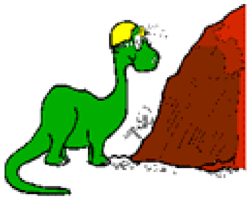
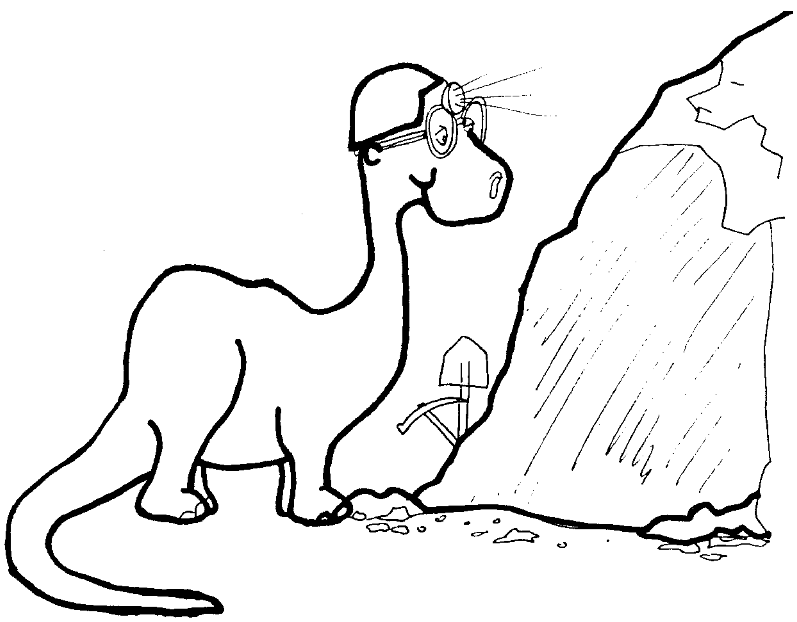


Rock Cycle

Understanding the Earth's Crust

FIFTH GRADE

ROCKS



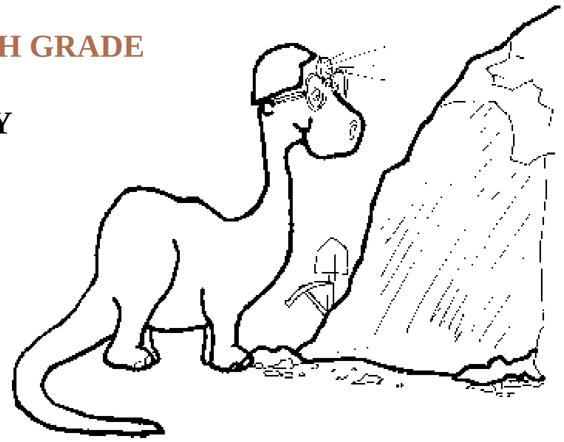
2 WEEKS

LESSON PLANS AND

ACTIVITIES

ROCK CYCLE

OVERVIEW OF FIFTH GRADE



CHEMISTRY

WEEK 1.
PRE: *Describing a chemical reaction.*
LAB: *Illustrating how molecules move.*
POST: *Comparing salt and sugar crystals.*

MINERALS

WEEK 2.
PRE: *Exploring minerals made of elements and compounds.*
LAB: *Discovering the different hardness of minerals.*
POST: *Analyzing why one mineral is harder than another.*

WEEK 3.
PRE: *Exploring how minerals are useful.*
LAB: *Analyzing minerals for their usefulness.*
POST: *Distinguishing colors derived from minerals.*

ROCKS

WEEK 4.
PRE: *Interpreting the different environments where rocks form.*
LAB: *Analyzing the origin of different sands.*
POST: *Comparing areas where sedimentary particles are deposited.*

WEEK 5.
PRE: *Exploring the creation of caves.*
LAB: *Examining different sedimentary rocks.*
POST: *Exploring the difficulties in identifying rocks.*

PAST LIFE

WEEK 6.
PRE: *Exploring paleontology.*
LAB: *Illustrating how fossils are preserved.*
POST: *Comparing the different eras of time.*

ROCK CYCLE - ROCKS (5A)

PRE LAB

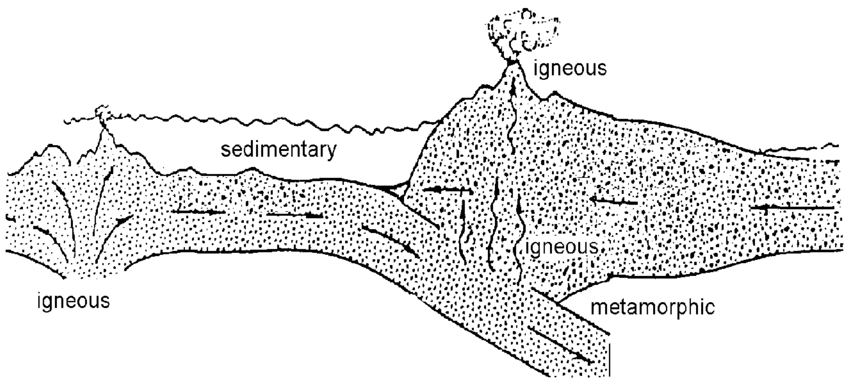
Students compare the three types of rocks.

