SIXTH GRADE
6 lessons

6

HELPING HANDS SCIENCE

Joint project
Fremont Unified School District
and Math Science Nucleus

Comments or correction please contact
msn@msnucleus.org

These are suggestions on how to use the materials with your students. The materials are set up so you can easily put out the materials. Make sure the students do not destroy materials. Many times the material can stay in the bag and a hand lens can be used for observation. Please put materials back the way you found them so all children at your school can enjoy them.

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Curriculum customized for FUSD by MSN

HELPING HANDS SCIENCE (FUSD) - SIXTH GRADE

Chapter	***Lab description and/or box label***	***Materials***	***Storybooks (on http://msnucleus.org)***
1.Introduction to Earth Science	6.1 Rock Cycle - Rocks 6B	3 sets of limestone, conglomerate, sandstone, marble, schist, gneiss, pumice, granite, obsidian, basalt	
2. Weathering Soil			
3. Erosion and Deposition	6.2 Water Cycle - Water 6	4 sets of Sands from Half Moon Bay, Montara, Del Mar, Long Beach, Ocean Beach, Santa Cruz, Ventura	
4. Plate Tectonics			
5. Earthquakes	6.3 Hayward Fault Topographic and geologic maps	Rock samples, topographic map	*Three Earthquake Dolls (storybook)* Earthquake(General) slideshow
6. Volcanoes	6.4 California Volcanoes – comparing rocks	Volcanic rocks from California (5 sets of basalt(Gilroy),basalt (Buttes), pumice, scoria, obsidian, andesite porphyry	*Leaving the Fiery Slops of Mt. Etna* (storybook) Volcanoes (slideshow)
7. Atmosphere			
8. Weather			
9. Climate and Climate Change			
10. Ecosystems	6.5 Soil - comparing soil characteristics	4sets of soil from Bryon, Hayward, Menlo Park, San Jose, Fremont, Berkeley, San Mateo, Half Moon Bay	
11. Living Resources	6.6 Coal – comparing types of coal formation	5 sets of Bituminous, Anthracite, lignite, charcoal briquette, charcoal, graphite	
12. Energy and Material Resources			*Nu, You and Water*

ROCK CYCLE – ROCKS (6A)

6.1

OBJECTIVES:

Exploring the complexity of the Rock Cycle.
Distinguishing where different rock types are located within the Rock Cycle.

VOCABULARY:

erosion
melt
pressure

MATERIALS:

Rock Cycle - Rocks (6A)
Hand lens

SLIDESHOW: Rock Cycle
STORYBOOK: Ricky the Rapping Rock

BACKGROUND:

In many books, the **Rock Cycle** is oversimplified. Statements like "igneous rocks can become sedimentary and metamorphic;" " sedimentary rocks can become igneous and metamorphic;" or "metamorphic can become sedimentary and igneous" are common.

The Rock cycle is much more complicated. This is illustrated on the Rock Cycle diagram. The large counterclockwise arrows show the general trend of the Rock Cycle. First, igneous rock forms from magma. This rock is then **uplifted**, **weathered**, and **eroded** on the Earth's surface, forming sedimentary rock. The sedimentary rock is eventually buried within the crust of the Earth, where pressure and temperature finally change it into metamorphic rock. Eventually, some metamorphic rock may melt, beginning the cycle again.

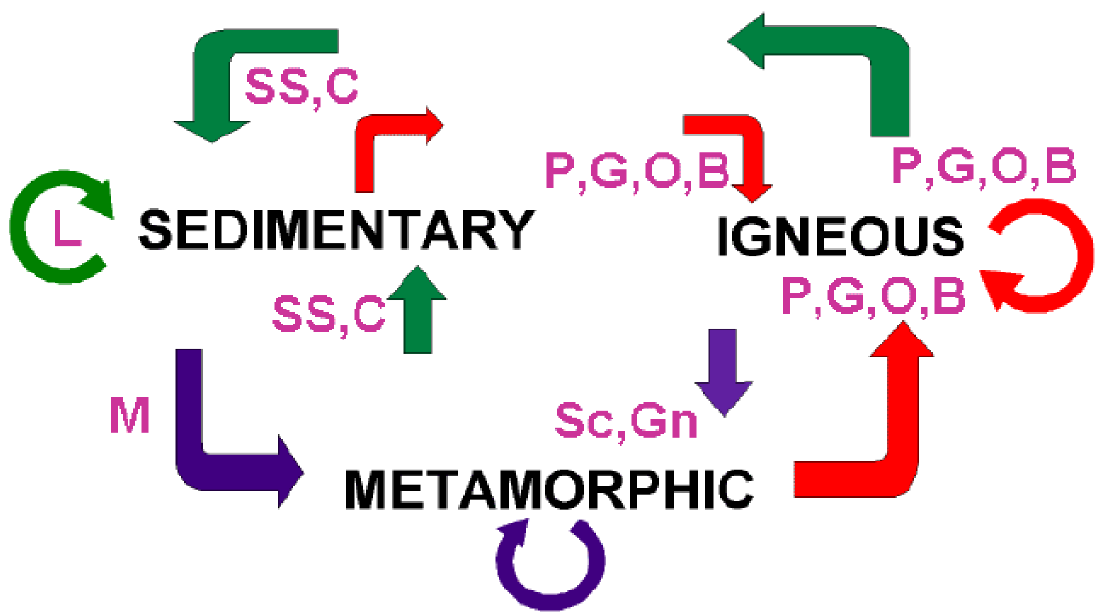
However, the smaller arrow indicate other paths of **rock formation**. Essentially, any rock type can be melted, weathered, or metamorphosed to make any other rock type. Moreover, a rock can be remade into the same type of rock, i.e., a metamorphic rock can be remetamorphosed. Rock formation is dynamic and very complicated.

