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FIELD TRIP

Rocks

Theme
The characteristics of rocks influence both our landscape and our lives.

Utah State Integrated Core Curriculum Topic
Standard Three: Students will develop an understanding of their environment.
Objective Three: Investigate the properties and the uses of rocks.

Field Trip Location
Any of the many sandstone slickrock areas of southeastern Utah. Sand Flats Recreation Area east of Moab is an excellent location. On the other hand, any outdoor location could be used for Stations #1 and #4, and any location with sandstone could be used for Station #2. A location with cryptobiotic soil is needed for Station #3.

Times
All lessons are 30 min.

Background

Rocks are made up of one or more minerals. Minerals are naturally occurring elements (e.g., gold) or inorganic compounds (e.g., quartz) that have specific crystal structures.

There are three major kinds of rocks: igneous, sedimentary, and metamorphic. Igneous rocks form from molten rock (magma) that has cooled. Examples include granite, basalt and pumice. They are usually unlayered (except basalts) and often contain visible crystals. Sedimentary rocks form when sediments that are deposited by water or wind on the surface of the earth, harden and solidify over time, as they are buried by more sediment. Sedimentary rocks commonly look layered. Metamorphic rocks are rocks of any type that have been altered (not melted) by heat or pressure. Sandstone metamorphoses into quartzite, limestone into marble, and granite into gneiss. Crystals commonly seen in metamorphic rocks are usually oriented in lines or sheets, at times giving both small hand samples and outcrops a wavy or crinkled appearance.

Rocks change. Heat or pressure can metamorphose any type of rock. If a rock is heated to the melting point and later recrystallizes, a new igneous rock can form. Any type of rock can erode, be redeposited, and become a sedimentary rock. These processes, changing one type of rock into another, are known collectively as the *rock cycle*. Many simpler cycles exist within the complex rock cycle. Metamorphic rocks may be remetamorphosed. Igneous rocks may melt and recrystallize.

Most rocks in southeastern Utah are sedimentary, and the most common sedimentary rock is sandstone. Sandstone is made up of quartz sand grains cemented together by calcium carbonate or silica. The red appearance of many types of sandstone in the area is due to oxidized iron that coats the sand grains. Generally, sandstone is easily eroded. Water is the most effective agent of erosion, but gravity and wind also play a part. The erosion of sandstone formed the unique canyons, needles, arches, natural bridges,

spires, and balanced rocks of southeastern Utah.

Petrified wood forms when minerals (usually quartz) replace organic materials in wood. Chert is microcrystalline quartz, without the cellular structure visible in petrified wood. It is very hard and breaks conchoidally. Limestone is calcium carbonate deposited on ocean floors.

Granite is found in the La Sal Mountains near Arches and Canyonlands National Parks. It is a hard igneous rock that cooled from magma while still underground. Granite is composed primarily of visible crystals of quartz, mica, and feldspar. Generally, granite erodes more slowly than sandstone. Small pebbles eroded from granite, along with organic materials from mountain vegetation, contribute to rich mountain soil.

Deserts have less, smaller, and slower-growing vegetation than mountains, so desert soils have a low organic content. Biological soil crusts are extremely common in the southeastern Utah high desert and help to make up for this lack of organic matter. The soil crusts are a community of small organisms that form a living mat and secure the top few inches of sand particles against water and wind erosion. The crusts also increase absorption and retention of water and add nitrogen to the soil, an essential for plant growth. Biological soil crusts give desert soils a lumpy, spongy look, a result of gases produced by each living, breathing community member.

Because of their incredible importance and extreme fragility, the preservation of biological soil crusts is the target of many educational efforts within the southeastern Utah national parks. To avoid walking on the crusts, hikers should walk on slickrock, on trails, or in washes. Don't bust the crust!

Biological soil crusts are common throughout southeast Utah-

PRET-TRIP ACTIVITY

Just What Are Rocks Anyway?

Objectives

Students will be able to:

a. Understand that rock underlies everything on the surface of the earth.

b. Name one set of categories that can be used to classify a rock collection.

Materials

Rock Collecting (Gans, 1984); *Everybody Needs a Rock* (Baylor, 1974); a variety of rocks.

PROCEDURE

1) Tell students that they will be exploring rocks on the upcoming field trip. Inform them of the field trip location and the food, water, and gear they need to bring to school on the day of the field trip.

2) Ask students if any of them have a rock collection at home. Have one or two students describe a favorite rock from their collection. Tell students that rock collecting is fun, but in some places it is not allowed. See if students can guess why you should not collect rocks in certain areas. Talk about areas in which rock collecting is inappropriate. Read and discuss the book *Rock Collecting*. Emphasize that rock underlies everything on the earth's surface. Review the book by asking a few students to name ways that rocks can be classified (for example: color, hardness, or the three rock types).

