John F. Kennedy High School

Charles Saltzman, Principal

Lesson Plans for General Earth Science

Herman Budow, A.P. Science

Harry S. Truman High School

Physical Sciences Department

Theodora V. Field, Assistant Principal

General Earth Science PG13 (SEIN)

AIM #1 - What is earth science?

INSTRUCTIONAL OBJECTIVE: Students will be able to identify the subtopics and their area of study that is found in earth science.

MOTIVATION: You are all here to take earth science. What is the study of earth science all about?

DEVELOPMENT:

1. From motivation. Earth science is not a single science but involves many different specialized science courses with theknowledge of the entire earth, and space.
2. What parts make up the earth?
   The earth is made up of solid surface and below water (oceans) and the atmosphere (air).
3. What specialized sciences are involved with the study of a) solid surface - Geology - concerns the study of the structure of the earth, solid surface and below, its composition and what causes it to change. This term we will be studying geology.
   b) The atmosphere - meteorology - science that deals with the earth's atmosphere, its composition, structure and changes - commonly called the weather. We have a separate course that studies this only for one term.
   c) The oceans - Oceanography is the science concerned with the properties and processes of the earth's oceans - important because?? 70% of earth surface is water. We have a separate course that studies this only for one term.
   d) The heavens or space - Astronomy. The science that deals with outer space, stars, planets and any other heavenly bodies.
   e) The study of all the water on earth above and below surface. Hychology - concerned with the body of the water on, below and in the atmosphere of the earth.
   f) Topography - the science of mapping the earth
   g) In addition, each of the sciences of earth science involves the sciences of chemistry, physics and biology.

PG13 - GENERAL EARTH SCIENCE 1

AIM #2: What are the major regions of the earth?

INSTRUCTIONAL OBJECTIVE: Students will be able to identify or list the four divisions of the earth.

MOTIVATION: DEMO - Show a rock, soil and water and an empty beaker (air) and ask the class how do these represent the earth?
USE WORKSHOP 1-1 to help develop the lesson.

DEVELOPMENT:

1. From motivation - The earth is composed of three states of matter - part of the earth is solid, liquid and gas.
2. What do we call the solid part of the earth and what is it made of?
   (Lithosphere is the solid part of the earth and it is composed of rocks, minerals and soil).
   Greek: litho = stone, sphere = ball (earth)
3. What makes up the liquid part of the earth and what do we call it? Hydrosphere makes up the liquid part of the earth which is mostly ocean. It covers about 3/4 of the earth = ? % (75%). Hydrosphere = all oceans, inland seas, lakes and streams (all the water found on earth below ground and in air).
   hydro = water, sphere = ball
4. What do we call the gaseous part of the earth?
   Atmosphere is the layer of gases (envelope of gases) around the earth.
   atmos = vapor
   sphere = ball (earth)
5. What does the atmosphere include?
   Atmosphere includes the blanket of air, water droplets, ice particles, etc. that completely cover the earth's lithosphere and hydrosphere.
6. How is earth's atmosphere divided?
   The earth's atmosphere is divided into zones or regions. The following is only one way that scientists divide the atmosphere.

350 KM	Thermosphere	)	
20 KM	Mesosphere	)	don't require
50 KM	Stratosphere	)	name for test
8-18 KM	Troposphere	)	except troposphere
surface			

7. Where do we and other life forms live?
   We live in a zone called the Biosphere, not a true division of the earth. The biosphere includes part of the lithsphere and atmosphere. This is a region near the earth's surface where all life is found.
   bio = life
   sphere = ball

SUMMARY:
1. What are the three divisions or zones of the earth?
2. What are the major features of each zone?
3. What is the biosphere?

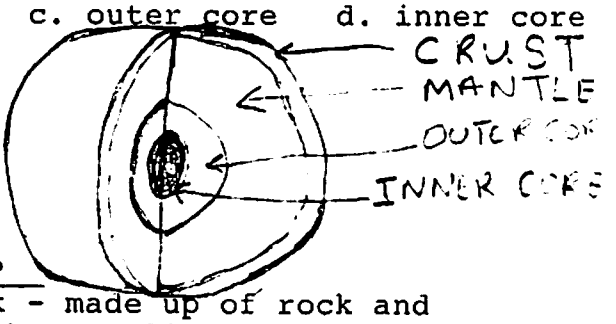
SB1N - GENERAL EARTH SCIENCE 1

AIM #3: What are the layers of the earth?

INSTRUCTIONAL OBJECTIVE: Students will be able to identify and list the layers of the earth.

MOTIVATION: Using Earth Science workbook 1 (Aim 2).
Ask: what are the four layers of the earth?

DEVELOPMENT: 1. From motivation 4 layers of the earth
a. crust b. mantle c. outer core d. inner core



2. What do each of these layers contain?
a) Crust - 5-80 miles (8-64 KM) thick - made up of rock and soil - under the soil is solid rock - we live on the crust

MOHO - b oundary between both

b) Mantle - layer below the crust - about 2800 KM thick. It's made up of solid rock that is heavier than the crust

c) Outer Core - below the mantle at about 2000 KM (1300 mi) thick and it's made up of molten (melted) iron and nickel(liquid)

d) Inner Core - center of the earth about 2800 KM (1800 mi) thick. Inner core is solid - not liquid iron and nickel

SUMMARY

3. Conclude lesson by having students use workbook by section. Go over each section with class.

SEIN SUGGESTED CONCEPTS AND DEMOS IN GENERAL EARTH SCIENCE

ASSIGNMENT #4

AIM: What is meant by latitude and how is it measured on a map?
(2 days)

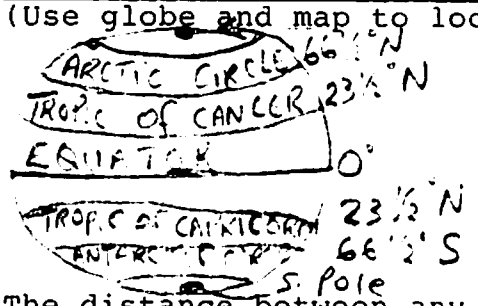
MOTIVATION: - Show map and ask what are these horizontal lines running from pole to pole called?

INSTRUCTIONAL OBJECTIVE

Students will be able to define latitude, locate the major parallels on earth and had the latitude in degrees of major cities in the U.S. and world.

DEVELOPMENT:

1. What is meant by lines of latitude?
   (Latitude of a point describes the distance north and south of the equator in degrees).
2. What is another name for lines of latitude?
   (Parallels are another name for latitude. Parallel latitude)
3. What are the major lines of latitude or parallels?
   (Use globe and map to locate and draw)



Reference lines

4. The distance between any two parallels of latitude is about 69 miles

   (Circumference of earth is about 24,000 miles of equator

   360° in a circle? $\frac{24{,}000 \text{ miles}}{360} = 69$ miles

5. How and why is latitude further subdivided?
   (Each degree is subdivided into 60 equal parts called MINUTES

   $1^{\circ} = 60$ minutes, 1 minute = 60 seconds $\therefore$ 1 minute = 1 1/6 miles
   1 sec = 100 feet

USE OVERHEAD PROJECTION MAP OF U.S. TO CALCULATE APPROXIMATE LATITUDE OF DIFFERENT CITIES.

2nd Period - Review major Reference Line and use map books (Steps in Map Reading) to do problems (pg. 5-16)

SUGGESTED CONCEPTS AND DEMOS

AIM: What is longitide: ORDER: Globe, map (large)

MOTIVATION: Ask pupils to locate lines of longitude on large map

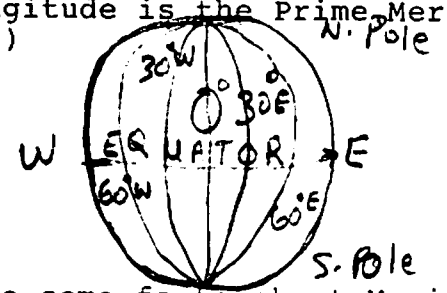
INSTRUCTIONAL OBJECTIVE:

Students will be able to identify lines of longitude on a map and calculate longitude and latitude of different cities given a map. USE MAP BOOK TO H ELP DEVELOP LESSON, PAGE 27-31.

DEVELOPMENT:

1. What is meant by lines of longitude?
   (Longitude or (Meridians) measure the distance in degrees east or west from 0° Longitude (Greenwich England). The lines travel from North Pole to South Pole).