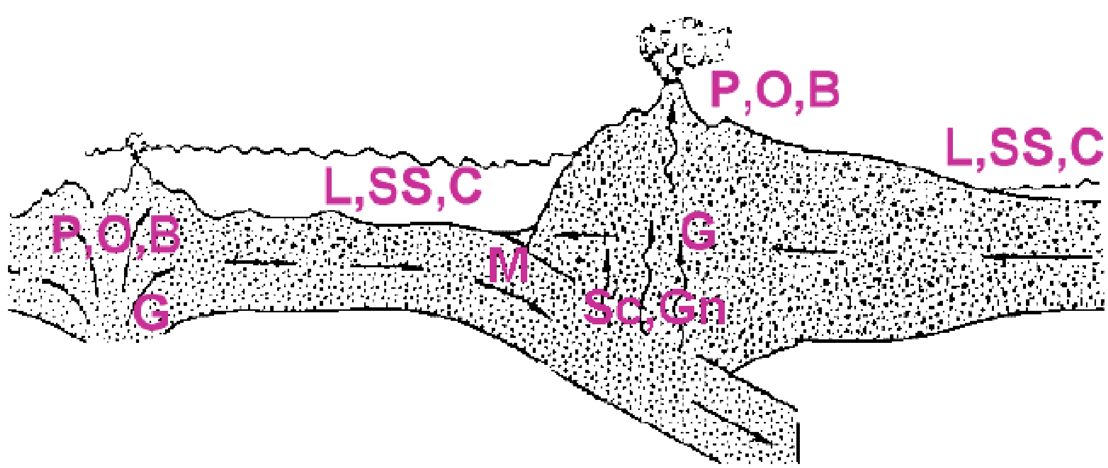
The Rock Cycle is tightly interwoven with the Plate Tectonic Cycle, in that most rocks form at plate boundaries. In general, igneous rocks and metamorphic rocks form most abundantly at divergent and convergent plate boundaries. Sedimentary rocks can form anywhere on the Earth's surface, but the thickest accumulations are associated with convergent plate boundaries, where volcanoes and mountain ranges form. Sedimentary rocks also cover most of the ocean floor.

PROCEDURE:

1. Go over the Rock Cycle diagram on the student's worksheet. Fill in the processes like "melt," "erosion," or any other word from the Rock Cycle diagram.

2. Set up examination specimens of each of the rocks listed below. Write the list of rock types and symbols (below) on the board. Explain the origin and environment of formation of each rock. Be sure to tell the students that these are just some of the places where these rock types can form. Tell the students to locate where each type of rock would form on the plate tectonic diagram. The rock cycle and plate tectonic diagrams below show the answers. There may be multiple answers for each rock type.





limestone (L) = sedimentary rock; fine grained, calcium carbonate, formed mainly in oceans, usually with organisms that make shells; fizzes in HCl (releases carbon dioxide)
conglomerate (C) = sedimentary rock; course grained, formed in rivers
sandstone (SS) = sedimentary rock; medium grained, formed in oceans, lakes, rivers
marble (M) = metamorphic rock; from limestone, formed under increased pressure and temperature
schist (Sc) = metamorphic rock; shiny surface, temperature and pressure; usually formed from basalt and other fine grained volcanic rocks
gneiss (Gn) = metamorphic rock; banded, pressure and temperature; usually formed from granite or other course grained plutonic rocks
pumice (P) = igneous rock; light in weight, volcanic eruption with high percentage of gas; volcanic
granite (G) = igneous rock; large minerals; formed in magma chamber (plutonic rocks)
obsidian (O) = igneous rock; cooled quickly from lava; volcanic rocks
basalt (B) = igneous rock; small, dark colored minerals, volcanic rocks

3. You may want students to write a description of each rock on their worksheet. Use a hand lens to look at the size of the crystals. Students may also want to draw a picture of the enlarged rock.

4. Review the answers with the whole class. Emphasize that the diagram the students have completed shows just some of the possible range of rock-forming environments.

5. For more information on rocks you may want to read the "Secondary" units on the individual rocks.

NAME:

PROBLEM: How are rocks formed on the crust of the Earth?

PREDICTION:

PROCEDURE: The rock cycle describes the processes by which rocks become other types of rocks by melting. erosion, and changes in temperature, and pressure in or on the Earth. Look at the rocks at the different stations around the room. Describe them on another sheet of paper. Try to place the rocks in the correct positions in the two diagrams below: the rock cycle and the plate tectonic cycle. Use the symbols for each rock type on each diagram.

Rocks on display: pumice **(P)**, sandstone **(SS)**, conglomerate **(C)**, granite **(G)**, marble **(M),** limestone **(L)**, obsidian **(O)**, basalt **(B)**, gneiss **(GN)**, schist **(SC)**

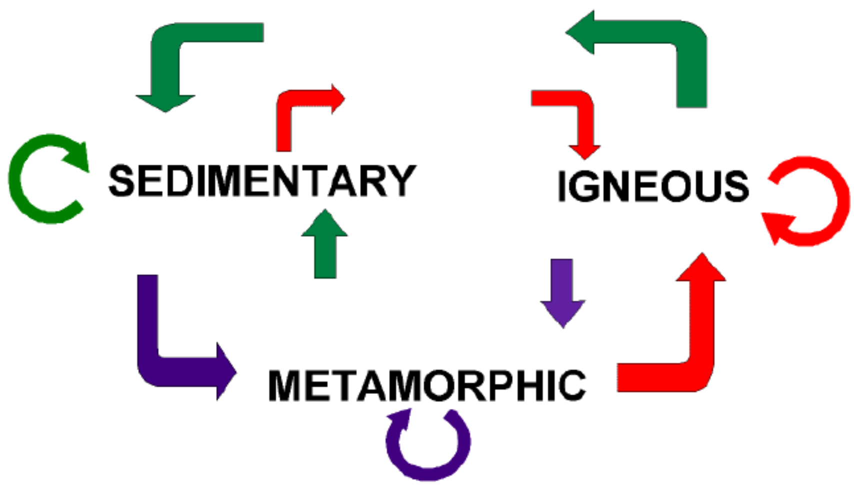
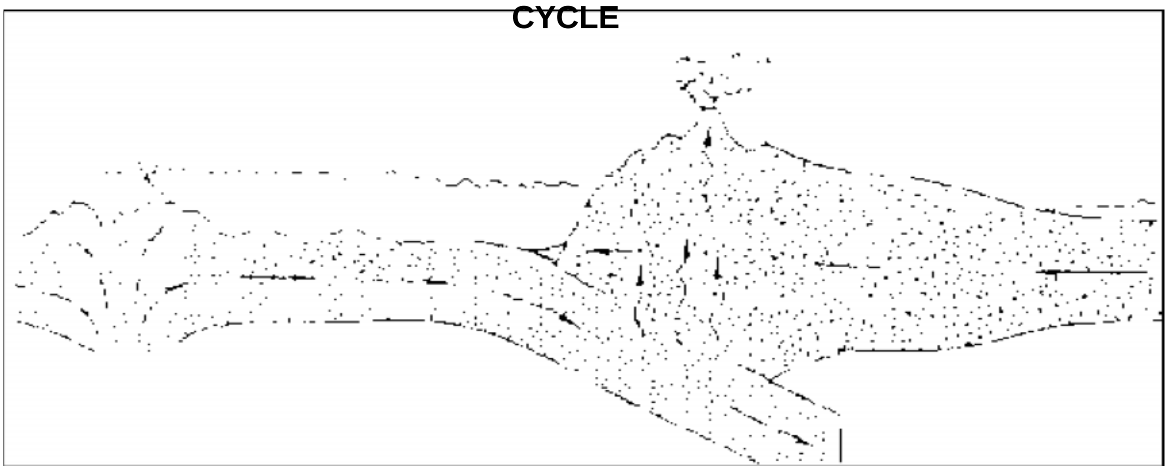


PLATE TECTONIC CYCLE



CONCLUSION: How are the plate tectonic and rock cycles related?

