Earth Works

DRC 2017

OVERVIEW:
Mountains, valleys, volcanoes, and beaches; students become budding geologists as they study weathering, minerals, and the wonders of rocks.

OBJECTIVES:
Students will be able to:
- Identify a diversity of elements, minerals, and rocks
- Differentiate weathering processes
- Classify the different rocks within the rock cycle
- Theorize human uses for geologic resources

VOCABULARY:

Chemical Weathering	Deposition	Element	Erosion
Extrusive Igneous Rock	Gem	Geology	Igneous
Intrusive Igneous Rock	Metamorphic	Mechanical Weathering	Mineral
Ore	Rock	Rock Cycle	Sedimentary
Weathering			

NEXT GENERATION SCIENCE STANDARDS:
- Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time or cost. (3-5ETS1-1)
- Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. (3-5ETS1-2)
- Make observations and measurements to identify materials based on their properties. (5-PS1-3)
- Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. (MS-ESS2-1)
- Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. (MS-ESS3-1Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. (MS-ESS2-2)
- Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. (MS-ETS1-3)
- Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. (MS-ETS1-4)
- Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. (MS-ETS3-3)
- Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. (MS-ESS3-4)

MATERIALS:
Toothpicks
Oatmeal raisin cookies (at least one per buddy pair)
Earth Works bag
Picture of the Periodic Table

PROCEDURES:
1. Introductory Activity: Rock Hunt (found in activity glossary)
   A. Frontload rock collection with students, then each student finds a small rock to investigate.
   B. Debrief: Poll the audience to see who found their rock. How were they able to identify their rock without seeing it? What did they feel with their hands? What causes the difference in texture between rocks?
   C. What is the study of rocks? ***Geology***

**Consider having students hold on to Rock Hunt rocks during the "What is a Rock Discussion", referring to their personal rock when describing the structure.*

