.

Nutshell/Skills:
Students can observe properties of minerals and rocks.

Science Essential Standards:
4.P.2.1, 4.P.2.2

Time:
45 minutes

Student Materials:
- Nature Journals
- Private Eyes
- Pencils
- "Rock Wall Scavenger Hunt" graphic organizer, ½ page copy per student
- Scrap paper for exit ticket

Name _____ Date _____

Nature Journaling: Rock Wall Scavenger Hunt

Look closely at the rock wall to find:

☐ Smooth Rock	☐ Gray Rock	☐ Visible Crystals
☐ Rough Rock	☐ Metallic Luster	☐ Large Rock
☐ White Rock	☐ Dull Luster	☐ Small Rock

Can you scratch one of the rocks with your fingernail? What does this tell you about that rock?

_____

What other properties of minerals do you see?

_____

_____

Describe any other observations.

_____

_____

Name _____ Date _____

Nature Journaling: Rock Wall Scavenger Hunt

Look closely at the rock wall to find:

☐ Smooth Rock	☐ Gray Rock	☐ Visible Crystals
☐ Rough Rock	☐ Metallic Luster	☐ Large Rock
☐ White Rock	☐ Dull Luster	☐ Small Rock

Can you scratch one of the rocks with your fingernail? What does this tell you about that rock?

_____

What other properties of minerals do you see?

_____

_____

Describe any other observations.

_____

_____

Learning Activity 4
Comparing Cookies & Rocks

Modified from *Lesson 2: That's the Way the Cookie Crumbles!*, Grade 4 Rocks and Minerals Unit by Catherine Alligood, Francine Bock and Judy Campbell, retrieved from the NC Geological Survey's Geoscience Education Resources.

Lesson Prep

- ✓ Gather rock samples made of visibly different minerals.
- ✓ Buy chocolate cookies, preferably enough for 1 per student.

Vocabulary

Property, shape, mineral, rock, hardness, crystal, color, luster, cleavage, fracture, streak

Procedure

Independent Work

- Each student will be given a chocolate chip cookie to observe and compare to a rock sample.
- Project the **instructions** at the end of this lesson which instruct students to:
  - **Observe** your cookie.
  - **Write** down 5 things about your cookie using your senses of sight, hearing, and touch only.
  - **Draw** your cookie.
  - **Count** and record the number of chocolate chips visible without breaking the cookie.
- Have students **share** at their tables the number of chocolate chips in their cookie and **discuss** why there are differences.
- On each table place a few **samples of rocks** that are visibly made of different materials such as granite, schist, or gneiss.
- Allow students to use The Private Eyes to make close observations.
- Have students **write** a paragraph making connections between the cookies and the rocks.
- Then, have partners **share** their paragraphs and **discuss** whether their connections are correct.
- **After** collecting their papers, discuss as a class the connections they made. Emphasize that both are made of more than one thing and that rocks are are made of different minerals. You could challenge students to think of a rock that is made of only one type of mineral. You could refer to the Moh's scale of hardness for a list of minerals that are also rocks.

Assessment

- Paragraphs connecting rocks and cookies will serve as an assessment.

Learning Objectives:
Students will be able to conclude that rocks are made of minerals.

Nutshell/Skills:
Students can recognize that rocks are made of minerals.

Science Essential Standards:
4.P.2.1, 4.P.2.2

ELA Essential Standards:
W.4.2

Math Essential Standards:
NC.4.MD.4 (extension)

Time:
45 minutes

Teacher Materials:
- Copy of instructions to project

Student Materials:
- Crunchy chocolate chip cookies
- Rock samples such as granite, schist, or gneiss
- Pencils
- Paper
- Private Eyes or other magnifiers

Opportunities for Extended Learning

1. Students can measure and weigh their cookies. Students can use a toothpick to separate the chocolate chips from the cookie. They could weigh the two different parts of the cookies.
2. Students could write about the connections between the cookies and their **pet rocks**.
3. Students could create a frequency table, scaled bar graph, or line plot of the number of chocolate cookies for the class.

Behavior & Materials Management Tips

- Discuss that they are using cookies for a science experiment today and whether or not it is safe to eat science experiments. Decide if you will allow students to eat any cookies after all experiments are done. If they are allowed to eat the cookies, discuss the obvious difference in eating cookies and not eating other science experiments.
- Have students describe proper ways to handle the rock samples before they begin.
- Emphasize that the materials provided are there to help the students learn about rocks and minerals.
- Remind students how to use The Private Eyes by modeling how to look closely at something. Explain that rocks can scratch The Private Eyes which makes them less useful.

- **Observe** your cookie.
- **Write** down 5 things about your cookie using **only** your senses of **sight**, **hearing**, and **touch**.
- **Draw** your cookie.

- **Count** and record the number of chocolate chips visible without breaking the cookie.

Essential Questions

How can we classify rocks and minerals?

NC Science Essential Standards – Unpacked Content

4.P.2.2 Students know that minerals can be identified by using particular tests. Students know how to perform tests for hardness and streak. Students are able to describe the color, luster, and cleavage of a mineral.

4.P.2.3 Students know that rocks are classified as metamorphic, igneous or sedimentary, and that these classifications are based on the processes that created the rock. Igneous rocks are formed from molten rock. Sedimentary rocks are formed from deposited rock particles (sediments) that are then compacted. Igneous and sedimentary rocks can be transformed into metamorphic rocks through the application of heat and pressure over long periods of time.

Lessons in this Arc

- ❖ Learning Activity 5: Rock Types
- ❖ Learning Activity 6: Rock Cycle Walk
- ❖ Learning Activity 7: Rolling through the Rock Cycle
- ❖ Learning Activity 8: Rock Families

Go Outdoors!