WATER CYCLE – WATER(6)

6.2

OBJECTIVES:

Exploring ground water.
Experimenting with porosity and permeability.

VOCABULARY:

groundwater
permeability
porosity
water movement

MATERIALS:

Water Cycle – Water (6)
Sand chart
Hand lens or microscope (reflecting)

STORYBOOKS: including Drippy the Hippy, Giving Water a Second Chance, or Dr. Drippy.

SLIDESHOWS: Water

BACKGROUND:

Ground water is water stored under the surface of the Earth. Convey to the students that ground water sometimes takes hundreds of years to accumulate. A good example of this occurs in the Sahara Desert in Africa, where ground water has accumulated for thousands of years and is still being used for drinking and irrigation. Ground water is stored in the ground below us, where different types of rocks can act as reservoirs. Sand or sandstone is the best material for a reservoir and forms extensive aquifers underground, but not all sands are created equal, as students will find out in lab.

Filtering water through different **porous** substances cleans water naturally in the ground. Substances like charcoal and diatomite (white powder that people put in pools), help to filter small particles that may be suspended in water.

The ground on which we live, is made up of many layers of different types of rocks. Water can move into the tiny pores within the rocks or soil. As they move, the different rocks can trap the particles in the pores. Some rocks have more pores than other rocks and can act as a reservoir of water or an **aquifer**. Some municipal water supplies depend on ground water for a source of drinking water. Filtering techniques are used in municipal water supplies. Water from a reservoir is cleaned through a combination of filtering and chemical processes.

This lab focuses on students looking at sands so they can observe first hand that sands, which is a product of erosion can be classified.

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:

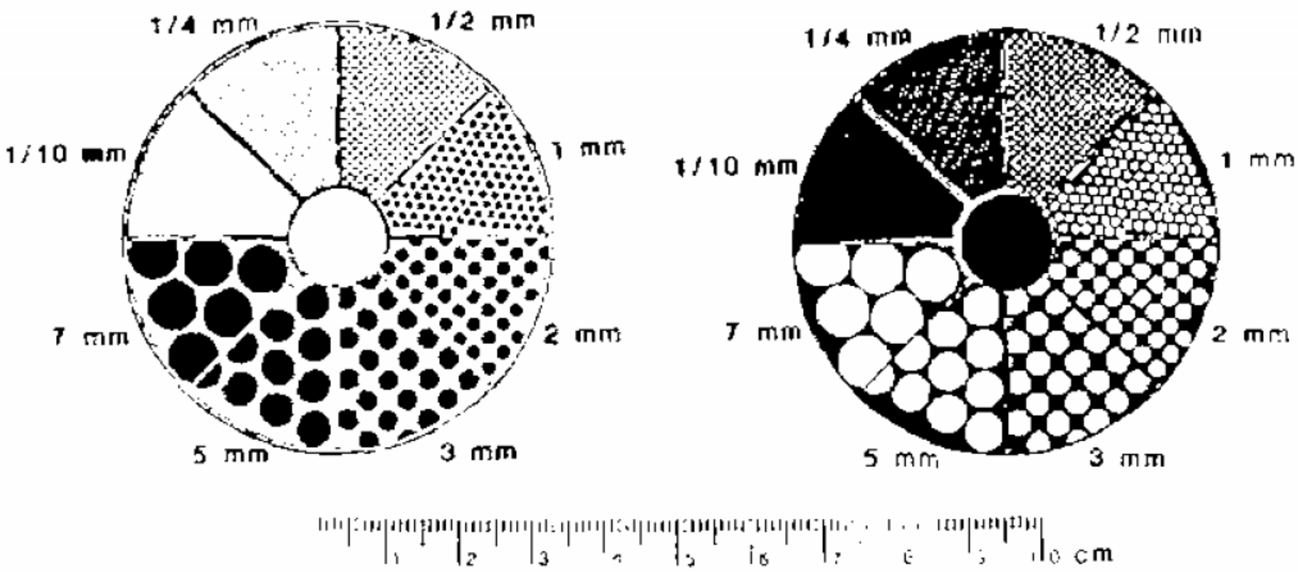
1. At the beginning of this lab, review the main components of the water cycle. This lab shows students how ground water moves through rocks that have a high porosity. There are several storybooks you can use including Drippy the Hippy, Giving Water a Second Chance, or Dr. Drippy.

2. Students will discover that large grains allow water to move freely and also have large pore spaces (can hold more water). You may want to use the diagram on the right to help you illustrate this principle. Have the students measure and compare their results in order to draw conclusions. **Sand size** and **sorting** of the sand particles do have a lot to do with how water moves. You may want to introduce the term **Porosity** (meaning the pore space available for liquid) and **Permeability** (how freely the liquid moves through the sand). In the diagram to the right, you can notice that water can only flow through open space. The best aquifers have large porosities and permeability. In poorly sorted sands, there is usually more pore space available.

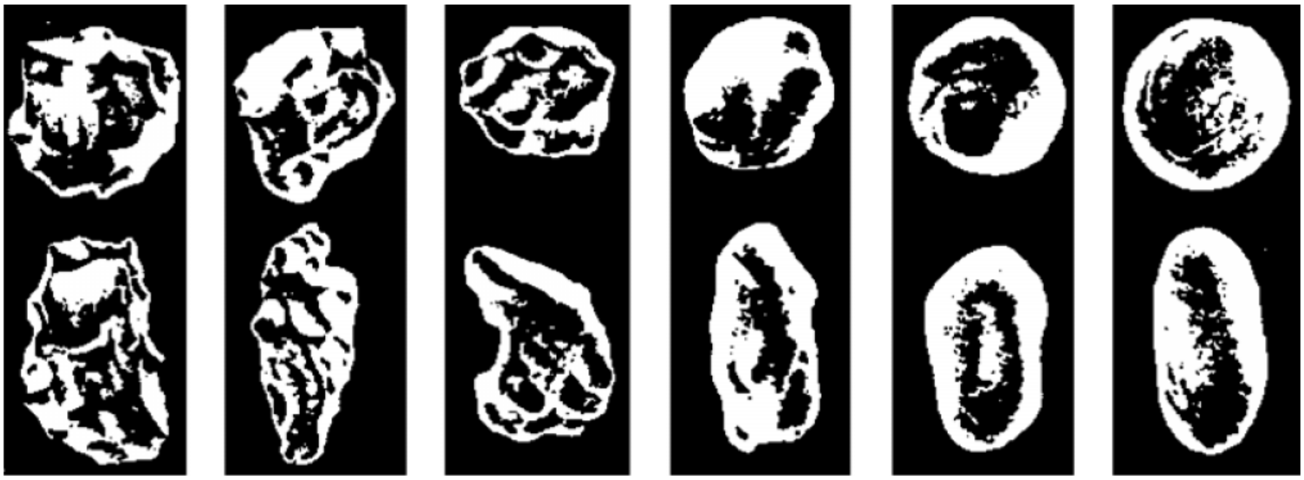
This is just an introduction to these concepts. If the sand grains are large it tends to have more porosity and permeability. The smaller the grains of sand the less pore space allowed for the movement of water. The small amount of sand used in this experiment may cause differences in results. The objective is just to recognize water movement.