2. What is the Prime Meridian?
   (0° Longitude is the Prime Meridian, the line where measurement begins)



DRAW ON GLOBE

3. What are some facts about Meridians or lines of longitude?
   PUPILS CHECK MAP
   a) or go to 180°E and 180° W
   b) Any point on a meridian like 30°E is always on or at 30°E
   c) The distance between two lines of longitude is not the same, it decreases as the lines extend north or south from the equator (SHOW ON GLOBE)

4. What are some distances between meridians at different places on the earth?

   (1 degree = 60 minutes, 1 minute = 60 seconds
   (at Equator 1° = 70 miles
   (at 40° N or 40°S - 1° = 50°
   (at North or South Pole 1° = 0 miles

5. Practice estimating or measuring longitude - Draw map

6. Traveler went west from 0° longitude to 180 be continued same direction 10° further. Where is he? 170°E
7. Use map of world and overhead to locate LATITUDE AND LONGITUDE OF CITIES - WORKSHEET

AIM #6: What is the difference between rocks and minerals (Composition of the earth's crust)

INSTRUCTIONAL OBJECTIVE:
Students will be able to list and identify what constitutes a rock and a mineral.

MOTIVATION: - What is the earth's crust composed of?
USE WORKBOOK

DEVELOPMENT:
1. Discuss composition of earth's crust (Solid made up of rocks and minerals).

DEMO: BOX OF ROCKS AND MINERALS

2. DEMO - Some minerals quartz, ores, halite (DaCl), diamond
   What is a mineral?
   A naturally occurring inorganic solid substance made up of a single element or compound (the same chemical compounds- E NcCl, S,O, etc). (The common atoms and molecules of the mineral are joined in a regular pattern called CRYSTALS.)

3. How many minerals are there on earth?
   There are about 2000 different minerals on earth.

4. What does naturally occurring mean?
   Minerals are natural. They are found in nature, not made by people. There are, however, synthetic minerals (man made), synthetic quartz, rubies and diamonds are made this way for use in industry (not real minerals).

5. What does inorganic mean?
   Inorganic means not organic or not made from living things. Coal is made up of dead plants. It is organic and therefore not a mineral.

6. What elements make up most minerals?
   92% of the earth's crust is made up of minerals called silicates. The element silicon and oxygen make up silicates. Quartz is an example, also garnet. DEMO QUARTZ

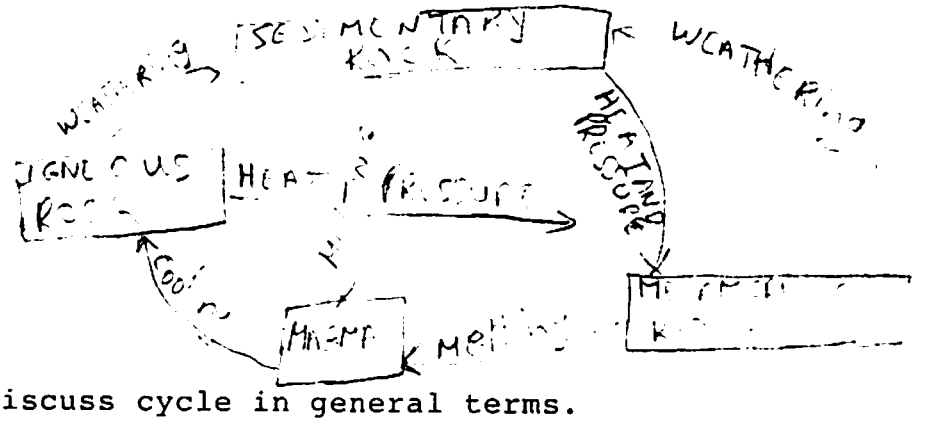
7. What are some examples of common minerals?
   a) Calcite or chalk Carbonates - contain calcium, carbon & oxygen
   b) Gypsum: (wallboard) - sulfite CaSo & water-contains calcium sulfur and oxygen
   c) ores like oxide-bauxite, iron ore
   d) salt - sodium chloride
   e) Native elements - only one kind of element-gold, silver copper (uncombined), diamond and graphite-only carbon. They differ in the way the carbon atoms are arranged. DEMO ALL .

8. What is a rock? (DEMO - BOX - HOW ROCKS ARE CLASSIFIED)
   a. Rocks are naturally occurring mixtures of two or more different minerals.
   b. Some rocks have some materials that were once alive (organic). Coal is a rock, it was formed from dead trees.
   c. Rocks have no definite ingredients. One part may be different from another.
   d. Rocks are grouped by the way they were originated and formed.
      1. Molten rock from inside the earth called magma, cools and forms IGNEOUS rocks, molten rock that reaches the surface is called lava and the rocks are also IGNEOUS. Ex. granite.
         DON'T GO INTO DETAIL HERE. SEPARATE LESSONS

      2. Sedimentary rock formed from sediments or small pieces of rock, shells, plants and animals that have been pressed and cemented together. Ex. sandstone.

      3. Metamorphic rock - existing rock that undergoes changes due to tremendous heat, pressure and chemical changes for a new rock. Ex. Marble.

9. What is the rock cycle? The continuous changing of rock from one type to another.



Record and discuss cycle in general terms.

10. SUMMARY
   a. What are minerals, give examples
   b. What are rocks?
   c. How does a mineral differ from a rock?
   d. What are the three types of rock?
   e. Describe the rock cycle.

AIM # 7 What are some economically important minerals and their uses?

INSTRUCTIONAL
OBJECTIVE:
Students will be able to identify some common minerals and their uses.

MOTIVATION: DEMO - BOX OF ECONOMIC MINERALS
Chart of minerals. Minerals like cryliten, bauxite, aluminum, hemalite or magnetite or galena. What do we call minerals that we can remove usable of metals in nonmetals from .

USE Sci. WORKBOOK 1
Aim #4 to help develop lesson

DEVELOPMENT:
1) From Motivation. Ores are minerals from which metals and nonmetals can be removed in useable amounts.
2) For metals - how is the ore used to make the metal?
   a) Most metals are found combined with other substances or impurities in ores. Ex: Galena - lead sulfide
   b) After the ores are removed from the earth by mining, the metals must be removed from the ores.
   c) Smelting is a process of removing the metals from the ores.
      Ex: lead comes from galena - lead sulfide ore
      iron comes from hematite - iron oxide ore

USE VIDEO ON MINERALS TO CONCLUDE LESSON

What are some common minerals and their uses? (Discuss uses)

Mineral	Uses
a. Bauxite - ore for aluminum	pots, pans, foil
b. Asbestos	fire retardent (often not used presently)
c. Graphite - nonmetal-a form of carbon	lead pencil, art drawing
d. Hematite - iron ore	pipes, cars, etc.
e. Galena lead ore	lead
f. Quartz-crystal-$S_1 0_2$	Electronic(watches)
g. halite - rock salt-NaCl	Melt ice, salt, water softener
h. Quartz-not crystal	abrasive (sanding and polishing)
i. Calcite-crystal form of $CaC0_3$ calcium carbonate (other forms-chalk, sea shells)	optics - lens
j. Talc	cosmetics, face powder, tailor's chalk
k. Gypsum-$CaS0_y$	plaster of Paris, wallboard
l. Coal-forms of carbon nonmetal	fuel
m. sulfur (nonmetal)	makes chemicals, fertilizer
n. Diamond-precious (amethyst, garnet, opal, semi-precious)	gem stones

USE BOX OF ECONOMIC MINERALS AND WORKBOOK.

AIM #4: TO DEVELOP THIS PART OF LESSON_DISCUSS USES WITH CLASS

SUMMARY

a. What are minerals?

b. What are ores?

c. Give some examples and uses for minerals

SEIN - GENERAL EARTH SCIENCE 1

Aim #8 How do we identify minerals?

INSTRUCTIONAL
OBJECTIVE : Students will be able to list the method and to identify minerals.

MOTIVATION: Demo box ofminerals (physical properties). Ask class to look at some minerals and identify them any way they want.

