What's the Story with Sand?

Lesson Focus: Sand

Learning objectives:

- Students will understand that sand is what is left after weathering of other rocks.
- Students will recognize that different types of sand exist.
- Students will differentiate between sand, soil, and other small particles.

Enduring Understandings for the lesson:

- Erosion and weathering is connected to our beaches.
- Our beaches reflect what our rivers are carrying and human activities can lead to greater sediment loads in our rivers.

Georgia Performance Standards Addressed:

S5-6CS1. Students will be aware of the importance of curiosity, honesty, openness, and skepticism in science and will exhibit these traits in their own efforts to understand how the world works.

a. Keep records of investigations and observations and do not alter the records later.
b. Carefully distinguish observations from ideas and speculation about those observations.
c. Offer reasons for findings and consider reasons suggested by others.

S5-6CS3. Students will use tools and instruments for observing, measuring, and manipulating objects in scientific activities.

d. Identify and practice accepted safety procedures in manipulating science materials and equipment.

S5-6CS5. Students will communicate scientific ideas and activities clearly.

b. Make sketches to aid in explaining scientific procedures or ideas.

S5-6CS4. Students will use ideas of system, model, change, and scale in exploring scientific and technological matters.

a. Observe and describe how parts influence one another in things with many parts.

S5E1. Students will identify surface features of the Earth caused by constructive and destructive processes.

a. Identify surface features caused by constructive processes.
  • Deposition (Deltas, sand dunes, etc.)
b. Identify and find examples of surface features caused by destructive processes.
  • Erosion (water—rivers and oceans, wind)
  • Weathering

c. Relate the role of technology and human intervention in the control of constructive and destructive processes. Examples include, but are not limited to
- Flood control, (dams, levees, storm drain management, etc.)
- Beach reclamation (Georgia coastal islands)

S6E5. Students will investigate the scientific view of how the earth's surface is formed.

b. Investigate the contribution of minerals to rock composition.

d. Describe processes that change rocks and the surface of the earth.

h. Describe soil as consisting of weathered rocks and decomposed organic material.

i. Explain the effects of human activity on the erosion of the earth's surface.

Grade level: 5^{th} – 6^{th}

Materials:

Sand samples from various beaches/rivers
Soil samples – from a variety of places
Hand lenses or Microscopes (If using microscopes, stereo microscopes are preferable but if using biological microscopes, use only the 4X magnification.)
Black and white paper
Colored pencils
Metric rulers
Magnets
Vinegar or other weak acid

Time needed: one to two 45-minute periods

Background information:

Weathering causes the splitting of rock into smaller pieces. There are three main types of weathering: physical, chemical and biological. Physical weathering does not affect the chemical makeup of the rock and it just changes the size of pieces. It can be caused by tumbling of rocks (such as in a river) or by the freeze/thaw cycle of water. Chemical weathering is caused by a chemical reaction between rocks and water (or water solutions) or gases in the air. Water (especially when acidic) can dissolve certain minerals such as calcite such as limestone or marble. Oxygen in the air reacts with iron- or manganese-containing elements and causes the formation of iron oxides which are the red pigments in Georgia's red clay. (This process is commonly known as "rusting.") Another chemical reaction – hydrolysis - causes weathering of silicate minerals to form clays. Biological weathering can be caused by plant roots growing into rock, by chemicals excreted by certain living organisms such as lichen, or by animals (including humans).

As rock is weathered, it breaks up into smaller and smaller pieces. Those pieces that survive as small rocks we call sand. The type of sand found in a river and on the beach varies from one to another based on whatever type of rock is common upstream. However, on some beaches, not all sand is deposited from rivers. Some of the "sand" is made up of tiny bits of coral, small shells or shell fragments caused by wave action on coral reefs. Sand found on a beach with lots of wave action will have more rounded and smooth grains of sand, whereas a more protected beach will have more angular and sharp grains.

For sand made from rocks, the color of the sand is related to whatever minerals are contained in the sand. Sand made of quartz will create a shiny white beach. Sand containing lots of feldspar will make a beach more orange colored. Black beaches are formed by sand derived from rocks that contain minerals such as mica and hornblende. If sand has magnetic properties, then it contains the mineral magnetite. Sand is defined according to specific parameters. If more than 50% of the material is bigger than 75 microns (0.075 mm) and smaller than 4.75 mm in diameter, it is considered sand. If the average particle size is smaller, it is actually considered silt or clay and if the average particle size is larger, it is considered gravel.