3) Give a rock to each student. Have students pass the rocks around the room, allowing each student the opportunity to see each rock. Ask a few students to stand up, show their rock to the class, and say something about it. Discuss how these observations can help in classifying rocks. Collect the rocks.

4) Read and discuss the book *Everybody Needs a Rock*. Inform students that although we won't be collecting any rocks on this field trip they may wish to at another time.

5) Reinforce what students should bring to school for the field trip by having students raise hands and take turns listing the items.

EXTENSION

Have students start a rock collection from rocks found in the schoolyard. Have students categorize the collected rocks by observable characteristics.

STATION #1

Rocks, Rocks and More Rocks

Objective

Students will be able to:

a. Identify and describe, using observable characteristics, three specific kinds of rocks found in the area.

Materials

blindfolds; rock samples (e.g., sandstone, granite, limestone, chert, and petrified wood).

PROCEDURE

1) Tell students that they will be examining rocks and you have a "magic box" full of rocks that you are going to share with them. As you show the rocks to the students, tell them the story of how each rock was created. Then hand out the rocks, one type at a time. As they pass them around the circle, ask students which rock they think is the hardest, softest, and heaviest. Ask them to point to the rock that matches what they are sitting on.

2) Ask students to sort the rocks by making piles. For example, have the students put all the rocks that were once liquid in one pile and all the rocks that were once living things in another. Have students sort the rocks in 5 or 6 different ways.

3) Split the students into pairs and blindfold one student in each pair. Ask that student to remain seated. Put all the rock samples in a pile and have the students without blindfolds choose one rock each to take to their partner. Have the blindfolded students feel their rocks (behind their backs so they can't peek). Ask them to feel for shape, size, weight, and texture. When they are done, tell them to hand the rock back to their partners, who will return the rocks to the pile. With blindfolds removed, students try to determine which rock they felt. Ask how they recognized their rocks. Tell partners to switch roles and repeat the activity. Discuss how geologists can tell the difference between kinds of rock by asking themselves similar questions: How heavy is it? Is it hard or soft? How does it break? What color is it?

4) Play the Rock Type Relay. Divide students into two relay teams. Place a pile of rocks 25 feet from a starting line. Explain that you will call out the name of or something about a rock. The first student in each team must run, pick up a sample of the rock, and run back to his/her team. Teammates must look at the selected rock and give a thumbs-up or thumbs-down. The runner then gives the rock to the next person in line to put back as they are getting a new rock.

Rock Type Relay

STATION #2

Build Up, Tear Down

Objectives

Students will be able to:
a. Name two processes that change rocks.
b. Name two things that harden rocks.
c. Name two things that erode rocks.

Materials

mountain overlay poster(a flip chart that depicts the changes in local geology through time); secret decoder; clues; *recipe card*; *ingredient cards*; water; arch formation poster(poster depicting the stages of arch formation).

Note

Hide the ingredient cards before the students arrive.

PROCEDURE

1) Ask students if they think that the way the earth looks changes over time? Tell them that the area where they are sitting looked different millions of years ago. In Colorado, there was a mountain as tall as Mount Everest. In Moab, there was an ocean. Show students a poster with overlays. Explain that over time, the dirt from the mountain washed down into the ocean, eventually hardening into rock.

2) Ask students if they know how sand hardens into rock. Tell students the recipe has four ingredients. Ask if they would like to go on a treasure hunt to find the missing ingredients for making sandstone. Ask students to walk fast, but not to run. Read the first clue, which will lead students to the *sand* card. Have students read *sand* together. Place the card on the *Recipe Card*. Continue in the same manner, next finding *pressure*, then *water*, and finally *time*. Demonstrate the meaning of pressure by having students and adults put their hands together in one pile. Ask if the hands near the bottom can feel the pressure.

3) Tell students it is time to try to make sandstone. Go to a sandy area and have each student make a personal pile of sand on a nearby rock. Ask students to apply pressure to their sand by stomping on it. Squirt a little water on each pile and discuss the role of water moving between sand grains and cementing them together. Tell students that for the time ingredient, they just need to keep stomping for another 5,000 years. Ask if they would be bored (or dead) before then.

4) Teach and practice the *Sandstone Recipe Rhyme*: "Sand, pressure, water and time; that's the sandstone recipe rhyme." Teach hand motions to go with the rhyme, moving fingers for "sand," pushing hands down for "pressure," make fish swimming motions for "water," pointing to wrist for "time," and marching in place with arms swinging (or snapping fingers) during "that's the sandstone recipe rhyme."

5) Tell students that once sandstone is exposed to the air it starts to erode. Ask students if anyone can tell you what erosion is? Explain that *erosion* is the wearing down or weathering of rocks. For example, ask the students if they have ever burned a piece of toast and then taken a knife and scraped off the burned part, making all the burnt crumbs fall on their plate? Tell the students that they were eroding their toast, slowly wearing it away and making small pieces fall off. Ask students if they think the rocks erode because some giant is scraping them with a knife. Discuss real causes of erosion, such as wind, water, and ice.