DEVELOPMENT: Use Workbook Earth Science 1 , Aim 5 to help develop lesson

1. From motivation - what are the physical properties that can be used to identify minerals?
   a) Color - color of mineral easy to identify
      Ex: Malachite is always green, azurite is always blue and quartz is usually colorless, may be purple, yellow or pink.
      Demo: box of varieties of quartz
      Color is not the most reliable way to identify minerals.
   b) Luster - describes the way a mineral reflects light or shines
      Ex: Metallic luster? silver, copper, gold, graphite
      Quartz - glassy luster, mica pearl luster, diamond brilliant luster (sparkle)
   c) Hardness- a most useful property- describes the ability of a mineral to resist being scratched
      Moho scale used to describe hardness
      1-10, 1-softest 10-hardest (Require only 1 and 10)
      1-softest-talc 2-gypsum 3-calcite
      4-fluorite 5-opalite 6-feldspar 7-quartz
      8-topaz, 9-corundum 10-diamond
      Test several against each other or against various items

DEMO-BOX _ MINERALS TO SHOW HARDNESS

   d) Cleavage- The way a mineral splits, fractures, breaks.
      Ex- mica cleaves along one surface, like sheets or layers.
      Quartz fractures like broken glass.

DEMO- BOX - MINERALS TO SHOW CLEAVAGE

Aim #8 (cont'd)

e) Streak - The color of the powder left by a mineral when it is rebbed against a hard, rough surface . (Use a streak plate to demo unglazed porcelain plate).
Ex - talc, gypsum and quartz - white anc colorless streak not useful for these minerals.

DEMO - iron pyrite - yellow - streak is greenish black
TEST - galena, graphite

f) acid test - mineral calcite-tested with hydrochloric acid gives off bubbles of carbon dioxide

DEMO - test-chalk (form of calcite) in tube with dilute HCl.

$CaCO_3 + HCl \quad CaCl_2 + H_20+C)_2$ (bubbles)

2. Summary
   1. What are the physical properties that can be used to identify minerals?
   2. What is the softness and hardness minerals and their Moh #?
   3. What is meant by cleavage and streak?

SEIN General Earth Science L

Aim #9 - How do we classify igneous rocks?

INSTRUCTIONAL
OBJECTIVE Students will be able to identify how igneous rocks form and some common examples.
Review rock cycle.

MOTIVATION: Demo - Box of igneous rocks

DEVELOPMENT:

1. From rock cycle - Where does igneous rock come from?
   (Rocks that form from MAGMA (molten rock beneath the earth's surface) is called IGNEOUS rock).

2. What are the two types of igneous rock?

   Magma (molten rock beneath earth's surface

intrusive rocks-magma that cools deep within earth	extrusive rocks Molten rock that forms on the earth's surface - LAVA

3. How do igneous rocks form?
   (Igneous rocks form when magma hardens or crystallizes)
   The size of the crystals is called texture.

DEMO - Rock sample

4. What are some common igneous rocks and how did they form?

MAGMA

	Extrusive rocks (lava)	Instrusive rocks
	cool quickly on surface producing small crystals	cool slowly below surface producing larger crystals
DEMO SAMPLES	EX: basalt, obsidian, pumice, scoria	Ex-granite, baggro

Show each and explain how each forms

DEMO - place pumice in beaker of water - it floats, why? many air holes escaped-gases produced

5. What are some uses for igneous rocks?
   a. Pumice - powder used is lava soap as a scouring agent
   b. Granite - used to build buildings and furniture tops for tables

6. Summary
   a. How does igneous rock form?
   b. What are the two types of igneous rock?
   c. How do large and small crystals form in igneous rock?

SEIN - General Earth Science L

Aim #10 - What are some igneous rock formations?

INSTRUCTIONAL OBJECTIVE: Students will be able to identify igneous rock formations from a given diagram.

MOTIVATION: Distribute diagram and ask class what diagram represents.

DEVELOPMENT:

1. How do we explain all the different formations shown in the diagram?
   Sometimes magma does not flow out onto the earth's surface. Instead the magma flows upward into cracks in the rock or spreads out between rock layers and hardens into irregular formations called Intrusion.

2. Using the diagram, go through each igneous intrusion and discuss how it formed and example of each.
   a. Dike - a narrow vertical intrusion in cracks in existing rock.
   b. Lacolith - magma pushes its way between rock layers and pushes up the overlaying rock into an arch or dome.
   c. Sill - magma that pushes its way between rock layers, but doesnot cause an arch or dome- Palisades on N.J. side of Hudson River is a sill 80km long (50 miles) and 300 in. thick
   d. batholith - a huge intrusive rock formation that is deep into the earth's crust, extends between 10-30 km (6-20 miles). Form the core of many mountain systems - Sierra Nevada, Calif.
   e. Stock - a smaller version of a batholith
   f. lava plateau - magma that flows between cracks and rocks the surface as lava and spreads out in a flat shape. Comumbus Plateau of U.S. covers most of eastern Oregan and parts of Washington and Idaho.

3. Summary
   1. Review each intrusion with class, also workbook 1 (Aim #7)

SEIN - General Earth Science 1

Aim #11 - How are sedimentary rocks formed?

INSTRUCTIONAL OBJECTIVE: Students will be able to identify some common sedimentary rocks and how they formed.
Get DEMO BOXES to show class. Use Aim 8 Workbook to help develop lesson.

MOTIVATION: DEMO - SAMPLES OF SEDIMENTARY ROCK from box.
Sandstone, shale, conglomerate, etc.

1. What type of rock is this and how do these rocks differ from igneous rock? (Sedimentary rocks- these rocks are made up of pieces, fragments or other sediments that are glued or pushed together.

2. Where do sedimentary rocks come from and where are they found?
Sedimentary rocks come from bits and pieces of other rocks and sediment - 75% of the rocks on the earth's surface are sedimentary rocks.

3. How do the bits and pieces of rocks form into sedimentary rocks?
Sedimentary rocks form in the following ways:
a) cementation - water that soaks the earth carries natural cements.
*** Ex - silica from quartz, calcium carbonate from limestone. These coat sediments such as sand - bind them together.
Ex - conglomerates
b) Compaction - layers of rock and sediment fall on one another. The pressure of the upper layers joins the fragments into rock.
Ex-sandstone
*** Ex-cement - sand, water and cement. The cement is the binder that holds the sand together.
Concrete - one adds stones to the sand, water and cement.

4. What are the major characteristics of all sedimentary rocks?
All sedimentary rocks form layers and are usually formed in water, many contain fossils.

5. What are the three types of sedimentary rocks?

DEMO
a) Clastic rock - made up of pieces of other rock
Ex - conglomerate large particles
sandstone (finer partial shale (clay and mud) cementated or compacted together.
b) Chemical rocks in sediments-comes from minerals dissolve in water. Sea water evaporates, the chemicals or sediments collect on the bottom and from chemical sediments. Compaction turns the sediments into sedimentary rocks.

Ex-limestone (calcium carbonate), gypsum, rock salt (NaCl)-halite

c) Organic Sediments - are rocks fromed from hard remains of once-living organisms as shells or skeleton of coral.
Ex - coquina, limestone, chalk, bituminous coal

6. What are some uses of sedimentary rock?
Sandstone used in blocks to build buildings-White House, DC mostly sandstone. Painted white to hide fire from War of 1812.
Rock gypsum used to make wallboard - plaster board.
Shale used to manufacture sewer pipe, drain tiles.

7. Summary
   a. What are the three main characteristics of sedimentary rock?
   b. How are sedimentary rocks held together?
   c. What are the three types of sedimentary rocks?

SEIN General Earth Science 1

Aim #12 - How are metamorphic rocks formed?

INSTRUCTIONAL OBJECTIVE: Students will be able to identify some common igneous rocks and describe how they are formed.
USE WORKBOOKS TO HELP DEVELOP LESSON

MOTIVATION: DEMO - Box of Metamorphic Rocks and its samples and Box of Sedimentary Rocks and its samples.

1. Show shale sample and then slate - ask class how did shale (sedimentary rock)change to this new rock slate?
   Already existing rocks buried deep in the earth have tremendous heat and pressure and chemical changes work on these rocks and thus change into different rocks.
   called Metamorphic rock
2. What do we call this process?
   Metamorphism-changing of one type of rock into another due to great heat, pressure and chemical reactions.
3. What is the source of the heat?
   magma (molten rock) deep in the earth causes rock to change (contact and metamorphise)
4. What is the source of the pressure?
   building and earthquakes cause huge pressure on rocks and change their texture and structure
5. What are the two types of metamorphic rock-based on texture/
   a) foliated- have layers and formed by pressure from one direction.
   b) nonfoliated - no visible layers formed by pressure in many different directions.
6. Examples

Rock (metamorphic)	Rock Origin
Foliated	
Slate	Shale-sedimentary
Gneiss	granite-igneous
unfoliated	
quartzite	sandstone-sedimentary
marble	limestone "

   Uses (foliated)
   blackboards, roof shingle, building monuments
   (unfoliated) building blocks, Lincoln Memorial

7. Summary
   a. What is metamorphism?
   b. What are the two major ways rocks can be metamorphised?
   c. List some common metamorphic rocks and their source.

