Clastic Rocks

Lesson 8

Rocks begin to weather as soon as they are exposed to air. Small and large chunks of rock break off due to physical weathering. These bits and pieces of rocks and minerals are called detritus (Latin for worn down) sediments or clastic (from the Greek word *klastos*, meaning broken into pieces) sediments. The individual clasts can range in size from giant boulders down to microscopic sized particles of clay. Clastic rocks consist chiefly of quartz, feldspars, rock fragments, micas, clay minerals, iron oxides and calcite. Other clasts result from chemical alteration of the minerals during chemical weathering.

Physical weathering of rocks occurs when water seeping into cracks in rocks freezes. The expanding ice breaks off parts of the rock. The expansion and contraction of rocks during hot days and freezing nights can also cause parts of a rock's face to break off. Roots of plants growing in cracks and crevices often cause rocks to break apart. During an earthquake, rocks are often broken apart as the pressure that has been building up in the rocks is suddenly released. Rocks on the face of a beach cliff can be undermined by pounding waves and break off. Clasts that break off rocks can be as large as a boulder or as small as a flake of clay.

Wentworth Scale of Clastic Sediments

Particle	Size of clasts	Sediments	Clastic rocks
Boulder	More than 256 mm	Boulder gravel	Boulder conglomerate
Cobble	64 to 256 mm	Cobble gravel	Cobble conglomerate
Pebble	2 to 64 mm	Pebble gravel	Pebble conglomerate
Sand	1/16 to 2 mm	Sand	Sandstone
Silt	1/256 to 1/16 mm	Silt	Siltstone
Clay	Less than 1/256 mm	Clay	Mudstone or shale

The range of particle sizes in a rock is used to classify clastic rocks. There are four main groups of particle sizes. The coarsest particles are gravel. Because of the great variation in sizes of gravel, there are three subgroups. The subgroups are boulder gravel that are more than 256 mm in size, cobble gravel between 64 and 256 mm in size, and pebble gravel that ranges between 2 and 64 mm in size. Sand, silt, and clay clasts complete the groups. The clasts may consist of any type of rock fragment or mineral. While most people think of sand as quartz, it can also be any sand-sized particle of rock or mineral.

Boulders and cobbles do not travel far from their source unless carried along in the ice of a glacier. Pebbles carried into streams are tumbled along the bottom of a stream or river during rainstorms and floods. When pebbles first tumble into a stream or river, they have sharp and jagged edges. The longer a pebble stays in a river the rounder and smoother it becomes. Small particles break off as rocks tumble around in streams creating smaller clasts that are sand or silt size particles. Quartz resists weathering in water because he does not have cleavage planes and is almost insoluble in water. Most quartz particles become sand-sized clasts. Smaller pieces of

quartz, silicates and other minerals break into clay-size and silt-size particles. River water carries the clay-size particles downstream in suspension, which gives the water a muddy color.

Sand

Pebbles

River rock

Chemical weathering of silicate minerals produces a large variety of clays. Most clay particles come from large igneous and metamorphic silicate minerals that combine with water in a process called hydrolysis. During hydrolysis, all clay minerals are hydrated and they have either HO or H_2O in their formula. The silicates literally rot away into small flakes of clay that are less than 1/256 mm in size. The crystal structures of these minerals are sheets of silicates that loosely bind together, giving clay its flaky nature.

Feldspars in granite rocks combine with slightly acid rainwater produce kaolinite, a type of clay used in making china. Kaolinite is a solid residue left behind as the rest of the materials wash away. There are some places where so much granite converted into kaolinite that it is mined for china clay. Pyroxenes and olivines found in basalt react with water producing iron oxide a solid residue. The rest of the material is carried away in solution. Water contributes to the breakdown of micas, amphiboles and many other metamorphic minerals. The only common mineral that is almost immune to chemical attack by water is pure quartz (SiO_2). Pure quartz is virtually insoluble on the surface of the Earth under normal conditions. It is soluble in acidic groundwater, which produces complex silicate minerals during hydrolysis.

Clay washed into a river during a rainstorm is carried to the ocean. The clay particles are so small and light that they stay suspended in the water until it stops moving some distance offshore. The clay settles out of suspension on continental shelves forming deep layers of clay. Each time a new layer of clay forms a bed. On top and bottom of each bed is a bedding plane that separates individual layers. Clast size and mineral content of each layer distinguishes them from those above and below. Compaction from layers above reduces the pore space forcing the water out. Substances dissolved in the pore water precipitate out binding the grains together forming shale or claystone. Silt is slightly larger and settles closer to shore. You can distinguish claystone from siltstone by the feel of the rock. Claystone is smooth to the touch while siltstone feels gritty to the touch.

Sandstones contain minerals or rock fragments that are sand-size. Quartz and other sand-sized particles form sedimentary beds much closer to the shore than clay and silt. Compaction by the overlying layers causes sand to lithify, turn to stone, forming sandstone. Moving water containing dissolved calcite and silica precipitates between the mineral grains binding the rock together. Most sandstone is predominantly quartz because of its resistance to weathering. Quartz

sandstone is almost pure quartz. Greywacke is dark coarse-grained sandstone containing quartz, feldspars and rock fragments.