6) Take a short hike on the sandstone, showing and/or asking students to find examples of erosion. Find a crack in the sandstone and discuss how water might get into the crack. Tell students that ice is the number one cause of erosion. Have everyone stand shoulder to shoulder in a circle. Tell the students that they are water molecules during a nice warm day. Explain that the sun is going down, it is getting really cold, and they are freezing. Have them stick out their elbows. Point out how the circle got bigger when the water molecules froze. Ask students if they've ever put a can of pop or a water bottle in the freezer and forgotten it. What happened? Explain that water expands when it freezes, making the cans or bottles explode. Explain that when water thaws it gets smaller again. Have everyone stand shoulder to shoulder again and go through the cycle of night and day, freezing and thawing, a few times. Next, pick two students and have them press their hands against each other. Explain that when water seeps into a crack and freezes it pushes the crack apart because of the expanding molecules. Put your hands in between the students' hands. As the ice thaws allow your hands to seep lower into the crack between their hands, demonstrating the thawing/freezing process. Do this several times until you have pushed their hands several inches apart.

7) Remind students that there was once sandstone covering this whole area and everything they see is the result of erosion.

Have the students create a model by building a mound of sand with rocks in the mound periodically. Tell the students that some sandstone is harder than others. Explain that the hard sandstone erodes more slowly than the soft sandstone, making the unique formations throughout the area. Have the students take turns pouring water on the mound. Point out the exposed rocks and the newly created formations.

8) Use the Arch Formation poster to describe how erosion causes cool formations such as arches. Use the damp sand to guide students through the process of arch formation, emphasizing the importance of water and ice. Let students then build their own arches and other erosional features. Emphasize that erosion takes a long time and that they are really speeding up the hands of geologic time!

Learning about the erosive force of water

SANDSTONE RECIPE CARD

Recipe For Sandstone

1.

2.

3.

4.

SANDSTONE INGREDIENTS

Cut apart and apply velcro or other sticky substance to back of each.

SAND

PRESSURE

WATER

TIME

STATION #3

Secrets in the Soil

Objectives

Students will be able to:

a. Explain two roles of biological soil crusts.
b. Name two places to walk in order to avoid stepping on biological soil crusts.

Materials

crypto puppet; crypto poster; crypto mat; the Sandstone Rock Cycle poster that highlights sand; potting soil or mountain soil in a bucket; sand in a bucket; crypto puppet (a brown sock puppet with button eyes and a brown lump of carpet padding or something spongy and crusty-feeling that resembles a bump of cryptobiotic soil); small poster that lists four functions of cryptobiotic soil (It holds the sand in place and prevents erosion, soaks up and holds water like a sponge, provides nutrients or fertilizer for other plants, and provides protected places for seeds to grow.); crypto mat (a 6'x 3' piece of carpet padding with several 1"-2" tall lumps of brown or black carpet padding glued onto it); hand lenses; cyanobacteria pictures

PROCEDURE

1) Have students look around and ask them if they see anything other than rock. Ask the students what happens to the sand when the wind blows? Ask them why all the sand does not blow away? Tell the students that there are living substances, biological soil crusts that keep the sand in place.

2) Introduce the crypto puppet to students, and have the puppet use the poster to tell students about the roles of biological soil crust. Emphasize that the crust holds the sand in place, preventing erosion, soaks up and holds water like a sponge, provides nutrients or fertilizer for other plants, and provides protected places for seeds to grow. Have the puppet tell the students that there's one thing that all crust fears: being crushed.

3) Tell students that you are going to go on a hike to look for biological soil crusts. Discuss the three good places to walk to avoid stepping on crusts: on trails or roads, on slickrock, or in washes. Have the students practice by taking turns tiptoeing across the crypto mat, trying to avoid stepping on any of the bumps in the soil crusts.

4) Go on a hike. Point out older and younger biological soil crusts. Have students lay belly-down on the slickrock adjacent to a pothole garden and look closely at the soil crust. Tell the students that soil crusts are intricate things; challenge them to look without talking for 30 seconds. Afterwards, ask each student to name one thing the area reminds them of: i.e. garden, nursery, bed, lumpy bumpy pillow. Hand out a hand lenses to each student and let them examine the soil crusts. After a few minutes, ask each student to name something that they see. Ask students to point to some of the different organisms that colonize the soil crusts: i.e. lichens and mosses. Show students pictures of magnified cyanobacteria and tell them this is what lies underneath the soil. If some crust is already loose, show students the real thing. Ask them to point to a good landing place for a seed, a spot where it won't be blown away. Discuss some of the other ways soil crusts help plants grow. Point out the larger plants in the pothole garden and discuss why soil crusts help them to thrive.