1. Students should 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.

HALF MOON BAY, California - 0.1 - .25 mm; very well sorted, subangular to subrounded. Contains quartz, feldspar, mica and minor magnetite. The cliffs along Half Moon Bay reveals the Mother Rock for this sand. The cliffs releases millions of sand grains to re-enter the rock cycle.

MONTARA BEACH, California - 0.1 - 7mm; very poorly sorted; subrounded. Contains quartz, feldspar, and small pieces of granite with mica and hornblende. This sand is eroded directly from granitic rock very close to the beach. This is near the famous "Devils Slide" area, where very badly weathered granite has created very spectacular cliffs.

DEL MAR, San Diego County, California - .25-.5mm, well sorted; subangular - subrounded. Contains quartz, feldspar, mica, and a dark mineral which is probably some type of amphibole (hornblende). This sand is eroded from local sandstones that are near the beach area.

LONG BEACH, Los Angeles County, California - .25 - 3mm; poorly sorted; subangular. Contains mica, quartz, feldspar, magnetite and shell fragments. The Mother Rock for the sands in this area are sandstones that were originally derived from granite. Offshore from these beaches are basins that are slowly filling up due to the introduction of sands from the continental area.

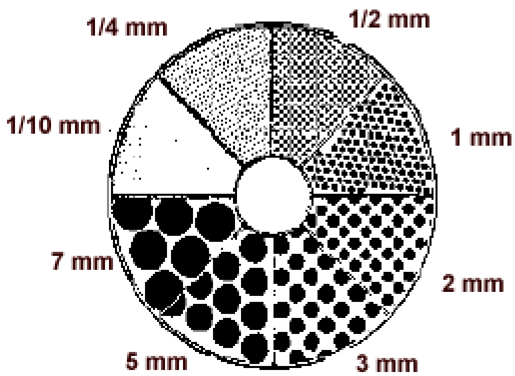
OCEAN BEACH, San Francisco, California -0.1 -0.5mm; well sorted; subangular to subrounded and crystals. Contains quartz, mica, feldspar and magnetite (magnetic) Derived from sandstones exposed along cliffs south of Ocean Beach.

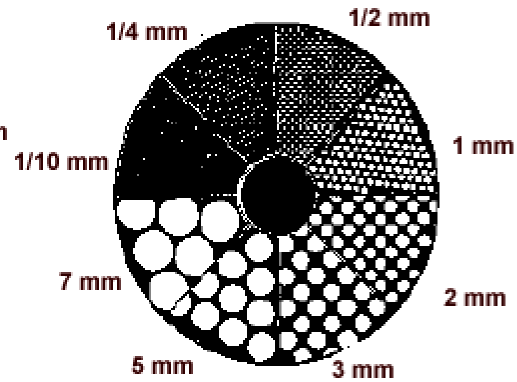
SANTA CRUZ, California - 0.1 -.25mm; well sorted; angular -rounded. Contains quartz, feldspar and magnetite. Eroded from the sandstones that make up some of the cliffs in that area.

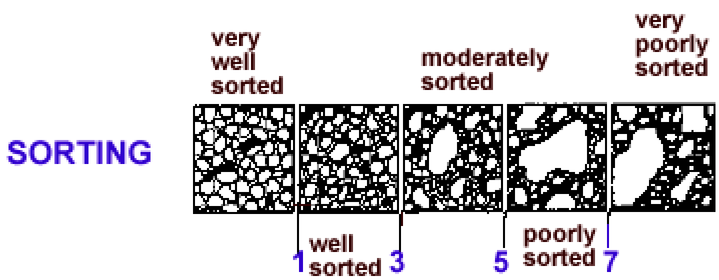
VENTURA, California - .25 -.5mm; well sorted; subrounded. Contains quartz, feldspar, mica, some dark minerals, magnetite. Eroding from nearby sandstones.

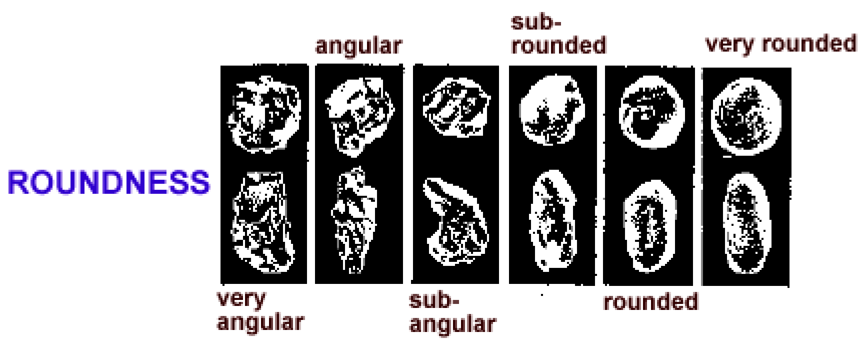
SAND CHART

Sorting refers to particles that are the same size (well sorted) or many different sizes (poorly sorted.) Roundness refers to whether the particle is angular or rounded. Both sorting and roundness provide information on the duration of the particle in the erosional cycle.









WATER CYCLE – WATER (6)

PROBLEM: Are sands different?