Aim #13 How does plate tectonics affect the earth?

INSTRUCTIONAL OBJECTIVE: Students will be able to describe the concept of plate tectonics and its effects.

MOTIVATION: Discuss the San Francisco Bay earthquake of October 1939 and ask the class what is the basic reason for that and other earthquakes.

USE VIDEO ON PLATE TECTONIC

DEVELOPMENT:

1. From Motivation; The earth during its formation was made up of one super continent called Pangaea. Due to continental drift (use worksheet/overhead to help discuss),the present continents were formed

2. How does continental drift explain eqrthquakes?
To explain continental drift - a new theory was put into place called Plate tectonics.

3. What is Plate tectonics?

a) It states that the lithosphere is divided into plates, each
b) moving indenendently of each other.
This theory helps to explain the formation of the earth's crust and its movements, collisions and destruction.

USE MAP TO SHOW FEATURES

c) It also helps to explain the origins of volcanoes, earthquakes and movements.
d) There are seven major (lithospheric)plates, some consist of ocean crust only, other plates contain continental and ocean crust.

4. What happens to these plates?
a) These plates slide or float on the layer of molten rock near the top of the mantle.
(Driven by convection cells in the mantle (optional)

b) These plates are moving at different speeds and in different directions.

5. How does this plate movement explain the San Francisco Bay earthquake?
a) Most earthquakes and volcanoes occur along the boundaries or edges of plates (there are exceptions).

b) The North American Plate (most of USA) is moving toward the Southwest at 2 in. per year. The adjoining plate, the Pacific plate, is moving Northwest at 13

1 Period Lesson

Aim #14-What are the constructive and destructive forces of the earth?

INSTRUCTIONAL
OBJECTIVE : Students will be able to define and list examples of constructive and destructive forces on earth.

MOTIVATION: Ask What is meant by the statement: "The only thing constant is change" in reference to the earth?

DEVELOPMENT:

1. From motivation - discuss statement (The earth is a dynamic planet that is every changing).
2. How do we know and what do we see that tells us that the earth is changing?
   (Examples of constant change on earth are
   a) the weather b) earthquakes c) volcanoes
   d) mountain building e) erosion f)weathering
   g) delta building
3. Which of these changes or processes are considered constructive forces and what are they?
   a. Constructive forces are those forces that help build up the earth's crust.
   b. Examples are eqrthquakes, volcanoes, mountain building and delta building (Mississippi River delta adding load to the area from its silt deposits).

   (Don't discuss these processes in detail - future lessons deal with each)
4. Which of these changes or processes are considered destructive and why?
   a. Destructive forces tend to wear away the earth's crust.
   b. Examples are:
      1. erosion (agents are wind, air and water [ice])
      2. weathering (chemical and mechanical)
5. Review plate tectonics to show how it acts to be a constructive force.
6. SUMMARY
   1. What is meant by constructive and destructive force?
   2. Give example of each.

Aim #15 - What are fault-block mountains?

INSTRUCTIONAL
OBJECTIVE: Students will be able to determine and list the causes for fault black mountains.

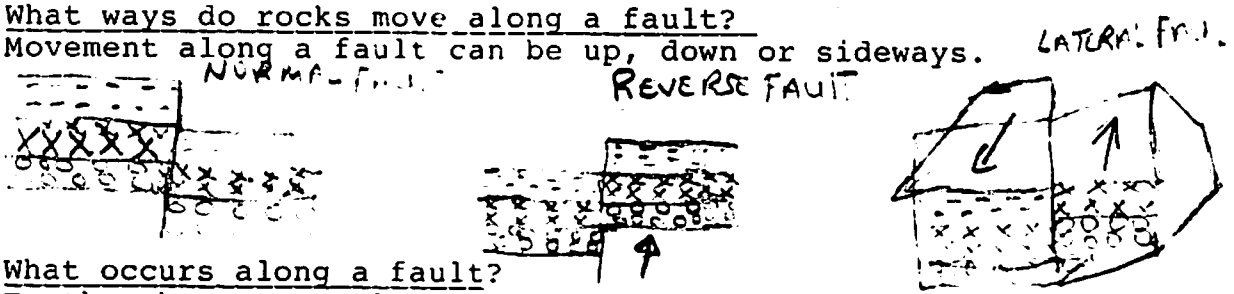
MOTIVATION:
1. Use plastic models of fault block mountain- show a fault.

DEVELOPMENT: Use Workshop 1, #21

1) From motivation - What is a fault?

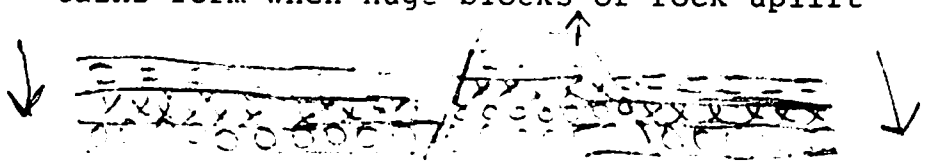
Fault - a rock fracture, crack or break along which there is movement. The rocks on one side of the fault slide past the rocks on the other side of the fault.

2) What ways do rocks move along a fault?
Movement along a fault can be up, down or sideways.



3) What occurs along a fault?
Earthquakes occur along a fault and mountains form.

4) How do fault block mountains form?
Fault block mountains form along normal faults, that mountains form when huge blocks of rock uplift



5) What are examples of these mountains?
Mountain in Oregon and Idaho, parts of the Rocky mountains.

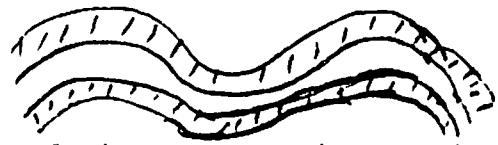
6) What happens when a huge block of rock slides down instead of up?
1. Valleys are created when huge blocks of rock slide down along a normal fault. They are called RIFT VALLEYS.
Ex: Death Valley, Calif. 87 meters or 250 feet below sea level.
2. The Great Rift Valley in Africa.

7) SUMMARY
1. What are faults?
2. What are three types of fault?
3. How do block mountains form, rift valleys form?

Aim #16 How are folded mountains created?

INSTRUCTIONAL
OBJECTIVE: Students will be able to identify folded mountains from diagrams and describe their origins.

MOTIVATION: DEMO - Stress on crusted rocks by using foam model to show folding (3 foam layers)



DEVELOPMENT: Workshop 1, #20

1. From motivation - What is produced when stress is applied by nature to crusted rocks that do not break?
   (A fold or bend in crusted rock is produced when stress is applied to rock that doesn't break).
2. What is an upward, downward fold called?
   a) An upward fold is called an anticline.
   b) A downward fold is called a syncline.

3) What determines if rocks fold or fault?
   a) Rocks fault if the temperature of the rocks get extremely hot during compression - why? less brittle
   b) Rocks fault if great pressure is applied to them- rocks that bend easily are called ductile.

4) What is formed due to huge or large folding of the crust?
   Mountains and mountain chains result from large crusted folding.
   Ex- Applachian Mts (From Canada to Alabama),
5) The Rocky Mountains. DEMO - USE STRATA MODEL
   The Alps

6) Conclude lesson with filmstrip Folded Mountains.
   DEMO: Use U.S.A. and world map.

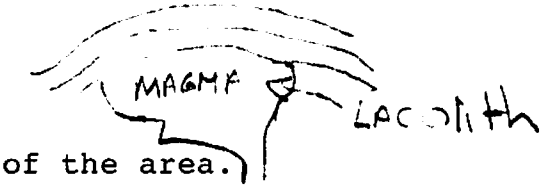
Aim #17 How are domed mountains formed? (one day)

Instructional
Objective: Students will be able to idnetify a domed mountain on a diagram and describe how they originate.

Motivation - Review
What two crustal changes produce or raise mountains high above the surrounding land?

Development:
1. Faulting - slippage along crust or fault and folding of the crust produce mountains.

2. How else may the crust of the earth be lifted to form mountains?
Magma (molten rock beneath the surface) pushes up overlying rock layers and cools.
USE WORKBOOK 1-DOMED MOUNTAINS TO INITIATE DISCUSSIONS



3. What do we call such a structure?
A dome is formed by the uplifting of the area.

4. What occurs when the overlying rock layers are worn away?
Domed mountains form when the overlying rock layers are worn away.