5) Return to the starting area. Review the roles of biological soil crusts and the three best places to walk in order to avoid busting the crust.

EXTENSION

Have students imagine they were shrunk to a size smaller than an ant. Have them write a story or draw a picture of their adventures exploring the pothole garden or crypto condo.

STATION #4

Rocks: Past and Present

Objectives

Students will be able to:
a. Name two modern uses of rocks.
b. Describe how people used to use rocks.

Materials

examples of stone tools; pictures of modern uses of rocks; "*make a fork*" poster (a poster that depicts the path ore takes from the mine to a finished metal product); "*ancient uses of rock*" poster (depicting stone tools and other evidence of the ways rocks were used); pictures of modern items corresponding to those depicted in the "*ancient uses of rock*" poster.

PROCEDURE

1) Ask students if at one time people use rocks in their lives every day? Have students suggest some ways that ancient people used rocks: i.e. arrowheads, grinding stones, etc. Show students some examples of ancient rock technology. Discuss what each was used for. Ask students why different rocks might have been used for different purposes? For example, ask students if sandstone would make a good knife? Discuss why chert was used for arrowheads? Ask students if they thought it was hard to make arrowheads and other tools?

2) Show students actions that symbolize many of the different stone tools. Play a quick game of ranger says using these actions.

3) Ask students if they believe people still use rocks every day? Have students give some examples of how rocks continue to be a part of our lives: i.e. jewelry, landscaping, pencils, etc. Show pictures of modern uses of rocks. Discuss with students how many of the rocks we use today have been changed or refined. Show students some examples of objects that were made out of rock ore. Have students name some other objects that were made out of rock. Explain how the refining process works by showing them the poster of the making of a fork.

4) Show students the Ancient Uses of Rock poster. Discuss each use with them. Tell the students that hidden around the area are pictures of the way we use rocks today. Tell them that they will have a few minutes to look for these pictures. If they find one, they have to bring it back and place it on the poster next to the corresponding ancient use for the rock. Remind students to keep their feet on the slickrock and that each student may only find 2 or 3 pictures.

MODERN OBJECT VS. ANCIENT OBJECT EXAMPLES

Pots and pans – ceramic pots
Knife – Knife
Bowls – Ceramic bowls\
Buildings – Buildings
Roofing – Roofing
Grinding stone – mano and matate
Landscaping – Farm development
Jewelry – Jewelry
Spatula – Stone scraper
Decorations – Decorations
Bullets – Spear points and arrowheads
Axe – Stone axe
Hammer – Stone hammer

POST-TRIP ACTIVITY

Rock Art

Objectives

Students will be able to:

a. Describe two things about a rock that could easily be missed.

b. Name one use for a rock.

Materials

posters showing igneous, sedimentary and metamorphic rocks; rocks for every student; paper; crayons.

PROCEDURE

1) Review field trip stations with students. Ask students to recall some ways people use rocks. Have volunteers name several different examples. Ask students if they can remember learning about a microscopic organism that helps to prevent erosion. Discuss how soil crusts help prevent erosion. Have students name several other things biological soil crusts provide for the natural environment. Have students name some things that can harm soil crusts. Discuss the characteristics of some local rocks.

2) Remind students that not all rocks were created the same way. Some rocks were once liquid inside the earth. We call these igneous rocks (show the appropriate poster). Ask students to name a rock that was once liquid (granite). Ask students what happens to rocks over time (erosion). Remind them that the sediments from erosion pile up. Ask students what happens to these sediments over millions of years (they harden into rocks). We call these rocks sedimentary rocks (show the appropriate poster). Tell the students that rocks sometimes get buried deep in the earth, melt, and change. If this happens, metamorphic rocks are formed (show the appropriate poster).

3) Pass out paper to each student and ask them to fold the paper in half. Bring out a box of rocks and give one to each student. Ask the students to draw their rocks on one side of their paper. Tell students not to trace their rocks because they do not want to accidentally draw on them. Tell the students to think about what type of rock they have while they are drawing. Ask them to write the type of rock under their drawing. Next, give each student a hand lens. Give the students a few minutes to examine their rocks and ask them to draw what they see on the other side of the paper. As students are working, walk around and discuss with individual students what type of rock they have.

4) When students are finishing up or there is only five minutes left, have students tell their neighbor one neat thing about their rock. Collect the hand lenses while they are talking. Next, have all the kids with igneous rocks raise them up and show the class. Point out some of the kinds of rocks you see. Repeat this activity with metamorphic and sedimentary rocks. Collect the rocks. Ask the students to raise their hands if they saw something with the hand lenses that they did not see with just their eyes. Do they think scientists use hand lenses to learn about rocks?

References and Resources

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Investigating rocks with a hand lens