PREDICTION:

PROCEDURE: Look at the different sands and try and determine the size, roundness, and whether they are well sorted or poorly sorted. Use the sand chart to help you determine the answers.

sand	location	size	sorting	roundness	characteristics

CONCLUSION:

HAYWARD FAULT- SIXTH GRADE

6.3

OBJECTIVES:

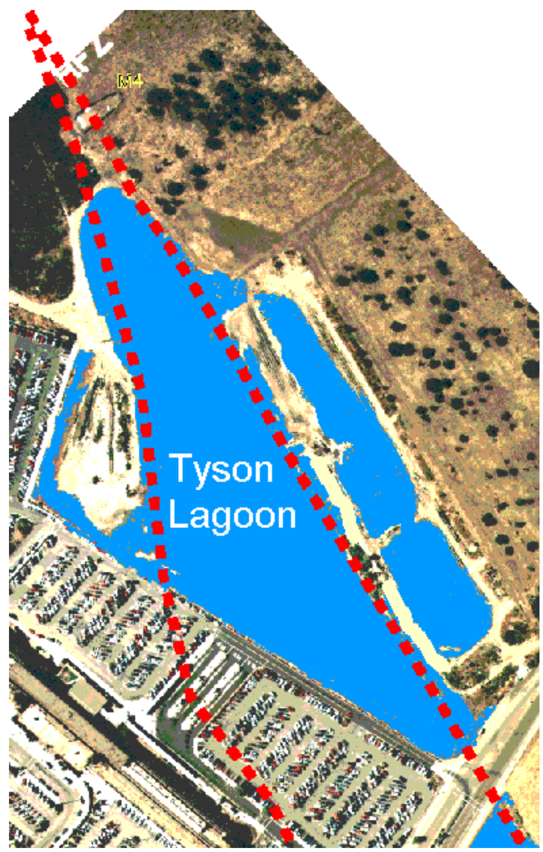
Comparing a local topographic and geologic map of the area.
Outlining the Hayward Fault in Fremont.

VOCABULARY:

contour lines - equal lines of elevation
ecosystem - biological community together with its environment, functioning as a unit
faults – fracture that can be traced by topographic and geological features, a break
formation – rocks that have been deposited in a similar environment about the same time
geologic map – map that shows where different types of rocks are located
sediments – small particles of rocks
topographic map - a map that shows relief on land

BACKGROUND:

Topographic maps show a 3 dimensional world in 2 dimensions by using **contour lines**. Many people have trouble reading these maps, because they have mountains and valleys are represented with **concentric** circles and lines. Many hikers use topographic maps, especially in areas where there are no roads with signs. Geologists depend on topographic maps to record the types of rocks. Engineers use topographic maps when they are planning roads, buildings, or other human–made structures. Imagine designing a city without considering where hills and valleys are located!



A geologic map is a map of the different types of rocks that are on the surface of the Earth. By mapping different rock types, geologists can determine the relationships between different rock formations which can then be used to find mineral resources, oil, and gravel deposits.

Earthquakes are caused by the sudden movement and fracturing of rock masses along pre-existing faults. A fault is a broken surface within the Earth's crust.

Tyson Lagoon has been a site of fresh water for at least the last 3700 years. This sag pond outlines the trace of the Hayward fault zone in this area. Looking at brittle deformation and liquefaction features in trenches just north of this area, Williams (1993) concluded there may have been 6-8 large earthquakes during the last 2000 years.

Lienkaemper, et al, with new data concluded that since late 1300's there were probably 4 large earthquakes (of magnitude 6.8-7.0) In trenches in the South Pond they found evidence of the 1868 earthquake. The earthquake destroyed most of the Mission Adobe structure and devastated the homes of many of the residents. Using detailed Stratigraphy and carbon dating they arrived at dates of 1730, 1630, and 1470 (±90 years) for the other earthquake occurrences.

Detailed trenching in the south pond of Tyson Lagoon by the U.S. Geological Survey has identified other earthquakes that occurred in the past. They use data derived from trench logs, radiocarbon, pollen, and detailed sedimentolgical data. The trenching has exposed typical pond sediments, including well-bedded deposits of silty clay, interbedded with organic layers including shell hashes, and slightly coarser, less organic silts to sandy silts. The composition and structure of the deposits indicate a rapidly subsiding, shallow aquatic environment that was subject to seasonal drying. Evidence of creeping along the fault has been calculated with an average slip rate of 9± 2mm/yr .

PROCEDURE:

1. Explain what a topographic map is, including contour lines. Locate region on the topographic map of the region. Instruct students to locate Tule Ponds at Tyson Lagoon, Lake Elizabeth, the railroad, Vallejo Mill School, Morrison Canyon, Shinn House, Alameda Creek, Hetch Hetchy Aqueduct, Benchmark 60, Mowry Well

2. Explain what a geologic map is. Show them the rocks that come from the different units.

EARTHQUAKES – SIXTH

PROBLEM: How can we define earthquake faults by using topographic and geologic maps?

PREDICTION:

Look at the topographic and geologic maps and answer the following questions:

1. Tyson Lagoon is a sag pond created by movement along the Hayward Fault. Find Tyson Lagoon and move your finger toward Lake Elizabeth. You have just traced a segment of the Hayward Fault. In Fremont you can see many sag ponds (naturally occurring wetland areas). They are a clue that there may be a fault.

2. Look at the Geologic Map, and notice that the Hayward Fault has 2 traces at Tyson Lagoon. The one on the east is the inactive trace and the one on the west is the active trace. Inactive means it is not moving; active is a segment that is creeping at about 5 mm per year.

3. Looking at both maps, where can you see the rocks on the surface? (Describe the area, hint: contours)

4. Where do you think you would be able to see rocks exposed? (Hint: What is a canyon?)

5. What is the symbol for railroad tracks? (Hint: look at Topographic map)

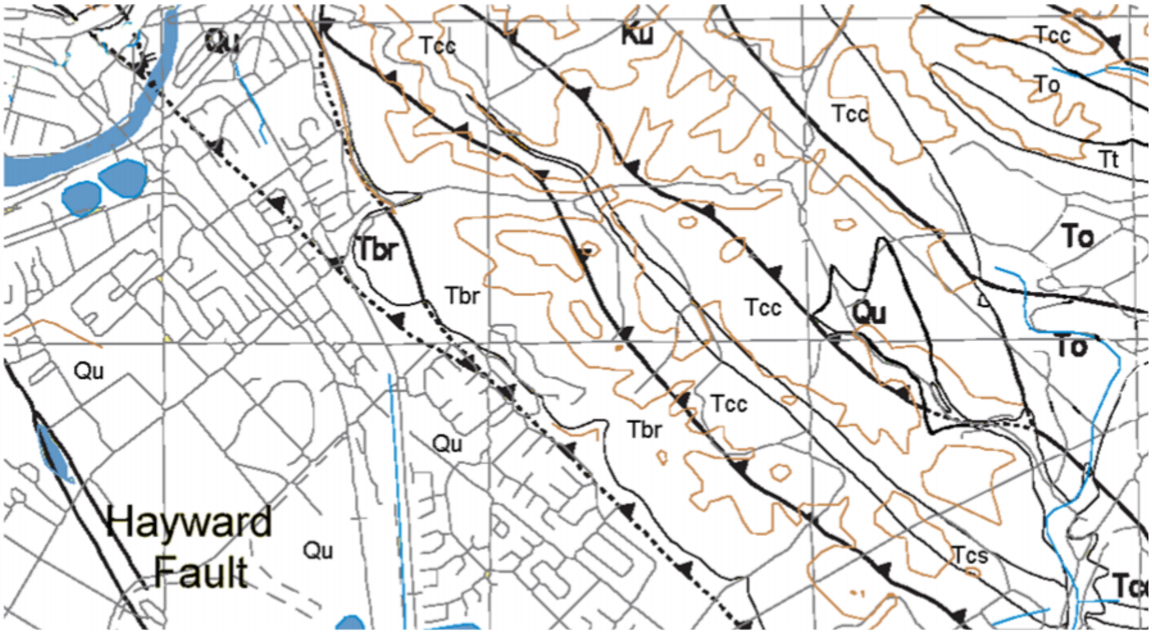
6. What school can be seen on the topographic map?