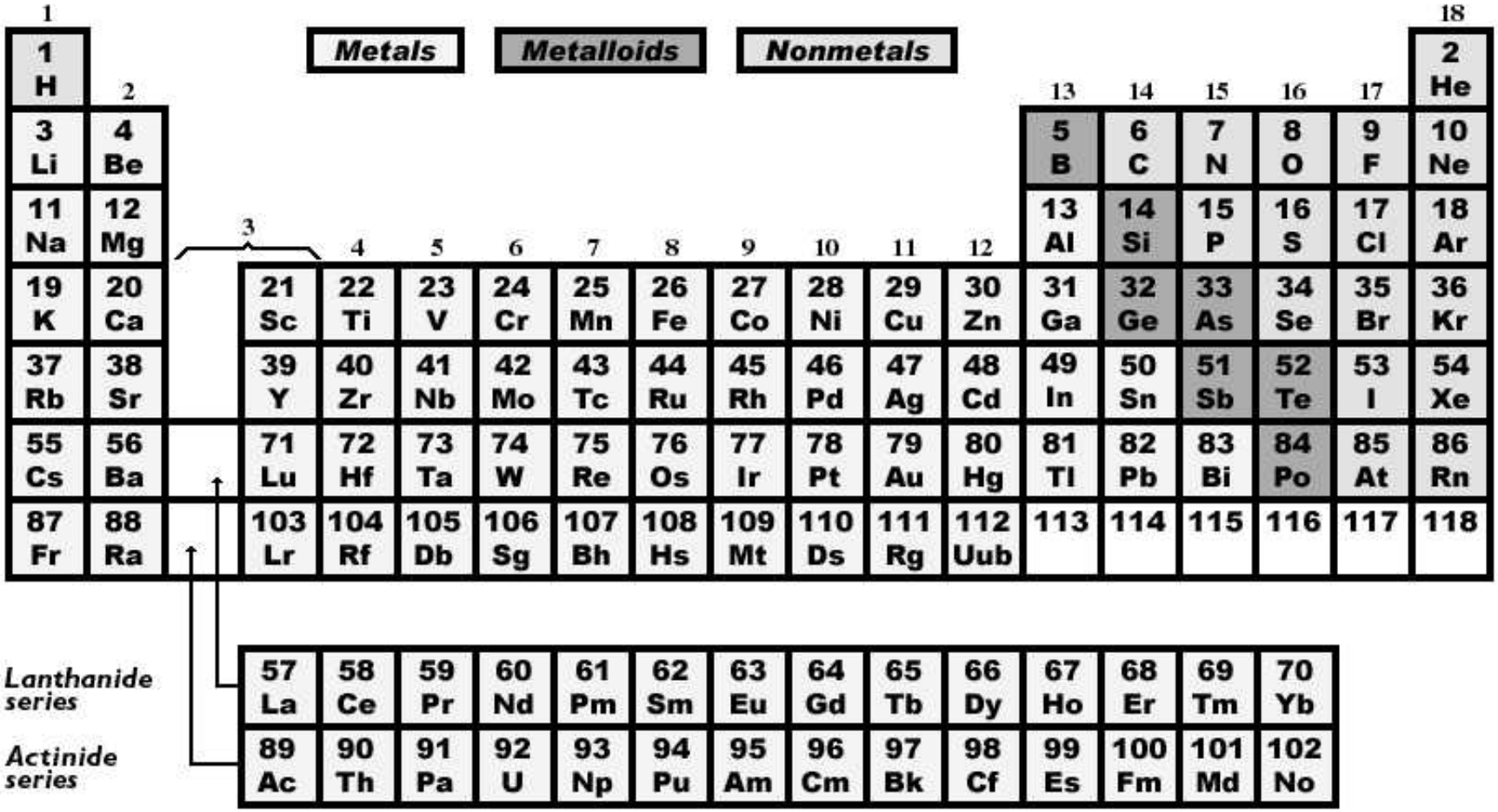
2. What is a Rock Discussion
   A. Explain that the structure of a **rock,** in the geologic sense, is any collection of **minerals** in a solid state at room temperature. The structure of rocks is like cookies. Each rock has different ingredients and different cooking times and temperatures.
   B. Minerals are substances with a constant chemical and physical structure. Minerals are the basic building blocks of all rocks; they are compounds made of **elements**. Diagram a chocolate chip cookie – minerals are the chocolate chips, the cocoa and sugar that make up the chips are the elements.
   C. Ask students if they have seen a table of elements—there are 118 elements. Show students a picture of the periodic table. Can anyone give some examples? Gold, iron, potassium, oxygen, carbon. These elements combine to make approximately 3,800 minerals.
   D. Some rocks are more valuable than others for different reasons. Have students brainstorm examples and attempt to categorize.
      Ores are valuable because of the metals that can be mined and separated from the rock. Gold and iron are two examples of ores found in these mountains making mining popular here in the early 1900's.
      Gems are valuable because they are very rare and have unique properties and characteristics. They are also very beautiful when polished. Many gems have been found in Riverside and San Diego counties, including topaz, garnet, quartz, and tourmaline.
      i. Mining for Minerals (found in activity glossary)
      ii. Debrief: How is your chip mine like a real one? (Lots of material, but small amount of ore or gems). How is it different? What incentive do you have to be careful while mining? ($$) What is an incentive in real life? (Reduce erosion, land reclamation, not destroying habitats). Which minerals are extracted from the San Bernardino Mountains? (Settlers used to mine gold; now mining limestone, used for cement, at Mitsubishi plant on HWY 18 near Lucerne Valley). What do you think will happen to mined land over time?
3. Changing and Shaping Rocks Discussion
   A. Explain that **weathering** is the breakdown of rocks by either mechanical or chemical processes.
   B. Discuss **mechanical weathering**. The physical breakdown of rock into sand, silt, clay. Chemicals stay the same. Examples are: frost action (water seeps into cracks, freezes and expands), roots (splitting), animals, and people.
   C. Fragments are rocks being transported by wind, water, or gravity is a process called **erosion.** It is the movement of rock and its particles, not the physical/chemical change**.** Finally, these particles are deposited, usually on the floors of lakes or oceans but sometimes in the beds of rivers. Steep trails around site are good examples of erosion.
   D. Discuss **deposition**. The dropping off of sediment. As sediment erodes, it is dropped off somewhere else. As this happens, the shape of the land changes. Landslides are an example of erosion and deposition together that greatly changes the shape of land (ie Big Sur 2017).
   E. Discuss **chemical weathering**. Chemical breakdown of rock. Examples are: carbonic acid (the combination of water and carbon dioxide. Dissolves the mineral calcite, found in limestone and marble), oxidation (oxygen in the air can react with rocks containing iron, causing rust to form), acid rain.
4. The Rock Cycle Discussion
   A. Explain the **rock cycle**. It is a never-ending series of processes, transitioning energy and matter throughout the cycle. It has no beginning or end. Rocks can be broken down into three categories.
   B. Define **igneous rock**: formed from cooling magma (melted rock). You can tell how quickly or slowly an igneous rock cools by the size of its crystals. Big crystals form from slowly cooling rock (think granite counter tops) and small crystals from quickly cooling rock (think basalt or pumice) If the rock cools and is formed inside the earth it is called **intrusive** igneous rock. An example of this is granite. If the rock cools outside the earth or above ground it is called **extrusive** igneous rock or volcanic rock. An example of this type is basalt.
   C. Define **metamorphic rock**: these rocks are changed because they are buried so deep and experience heat and pressure. During metamorphosis the minerals move around and form layers or actually re-crystallize and form new minerals. Limestone morphs into marble, and granite and sandstone into gneiss and sandstone into quartzite through this process.