5. What are examples of domed mountains?
Black Hills of South Dakota

6. Summary. Show Video
Making of a Continent. Nova 55 min. Collision Courses.

Aim #18 What is Vulcanism?

Instructional
Objective: Students will be able to define and identify vulcanism and the types of eruptions.

Motivation - Show Video - Volcanos - 20 minutes

Development:

1. What is a volcano?
   The place where molten rock LAVA reaches surface is a volcano.
2. What is molten rock called deep within the earth?
   (Magma molten rock within earth)
3. How does the magma form and then surface to the earth?
   a. When crustal plates collide, crustal rock is moved into the mantle where it melts into magma due to high
   b. When crustal plates diverge (spread apart), pressure is retained, magma rises, sometimes it doesn't reach the surface and forms a variety of features called intrusion.
4. What are the resulting igneous intrusions due to rising and cooling magma? USE WORKSHEET or workbook.
   a. Batholith - huge body of magma
   b. Stock - smaller intrusive body of magma
   c. Sill - small (sideways) horizontal intrusions of magma. Ex: Palisades, NJ
   d. Dike - long narrow intrusions of magma (vertical) that cut across rock layers.
5. How does a volcano form?
   When magma reaches the surface through cracks or faults, it forms lava - a volcano is born.
6. How may magma rise to the surface?
   a) Magma rises slowly-oozes out on the surface through an opening called a VENT
   b) When magma reaches the surface, it is called LAVA.
7. What are the types of lava that result from a volcano eruption?
   a) Volcanic dust - smallest particles
   b) Volcano rock - size of rice grains
   c) Volcano bombs - small rocks or large boulders out molten and cool as they travel through the air.
8. Summary
   a) What is a volcano?
   b) How does magma differ from lava?
   c) What are igneous intrusions?

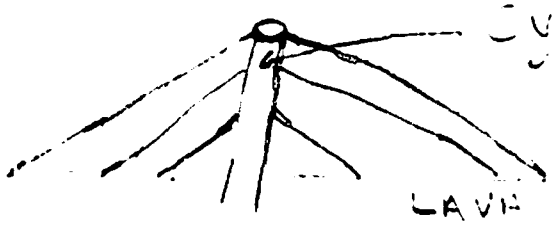
Aim # 19 - What are the types of volcanos?

Instructional
Objective : Students will be able to identify the three basic types of volcanos and describe their effects.

Motivation: Show cut-away model of cinder cone volcano and ask "Are all volcanic eruptions the same?"
Ask class to describe different eruptions.
Ex: Mt. St. Helens, May 1980 erupted (p. 437-test), threw out tons of ash, cinders, rocks.
Mt. Ki in hawaii - oozes lava
others combine ash

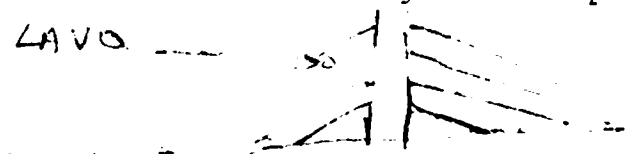
Development

1. How many different types of structures of volcanos are there?
   (There are three types of volcanos, they depend on their shape)
2. What does the shape of a volcano depend on?
   The shape of a volcano depends upon the type of lava and force of the eruption. They are a) cinder cone volcanos b) shielded volcanos c) composite volcanos
3. How are cinder-cone volcanos formed?
   Thick lava (viscous lava) traps gases inside of the volcano until enough pressure builds up to push or blow the lava out as ash, cinders and bombs. The pressure usually results from steam trapped in the volcano.
4. What shape results from cinder cone volcanos?



Example: Many Volcanoes in Mexico and Central America

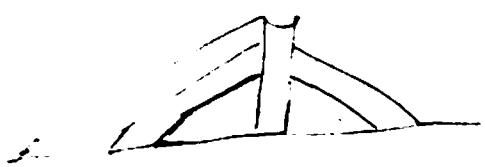
5. What type of volcanos are produced when lava gently flows from opening?
   Shield volcanos - are formed from quiet eruptions of lava that
6. What does a shield volcano look like?
   Shield volcanos have gentle slopes and a very large base (very wide).



EXAMPLE: Volcanoes in Hawaii

7. What is a composite volcano?
   Composite volcano is made up of alternating layers--one layer results of an explosion followed by lava flowing out.
   Ex: Mt. Fuji - Japan

MT. ETNA - Sicily
MT. VESUVIUS - Italy



8. What is the top of a volcano called?
   Top of volcano cone often has a pit called a crater. If the crater becomes very large, it is called a caldera (Latin for pot or kettle). - may form when top of volcano explodes.

9. What are undersea volcanos called?
   Underwater volcanos are called seamounts - 10,000 on Pacific Ocean floor. Hawaiian Island are seamounts elevated above the water (only 8-many are below the water line)

10. Summary
    SHOW VIDEO OF KILAUA ERUPTION

Aim #21 What are the destructive forces on the earth's crust?

INSTRUCTIONAL OBJECTIVE: Students will be able to list and identify constructive and destructive forces that affect the earth's crust.

Motivation: Why are volcanos and earthquakes considered constructive forces to the earth's crust? Use workbook 1 - Aim 10 - to help develop lesson.

Development: From motivation:

1. Volcanos and earthquakes tend to build up the earth's crust. Therefore, they are constructive forces.

2. How does a volcano act as a constructive force?
   (Volcanos build up the crust by the eruption of molten rock called lava. This tends to add to the earth's crust and thus build it up).

3. If there are constructive forces on earth, are there destructive ones and if so, what does it mean?
   a. Destructive forces are thos forces that tend to break down the earth's crust or solid surface).

4. What are examples of destructive forces?
   a) Weathering - the breaking down of the earth's crust, usually rocks, into smaller and smaller pieces.

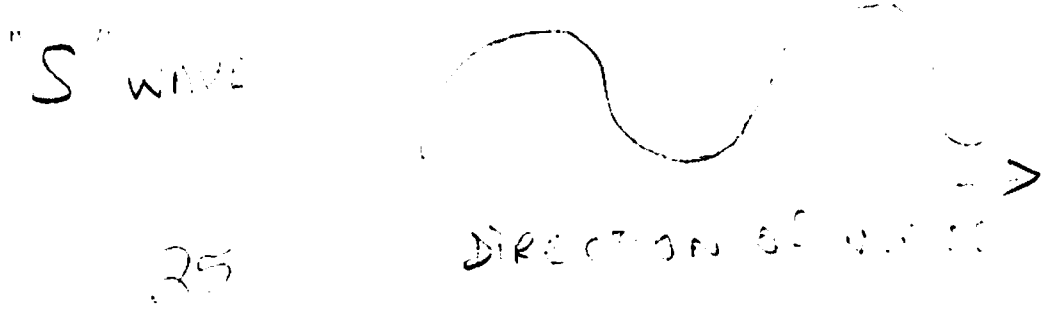
5. What do earthquakes that occur on the ocean floor produce?
   Earthquakes on the ocean floor cause great sea waves called tsunamis. Waves can be 30-60 feet high and move at 400-500 miles per hour. When they hit the coast of land they destroy everything in their path.

6. How does earthquake energy travel?
   a. Earthquakes travel by waves called seismic waves.
   b. Three main types of waves:
      1. "P" waves - primary waves-they are push-pull waves and make the rock and earth move back and forth in the direction the waves are moving. Push rocks and compress them, then spring back.

DEMO - SLINKY LONGITUDINAL

      2. "S" waves - secondary waves - slower than "P" travel only through solids, not liquids and gases. They move like a shaken rope.

DEMO: shape a rope or long spring



3. "L" waves - travel like waves in the ocean-makes the land move up and down-the most destructive wave-bend and travel earth's surface.

7. How are earthquakes detected?
A sesimograph is the instrument used to detect earthquakes. It records vibrations in the rocks that it was buried in.

8. How are earthquakes measured?
Earthquakes are measured according to scale called the Richter scale 1-10. The number indicates how strong the quake is. Any number above 6 is very destructive. Each number is 10 times stronger than the number before it.

9. Summary:
a) What is a fault, focus, epicenter, tsunamis?
b) How do earthquakes travel?
c) How are earthquakes detected and measured?

Conclusion: Show video - Earthquake - 20 minutes

Aim #22 What is weathering?

I.O.: Students will be able to identify and define weathering and the two processes that make up weathering.

Motivation: Demo: Rub 2 rocks together and ask what is occurring? Discuss: wearing away of monuments and statues.