OBJECTIVE:

1. Interpreting the different environments in which rocks form.
2. Comparing rock formation with plate tectonics.

VOCABULARY:

igneous
metamorphic
sedimentary



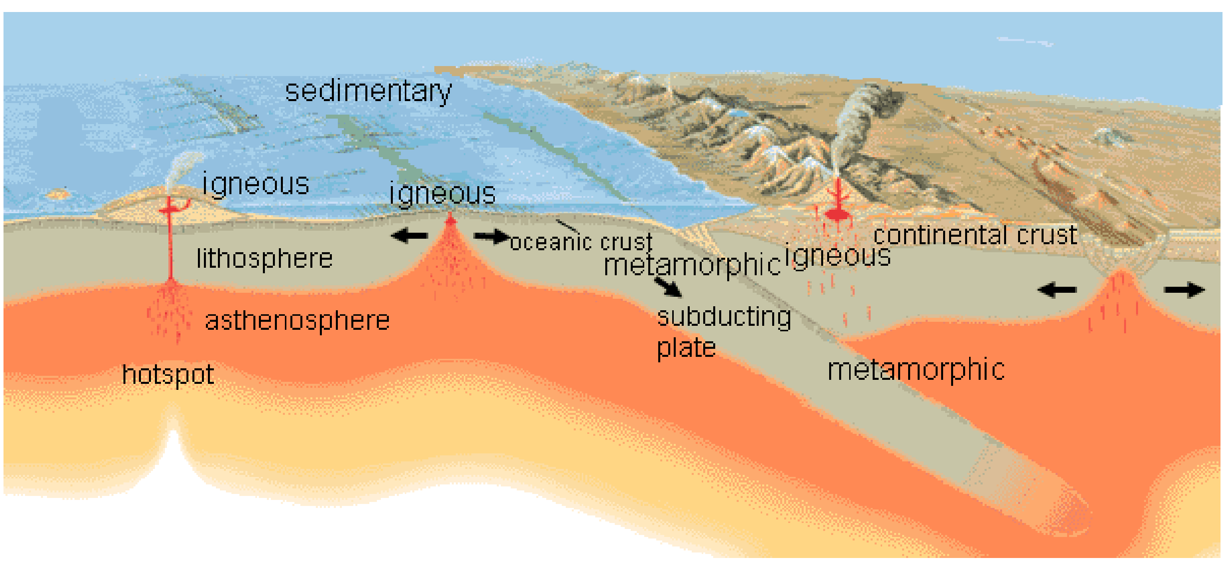
MATERIALS:

none

BACKGROUND:

Rocks form mainly within the crust of the Earth. Igneous rocks are formed when molten magma formed in the lithosphere cools and crystallizes into solid rock. Magma cools slowly inside the Earth, forming rocks like granite, which have large minerals that can be seen with the naked eye. These are called plutonic igneous rocks. Quick cooling magmas are generally erupted onto the Earth's surface called volcanic rocks.

Sedimentary rocks are formed only on the surface of the Earth. Sedimentary rocks form at the Earth's surface in two main ways: (1) from clastic material (pieces of other rocks or fragments of skeletons) which have become cemented together, and (2) by



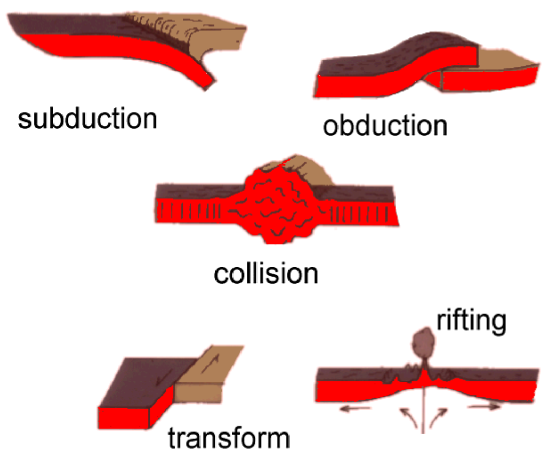
chemical mechanisms including precipitation and evaporation. There are many environments associated with sedimentary rock formation, including oceans, lakes, deserts, rivers, beaches, and glaciers. They may form at all types of plate boundaries, but the thickest sedimentary rock accumulations occur at convergent plate boundaries.

Metamorphic rocks are formed mainly in the lithosphere, wherever there is high pressure and high temperature. If the pressure and temperature are too high, metamorphic rock will melt and become magma. The areas where metamorphic rocks form tend to be very close to those where igneous rocks form.

The key objective of this unit is to emphasize that rock formation can be conceptualized as a very dynamic system called the Rock Cycle. The Rock Cycle is driven by the Plate Tectonic Cycle.

PROCEDURE:

1. In this exercise, the students locate where rocks are formed within the context of plate tectonics. Review igneous, sedimentary, and metamorphic rocks and their origins. Discuss the various environments where rocks are created. Ask the students to help you fill in the environments that they think might create the three types of rocks.



2. In the diagram to the left go over which rocks are created. In converging zones, such as subduction, obduction, and collision, metamorphic rocks are always created. However, only in subduction does igneous rock form. Sedimentary rocks will form as the mountains, erode and sediments settle into basins.

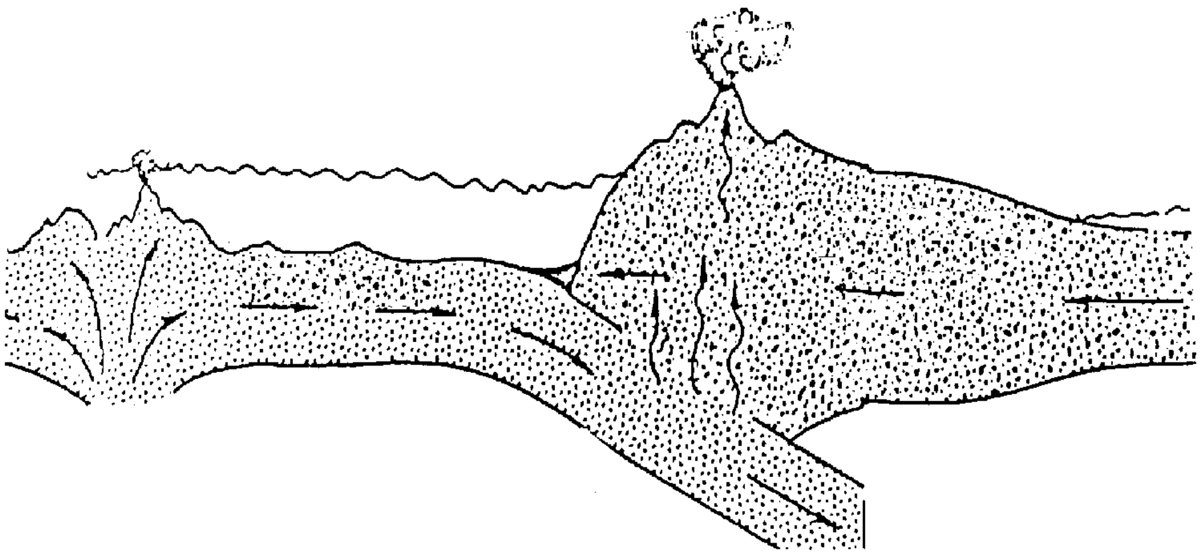
At diverging or rift zones igneous rocks are formed. Sedimentary rocks will form if the area is submerged, like in the mid-Atlantic rift zone. Metamorphic rocks can be formed as the plates move the rocks apart, but it will be only localized. At transform or slip-slide boundaries metamorphic rocks form.