Sandstone

Rocks, pebbles and sand left behind when rivers change their channel form conglomerates. Conglomerates usually contain a variety of sizes of rock particles. They look similar to a manmade rock with pebbles held together with sandy cement. Conglomerates form as calcite and quartz precipitates between the individual rock grains. Conglomerates with bright colored pebbles cemented together are puddingstone. Breccia is similar to a conglomerate, except the rock particles have jagged and sharp edges. Breccia usually forms at the base of cliffs or in a fault zone.

When first learning the different types of sedimentary rocks you might begin by studying the three major types of clastic rocks.

1. Sandstones are clastic rocks made from sand.
2. Shales are clastic rocks made from mud.
3. Conglomerates are pebbles and sand cemented together.

Lesson summary

- Clastic sediments are broken off bits and pieces of rocks and minerals that accumulate in layers called beds.
- Clastic rock particles can be as large as boulders or as small as dust.
- Quartz and calcite usually cement clastic rocks together.
- Most sandstone is predominantly quartz because it is hard, resists erosion and is almost insoluble.

Name _____

Date _____

Clastic Rocks

Quiz 8

Fill in the blanks using words from the Word Bank

1. Conglomerates form when _____ and sand are cemented together.

2. The longer a rock stays in streams and rivers the smoother and _____ it becomes.

3. Sandstone forms from sand-sized grains of _____ _____ and rock fragments.

4. Breccia has jagged and sharp edges because it usually forms at the base of cliffs or in a _____ zone.

5. Clasts, small rock particles, break off as rocks _____ ___ around in streams.

6. Claystone is _____ to the touch while siltstone feels gritty to the touch.

7. Rocks begin to weather as soon as they are _____ to the air.

8. _____ and calcite bind sandstones together.

9. Small and large chunks of rock break off due to _____.

10. _____ is coarse-grained sandstone containing quartz, feldspars and rock fragments.

Word Bank

minerals	exposed	tumble	pebbles	greywacke
smooth	silica	rounder	weathering	fault

T-Notes on Clastic Rocks

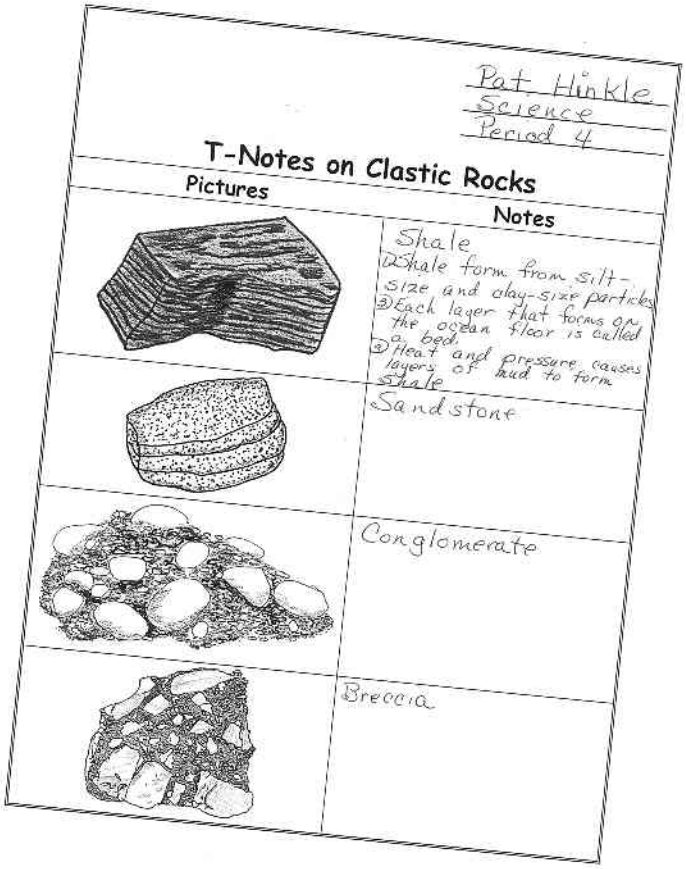
Activity 8

Introduction

You will look over several clastic sedimentary rocks with your unaided eye and then with a hand lenses. After studying each rock sample, make a scientific drawing of the rock. Beside each picture, write some identifying features of the rock either from your observations or from your class notes on clastic rocks.

Materials

- Blank typing paper
- Clastic sedimentary rocks in kit
- Colored pencils
- Keychain microscope



Directions

1. Take your samples of rocks out and look them over carefully.
2. Draw a picture of each rock on the left-hand column of the paper.
3. Write some notes about each rock in the right-hand column.

Extension

- Write T-Notes about igneous and metamorphic rocks.
- Collect other types of sedimentary rocks and include pictures and notes on these rocks on the T-Notes page.