- ✓ Learning Activity 2: Rock Cycle Walk

Nature Journal Connection

- ▪ Learning Activity 2: Rock Cycle Walk

Duration

4 days of 45 minute learning activities

Background Information

Rocks are classified by the processes that form them. The **rock cycle** is the compilation of these different processes and the paths that rocks can take to become other types of rocks. The rock cycle shows the three types of rocks as well as the intermediary steps that happen as they form. The three types of rocks are igneous, sedimentary, and metamorphic rocks. **Igneous rocks** form from the cooling of magma inside the Earth or lava on the Earth's surface. An igneous rock formed on the surface of the Earth is referred to as extrusive and has small or no crystals due to the rapid rate of cooling that happens to the lava. When magma cools inside the Earth, an intrusive igneous rock is formed. **Sedimentary rocks** are formed when sediment particles or organismal remains consolidate in layers. Due to the way they are formed, sedimentary rocks are the type of rock that contain fossils. **Metamorphic rocks** are formed from the combination of heat and pressure to change existing rocks.

Sedimentary and igneous rocks can both transform into metamorphic rock. A metamorphic rock can also be changed into another type of metamorphic rock. For example, the metamorphic rock slate can then be changed into schist and then into gneiss through increased heat and pressure.

Vocabulary

- **Igneous rocks** are a type of rock formed when magma inside the Earth or lava on the Earth's surface cools.
- **Sedimentary rocks** are a type of rock that is formed by the consolidation of sediment particles or of the remains of plants and animals.
- **Metamorphic rocks** are rocks formed by great heat and pressure.
- The **rock cycle** is the processes through which rocks change from one type to another.

Literature Connections

Book sets

- *Geology Rocks! Metamorphic Rock* by Rebecca Faulkner*
- *Geology Rocks! Sedimentary Rock* by Rebecca Faulkner*
- *Geology Rocks! Igneous Rock* by Rebecca Faulkner*

***currently available in Northside library**

Adapted from NC Geological Survey Rock Match Activity by Randy Bechtel

Lesson Prep

- ✓ Preview "*Types of Rocks*" and "*Rock Climbing*".
- ✓ Print each sheet of the "Rock Match Information Cards" below on colored card stock, so similar rock types have similar colors (e.g. sedimentary are yellow, igneous are pink; metamorphic are blue). There are 18 cards total, so be sure to print enough sets for your entire class.
- ✓ Cut out the cards.
- ✓ Preferably laminate the cards for multiple uses.
- ✓ Place each left column card into a separate plastic bag with the corresponding rock sample.
- ✓ Mix up the right column cards into a stack.

Vocabulary

Igneous, sedimentary, metamorphic, rock cycle

Procedure

Mini-Lesson

- Use the Flocabulary lesson and video to guide a lesson on the **types of rocks and the rock cycle**.
  - Flocabulary on "*Types of Rocks*".
- Watch "*Rock Climbing*" (6:10) from Dragonfly TV which shows two children testing the "climbability" of the different types of rock. They discuss the characteristics of each rock type.

Guided Practice

- Students will complete a **Rock Match** activity.
- They are randomly given either a card with a description of a rock sample or a rock sample and a card with a description of how it formed.
- At the bottom of each card is the sample name, split in half, so when the correct cards are matched, they spell out the name of the sample.
- Once all students have a rock description card, have them stand up and move around the room to try to match their card with the appropriate card from the other column. Students are trying to match their description and rock samples correctly.

Learning Objectives:
Students will be able to describe the 3 types of rocks.

Nutshell/Skills:
Students can describe igneous, sedimentary, and metamorphic rocks.

Science Essential Standards:
4.P.2.1, 4.P.2.2

Time:
45 minutes

Teacher Materials:
- "*Rock Climbing*" video
- Flocabulary on "*Types of Rocks*"

Student Materials:
- Heavy-duty quart sized clear zipper closure plastic bags
- Rock Match Information Cards
- Rock samples: siltstone, limestone, conglomerate, granite, diabase, obsidian, gneiss, schist, slate
- Chromebooks, if students doing Flocabulary on own versus as class

- Once students have found their match, instruct them to place a hand on their head, make an "x" with their arms across their chest, or some other visible means of indicating they have a match.
- After all students have matched their descriptions, each pair of students reports out to the group about what samples they have and read the descriptions. If duplicates are used, have all students with the same sample report out together. If possible, use a document camera to project the rock sample as students share.
- With each sample, ask students to make a connection with how we know which type of rock it is. You could have them turn and talk to their partner or call on a student to share with the group.

Assessment

- Use the discussion of the Rock Match to formatively assess student understanding of the types of rocks.

Opportunities for Extended Learning

1. Watch the BrainPop on the "*Rock Cycle*" (2:03).
2. Watch the video "*Geology Kitchen: The 3 Types of Rocks*" (8:35) from *Explorer Multimedia*.

Behavior & Materials Management Tips

- Have students describe proper ways to handle the rock samples, rock match information cards, and bags before they begin.
- Emphasize that the materials provided are there to help the students learn about rocks and minerals.
- Discuss how to safely move around the room looking for their match.

Rock Match Information Cards

1. Print each sheet on a different color card stock, so similar rock types have similar colors (e.g. sedimentary are yellow, igneous are pink; metamorphic are blue). There are 18 cards total, so be sure to print enough sets for your entire class.
2. Cut out the cards.
3. Preferably laminate the cards for multiple uses.
4. The left column cards go into the bags with the corresponding rock sample.