Sedimentary rocks form as an overlay to all these plate interactions.

ROCK CYCLE - ROCKS (5A)

PRE LAB

Locate where igneous, sedimentary, and metamorphic rocks are formed. Color the igneous rock areas red, the sedimentary rock areas yellow, and the metamorphic rock areas green.



Where are sedimentary rocks usually created? Give examples of areas.

____

____

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Where are igneous rocks usually created? Give examples of areas.

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____

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Where are metamorphic rocks usually created? Give examples of areas.

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ROCK CYCLE - ROCKS (5A)

LAB

Students determine the source rocks of sand samples.

OBJECTIVE:

1. Analyzing the origin of sands.
2. Distinguishing "mother" rock from "baby" rock.

VOCABULARY:

igneous
metamorphic
sedimentary

MATERIALS:

Rock Cycle - Rocks (5A)
Swift GH microscope
sand chart
round Avery labels
index cards
glue sticks

Beach sand from Coco Beach, Florida

BACKGROUND:

The Rock Cycle creates new rocks and destroys pre-existing rocks. Sand is an example of this. Sand is a kind of rock in transition. Sand grains form from a pre-existing rock that was destroyed by weathering and erosion. Sand grains become a sedimentary rock when they are cemented together. In this lab, students will look at four key characteristics of sand including composition, grain size, grain roundness, and sorting.

Since sand comes from a "mother" or source rock, it is possible to determine what type of rock produced the sand or "baby rocks." This is because the composition and general color of both the "baby" and "mother" rock are often very similar. The students will use this concept in the lab to identify sand samples and their potential "mother" rocks.

For example, the plutonic igneous rock granite is largely composed of the minerals quartz, feldspar, mica, and hornblende (a dark colored iron- and magnesium-rich mineral). When a granite weathers, two types of sand can form composed of granite rock fragments or individual loose minerals. In the case of granite, these crystals might be quartz, feldspar, mica, and hornblende. Therefore, sand composed of a mixture of granite fragments, quartz, mica, and feldspar was probably from a granite source area. Hornblende and mica weather very quickly, so most sand derived from granite is mostly quartz and feldspar.

Three textures are relevant to this lab including grain size, grain roundness, and sorting. Grain size is the size of the particles, measured by grain diameters. “Sand-sized” in this sense is defined as particles from 1/16 to 2 mm in diameter.

Grain roundness is the presence or absence of corners and sharp edges on the particle. Particles with many edges are “angular”.   Particles lacking edges are “rounded”. Note that roundness is not the same as spherical. An oblong particle can also be highly rounded.

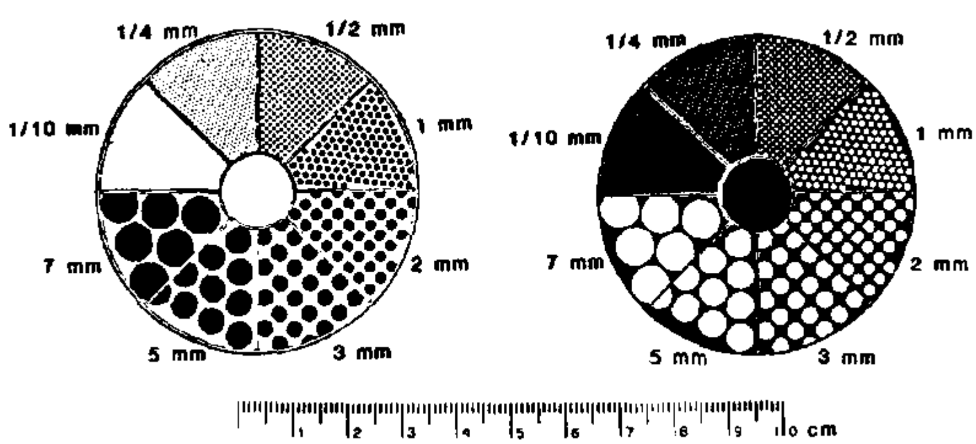
Sorting is the range of grain sizes in a sand. Poorly sorted sands show a wide range of grain diameters, well-sorted sands have similar sized grains. As sand grains are transported by wind, water or whatever process, the grain size tends to decrease, roundness increases, and sorting increases.   Determining these textural properties is a very visual process. Students should learn to be active observers.

PROCEDURE:

1. Make sure you are familiar with the “Sand Identification Chart” that the students will be using.

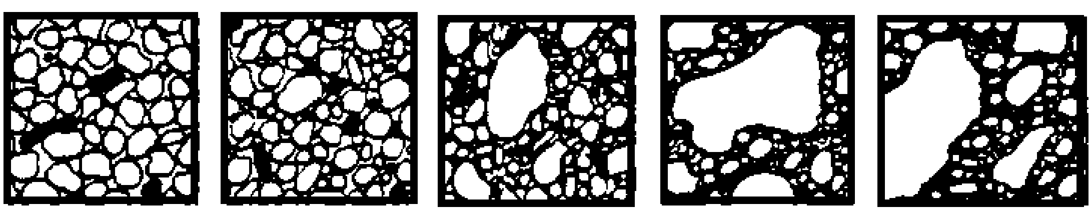
2. Have the students describe the grain size, roundness, sorting, and composition of each sand sample.