Development:

1. From motivation (Weathering the breaking down of rocks and other materials on the earth's surface. Weathering is a slow, continuous process that affects all substances exposed to the atmosphere.
2. What are the factors that determine the rate of how fast rocks will weather?
   The factors that influence the rate of weathering are a) composition of rocks - softer rocks break up faster
   b) climate - deserts and areas of little rainfall weathering is slower than wet area (water is the fastest agent of weathering).
   c) topography - (contour or shape of land surface) of features affect weathering, maceration slopes weather faster due to more exposure.
   d) vegetation - plants protext rocks from wind and rain.
3. What are the 2 types of weathering and how do they differ?
   a) Mechanical or Physical Weathering
      The breaking down of rocks into smaller pieces but there is no charge in the chemical makeup of the rocks.
   b) Chemical weathering - occurs when the chemical makeup of the rocks is changed.
4. How does mechanical weathering (physical weathering) break up rocks? or What are the agents of mechanical weathering?
   a) ASK what are potholes and how do they occur? (potholes result when water gets into cracks on the road and freezes. Ice expands and breaks the crack a bit more and so on until a large hole is formed).
      Water expands when frozen - repeated freezing and melting of water breaks up rock-called frost action.
   b) temperature
      ASK what happens to rock when it sits in the sun-gets hot
      DEMO-ring and ball (silver heats up rock-it expands as it cools. It contracts, expansion and contraction cause the potholes in the surface of the rock to crack or flake off. called EXFOLIATION).

c) plant action- plant roots loosen and crack rock- sidewalks are often cracked by plants
d) gravity- gravity pulls loosened rocks down mountains called landslides. This breaks up larger rocks into smaller ones.
Sink holes- water dissolves roots and grass- causes topsoil to cave in--in Florida and N.J.
DEMO: rub 2 rocks together
e) abrasion- Wind blown soil and rock hits other rocks and wears them down and makes them smooth
Ex: smooth pebbles near lakes or oceans

5. What are the agents of chemical weathering?
Chemical weathering results in chemical changes taking place in rocks, resulting in mineral being added or removed from rock.
a) water - most chemical weather done by water dissolves, certain minerals in rocks (rocks that dissolve are called soluble).
b) OXIDATION - DEMO: Bite apple-turns brown peeled potato turns brown, paper yellows.
Oxygen combines with another substance from entirely different substance-iron and oxygen
CARBONATION DEMO: pour seltzer on chalk
carbon dioxide dissolves in water, forming a weak acid, carbonic acid. This acid chemically reacts with rocks to form new substances-wears away rock of centuries. Too weak to damage plants and animals.
c) acid rain - sulfuric acid formed from burning coals and gas with sulfur that dissolves in rain water to dissolve rock and kill trees and fish.
Discuss acid tain and danger and what can be done.

SHOW FILMSTRIP - WEATHERING (and videos)
Physical and Chemical Weathering

Summary:
a) What is weathering?
b) What are the two forms of weathering?
c) What are the agents of mechanical and chemical weathering?

Aim #23 -What results from weathering or How is soil formed?

I.O.: Students will be able to identify how rock weathers into soil and the composition of soil.

Motivation
Show a handful of soil (dirt) and ask the class what it is and how did it form?

Development:

1. From motivation: (Soil results from the weathering of rocks on the earth's surface).
2. Why is the formation of soil so important?
   The formation of soil is one of the most important parts of the weathering process because life as we know it would not be possible without soil.
3. Why? Soil is needed for growing grains (wheat, corn, rice, barley), fruits, vegetables and pasture grass.
4. Why is soil conservation [protection] so important?
   Soil is essential for growing food and the process of soil formation is very slow. It takes 100 years to make one can of soil.
5. What are the 5 factors in the formation of soil?
   a) The parent material
   b) The climate
   c) The topography (contour and shape of the land surface)
   d) The organisms in the soil
   e) time

   a. parent material
      The original rock from which the soil forms different rocks from different kinds of soil.
   b. climate - climates weather rock faster into soil. Large temperature changes also weather rock into soil faster
   c. Topography (shape of the land) - steep slopes drain faster, less soil, gradual slopes allow soil to remain and build up.
   d. Plant and animal life in soil help form it. Ants, worms create spaces for water, allow more weathering
   e. time - longer the time, the more soil is formed

6. What do we call the dead plants and animals that make up soil?
   (Humus-decaying material [plants and amimals that form a rich type of soil].)
7. What are soils composed of?
   (Soils are composed of inorganic and organic [once-living] material. Rock particles form).
   80% of soil.
   DEMO: Who sand vs. potting soil
8. How do different soils form?
   a. The type of rock (parent rock) broken down by weathering determines the kind of minerals in the soil or the type of soil.
   b) Soil texture (size of individual particles) is also affected by the type of weathering.

gravel - large particle
sand - smaller particles
silt - very small particles
clay - smallest particles produced only by chemical weathering

9. What are soil horizons?
   All soil as it forms, it develops separate soil layers called horizon.
   Mature soils develop 3 layers. It takes 1000's of years to develop (2 layers immature soil).
   a) upper layer called top soil, 2nd layer subsoil

10. What is leaching?
    The removal, usually by water, of mineral from the top soil. The 2nd layer is subsoil.

11. Why is leaching destructive?
    Leaching takes out minerals from the top soil making it less useful.

What is the danger in the world when our tropical rain forests are cut down?

12. Why are tropical rain forest soils poor soils when the trees are cut down?
    Heavy rainfall leaches most minerals far down into the soil and washes away most of the humus layer. Abundant plant and animal life quickly replace the humus.

13. Summary
    1. What is soil?
    2. What is parent soil, humus, top soil
    3. How do different soil textures c ome about?

SE1N General Earth Science 1

Aim #24: What are the types of erosion?

I.O.: Students will be able to identify the process of erosion and list its factors.

Motivation: Place a tray with sand or dirt on lab table.

DEMO: 1. Blow-move sand or dirt
2. Pour water onto tray. Move sand or dirt or discuss Grand Canyon.

Development:

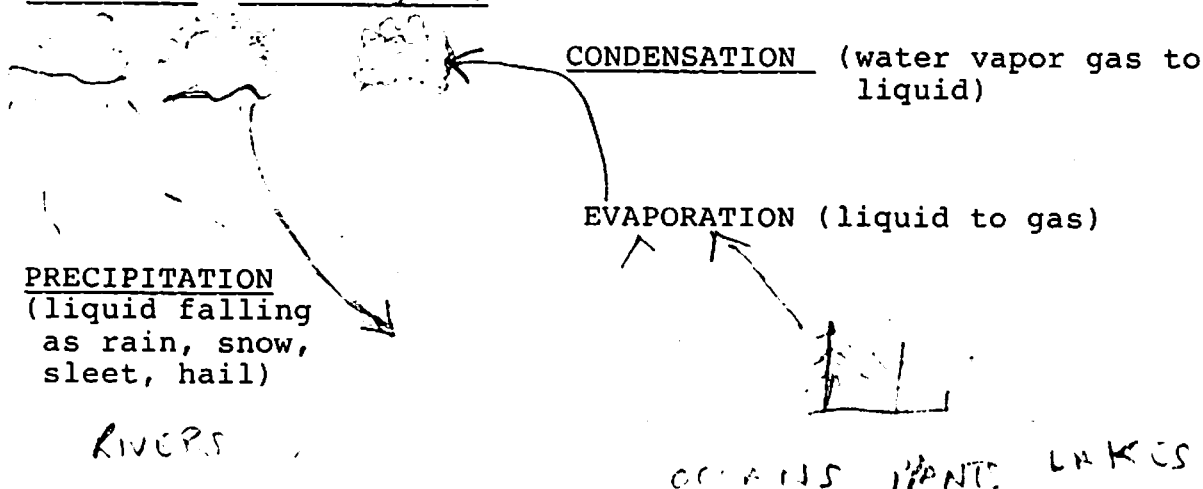
1. What process was shown by the demonstrator or by the Grand Canyon? (erosion)
2. What is erosion? (Erosion is the process by which weathered rock and soil is moved from one place to another).
3. What is weathering? (The breaking down of rocks and other material on the earth's surface. REVIEW TYPES OF WEATHERING (Lessson #22).
4. What occurs to the material after it is eroded? (Rocks and soil particles are carried away by erosion and DEPOSITED in other places).
5. What is the name of this process? (DEPOSITION is the process by which sediments are laid down or deposited in new locations).
6. What results from erosion and deposits? (Hint Grand Canyon is an example).
   a. Both erosion and deposition change the shape of the earth's surface.
   b. Erosion moves material from place to place
   c. Deposition builds new land forms

Aim #25. What effect does groundwater have on the earth?