7. How many benchmarks (BM) can you locate? A benchmark is a measured area.

8. Which map is more detailed?

9. Look at the following rocks and describe them. Locate them on the map?

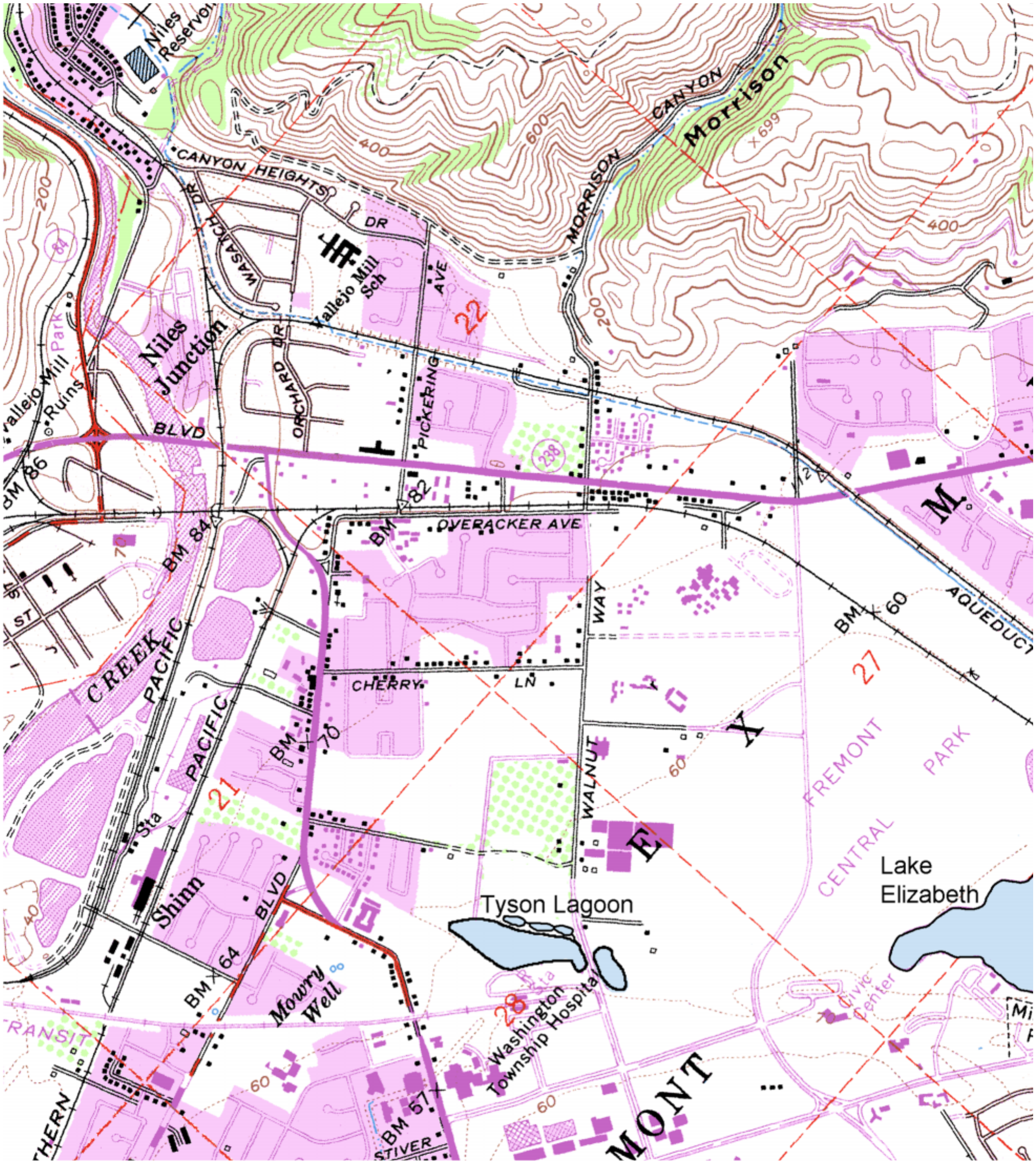
Rock symbol		



GEOLOGIC MAP

Age	Name and Description of Rock Formation in Fremont Area
(Holocene-Pleistocene)	**UNNAMED** (Qu) Clays to silt.(on Graymer) Qhaf – Alluvial fan deposit and Qhb – floodplain deposits (Holocene) Qpaf - older alluvial fan deposits and Qtig – Irvington Gravel (Pleistocene)
Pliocene	**ORINDA FORMATION** (Tor) sandstone-conglomerate
(late Miocene)	**BRIONES FORMATION** (Tbr) Sandstone to conglomerate with shells
(middle Miocene ?)	**TICE SHALE** (Tt) Distinctly bedded, dark brown, gray and tan, siltstone, mudstone and siliceous shale.
middle to late Miocene	**OURSAN SANDSTONE** (To) mudstone-sandstone
middle to late Miocene	**CLAREMONT FORMATION** (Tcc, Tcs) Chert and siliceous shale
(middle Miocene)	**SOBRANTE FORMATION** (Ts) White, fine to medium grained quartz sandstone.
Paleocene	**Unamed** Tps - siltone and sandstone
(Paleocene to Cretaceous	**UNNAMED** (Ku) Distinctly bedded gray to white, well lithified, massive to cross bedded, micaceous, coarse to fine grained sandstone, siltstone and shale (on Graymer) Ks – sandstone, shale; Kc - conglomerate
Jurassic/Early Cretaceous	**Knoxville Formation** Jkk – sandstone, mudstone, shale

Topographic Map of Tyson Lagoon area



6.4

VOLCANOES - SIXTH GRADE

OBJECTIVES:

Comparing igneous rocks.
Describing characteristics of igneous rocks.

VOCABULARY:

andesite
basalt
obsidian
pumice
scoria
vesicular

MATERIALS:

Volcanoes – Sixth

BACKGROUND:

There are many different types of igneous rocks. They all have in common that they were all once melted, and have since cooled down and become solid. Igneous rocks look different because of two factors: they cooled at different rates and the "Mother" Magma (original melted rock) was different. In addition, volcanoes erupt in different ways. Some extrude quiet lava flows, while others explode violently, blowing lava into fragments of pumice or scoria. Geologists use these differences as criteria to name igneous rocks. Rocks that are cooled outside of the volcano are called volcanic rocks, and those that cool inside the lithosphere are called plutonic rocks.