SIZE: You have two circles with dots that are the size that is written along the outside of the circle. There is a dark circle and a light one...only because light sands are seen lighter backgrounds. Have them sprinkle a little on the paper and find the size that the particles fit into. In most cases their will be a range of sizes. Size just tells you how long a particle has been eroding...the longer it has been moving around the smaller it will be in general.



ROUNDNESS: Have the students compare the particles in their sand with the pictures of roundness. You might need a magnifying glass...but a little imagination is fine. The rounder a particle, the longer it has been moving. In the diagram below the most rounded are on the right, the most angular is on the left.

SORTING: Sorting refers to the range in size of particles. If a sample has big and little pieces it is not well sorted, but if all the particles were of the same size it would be very well sorted. Sorting is due to how the sand particles settled down...if it was turbulent sand would not be well sorted, if in a quiet setting it would be well sorted. Also, wind can carry small particles to areas on a beach that are controlled by the wind, like dunes, and these tend to be well sorted. In the diagram below poorly sorted is on the right, and well sorted is on the left.



3. An alternative method can be used if you have microscopes. Use tape to hold a few particles in place under the objective. You can also have students use round Avery labels and "pat" the sticky side on the sand. Then glue the other side on an index card and view it under the microscope. Make sure students label the sand. If you have the Swift GH microscope, you can keep the sand in the bag and have the students observe the sand through the bags. Have the students illustrate their observations. In most cases, the students will see a range of sizes.

4. Have the students determine the mother rock(s) for each sand sample. They can best do this by matching the minerals and rock fragments in the sand samples to the possible mother rock samples on display.

Here is basic information on each source rock in the lab. Samples of each rock should be available to the students as they work on the lab:

CHERT (sedimentary) - A rock that is composed of quartz formed from recrystallized microscopic skeletons of radiolarians (protozoa). If you look under the microscope, you can see very small spots in the rock. These are the radiolarians. Radiolarians are only about 150 microns in diameter, so you cannot see much detail. Chert is very hard, and comes in many colors. Chert forms in deep ocean environments, and becomes a source rock when it is uplifted above sea level by mountain building.

BASALT (igneous) Basalt is a dark, fine -grained igneous rock. It forms during volcanic eruptions from magma that cooled relatively quickly (in days to weeks). Minerals can be seen under a microscope (transmitted light).

GRANITE (igneous) - A plutonic igneous rock that formed when molten magma slowly cooled inside the earth. It occurs in varying shades of light and dark colors depending on the specimen's mineral composition. The minerals in granite can be seen without a microscope.

SERPENTINITE (metamorphic) - This rock is the "state rock" of California. It has a mottled green color and a "scaly" appearance. This metamorphic rock is formed in areas that have been under high pressure and low temperature, and is often associated with convergent plate boundaries.

5. ANSWERS:
MONTARA = light color, .1-7mm, very poorly sorted, subrounded, mother rock =granite;
RODEO BEACH = dark color, .1-7mm, poorly sorted, angular-rounded, mother rocks = chert, serpentinite, basalt
HALF MOON BAY = light color, 0.23-3 mm, poorly sorted, subangular, mother rock = granite
BODEGA BAY = dark color, .1-1mm, well sorted, subangular-subrounded, mother rock = basalt

ROCK CYCLE - ROCKS (5A) LAB

PROBLEM: Where do sand particles come from?

PREDICTION:____

PROCEDURE: Examine the sand samples and describe their key characteristics. Use the sand chart to help measure the size of the grains, their sorting, and roundness. Look at the display rocks. Find which MOTHER ROCK(S) or minerals make up the sands. MOTHER ROCKS include chert, serpentinite, basalt, and granite.

SAND LOCALITY	DESCRIPTION OF SAND (size, sorting, roundness)	MOTHER ROCKS
HALF MOON BAY CENTRAL CALIF.		
BODEGA BAY, NORTHERN CALIF.		
MONTARA CENTRAL CALIFORNIA		
RODEO BEACH, MARIN NORTHERN CALIF.		

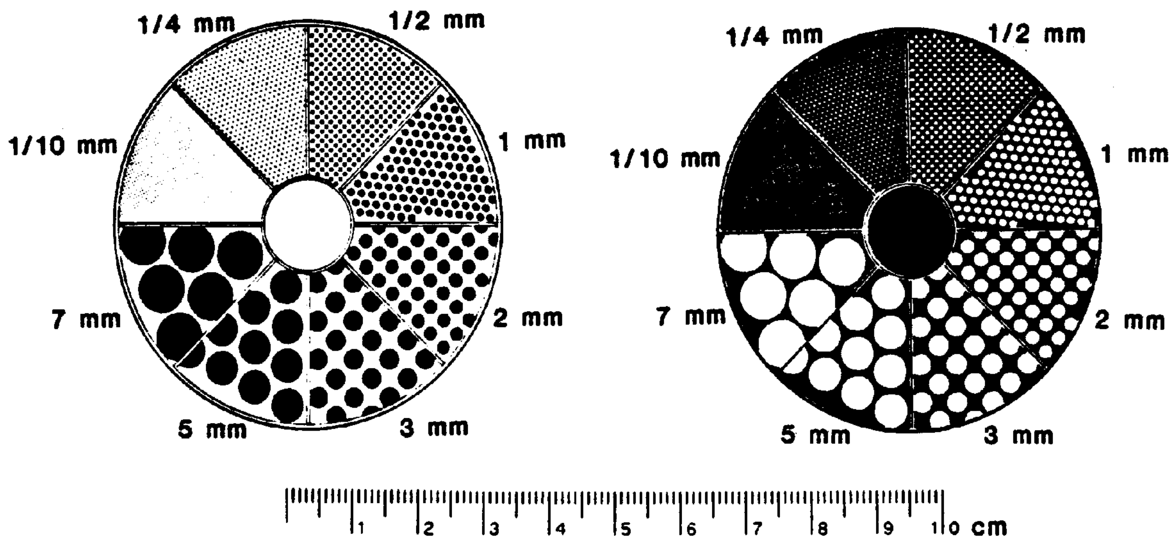
CONCLUSION: How can describing the sand reveal the rock from where it started?