D. Define **sedimentary rock**: formed from sediments (things like sand and mud) solidifying. These sediments are deposited in layers. These rocks usually have the most historical information in the form of fossils, ripple marks, and mud cracks. By looking at these rocks we can often tell how past environmental conditions were. Sedimentary rocks hold our natural fuels such as coal, oil, and underground water supplies. Sandstone and limestone are two common sedimentary rocks in the area.
   i. Activity: Rockity-Rock, Rock, Rock (found in activity glossary)
   ii. Debrief: What are the three main rock types? How is each of them formed? Can any rock change into any other rock in the rock cycle?

5. *Experiment: Breakin' Rocks*
   A. To show that the outer layers of rocks can be weathered, have student break open rocks, use magnifying glasses to study the characteristics of the rock. Use safety precautions. Other things to look for are different grain sizes in different rocks (large in granite, small in sandstone).
   B. Conduct experiment.
   C. Debrief: How does the inside of your rock look as compared to the outside, why? What differences and similarities were noted when comparing the outside and inside of each rock? Was your rock hard to break, what does that tell us? Theorize how breaking a rock helps geologists learn about the rock and forces that are weathering that rock?
6. Wrap Up
   A. *What?*] Concisely review the major points of the lesson, all the way back from the introductory activity.
   B. [*So what?*] What was important for you to discover from the lesson? Why was it important for all of us to take this class?
   C. [*Now what?*] What can you now do with this information? What changes can you make in your life? What can you teach to others? Who will you tell? What will you say?
   D. Pass out beads after all students have contributed.

THINGS TO THINK ABOUT:

Additional Tips: Throughout your day point out different examples of weathering, deposition, and erosion.
Special Needs: Plan your trip. Make sure you are going to places with good small rocks.
Time Fillers: Trail mix handy? Illustrate the types of rock by having students stack a few "minerals" together to make sedimentary rock. Then have them partially chew their creation and show how it changes under heat and pressure as metamorphic rock. How could they demonstrate igneous rock? Keep it school appropriate…
Weather: Snow will inhibit your ability to find rocks. Adjust *Rock Hunt* if necessary.


Metals
Metalloids
Nonmetals
1 H
2 He
3 Li
4 Be
5 B
6 C
7 N
8 O
9 F
10 Ne
11 Na
12 Mg
13 Al
14 Si
15 P
16 S
17 Cl
18 Ar
19 K
20 Ca
21 Sc
22 Ti
23 V
24 Cr
25 Mn
26 Fe
27 Co
28 Ni
29 Cu
30 Zn
31 Ga
32 Ge
33 As
34 Se
35 Br
36 Kr
37 Rb
38 Sr
39 Y
40 Zr
41 Nb
42 Mo
43 Tc
44 Ru
45 Rh
46 Pd
47 Ag
48 Cd
49 In
50 Sn
51 Sb
52 Te
53 I
54 Xe
55 Cs
56 Ba
71 Lu
72 Hf
73 Ta
74 W
75 Re
76 Os
77 Ir
78 Pt
79 Au
80 Hg
81 Tl
82 Pb
83 Bi
84 Po
85 At
86 Rn
87 Fr
88 Ra
103 Lr
104 Rf
105 Db
106 Sg
107 Bh
108 Hs
109 Mt
110 Ds
111 Rg
112 Uub
113
114
115
116
117
118
Lanthanide series
57 La
58 Ce
59 Pr
60 Nd
61 Pm
62 Sm
63 Eu
64 Gd
65 Tb
66 Dy
67 Ho
68 Er
69 Tm
70 Yb
Actinide series
89 Ac
90 Th
91 Pa
92 U
93 Np
94 Pu
95 Am
96 Cm
97 Bk
98 Cf
99 Es
100 Fm
101 Md
102 No