Magmas that cool at different rates develop different sized crystals. Quick cooling volcanic rocks such as lava are composed of small crystals. For example, basalt has small crystals that can be seen under a microscope, inferring that basalt cooled quickly. Obsidian is also a volcanic rock, however, this rock cooled so quickly that no crystals had time to form. Slow cooling magma inside the Earth creates plutonic rocks like granite, which is composed of large, visible minerals.

Some of the samples in this lab have a "holey" or sponge-like appearance. Geologists call this a vesicular texture and the holes are called vesicles. They form in lava that contains gas. As the pressure on the lava decreases near or on the Earth's surface, the gas forms bubbles. This is physically similar to the bubbles that happen when a can of soda is opened. In the rock samples the students will see (pumice and scoria) the gas has long since escaped into the atmosphere, leaving the holes behind.

PROCEDURE:

1. Ask the students if they think that one volcano can produce different types of rocks. Explain that not all volcanoes are the same. Volcanic rocks differ in

composition and eruptive style. Explain the differences in appearance between plutonic and volcanic rocks.

2. On a map of California point out the areas that these rocks are from.

3. Discuss how to describe igneous rocks by offering the students the following words: bumpy, glossy, black, red, greenish, holey, grayish. Review any words that will help them describe the rocks further. Instruct students to find the locations where these rocks were formed by using the map of California to the right. Give them the following information about each location. Ask them if there are enough data points to conclude if there is a pattern of volcanic rocks in California. The answer is no. You need more data points to make a conclusion.

4. Here is information on each of the rock types:

   Gilroy is south of San Jose. The volcanic rock records volcanism that occurred millions of years ago. The volcanoes are now extinct. The type of rock is basalt.

Clearlake is north of the San Francisco Bay Region. The volcanism in Clearlake was more recent that in Gilroy, and were thought to be extinct, but recent studies may list this area as "dormant". The type of rock is obsidian. The Clearlake volcanoes also produced another type of rock called scoria, or a reddish looking rock.

Mono Craters which produces the pumice, is presently dormant. However the magma chamber below is still moving upwards and small earthquakes are common in the area.

Inyo Mountains is along the California-Nevada border north of Death Valley and south of Mono Craters. This rock is andesite porphyry and was deposited in the Jurassic. This volcanic complex has long been extinct.

5. The students should conclude that volcanoes produce different types of rocks. The samples that the students have are insufficient to conclude if there are differences between a quiet and violent eruption. However, students may see that some rocks are more "holey" which represents gas being trapped in the rock which is more common in a violent eruption.

PROBLEM: Do rocks produced by volcanoes provide clues about that volcanic eruption?

PREDICTION:

Look at a map and locate where the rocks came from in California. Describe the rocks in the area provided below. After learning about the type of eruption that caused the volcano, can you interpret if there is a difference in rock type between a violent eruption and a quiet eruption?

1. **GILROY, CALIFORNIA** - This ancient lava flow erupted with a powerful blast. Lava cascaded down the slopes of the growing volcano.

   DESCRIPTION:

2. **CLEARLAKE, CALIFORNIA** - The cinders swished from the volcano, causing extensive deposits, (scoria). Flows of lava cooled quickly to form thick bands of obsidian.

   DESCRIPTION: (scoria)

   DESCRIPTION: (obsidian)

3. **BLACK BUTTES, CALIFORNIA** - Lava slowly moved from the crater of the volcano. A thick layer of basalt was deposited.

   DESCRIPTION:

4. **MONO CRATERS, CALIFORNIA** - the volcano "coughed" violently, gas trapped in the molten rock formed pumice.

   DESCRIPTION:

5. **INYO MOUNTAINS, CALIFORNIA** - The magma chamber was cooling, but suddenly the volcano erupted formed a rock called andesite porphyry.

   DESCRIPTION:

CONCLUSION: Are there characteristics of volcanic rocks that indicate what type of eruption produces them?

Is there enough data here to really tell? Explain

6.5

SOIL ENVIRONMENT
SIXTH GRADE

OBJECTIVES:
- Exploring ecosystem requirements.
- Determining which soil type can sustain plants.

VOCABULARY:
soil
environment

MATERIALS: Soil Environment – Sixth, Hand lens

BACKGROUND:

The **soil** that we walk on is an underground city. In this city, every organism does its part to make sure the city works together. The actions of the animals, insects, and microorganisms that live in the soil not only influence what happens in the soil but also what happens above the soil. Soil is made of **inorganic matter** (mainly rocks and minerals) mixed with **organic matter**. Soil is formed from the weathering of minerals derived from bedrock and contains living organisms and the products of their decay. Soil can be considered a mixture of mineral materials, organic matter, water, and air in varying proportions. Topsoil, the **A horizon**, is usually the upper ten inches of a soil in a well-developed soil profile. Plant roots, bacteria, fungi, and small animals are abundant in this area along with plants who thrive in this type of environment. Topsoil has less organic matter than in the **O horizon** (the surface) which is the reason that topsoil is lighter than surface soil. Topsoil is one of our most valued commodities since it provides the nutrients and environment for the growth of plants.

Subsoil or the **B horizon**, is the middle soil layer. It has fewer organisms and less organic materials than both the A and O horizons. Consequently, the B horizon cannot support the growth of plants very well. If subsoils are clayey, they usually are harder when dry and sticky when wet than the surrounding soil layers.

The **C horizon** is the lowest layer and is partially weathered parent material from which the other horizons are formed. It is less altered and weathered than the layers above and has less living matter. The parent material is sometimes named the D horizon.

The constituents of soil are extremely variable in size, shape and chemical composition. The size of particles is one of the most significant characteristics. Water absorption, air movement, rate of solution and ease of tillage are a few things that are affected by particle size.

The **texture of soil** refers to particle sizes and is classified on an arbitrary scale. It can be coarse, sandy, or clayey. Sand would be about the size of sand, coarse would refer to soil that is larger and clayey would be smaller. You can also describe the structure of soil by how the soil particles tick together. When particles are rather porous and small, the soil is considered to have a granular or crumby structure, which is characteristic of many soils high in organic matter. Soil that is lumpy stick together. Sometimes soil has magnetite in it, a magnetic mineral that is attracted to a magnet.

Humus, the partially decayed organic matter accumulated in soils, is a dark-colored structure less material.

Soil horizons can be different for high productive areas versus low productive areas. The ideal soil horizon as shown in the Pre Lab, may not be present in all areas. You can use the following to help guide you with your students.