Sedimentary rocks

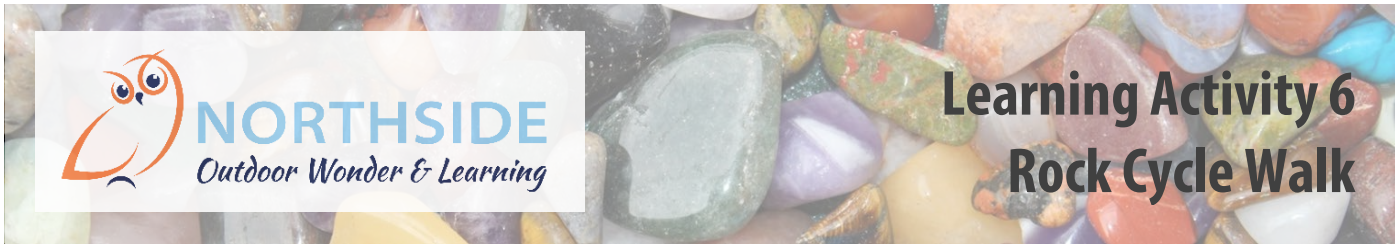
I am a sedimentary rock that was deposited at the bottom of a lake, pond or other calm, watery environment. SILT-	I am a sedimentary rock made of microscopic clay particles and larger silt particles that settled down in a quiet, watery environment. My reddish-brown color comes from oxidized (rusted) iron. -STONE
I am a sedimentary rock that formed in a marine environment. LIME-	I am a sedimentary rock that forms when mollusk shells were buried in a calcium-rich mud. These “sea” shells later dissolved away, leaving a 3-D mold of the shells in the gray mud. -STONE
I am a sedimentary rock that was deposited in a fast-flowing stream or current. CON-	I am a sedimentary rock made of river-rounded pebbles and mud. The pebbles are gray and brown, while the mud is reddish brown. The mud glued together the pebbles. -GLOMERATE

Igneous rocks

I am an intrusive igneous rock that was once molten and very hot. I intruded the rocks around me and cooled slowly, deep underground. GRA-	I am an intrusive igneous rock that was once hot, molten magma. Can you see the speckled colors of the sparkling minerals that make me up? These minerals are white feldspar, gray quartz and black mica. -NITE
I am an igneous rock that cooled relatively quickly near the surface of the Earth, not quite on the surface but close. DIA-	I am an igneous rock that was once hot, molten magma. In this sample I have two sides: a weathered, reddish-brown side that formed from oxidizing iron; and a black "fresh" side that shows some sparkling minerals. I am similar to basalt and have a lot of iron in me. -BASE
I am an extrusive igneous rock that cooled extremely quickly. I may have formed when my lava was blown out of a volcano or plunged into the ocean. OBS-	I am an extrusive igneous rock that was once hot, molten lava. I formed into this shiny, black, smooth rock because I cooled extremely quickly. -IDIAN

Metamorphic rocks

I am a metamorphic rock that formed under intense heat and pressure. GNE-	I am a metamorphic rock that changed from my original form when I was squished and heated so much I almost melted. I now have thin black and white stripes of minerals. -ISS (my full name sounds like 'nice')
I am a metamorphic rock that formed under heat and pressure. Can you see two of my main minerals? SCH-	I am a metamorphic rock that changed from my original form when I was squished and heated. I am now made of shiny, silvery mica along with other minerals. Can you find the round, dark minerals? Those are garnets. -IST
I am a metaphoric rock that formed under relatively low heat and pressure. Can you see the very thin layers visible on my sides? SL-	I am a metamorphic rock that changed from my original form when I was lightly compressed and baked. I now have microscopic mineral grains (mica) that, like my original rock, make up very thin layers. -ATE



Learning Activity 6
Rock Cycle Walk

Background information written by Michelle Haskin, Teaching Assistant Professor in UNC Department of Geological Sciences, and Northside Elementary parent.

Lesson Prep

- ✓ Determine where you will be taking your students outdoors to look at rocks.
- ✓ Review the *background information* on the rocks around Northside, created for this lesson by Michelle Haskin, UNC Department of Geological Sciences.
- ✓ Contact Michelle Haskin if you want her assistance in leading this activity – she may be willing to .

Vocabulary

Igneous, sedimentary, metamorphic, rock cycle

Procedure

Mini-Lesson

- Before going outside, use the *Rock Odyssey* poster or other visual aids to review characteristics of igneous, metamorphic, and sedimentary rocks as well as the rock cycle.

Guided Practice

- Have students look for examples of the different types of rocks in the school garden.
- Use *Michelle Haskin's information* to identify the three types of rocks.
- Ask students questions such as "How is this rock like an igneous rock?", "If this is a sedimentary rock, what might happen to it next in the rock cycle?", and "How are these two rocks different?"
- Students can look at different size rocks and make connections between them. Observe how sediments and the tiny rocks resemble bigger rocks by using the Private Eyes to take a closer look.
- Compare samples looked at in class to other rock samples found outside.
- **Note:** Students should focus on observational skills and comparing rocks. They may not be able to identify the 3 types themselves.

Independent Work

- **Nature Journaling Prompt**: Compare your **pet rock** with a rock in the garden.

Assessment

- The Nature Journal entry will serve as an assessment.

Learning Objectives:
Students will be able to compare different rock samples in a natural setting.

Nutshell/Skills:
Students can use their observational skills to compare different rock samples.

Science Essential Standards:
4.P.2.1, 4.P.2.2

Time:
45 minutes

Teacher Materials:
- *Rock Odyssey* posters or other visual aids showing the types of rocks/rock cycle

Student Materials:
- Nature Journals
- Writing utensils
- Private Eyes or other magnifiers

Opportunities for Extended Learning

1. Ask Michelle Haskins from UNC Geological Sciences department (and NES mom) to lead the rock walk. She has created a lesson with student materials that focuses on the types of rocks and the rock cycle.
2. Take a walking field trip to *UNC Geological Sciences* department located in Mitchell Hall. Include a visit to the Geology Department's Walter H. Wheeler Garden, a rock garden.
3. Walk through UNC campus looking at types of rocks found in and around buildings.
4. Contact UNC's Geology Department for program opportunities.