____

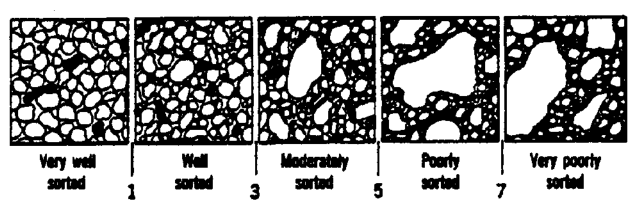
____

SAND IDENTIFICATION CHART

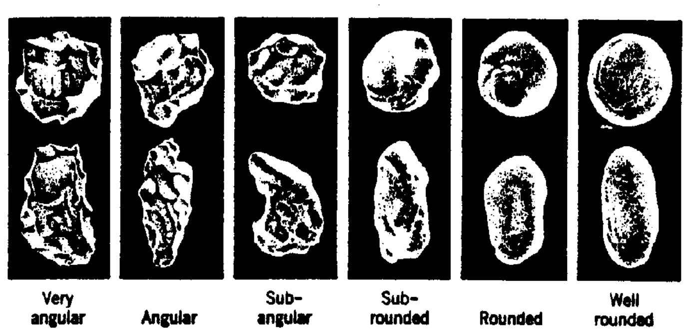
Sorting is the variety of grain sizes in a sample. Sands may be well sorted (all the same size) or poorly sorted (many different sizes). Roundness is the shape of the sand particle including angular, rounded or in between.



sorting



roundness



ROCK CYCLE - ROCKS (5A)

POST LAB

Students compare “sands” found in sand boxes.

OBJECTIVES:

1. Analyzing playground sand.
2. Comparing areas where sedimentary particles are deposited.

VOCABULARY:

clay
gravel
sand
silt

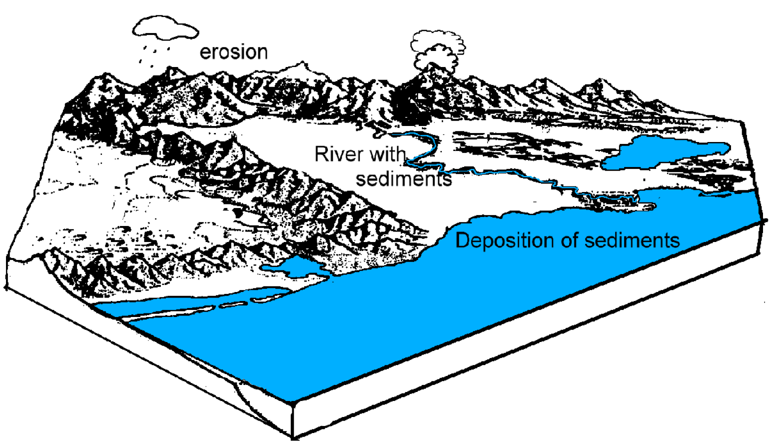
MATERIALS:

sand samples from playground sand
Sand Kit
worksheet

BACKGROUND:

Sand has been used to describe many human qualities. A vagabond is described as "driftless like ...sand" and " we are all but a "grain of sand on the beach." Children look at sand falling through an hour glass, fascinated by every grain that falls. Sand is loved so much by children that adults have created sand boxes, so their children can play.

Sand is the Earth in miniature. Every rock on the surface of the Earth will erode and will become sediment or sand with time. This process is part of the Rock Cycle. Mighty mountains are slowly chipped away by natural forces like wind and rain. Sand is often associated with two very opposite climatic conditions. Sand occurs at the beach, where waves continually crash upon the shore, and in deserts, where wind sometimes builds sand dunes. In both environments, some kind of erosion of the surrounding rock is creating the sand.



Weathering produces sedimentary particles in a variety of sizes and compositions. Erosion and transportation often reduce particle size and destroy unstable minerals.

As transportation ceases, the sediment is deposited. Deposition takes place because the transporting medium no longer has the energy needed to carry the particles. For example, a river deposits sand as it flows into a lake. The smaller a particle, the longer it takes to be deposited. This means that the largest and heaviest particles, likely gravel-sized settle nearest to shore, while sand-sized particles are deposited further out. Silt and mud grains, which are the smallest particles, settle even further from shore.

When the particles are cemented together, each of these grain sizes forms a corresponding sedimentary rock: Gravel forms conglomerate, sand makes sandstone, silt makes siltstone, and clay forms claystone. Rocks composed of clay- and silt-sized grains are often collectively called shale. Note that these sedimentary rock names refer only to grain size.

PROCEDURE:

1. Ask students to bring small samples of sands from their homes (if available). Your school's sand box, local beaches or garden supply stores are also good sources of sands. Most commercial sand is derived from a granitic source, so it should be light in color, and contain a lot of quartz and feldspar crystals. Most commercial granitic sand is also usually well sorted (this way no "dirt" sized particles are present).

2. Have the students compare their sands with the other students' sands and with the sand in the lab and in the Sand Kit. Have them predict the Mother Rock(s) for their samples. Remember that the ability to determine the origin or Mother Rock from which the sand comes from is a much more sophisticated and helpful process than knowing or being told the actual Mother Rock.

3. The worksheet can help you show your students how the particles from erosion in a river form different layers. Heavy and large particles that are moved by a river to an ocean or lake, drop out first to the bottom. The smaller the particle the longer it takes to settle out of the water. Sedimentary rocks form when particles (broken down rocks) are “cemented” together by natural cements. In this diagram we want the student to point out where gravel, sand, silt, and clay will settle out. Gravel settles nearest to shore and the largest particles, sand is larger than silt, and is deposited next, and silt is larger than clay. Clay is deposited the furthest out.