I.O.: Students will be able to identify the water cycle and define the concepts of groundwater, water table, aquifer and artesian well.

Motivation:
Have pupils look at globe or map of the earth. Ask after looking at the map or globe what % of the earth's surface is made up of water.

Development:
1. From motivation-(Oceans cover about 70% of the earth's surface).
2. Why can't ocean water be used by most living things?
   (Ocean water cannot be used by most living things because it contains too much salt. The salt must be removed before the water can be used).
3. What do we call water without salt?
   (Fresh water - it makes up about 3% of the earth's water. Most can't be used because it is locked up in icecaps and glaciers - only 15% of the earth's fresh water is available for use by living things).
4. With such a limited supply of fresh water why don't we run out of fresh water?
   (Fresh water is continuously being renewed by the water cycle).
5. What is the water cycle?



6. What are the 3 forces involved in wearing down and building up the earth's surface?

   Weathering

Deposition — These 3 form a cycle

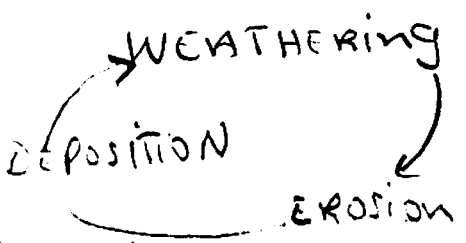
   Erosion

7. What are the agents that erode the earth's surface?
   Erosion can be caused by
   a. Gravity b. wind c. running water d. glaciers e. waves

8. Ask class to explain how gravity erodes the earth's surface?
   Gravity pulls rocks and soil down slopes.
   Ex: landslides can be caused by earthquake, volcanic eruptions or weakened supporting rocks due to heavy rain. Mudflow is another example.

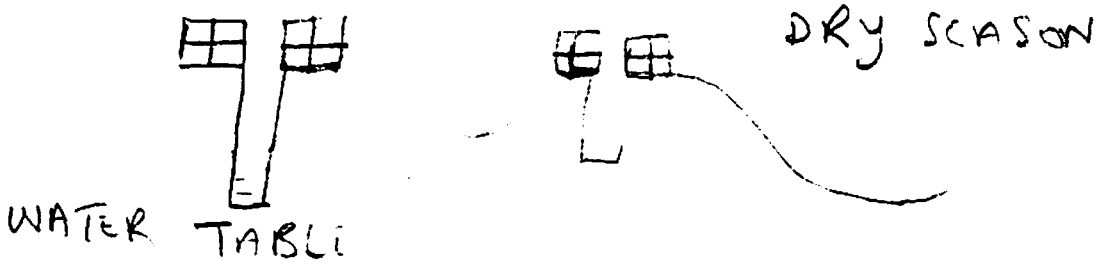
9. Summary
   a. What is weathering, erosion and deposition?
   b. How are these 3 connected?
   c. What are some agents of erosion?

   DRAW ON BOARD OR HAND OUT



10. What causes the water table to rise and fall?
    a. Heavy rains and melting snow will make the water table rise.
    b. Long dry periods will make the water table fall.

11. Where does a well get its water from?
    a. Ordinary well water table doesn't reach surface. One digs a well into the ground until the water table is hit. Water must be pumbped up to the surface. Water 20 meters or more below ground is generally cool.



    b. Artesian wells - water rises from teh aquifer (water bearing rock) that lies beneath an impermeable layer. In artesian wells water rises on its own due to the pressure the water is under deep in the ground.

12. What are other groundwater formations?
    Where groundwater meets limestone, it dissolves it and forms caverns.

13. Summary
    1. What are the parts to the water cycle?
    2. What is ground water?
    3. What is meant by permeable and impermeable rock layers, the water table.
    4. How are swamps and marshes formed?

SE1N

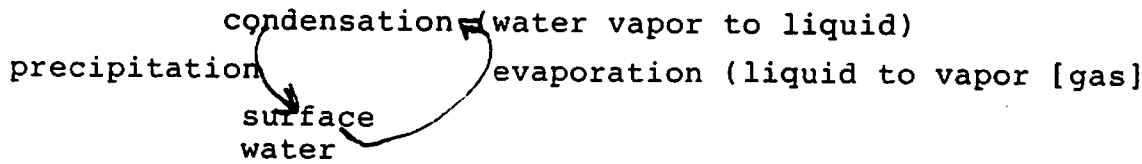
Aim #26-How are rivers and streams formed?

I.O.: Students will be able to define the water cycle and what surface water is and its results.

Motivation:
Spill some water on the lab table top. What kind of water is this called (analogy to water hitting the earth's surface).

Development

1. From motivation - Surface water is water that remains on the surface.
2. How does surface water usually form?
   (Precipitation - rain, snow, sleet, hail) falls to earth and remains on the surface as surface water).
3. How does precipitation form or fall to earth?
   The water cycle is the movement of water from the surface to the atmosphere and back to the surface



4. What is the difference between surface water and ground water?
   Surface water is that water that falls to earth that remains on the surface, while ground water moves below the surface.

5. What happens to most rain water that falls to earth?
   (Some rainfall soaks into the ground as ground water. Most rainfall or precipitation moves across the earth's surface from a higher level to a lower level).

6. What do we call the movement of surface water?
   (Runoff is the movement of water on the surface of the earth).

7. What affects the runoff of water?
   The shape of the land and the amount of rainfall affects runoff. Steep slopes produce greater speed of runoff. Heavy rain produces more volume of runoff.

8. What kind of land or surface features prevent the water from being absorbed or produces more runoff?
   Hard, rocky or cemental area like cities produce large land runoff. Congruence - heavy rains produce flooding.

9. What does runoff usually produce if it is very heavy and fast?
   Erosion by runoff is very common. It is the process that moves sediment and reshapes landscapes.

10. What is a gully? A small channel produced by the runoff of water. Sediment is carried away to form this channel.

11. What occurs as gullies begin to widen and carry more and more sediment?
    a) As gullies develop, a stream might form. Streams carry water all year, gullies only during rainfall.
    b) As time passes, move land may erode and a stream expands into a small river.

12. Why is water called "the great leveler?"
    (Water has the ability to erode highlands and fell in lowlands. Water carries a large quantity of eroded material).

13. What is the amount of eroded material carried by surface water called?
    (Food is the amount of eroded material carried by a stream or river.)

14. Runoff in open areas occurs in many places. What do we call an area that has many streams or runoff areas that flow into a river?

    (Drainage basin - is an area drained by streams or tributaries into a river).

15. (Tributary - streams that flow into a river).

16. Summary
    1. What is meant by:
       a. surface water
       b. runoff
       c. erosion
    2. How does a gully form?
    3. What is a drainage basin?

Aim #27 What is meant by the life history of a river?

I.O.: Students will be able to define the 3 stages of a river and describe their features and characteristics.

Motivation: Ask students to describe rivers they have seen and how they observed their flow.

Development:

1) Review the steps that form a stream
   a. runoff deepest gullies join streams lengthen or river
      widens form join to form
      forms
   b. All usually begin in mountains or hills
   c. Downward pull of gravity gives the water the energy to cut (erode) away the land and form valleys.

2. How do streams increase their length to form rivers?
   (Streams increase their length by a process called headward erosion- more and more materials erodes from the source or origin of the stream - the mouth of the stream or river is where the stream or river flows into some other body of water.
   DEMO: plaster pan filled with sand; pour water into pan; erodes sand from gully or stream.

3. How far down can a stream or river erode?
   A stream or river cannot erode below the elevation of its mouth. This point is called the BASE LEVEL. Sea level is ultimately the base level of all rivers.

4. Why do we say that a stream or river goes through stages as does a person?
   Streams and rivers as they wear away the land, go through three stages, youth, maturity and old age.