Behavior & Materials Management Tips

- Have students describe proper ways to handle the rock samples before they begin.
- Emphasize that the materials provided are there to help the students learn about rocks and minerals.
- Remind students how to use The Private Eyes by modeling how to look closely at something. Explain that rocks can scratch The Private Eyes, which makes them less useful.
- Help students stay on task by reminding them that we are focusing on rocks right now.
- Ask students to remind you of the expectations for outdoor learning.

Learning Activity 7
Rolling through the Rock

Lesson Prep

- ✓ Review the *Rocking the Rock Cycle* (Part 1) activity from NASA.
- ✓ Print the 5 station signs and diagram of the rock cycle. You may want a copy of the diagram for each station.
- ✓ Print and copy the student "Rock Cycle Game Worksheet", 1 per student.
- ✓ Decide if you want students to work alone or in pairs.

Vocabulary

Igneous, sedimentary, metamorphic, rock cycle

Procedure

Independent Group Work

- Students will complete Part 1 of *Rocking the Rock Cycle* from NASA.
  - In this activity, students follow a rock traveling through the rock cycle. Students simulate the rock cycle by rolling dice and following the instructions as they move around the room.
- Set a time limit of how long you want them playing the game. Make sure to have a few minutes before to explain the game and time afterward to discuss.

Assessment

- Collect their "Rock Cycle Game Worksheet".
- Have students write a summary of the rock cycle.

Opportunities for Extended Learning

1. Watch SciShow Kids video "*Be a Rock Detective!*" (4:22).
2. Make rocks from crayons. Use crayon shavings to represent sediment. Place shavings in foil. Then have students press the "sediments" together to form "sedimentary rock". You can also put them in the sun to heat them or break them back apart.

Behavior Management Tips

- ♦ Remind students of how to safely move around the room for this activity.
- ♦ Count off your students 1-5 to assign them which station at which to start.

Learning Objectives:
Students will be able to describe how one type of rock can change into another type of rock.

Nutshell/Skills:
Students can summarize the rock cycle.

Science Essential Standards:
4.P.2.1, 4.P.2.2

ELA Essential Standards:
RI.4.2, W.4.2

Time:
45 minutes

Teacher Materials:
- Station signs
- Rock cycle diagrams
- Dice (at least 5, preferably 10)

Student Materials:
- Rock Cycle Game Worksheet
- Pencil

Learning Activity 8
Rock Families: Igneous, Sedimentary, & Metamorphic

Adapted from NC Geological Survey's *Rock and Mineral Stations Activity* by Randy Bechtel.

Lesson Prep

- ✓ Make copies of "Rock Cycle: Which One is Which?", 1 per group.
- ✓ Gather rock samples representing all 3 types of rocks (see student materials for examples).
- ✓ Have copies of the *Rock Odyssey* poster or other depictions of the 3 types of rocks.

Vocabulary

Igneous, sedimentary, metamorphic, rock cycle

Procedure

Independent Group Work

- Divide students into groups, giving each group a copy of the Rock Odyssey poster or other similar resource.
- Using the *Rock Cycle: Which One is Which*? worksheet, have students match the rock samples you provided to their appropriate rock type using the *Rock Odyssey* posters.
- Students will then apply what they have learned about their **pet rocks** to try to identify if their **pet rock** is an igneous, sedimentary, or metamorphic rock.
  - Have students gather in 3 different locations of the room to form a "family" of metamorphic rocks, a "family" of sedimentary rocks, and a "family" of igneous rocks.
  - Have students compare their rocks and assess as a group if everyone is in the correct "family".
  - Put the Rock Odyssey poster on the board and rotate between groups to help students find the right "family".

Assessment

- Discuss how students knew which rock type represented their **pet rock**.
- **Exit ticket:** Into which rock "family" did you categorize your **pet rock** and **why**?

Opportunities for Extended Learning

1. Have students **write** a story about the "life" of their **pet rock**. Have students choose a starting point within the rock cycle for their pet

Learning Objectives:
Students will be able to identify igneous, sedimentary, and metamorphic rocks.

Nutshell/Skills:
Students can differentiate between igneous, sedimentary, and metamorphic rocks.

Science Essential Standards:
4.P.2.3

ELA Essential Standards:
SL.4.1, W.4.3 (extension)

Time:
45 minutes

Teacher Materials:
- *Rock Odyssey* posters

Student Materials:
- Rock samples representing igneous (I), sedimentary (S), and metamorphic (M) rocks, such as
  - Obsidian (I)
  - Pumice (I)
  - Slate (M)
  - Gneiss (M)
  - Coal (S)
  - Shale (S)
  - Conglomerate (S)
  - Granite (I)
  - Basalt (I)
  - Schist (M)
  - Marble (M)
  - Limestone (S)
  - Sandstone (S)
- Pet rocks
- Scrap paper

rock. The story should include having their rocks become each of the different types of rocks as it travels through the rock cycle.

2. Use *Lesson 7: Are They From North Carolina?* (p. 43) to learn about rocks from North Carolina, including where they are found, how they are formed, and their uses.

Behavior & Materials Management Tips

- Have students describe proper ways to handle the rock samples before they begin.
- Emphasize that the materials provided are there to help the students learn about rocks and minerals.
- Discuss how to safely move around the room to find their rock "family".

Rock Cycle: Which One is Which?

Directions:

- ❖ Put all the samples in the correct rock group on the poster: Igneous, Sedimentary and Metamorphic
- ❖ Carefully and slowly pick up each sample to move them. Do not slide them on the table.
- ❖ Note: The rock samples don't all exactly match those that are on the poster.

Hints:

- ◘ *Remember the 3 types of rocks.*

- ◘ ***Metamorphic rocks*** sometimes:
  - Have zebra stripes – an example is gneiss.
  - Are shiny (from the mineral mica) – an example is schist.

- ◘ ***Sedimentary rocks*** sometimes:
  - Are made of other pieces of rock like sand (sandstone), pebbles (conglomerate), or fossils, like seashells, (limestone).