4. Ask students to predict where you would find siltstone, claystone, sandstone and conglomerated. Siltstone would form when the silt sized particles are cemented, claystone when the clay sized particles are cemented, and sandstone when sand sized particles are cemented. Conglomerate is cemented together gravel and any other larger or smaller sized particles.

The Sedimentary Rock Classification Chart can help you compare clastic and chemically derived sedimentary rocks.

SEDIMENTARY ROCK CLASSIFICATION CHART

CLASTIC SEDIMENTARY ROCKS

TEXTURE		ROCK NAME	MINERAL COMPOSITION	ROCK NAME IF IT INCLUDES FOSSILS
finer than sand < 1/16 mm	*SMOOTH*	MUDSTONE	Clay	DIATOMITE (diatoms) RADIOLARITE (radiolarians) FOSSILEROUS MUDSTONE or SILTSTONE
	GRITTY	SILTSTONE		
sand size (1/16 to 2 mm)		SANDSTONE	quartz (quartz sandstone)	FOSSILEROUS SANDSTONE
			rock fragments, feldspar, quartz, mica (greywacke)	
			quartz, feldspar (arkose)	
coarser than sand >2mm	*rounded grains*	CONGLOMERATE	quarts, feldspar, rock fragments	FOSSILEROUS CONGLOMERATE
	angular grains	BRECCIA		FOSSILEROUS BRECCIA

CHEMICAL (precipitated) SEDIMENTARY ROCKS

TEXTURE	ROCK NAME	MINERAL COMPOSITION	WITH FOSSILS
microcrystalline	CHERT	quartz	RADIOLARIAN CHERT
crystalline	GYPSUM	gypsum	
crystalline	ROCK SALT	halite	
crystalline	DOLOMITE	dolomite	
crystalline	LITHOGRAPHIC LIMESTONE	calcite	FOSSILIFEROUS LIMESTONE
spongy, crumbly	COAL	no true minerals, various stages of altered plant remains	PEAT
spongy brown			LIGNITE
hard, black to brown			BITUMINOUS
hard, shiny dark			ANTHRACITE

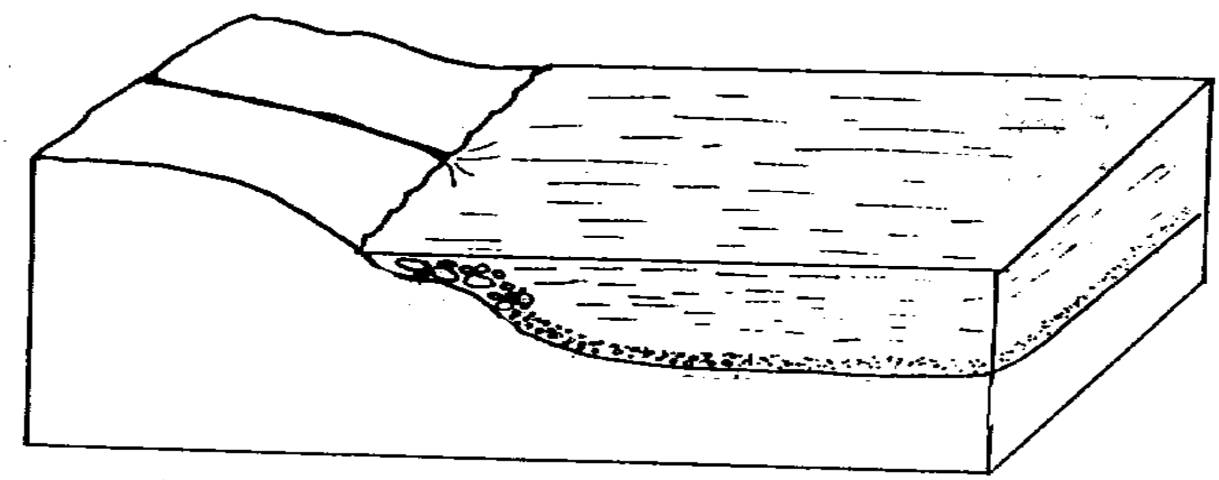
ROCK CYCLE - ROCKS (5A)

POST LAB

WHERE ARE SEDIMENTARY ROCKS FORMED?

This figure shows that heavy and/or large particles, moved by a river to the ocean, drop out first to the ocean bottom. The smaller the particles the longer it takes to settle out of the water. Sedimentary rocks form when particles (broken down rocks) are cemented together by minerals like calcite or quartz. Place a number on the diagram where you would find these sedimentary rocks:

1. SILTSTONE
2. CLAYSTONE
3. SANDSTONE
4. CONGLOMERATE (hint: cemented together gravel)



ROCK CYCLE - ROCKS (5B)

PRE LAB

Students make a stalactite and stalagmite.

OBJECTIVES:

1. Exploring the creation of caves.
2. Comparing stalactites and stalagmites.

VOCABULARY:

calcite
dissolve
stalactite
stalagmite

MATERIALS:

two glass jars
warm water
baking soda
wool thread or mop tread

Ohio Caverns

BACKGROUND:

Many areas of the Earth's surface were once under the oceans. Large coral reefs covered many of these areas. For example, Texas and New Mexico were living coral reefs at one time, larger than the present Great Barrier Reefs in Australia. These great reefs became rock as the sea retreated from the land. This rock consists of the remains of shelled animals, which are composed mainly of calcium carbonate (calcite). This type of calcium carbonate rock is called limestone. Limestone will dissolve if acid is put on it. Geologists usually use a 10% HCl solution for this "fizz" test.

Groundwater percolates through soil and rock within the earth. Groundwater is naturally acidic. When groundwater percolates through limestone, it dissolves it. This is how caves form.