Learning Procedure:

1. Start the discussion by reviewing what the students already know about weathering and erosion. (This lesson should occur after they have learned these concepts and will help reinforce them.)
2. List on a poster what questions do students have about sand. Here are a few to consider if they don't mention them: Where does sand come from? What story does the sand tell you? Why is most sand white or beige? Why are some beaches black? What else can beaches be made of besides sand – or what else can "sand" be made of? How big or little can a particle be and still be considered sand?
3. Introduce different samples of sand and where they came from. Explain to the students some of the things they can look for when investigating sand and give them Student Worksheet to fill out as they investigate six known samples.
4. Tell the students we have some mystery sand that has been send to the classroom. There is no return address so we have no idea where it came from so we need to do an investigation to figure out what it is made of to figure out where it came from.
5. Have the students work through the student worksheet using the. black and white paper and the light source to see better. I am not sure where you were going here… I am confused!
6. Have a discussion on what the answers are to the two mystery samples and then recap answering the questions to #2.

Evaluation:

1. From samples of rock or minerals, have students identify which rock/rocks their sand could have come from.

Extensions:

1. Have students write a story from the sand's point of view from beginning to end. This could allow the teacher to evaluate their knowledge of weathering and even the rock cycle.
2. Ask the students to investigate the process of dune-building and how big desert dunes come to be where they are and how they form and change over time.
3. Some beaches seem dirty. If this is the case, where does that dirt come from? What would this tell you about the watershed from which this sand is being deposited?
4. Have students brainstorm ways that beaches get "altered" by humans including, but not limited to, damming up rivers, beach reclamation and refurbishing, building on the very edge the ocean, building seawalls, breakwaters and groins to prevent erosion, etc. Have them research a topic of their choosing.

Resources:

Microscopy Society of America -- a source to order sand samples from:
http://www.microscopy.org/education/ProjectMICRO/SandList.cfm

Microbus – Take a Microscope Trip -- information and lessons for using microscopes with a nice discussion about sand:
http://www.microscope-microscope.org/applications/sand/microscopic-sand.htm

Coastal Regions and Small Island Papers: *An Introduction to Sand Watch: An Educational Tool for Sustainable Development* – an online article about sand
http://www.unesco.org/csi/pub/papers3/sande7.htm

Lesson developed by: Sarah Topper, Greenfield Hebrew Academy

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What's the Story with Sand?

Student Worksheet Name: _____

Directions: Collect some of each of the six samples of sand. Write an answer for each step (#1-11) in Data Table #1 below.

1. Record the source of each of your samples.

2. What is the general color of the sample (before magnification)?

3. Looking at your samples of sand under the microscope (at 4X magnification only), place a metric ruler in the view to get a sense of the size of grains. What is the size of the grains?

4. Are the sample grains all about the same size or very different sizes?

5. What shapes do you see? Sketch a few if you can't describe them well.

6. Are the grains rough or smooth?

7. What colors are the grains? Use your white or black paper to help you see the color of the sand better.

8. Sketch the magnified view of the sand using color pencils.

9. Try using a magnet on the sand to see if it picks anything up.

10. Try putting a few grains of sand in a small cup and adding a few drops of vinegar. If it is bubbling, that is considered a reaction. A reaction indicates the presence of calcite in rocks or carbonate in shells.

11. Decide whether based on all the evidence, if you have sand made from rocks or sand made from shells.

Data Table #1

Sample	1	2	3	4	5	6
1. Source of Sample						
2. General Color before magnification						
3. Size of Grains (mm)						
4. Grains all same size or different sizes?						
5. What shapes?						
6. Rough or smooth?						
7. Color(s)						
8. Sketch						
9. Magnetic?						
10. React with acid?						
11. Rocks or Shells?						

Now, collect 2 of the mystery samples and examine them using the 11 steps above. Guess which of the six locations they came from by your observations.

Data Table #2

Sample	Mystery Sand 1	Mystery Sand 2
1. Source of Sample		
2. General Color before magnification		
3. Size of Grains (mm)		
4. Grains all same size or different sizes?		
5. What shapes?		
6. Rough or smooth?		
7. Color(s)		
8. Sketch		
9. Magnetic?		
10. React with acid?		
11. Rocks or Shells?		

Questions

1. What are some things that the color of the sand could tell you?

2. When the sand is smooth vs. rough, what can that tell you about the conditions on that beach?

3. What mineral would cause the sand to be magnetic?

4. What is the range of sizes you found for sand?

5. What do you think determines the minerals/rocks that are most likely to become sand?

6. Predict what would happen to beaches when people dam up rivers?