- ◘ ***Igneous rocks*** sometimes:
  - May have spots or blotches of colors.
  - Have interlocking crystals (spots or blotches) of different colors (an example is granite) or the same color (an example is basalt).

How many of each type of rock do you have?

Arc 3 - Changing Rocks and Landforms

Essential Questions

How do rocks and landforms change under different circumstances?

NC Science Essential Standards – Unpacked Content

4.P.2.3 Students know that rocks are classified as metamorphic, igneous or sedimentary, and that these classifications are based on the processes that created the rock. Igneous rocks are formed from molten rock. Sedimentary rocks are formed from deposited rock particles (sediments) that are then compacted. Igneous and sedimentary rocks can be transformed into metamorphic rocks through the application of heat and pressure over long periods of time.

4.E.2.3 Students know that the surface of the earth changes over time. Students know that there are many factors that contribute to these changes. Students know that such changes may be slow or rapid, subtle or drastic. Erosion and weathering are processes that change the Earth. Wind, water (including ice), and chemicals break down rock and can carry soil from one place to another. Under the right conditions, gravity can cause large sections of soil and rock to move suddenly down an incline. This is known as a landslide. Volcanic eruptions occur when heat and pressure of melted rock and gases under the ground cause the crust of the Earth to crack and release these materials. Solid rock can deform or break if it is subject to sufficient pressure. The vibration produced by this is called an earthquake.

4.L.1.3 Students know that humans can adapt their behavior in order to conserve the materials and preserve the ecological systems that they depend on for survival.

Lessons in this Arc

- ❖ Learning Activity 9: Erosion & Deposition
- ❖ Learning Activity 10: Erosion & Weathering Hike
- ❖ Learning Activity 11: Living with Geohazards

Go Outdoors!

- ✓ Learning Activity 9: Erosion & Deposition
- ✓ Learning Activity 10: Erosion & Weathering Hike

Nature Journal Connection

- ▪ Learning Activity 9: Erosion & Deposition
- ▪ Learning Activity 10: Erosion & Weathering Hike

Duration

3-5 days of 45 minute learning activities (plus additional collection dates for Learning Activity 9 as desired)

Background Information

The earth is constantly changing due to natural processes. **Geologists** are the earth scientists who study the earth, its composition, and the changes that occur over time. **Erosion** wears away the surface of the earth. This can be caused by water, wind, and ice. A well-known example of erosion is the formation of the Grand Canyon. When the transported sediments are settled in a new place it is called **deposition. Weathering** involves both physical and chemical forces to change the color, texture, composition, or firmness of earth and rock materials. Soil is made from weathered rocks, plant material, and other organisms. Erosion, deposition, and weathering are processes that occur gradually. However, there are other rapid processes that can change the surface of the earth. Earthquakes, landslides, and volcanoes are **geohazards** that can cause massive damage and risk. **Earthquakes** are caused by movements in the Earth's crust or by volcanoes. This results in sudden shaking of the ground. A **landslide** is the downward movement of material due to gravity. Rock, soil, volcanic ash, or other materials are quickly moved during a landslide. A **volcano** is an opening on the Earth's surface where molten rock erupts. Igneous rocks are the product of volcanoes.

Vocabulary

- **Erosion** is the wearing away of the land by forces such as water, wind, and ice.
- **Deposition** is the settling from suspension of transported sediments.
- **Weathering** is the process of physical disintegration and chemical decomposition whereby earth and rock materials are changed in color, texture, composition, firmness, or form upon exposure to the atmosphere.
- **Geohazards** are geological states that may lead to widespread damage or risk (earthquake, landslide, tsunami).
- An **earthquake** is the shaking of the surface of the Earth caused by sudden movement of the Earth's crust.
- A **landslide** is the movement of rock, soil, volcanic ash, or other material downslope under the influence of gravity.
- A **volcano** is an opening in the Earth's crust where molten rock erupts to the surface.

Literature Connections

Book sets

- *Erosion and Weathering* by Willa Dee*
- *Rock Cycles: Formation, Properties, and Erosion* by Rebecca Harmon*

***currently available in Northside library**

Learning Activity 9
Erosion & Deposition

This activity adapted from the *Measuring and Analyzing Erosion* activity in *Outdoor Science: A Practical Guide* by Steve Rich (NSTA Press). A copy of *Outdoor Science* is available in the Northside Elementary Media Center's professional collection.

Lesson Prep

- ✓ Walk around the schoolyard to identify evidence of erosion and deposition for students to examine.
- ✓ Make copies of "Erosion & Deposition Journaling Prompt" and "Erosion & Deposition – Represent & Interpret Your Data", 1 per student.
- ✓ Make additional copies of "Erosion & Deposition Journaling Prompt" for each additional day you are able to return to your location to collect data.

Vocabulary

Erosion, deposition, weathering

Procedure Part 1

Mini-Lesson

- Explain the processes of erosion and deposition.

Independent Group Work

- Take students outside to an area that shows **erosion**. The greenway section closest to the school would be a good spot.
- Have them work in small groups to take **measurements** of the erosion width and depth of erosion, and look for **evidence** of where the soil is deposited.
- Use the **Nature Journaling** prompt "Erosion & Deposition Journaling Prompt" to collect your data.
- Preferably take the students out over **multiple days,** including after a rain event, to see evidence of erosion. If multiple visits are not possible, at least two visits would give them something to compare.
- You could continue your walk down the greenway towards the creek and Umstead Park noting not only signs of **erosion** and **deposition,** but also **erosion control methods** implemented along the way.

Procedure Part 2

Independent Work

- Students should use the data from multiple days to create a graph of their data using the second **Nature Journaling** prompt "Erosion & Deposition – Represent & Interpret Your Data".

Learning Objectives:
Students will be able to describe erosion and deposition.

Nutshell/Skills:
Students can describe erosion and deposition.