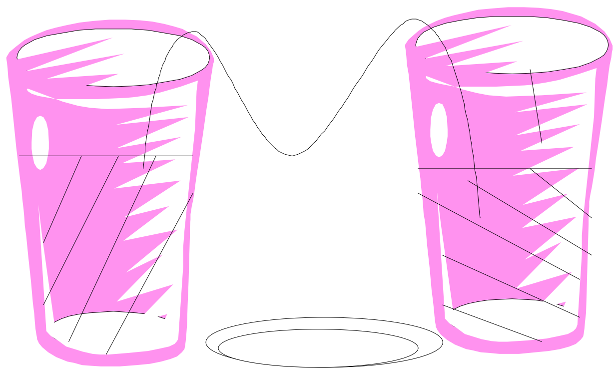
The dissolved limestone is transported in solution by groundwater. Stalactites and stalagmites form as groundwater drips from the ceiling of a cave. Some of the water evaporates, and new limestone precipitates from the remaining saturated solution. This builds hanging pillars of limestone called stalactites, and stalagmites, limestone pillars that rise from the floor of the cave. You can remember that stalactites hang from the top, by remembering the "t" in "tite," stands for the "t" in "top." Limestone formed by this type of inorganic precipitation is called travertine.

PROCEDURE:

1. Before lab, gather the materials needed for each student group. You may wish to run the experiment once before class to get a feel for how quickly the "stalactites" form.

2. Illustrate how stalactites form with the following experiment. Make a solution of warm to hot water and dissolve baking soda in it until it forms a saturated solution. It is easier to boil water and stir in as much baking soda as will dissolve.

3. Fill two small containers half full with the baking soda solution. Place the containers about 20 cm apart, and put a small saucer or lid between them. Saturate the mop thread with the solution. Put an end of the mop thread into each container. Suspend the thread between the two containers. Crystals of baking soda (or tiny stalactites) will slowly form in the saddle area of the thread. Use the picture below as a guide.



ROCK CYCLE - ROCKS (5B)

LAB

Students examine sedimentary rocks.

OBJECTIVES:

1. Examining different sedimentary rocks.
2. Discussing environments of sedimentary deposition.

VOCABULARY:

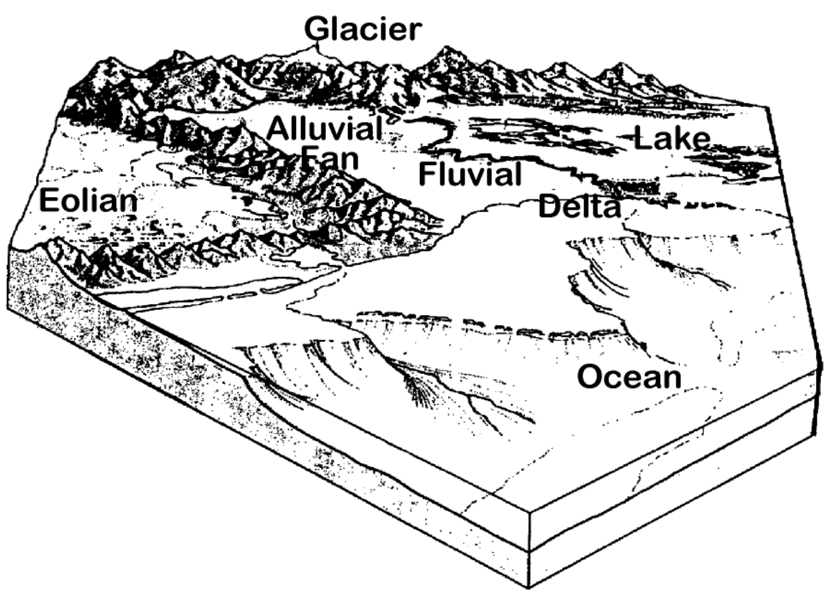
chert
conglomerate
diatomite
limestone
mudstone
sand
sandstone

Russian River in Northern California brings sediment to the coast.

MATERIALS:

Rock Cycle - Rocks (5B)
hand lens or
Swift-GH microscope

BACKGROUND:



Sedimentary rocks form at the Earth's surface from clastic material (pieces of other rocks or fragments of skeletons) which have become cemented together, and by chemical mechanisms including precipitation and evaporation.

There are many environments associated with sedimentary rock formation, including oceans, lakes, deserts, rivers, beaches, and glaciers. The diagram shows several important sedimentary rock forming environments:

EOLIAN - Eolian refers sediment erosion, transportation, and deposition by wind. Eolian environments are particularly common in deserts. Sand dunes are an excellent example of an eolian feature.

ALLUVIAL FAN - Alluvium is the cover of soil, sand, and fine grained rocks on the Earth's surface. An alluvial fan is a large fan-shaped pile of alluvium, deposited by a combination of stream and landslide processes.

GLACIER - As they flow downhill, glaciers carry lots of loose rock and debris. This material acts like sandpaper, and cuts away at the underlying rock. Glacial sediment is deposited as the ice melts. Students may not realize the power of glaciers.

FLUVIAL - Fluvial refers river environments. Water is very efficient at eroding and transporting sediment. You may want to show students pictures of different types of rivers.

DELTA - A delta is the sediment deposit that forms at the mouth or a river, where it enters a lake or the ocean. Sediment is deposited as the water slows down, producing an underwater fan shaped deposit.

PROCEDURE:

1. Point out different sedimentary rock forming environments to the students. Emphasize there are many environments in which sedimentary rocks are formed, and that is why sedimentary rocks are very common on the surface of the Earth.

2. Go over the rock specimens before the students examine them. This will help guide each student's observational skills on the key characteristics of each rock. Encourage them to use a hand lens or microscope. In your review, point out the following:

CLASTIC SEDIMENTARY ROCKS - In general, produced from broken particles that have been cemented together.

SAND: particles are separate, no cement

SANDSTONE: sand size particles that are cemented together; individual grains are visible.

DIATOMITE: very small particles that are cemented together. These are diatoms (one celled marine plant) and radiolarians (marine protozoans). They are visible only with special microscope slides.

CONGLOMERATE: larger particles (pebble- or gravel- sized) that are cemented together, coarse grained

MUDSTONE: very small particles cemented together, with no biological ingredients, fine grained

CHEMICALLY DERIVED - Composed of precipitated minerals, which grew out of water.