5. How do these stages develop and what are their characteristics?
   a. Youth - (stream or river)
      1. narrow, deep, v-shaped valleys with steep walls
      2. water flows rapidly and erodes the surrounding area rapidly.
      3. Waterfalls are common as are rapids
   b. Mature river - develops for many thousands of years
      1. due to continued erosion. waterfalls and rapids disappear; valley walls and river banks erode and widen and flatten
      2. river flows slower
      3. river meanders (broad curves or loops)
      4. Flat areas on both sides of the river form called flood plains Ex. Nile before Aswan flood every year; this flooding provided rich nutrients for soil for farming.
      5. Levee forms from flooding; levees-ridgelike deposits on sides of the river. (Artificial levees are made to prevent flooding).

c. Old Age
   1. very slow moving water (Mississippi river at mouth)
   2. wide flood plains
   3. many lakes, swamps and meanders
   4. meanders often cuts into another meander forming lakes
   5. Form deltas at the mouth of the river - slows down so much that it deposits much of its sediment at the mouth; forms delta. Ex: Mississippi Riber at New Orleans

6. Summary
   1. What are the stages of a river?
   2. Which stages flow fastest, slowest from deltas?

Aim #28 What are the affects of wave erosion and deposition?

I.O.: Students will be able to identify major features due to wave erosion and wave deposition.

Motivation: What are the distinguishing features found at an ocean beach? (waves, sandbeach, etc.)

Development: 1) What are waves caused by?
(waves are caused by winds and tides).

2) What are the results of wave action on a beach or the land?
Power forces of waves constantly erode and shape the shoreline.

3) How does wave action erode the ocean shore?
a. Waves force breaks off existing rock formation
b. Waves force water into cracks in the rock, producing pressure which opens the cracks more and breaks up rock
c. Chemical action of salt water breaks down rock

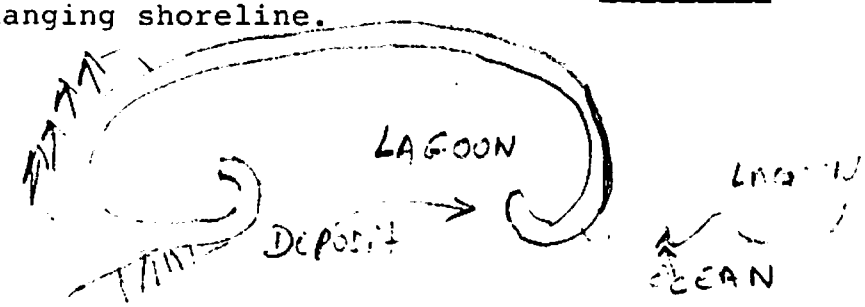
4) What rate or speed is a shore eroded?
a) Erosion occurs at different rates.
b) size and force of waves
number of storms that hit shoreline
c) type of rock that makes up shoreline

Deposition?

5) What are some features produced by wave erosion?
a. sea cliff and steep drops from higher ground
b. sea stacks columns of more resistant rock that remains after sea cliff is further eroded
c. sea caves

6) What are the features produced when waves (drop) deposit material?
What do waves carry besides water?
a) Waves carry large amounts of sand, rock particles and sea shells.
Where does this come from?
b) These particles come from other parts of the shoreline and are deposited elsewhere resulting in a changing shoreline.

a) beaches
b) sandbars — long underwater ridge of sand
c) spits — sandbar connected to a shoreline



d) lagoons - protected area of beach, protected by sandbar
e) hook - carved spit-Sandy Hook, NJ

7) Summary
1. What are the effects of erosion?
2. What are the effects of deposition or depository?

SEIN
Aim #29: How does wind erode the land?

I.O.: Students will be able to describe how wind erodes the land, including major land features resulting from this erosion.

Motivation: Describe a windy day at the beach. What occurs with the sand? (blows in face, etc.) Wind picks up loose sand.

Development:

1) From motivation: Wind is the most active agent of erosion in deserts, fields and beaches.
2) How does wind erode the land?
   Wind erodes the land in 2 ways
   a. removes loose material, sand, dust, etc. - called DEFLATION
   b. Particles that have been windblown slowly wear away exposed rock - like sandblasting - ABRASION
3) What does the amount of erosion depend upon?
   a. Amount of erosion depends on
      1. size of particle
      2. speed of wind
      3. length of time it blows
      4. resistence of rock exposed
4) What are some features formed by wind erosion?
   a. caves and canyons out west
   b. sand dunes
   c. Dust storms that remove precious top soil

5) How do you prevent wind erosion?
   a. Plant vegetation to hold down rock
   b. Plant trees to act as a wind break

6) Summary
   Show video The Rich High Desert

Aim #30: How do glaciers erode the land?

I.O.: Students will be able to state how a glacier forms and what it does to the land.

Motivation:
When you make a snowball and press the snow, what does it turn into? (ice)

Development:

1. What do we call the large mass of snow that falls in very cold areas that turns into large masses of ice?
   Glaciers form in very cold areas, such as high in mountains and near the North and South Pole.

2. How do glaciers exactly form?
   Snow falls in these very cold areas and does not completely meet because of the cold temperature. As more snow falls, it covers the older snow. As snow builds up, the pressure on the older snow squeezes it into layers. Ice becomes very thick and heavy and begins to move. As they move, they erode the land it moves over.

3. What are the two main types of glaciers?
   a. valley glaciers
   b. continental glaciers

4. What is a valley glacier and what does it do to the land it moves over?
   a. Valley glaciers form high in the mountains and move downhill between the sides of the mountain valleys
   b. As valley glaciers move downhill, it tears rocks and pebbles and sand from the mountains and these rocks cut and wear away the walls of the valley. Rocky material called TILL forms "U" shape valleys.
   c. Cracks in the surface of the glacier are called CREVASSES
   d. When they reach warm places down the mountain, they melt, leaving all of the called rock (till) in mounds called MORAINES and holes which become glaciel lakes.

5. What are some famous valley glaciers?
   Mt. Rainier in Washington State, Mt. Washington in New Hampshire, many glaciers in Alaska.

6. What are continental glaciers and what do they do to the land they move over?
   a. In polar regions, ice builds up into large, thick sheets called CONTINENTAL glaciers.
   b. Continental glaciers cover millions of square miles and are several 1000 feet thick and move out very slowly.
   c. 80% of Greenland is a continental glacier.
      90% of Antarctica is a continental glacier.

7. Where do icebergs come from?
   Icebergs are large chunks of continental glaciers that break off when the glacier meets the ocean. They float in the oceans, causing danger to passing ships.

8. What are some uses for icebergs?
   Icebergs can be a source of fresh water.
   Problems: a. cost to tow it
             b. melts as you tow it south
             c. can effect climate of area as you tow it next to land

9. What is the ice age and how did it happen?
   About 1 million years ago it was very cold in northern North America and Europe as it is today in Greenland. Great ice sheets developed as far south as Ohio and Central Long Island. The ice sheet advanced and receded four times during the one million years. Climate changed from warm to cold and back again. Last ice sheet 11,000 years ago.

10. Summary
    a. How are glaciers formed?
    b. What do valley glaciers do to the land they grow over?
    c. Where do glaciers come from?

SEIN - General Earth Science 1

Aim #31: What is meant by geologic time?

I.O.: Students will be able to identify the concept of geologic time and identify major divisions of it.

Motivation:
Why was it impossible for early human beings to hunt dinosaurs? (Dinosaurs were long dead when humans began to populate the earth).

Development

1. What do we call the millions and billions of years that the earth existed?
   (Geologic time is the very long period of time the earth has exited.)
2. How is geologic time broken up or set up?
   a. Scientists set up a geologic time scale to record the history of the earth.
   b. The largest divisions of geologic time are called ERAS. Eras are broken up into PERIODS.

DISTRIBUTE ATTACHED STUDY SHEET TO DEVELOP THE ERAS

   c. There are 4 eras that make up geologic time - highlight
      1. Precambrian Era
         a. earliest history of the earth
         b. No life on land
         c. Simple sea plants - little fossil evidence remains
         d. Much mountain building and volcanic activity
         e. last 4 billion years
      2. Paleozoic Era
         "Age of invertebrates"
         a. most common life - invertebrate (no backbone)
         b. amphibians were also evident (live on land and water -frog)
         c. first reptiles and giant insects
      3. Mesozoic Era - Age of Reptiles - dinosaurs roamed
         b. first mammals c. widespread tropical climate - replaced by colder climate - plant eating dinosaurs died off (extinct 65 million years ago)
      4. Cenozoic Era (started 65 million years ago) - you live in Age of mammals. Ice age occurred here, last one 11,000 years ago. Monkeys and apes appeared 30 million years ago. First huminoids - human-like 3.5 million years ago. Man as we know it today appeared 125, 000 years ago.

(DON'T REQUIRE STUDENTS TO MEMORIZE THIS INFORMATION. LET THEM BECOME FAMILIAR)

3. Summary
   Have pupils review worksheet.