Science Essential Standards:
4.P.2.1, 4.P.2.2

Math Essential Standards:
NC.4.MD.1, NC.4.MD.4

Time:
Part 1: 45 minutes
Additional collection dates: 30 minutes each day
Part 2: 20 minutes

Student Materials:
- Nature Journals
- Meter sticks or measuring tapes
- Thermometers
- Erosion & Deposition Journaling Prompt
- Erosion & Deposition – Represent & Interpret Your Data
- Pencils
- Clipboards (optional)

Assessment

- Data collected and graph using the Nature Journaling prompts.

Opportunities for Extended Learning

1. Have students complete the PebbleGo lesson on "*Erosion*".

Behavior Management Tips

- Ask students to remind you of the expectations for outdoor learning.
- Help students stay on task by reminding them that we are focusing on erosion and deposition right now.
- Emphasize that they are collecting data, not creating erosion. Students should walk around areas where data is being collected.

Erosion & Deposition Journaling Prompt

Look for signs of **erosion** (*the movement of soil caused by water or wind*) and **deposition** (*the deposit of soil after it has eroded*) in the schoolyard.

Observation Date: _____ Time: _____

Temperature: _____

Weather: (*Clouds? Precipitation? Has it been raining in the last 24 hours?*)

_____

Fill in the blanks below. *Be sure to make accurate marks when measuring the ground with a meter stick or measuring tape and keep exact records.*

1. Width of the eroded gully: _____ cm.
2. Depth of the eroded gully: _____ cm.
3. Length of the eroded gully: _____ cm.

4a. Area of deposition identified: Yes _____ No _____

4b. If yes, deposition depth: _____ cm.

Erosion & Deposition Journaling Prompt

Look for signs of **erosion** (*the movement of soil caused by water or wind*) and **deposition** (*the deposit of soil after it has eroded*) in the schoolyard.

Observation Date: _____ Time: _____

Temperature: _____

Weather: (*Clouds? Precipitation? Has it been raining in the last 24 hours?*)

_____

Fill in the blanks below. *Be sure to make accurate marks when measuring the ground with a meter stick or measuring tape and keep exact records.*

1. Width of the eroded gully: _____ cm.
2. Depth of the eroded gully: _____ cm.
3. Length of the eroded gully: _____ cm.

4a. Area of deposition identified: Yes _____ No _____

4b. If yes, deposition depth: _____ cm.

Erosion & Deposition – Represent & Interpret Your Data

Look at the data you have collected for the eroded gully. Make line plots, scaled bar graphs, or frequency tables to represent the width, depth, and length of your eroded gully.

1. How did the **size** of your eroded gully change?

_____

2. Which dimension (*width, depth, length*) changed the **most**?

_____

3. **When** did the biggest change happen?

_____

4. What could be the **cause** of the erosion?

_____

_____

Erosion & Deposition – Represent & Interpret Your Data

Look at the data you have collected for the eroded gully. Make line plots, scaled bar graphs, or frequency tables to represent the width, depth, and length of your eroded gully.

1. How did the **size** of your eroded gully change?

_____

2. Which dimension (*width, depth, length*) changed the **most**?

_____

3. **When** did the biggest change happen?

_____

4. What could be the **cause** of the erosion?

_____

_____

Learning Activity 10
Weathering and Erosion Hike

Lesson Prep

✓ Walk around the schoolyard to identify evidence of weathering and erosion for students to examine.

Vocabulary

Erosion, deposition, weathering

Procedure

Mini-Lesson

- Differentiate between weathering and erosion. Discuss the types of weathering.

Guided Practice

- Walk around school and the greenway looking for examples of weathering and erosion. Use the *background information* on rocks of Northside Elementary from Michelle Haskin, UNC Geology Professor, to help guide you.
- Briefly walk through the garden revisiting the rocks observed previously during Activity 6.
- Stop on the steps to Caldwell St. Explain the history of the steps. Have students explore how the old and new steps are different while looking for signs of chemical and physical weathering.
- Continue down to the greenway noting evidence of weathering on the rock wall and on the rocks at the trailhead on both sides of Caldwell Street
- Follow the greenway to McMasters Street looking for signs of erosion and weathering.

Independent Work

- Choose a spot while still outside where students can sit to complete the Nature Journaling Prompt.
- **Nature Journaling Prompt:** Describe an example of weathering or erosion that you saw today. Has weathering affected your **pet rock**?

Assessment

- Discuss the examples of weathering and erosion that the students saw as a formative assessment.

Learning Objectives:
Students will be able to identify examples of erosion and weathering.

Nutshell/Skills:
Students can identify examples of erosion and weathering.

Science Essential Standards:
4.P.2.1, 4.P.2.2

Time:
45 minutes

Student Materials:
- Nature Journals
- Writing utensils

Opportunities for Extended Learning

1. Watch "*Weathering & Erosion*" Crash Course Kids video (4:05). (You can click on the settings of the video to adjust the playback speed from normal to 0.75 to slow the video down if desired.)

Behavior Management Tips

- Ask students to remind you of the expectations for outdoor learning.
- Help students stay on task by reminding them that we are focusing on erosion and weathering right now.

Learning Activity 11
Living with Geohazards

Lesson Prep

- ✓ Preview earthquake and landslide teaching materials. Determine which ones you prefer to use.
- ✓ Read the directions for the *landslide activity* by Teach Engineering from the University of Colorado Boulder's College of Engineering.
- ✓ Gather landslide activity materials.
- ✓ Preview the earthquake *article,* which students will read online.