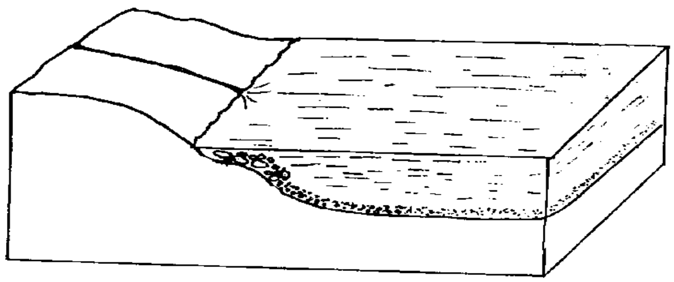
CHERT: red, hard, very fine-grained, cannot see any particles.

LIMESTONE: fizzes with dilute HCl, hard, generally cannot see particles, although composed of fossils

3. Have the students look at the rocks above. The students should notice that the chemically produced rocks do not resemble the other sedimentary rocks. Conclude with the students that sedimentary rocks are sometimes easy to interpret, sometimes not!

ROCK CYCLE - ROCKS (5B) LAB

PROBLEM: Where are sedimentary rocks found?
PREDICTION:____
PROCEDURE: Examine each of the sedimentary rock samples. On the chart below, describe each sample, and record where you think it formed on the picture below.



	DESCRIPTION	WHERE FORMED
sand		
sandstone		
diatomite		
mudstone		
conglomerate		

Chert and limestone are also sedimentary rocks. How do they differ from the samples above?

	DESCRIPTION	HOW IT DIFFERS
chert		
limestone		

CONCLUSION: Describe the environments in which sedimentary rocks are found.

____

____

ROCK CYCLE - ROCKS (5B)

POST LAB

Students review the different type of rocks and where they are formed.

OBJECTIVES:

1. Comparing the different types of rocks.
2. Exploring the difficulties in identifying rocks.

VOCABULARY:

igneous
metamorphic
sedimentary

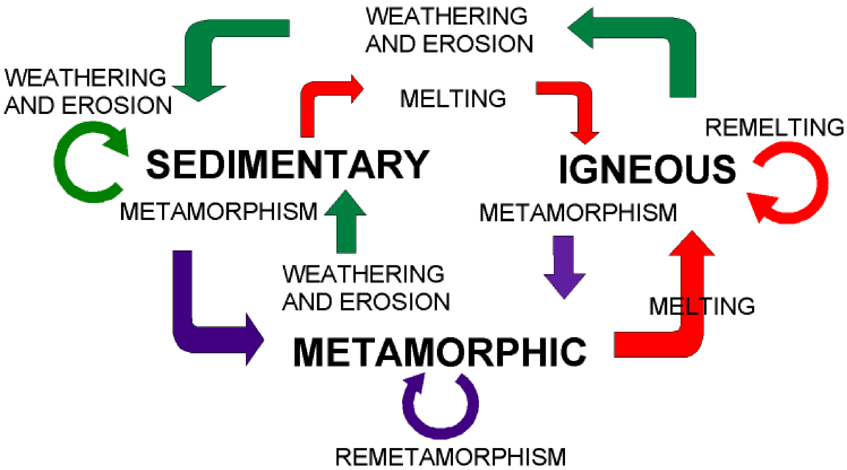
MATERIALS:

Mineral and Rock Display Kit
worksheet

BACKGROUND:

The students have learned the origin of sedimentary, igneous, and metamorphic rocks. However, this does not guarantee that students can pick up any rock and name it. Rock identification is difficult; it is important to impress upon students that they are just beginning to learn the process.

If you understand how the Rock Cycle works you can picture how the rocks are formed. Once children get the "picture in their head," then the names of the rocks will convey a more complete picture of how it was formed and why it has that name.

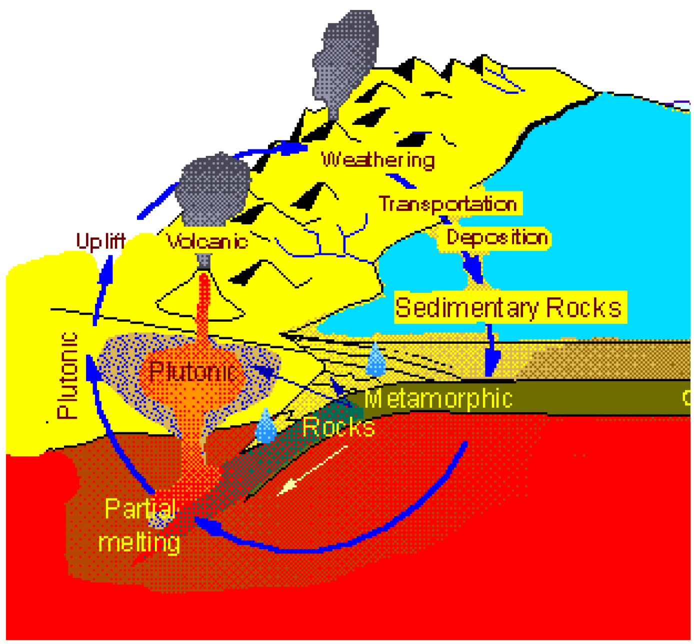


PROCEDURE:

1. Use the Display Kit to review the origins and compositions of minerals and rocks. The students will find some of the specimens easy to recognize, but others will be more difficult. Compare the Rock Cycle to where these rocks can be found.

2. The more you review the specimens, the more the students will become familiar with them. The information sheet on the specimens included in the Mineral and Rock Kit will help guide in-class descriptions of each specimen. For each rock, emphasize whether it is igneous, sedimentary, or metamorphic in origin.

3. Use the worksheet to emphasize the movement of rocks within the Rock Cycle. The answers are below.



ROCK CYCLE - ROCKS (5B) POST LAB

Create your own Rock Cycle. Use the following words in your "cycle." Weathering, Transportation, Deposition, Partial Melting, Uplift. Make sure you label areas where Sedimentary, Igneous (Plutonic and Volcanic), and Metamorphic Rocks are being produced.