PRODUCTIVE

A. contains more organic matter in most areas, most weathered and leached at all levels, loose, easily tilled, fertile

B. Yellow layer containing small quantities of clay and easily penetrated by air, water, and plant roots

C. slightly weathered, permeable, calcareous

NON PRODUCTIVE

A. light gray layer, low in fertility and difficult to till

B. heavy clay layer impermeable to air, water, and plant roots, massive stable aggregates of small particles

C. heavy clay parent matter

PROCEDURE:

1. Go over the soil horizon with students, making sure they understand the descriptions.

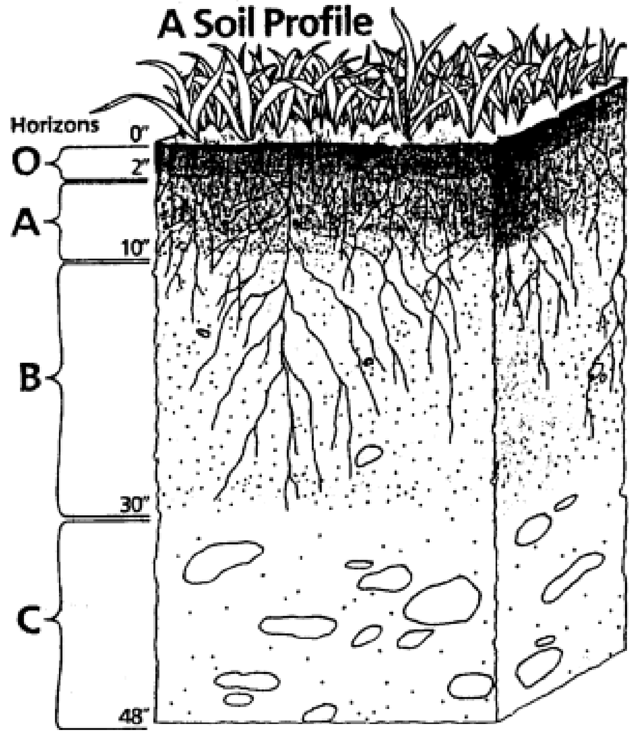
2. Instruct the students to look at the reference soil samples under the hand lens (or microscope) and describe what they see. They should ask themselves if the sample has broken up rocks or very fine clay particles. They should also see if there are other distinguishing characteristics like plant debris or animal remains.

3. If you have time it would be good for students to look at the soil around the school to see if they can identify any horizon.

SOIL ENVIRONMENT - SIXTH

PROBLEM: Can you determine how well plants can survive by looking at soil?

PREDICTION:



Surface: organic material dead plants, animal material **O horizon**
Topsoil: plant roots, bacteria, fungi, small animal **A horizon**
Subsoil: Fewer organisms less topsoil; plants don't grow well **B horizon**
Altered Parent Material: Weathered, less living matter layers above were formed form it **C horizon**

Look at the samples of the following areas and see if you can determine the horizon. First describe the sample by looking at it with a hand lens and predict if it would be a good soil for growing plants.

Sample	Horizon	Description and is it good soil for growing plants
Bryon		
Menlo Park		
Berkeley		
Hayward		
San Jose		
Fremont		
Half Moon Bay		
San Mateo		

COAL
SIXTH GRADE

6.6

Objective:
Students compare different types of coal.

MATERIALS:

Coal-Sixth
hand lens

BACKGROUND:

Throughout history, coal probably has fueled more expansion of industrialized society than any other fuel. Today, it is used to create steam from water which turns generators to create electricity. Many countries in the world still use coal to cook. Typically, it takes about one ton of coal to produce 2,500 kilowatt-hours of electricity. Coal is by far more plentiful than **domestic** oil or natural gas, making up about 95 percent of America's fossil energy reserves.

Historically coal has been used to heat and work wherever sources of coal were near by. In the 1300's Hopi Indians in America regularly mined coal to cook and heat their homes. In the 1700's coal was better and more abundant than wood in the emerging industrialized nations of United States and Europe. Coal fueled most of the steam engines which were vital for rail and ocean transportation. By 1875 a by-product of coal (coke) replaced charcoal to make steel

There are four basic forms in the evolution of coal including **peat**, **lignite**, **bituminous**, and **anthracite** coal. Peat is compressed plant remains derived from swampy regions. It is the raw material from which coal is made. It is used in various areas of the world, especially in the British Isles where it is cut into cubes and dried to be burned in stoves. There are substantial quantities of fuel peat worldwide, mainly in Canada, Russia, Northern Europe, and in tropical countries such as Indonesia.

Lignite is a brownish-black coal with generally high moisture and ash content, and the lowest **carbon** content and heating value. About 79 percent of lignite coal is used to generate electricity, 13.5 percent is used to generate synthetic natural gas, and 7.5 percent is used to produce **fertilizer** products.

After millions of years of more heat and pressure from within the Earth's surface, lignite changes into bituminous or hard coal. Bituminous coal is an intermediate grade of coal that is the most common and widely used in the United States. A grade referred to sub-bituminous is a dull black coal with a higher heating value than lignite, but lower than true bituminous. Bituminous coal is primarily used for power generation, and the production of cement, iron and steel.

Bituminous coal in nature, transforms into a harder form called anthracite coal. Anthracite is the hardest type, consisting of nearly pure carbon. Anthracite coal has the highest heating value and lowest moisture and ash content. It is used for domestic and industrial purposes, including smokeless fuel.

Coal was once a symbol of destruction of the environment and abuse of mine workers. The demand for coal during the later part of the 1800's and early 1900's and lack of heavy equipment for mining drove companies to push miners to produce more. This combination of demand and exploitation of workers lead to miner strikes which could have crippled the growth of the United States and England.

Underground mining cost the lives of many men and many died of "black lung" disease. The dust of the coal would almost "coat" the lining of miners' lungs and cause respiratory failure after just a few years exposure in the mines.

PROCEDURE

1. Have students look at the specimens and describe them. A hand lens or microscope would be helpful. Help students with descriptive terms:
   a. Is the specimen hard?
   b. Can you see bits of wood?
   c. Is it dense?
   d. does it rub off easily
   e. it black or gray

2. One of the specimens that students will be observing is inorganic carbon. This means that is was formed inside the Earth without its origins from a living organism. This will be Graphite. Graphite is used in pencil "lead."

3. There is no peat sample, but there is lignite, bituminous, and anthracite coal. Anthracite and bituminous are difficult to tell the difference, but anthracite is usually shiny and denser.

4. The difference between charcoal and a charcoal briquette is that charcoal is burnt wood, while a briquette is compressed and denser. The briquette will burn longer.

COAL - SIXTH

PROBLEM: How are grades of coal different and how does it affect it energy efficiency?

PREDICTION:

MATERIALS: carbon samples
PROCEDURE: Describe each specimen.

NAME	**describe**