Vocabulary

Earthquake, geohazard, landslide, volcano

Procedure

Mini-Lesson

- Explain that geohazards are geological states that may lead to widespread damage or risk. This includes earthquakes, landslides, tsunamis, and volcanoes.
- Ask students if they have experienced any geohazards. You could do a thumbs up/thumbs down for each type or have a few students share their experiences.
- Briefly define volcanoes and tsunamis. Point out that these geohazards don't occur here now. Can students think why we don't experience these geohazards? (Hint: plate tectonics & plate boundaries)
- Focus the lesson on landslides, as this is the most common type of geohazard in North Carolina. Teachers may desire to also cover earthquakes as they do occasionally occur here.
- Materials to teach about earthquakes:
  - *Video* showing earthquake activity over the past 15 years.
  - *USGS map* that shows earthquakes over the past 24 hours. You can zoom out to a world view or into a local view.
  - *Demo* that shows exponential increase on Richter scale
- Materials to teach about landslides:
  - Explain what a landslide is. *Weather Wiz Kids* website has lots of good background information:
  - Discuss incidents of landslides in NC. *Article* about February 2019 landslides which closed I-40 in the mountains.
  - *NCGS information about landslides*.

Learning Objectives:
Students will be able to define the different types of geohazards and describe how they impact humans.

Nutshell/Skills:
Students can describe types of geohazards and their impacts.

Science Essential Standards:
4.P.2.1, 4.P.2.2

Time:
1-2 sessions of 45 minutes each

Teacher Materials:
- *Landslide lesson*
- *Video* of earthquake activity
- *USGS map* of earthquakes
- *Demo* of Richter scale
- *Weather Wiz Kids* on landslides
- *Article* about NC landslide
- *NCGS information about landslides*

Student Materials:
- Chromebooks or iPads

Per group:
- Model House Template
- Cardstock, 1 sheet, for construction of model houses
- Transparent tape
- Scissors
- Markers, colored pencils, or crayons to decorate houses
- 2 small paper cups; one for water, one for test material
- Mini-Landslide Worksheet, one per student

For class to share:
- 2 ft section of plastic downspout
- 1 small bag of sand
- 1 small bag of gravel
- 1 small bag of volcanic potting rock
- 1 large, shallow waterproof tub
- Duct tape
- Ruler (or tape measure)

Independent Work

- Students will work in groups to create a model of a landslide using *this lesson*.
- Have students read the NASA *article* about earthquakes using iPads or Chromebooks.
  - As they read the article, they should create a KWL chart, writing down
    - 3 things they knew
    - 3 things they still wonder
    - 3 things they learned.

Assessment

- Landslide activity data table. On the back of their paper, have students describe how they would modify the houses and their placement to make them safer from landslides.
- Earthquake article KWL chart.

Opportunities for Extended Learning

1. Complete the *Mystery Science activity: How do you survive a landslide?*
2. Watch Mystery Doug "*How do earthquakes happen?*" (6:30).
3. Have students write a narrative about their **pet rock** experiencing a geohazard.
4. The NC Geological Survey's *Geoscience Education Resources* page includes many resources and other lessons, including an opportunity to download and use all of their *Earthquakes in NC Workshop Materials*.

Behavior & Materials Management Tips

- Have students describe proper ways to handle the materials before they begin.
- Emphasize that the materials provided are there to help the students learn about landslides.

Unless otherwise noted, activities written by Lauren Greene, Dana Haine, Toni Stadelman, and Sarah Yelton
Center for Public Engagement with Science, Institute for the Environment, UNC-Chapel Hill

For more information, contact:
Sarah Yelton, Environmental Education & Citizen Science Program Manager
UNC Institute for the Environment Center for Public Engagement with Science
sarah.yelton@unc.edu

Engaging Activity: Pet Rocks

Aston, D. H. (2018). *A Rock is Lively*. Halifax, Nova Scotia: Atlantic Provinces Special Education Authority Library.
Baylor, B., & Parnall, P. (1999). *Everybody Needs a Rock*. New York: Econo-Clad Books.
Christian, P., & Lember, B. H. (2015). *If You Find a Rock*. Boston, MA: National Braille Press.
Formento, A., & Snow, S. (2017). *These Rocks Count!* New York: Scholastic.

Learning Activity 1: Properties of Minerals

BrainPOP. (n.d.). Crystals. Retrieved from https://www.brainpop.com/science/earthsystem/crystals/
Flocabulary. (n.d.). Minerals - Rocks and minerals - physical properties. Retrieved from https://www.flocabulary.com/unit/minerals/
Giverny, Inc. (n.d.). Dig Into Geology. Retrieved from https://www.minimegeology.com/home/mgeo/smartlist_11/dig-into-geology-resources.html
Mineralogy 4 Kids. (2015). All About Crystals. Retrieved from http://www.mineralogy4kids.org/?q=all-about-crystals
Mineralogy 4 Kids. (2015). Mineral Properties. Retrieved from http://www.mineralogy4kids.org/?q=mineral-properties
Quick-Hooker, A. (2018, March 28). Minerals Research. Retrieved from https://padlet.com/aquick/minerals

Learning Activity 2: Rock and Mineral Stations

Bechtel, R. (2018, May 05). 4th Grade Classroom Activity- Five Stations of Rock and Mineral Identifications. Retrieved from https://serc.carleton.edu/earth_rendezvous/2017/program/demos/fridayA/174383.html
Mystery Doug. (2017, May 30). Why does this rock look like a sponge? Retrieved from https://www.youtube.com/watch?v=6lHsilr9ne0
Ward's Science. (n.d.). Geology Specimen Key Cards. Retrieved from https://www.wardsci.com/cms/geology_study_cards

Learning Activity 3: Rock Wall Scavenger Hunt

Mystery Doug. (2017, September 05). Where does metal come from? Retrieved from https://www.youtube.com/watch?v=zmjZC1cFOKk

Learning Activity 4: Comparing Cookies & Rocks

Alligood, C., Bock, F., & Campbell, J. (n.d.). Grade 4 Unit 4 Rocks and Minerals. Retrieved from https://files.nc.gov/ncdeq/Energy Mineral and Land Resources/Geological Survey/Geoscience Education/0-Lesson7-4thgrade-RocksMinerals-C-Alligood--Oct08.pdf
North Carolina Environmental Quality. (2014). NCSTA Resource Downloads. Retrieved from https://deq.nc.gov/about/divisions/energy-mineral-land-resources/north-carolina-geological-survey/geoscience-education/ncsta-resources-downloads

Learning Activity 5: Rock Types

Bechtel, R. (2014). Rock Matching Activity. Retrieved from https://files.nc.gov/ncdeq/Energy Mineral and Land Resources/Geological Survey/Geoscience Education/2014 NCSTA-PDI/2014RockAway_Lesson7DPI_RockMin_IDCards_RBedits.pdf

BrainPOP. (n.d.). Rock Cycle. Retrieved from https://www.brainpop.com/science/earthsystem/rockcycle/

Explorer Multimedia. (2012). Geology Kitchen Pilot Episode: The Three Types of Rocks. Retrieved from http://www.geologykitchen.com/pilot.html

Flocabulary. (n.d.). Types of Rocks - Rock Cycle - Igneous Sedimentary Metamorphic Rocks. Retrieved from https://www.flocabulary.com/unit/types-of-rocks/

PBS. (2017, November 14). Rock Climbing. Retrieved from https://unctv.pbslearningmedia.org/resource/18b4a26a-e11f-4607-b343-7de12d3daa37/18b4a26a-e11f-4607-b343-7de12d3daa37/

Learning Activity 6: Rock Cycle Walk

Haskin, M. (2019, February). Reconnaissance for Earth-Science Curriculum at Northside Elementary, Chapel Hill. Retrieved from https://ie.unc.edu/files/2019/07/4th_6Rrock-Cycle-Walk_Michelle-Haskin.pdf

Department of Geological Sciences at UNC Chapel Hill. (n.d.). Geological Sciences. Retrieved from https://geosci.unc.edu/

Learning Activity 7: Rolling Through the Rock Cycle

NASA. (n.d.). Rocking the Rock Cycle. Retrieved from https://www.nasa.gov/sites/default/files/rockingtherockcycle.pdf

SciShow Kids. (2015, July 20). Be a Rock Detective! Retrieved from https://www.youtube.com/watch?v=tNs1gqkYerg

Learning Activity 8: Rock Families

Alligood, C., Bock, F., & Campbell, J. (n.d.). Grade 4 Unit 4 Rocks and Minerals. Retrieved from https://files.nc.gov/ncdeq/Energy Mineral and Land Resources/Geological Survey/Geoscience Education/0-Lesson7-4thgrade-RocksMinerals-C-Alligood--Oct08.pdf

Bechtel, R. (2018, May 05). 4th Grade Classroom Activity- Five Stations of Rock and Mineral Identifications. Retrieved from https://serc.carleton.edu/earth_rendezvous/2017/program/demos/fridayA/174383.html

Minerals Education Coalition. (n.d.). Large Rock Odyssey Poster: Minerals Education Coalition Store. Retrieved from https://mineralseducationcoalition.org/store/large-rock-odyssey-poster/

Learning Activity 9: Erosion & Deposition

Rich, S. (2010). Measuring and Analyzing Erosion. In *Outdoor Science: A Practical Guide*. Arlington, VA: NSTA.

Capstone. (n.d.). Erosion. Retrieved from https://www.pebblego.com/modules/2/categories/2968/articles/2052

Learning Activity 10: Weathering & Erosion Hike

Haskin, M. (2019, February). Reconnaissance for Earth-Science Curriculum at Northside Elementary, Chapel Hill. Retrieved from https://ie.unc.edu/files/2019/07/4th_6Rrock-Cycle-Walk_Michelle-Haskin.pdf

Crash Course Kids. (2015, May 15). Weathering and Erosion: Crash Course Kids #10.2. Retrieved from https://www.youtube.com/watch?v=R-Iak3Wvh9c

Learning Activity 11: Living with Geohazards

Integrated Teaching and Learning Program, College of Engineering, University of Colorado Boulder. (2019, April 17). Mini-Landslide Activity. Retrieved from https://www.teachengineering.org/activities/view/cub_natdis_lesson05_activity1

Marusak, J., & Price, M. (2019, February 26). 4 rock slides in 4 days block major highways and other roads in NC mountains. Retrieved from https://www.charlotteobserver.com/news/state/north-carolina/article226817774.html

Mystery Doug. (2019, March 25). How do earthquakes happen? Retrieved from https://www.youtube.com/watch?v=Rmkds_ox_6k
Mystery Science. (n.d.). How could you survive a landslide? Retrieved from https://mysteryscience.com/rocks/mystery-4/erosion-natural-hazards-engineering/58
NASA. (2019, June 28). What is an Earthquake? Retrieved from https://spaceplace.nasa.gov/earthquakes/en/
North Carolina Environmental Quality. (2014). NCSTA Resource Downloads. Retrieved from https://deq.nc.gov/about/divisions/energy-mineral-land-resources/north-carolina-geological-survey/geoscience-education/ncsta-resources-downloads
North Carolina Environmental Quality. (n.d.). Recognizing Landslides. Retrieved from https://deq.nc.gov/about/divisions/energy-mineral-land-resources/north-carolina-geological-survey/geologic-hazards/landslide-types-causes
Pasta Quake - The San Francisco Treat. (2017). Retrieved from https://files.nc.gov/ncdeq/NC_Pasta_Quake.pdf
Tech Insider. (2016, December 20). Animated map: All earthquakes of the past 15 years. Retrieved from https://www.youtube.com/watch?v=Ed0tGlfJHiY
USGS. (n.d.). Latest Earthquakes. Retrieved from https://earthquake.usgs.gov/earthquakes/map/?utm_source=Science Explorer&utm_m...=
Weather Wiz Kids. (n.d.). Landslides. Retrieved from http://www.weatherwizkids.com/?page_id=1326