Mount St Helens National Volcanic Monument
Gifford Pinchot National Forest
USDA Forest Service

Rock Program – Elementary School

Time Commitment: 45 minutes

Location: Johnston Ridge Observatory – outside deck or inside visitor center

Materials: Rocks, worksheets, gray scale/texture chart, pencil, clipboards

Students will identify samples of MSH "B.A.D" rocks and record their observations on a data sheet.

Goal:

1) Students will become familiar with igneous rocks types produced by MSH.
2) Students will understand that different igneous rock types have different characteristics.

Objectives:

1) Students will be able to explain what an igneous rock is.
2) Students will observe and examine physical properties e.g. texture and color of MSH rocks (5^{th} grade science benchmark – WA state).
3) Students will be able to identify rocks by their physical properties.
4) Students will make a record of their observations.

Case Facts and Evidence:

1) Igneous rocks are formed by magma or lava
2) Magma is molten rock underground; lava is molten rock that has reached Earth's surface.
3) Igneous rocks are differentiated by a percentage of silica
4) The amount of silica determines the shade of gray for each rock.
5) Lava with high silica content tends to flow more slowly (is more viscous) than lava with low silica content.
6) Igneous rocks with large crystals tend to have cooled slowly under the ground (intrusive)
7) Rock samples.

Volcanic Vocabulary:

1) **Igneous:** rocks formed by the cooling and crystallization of molten rock. The term **igneous** is derived from *ignius*, the Latin word for fire. Scientists have divided **igneous** rocks into two broad categories based on where the molten rock solidified: *volcanic rocks* (also called **extrusive igneous** rocks) which form above ground and *plutonic rocks* (also called **intrusive igneous** rocks) which form under ground.
2) **Intrusive:** formation of rocks below the earth's surface
3) **Extrusive:** formation of rocks at the earth's surface
4) **Minerals:** materials that make up the Earth's top layer; particles that make up a rock.
5) **Silica:** a glass-like building block of **minerals**
6) **Texture:** size, shape, and distribution of particles that make a rock
7) **Vesicular:** containing vesicles (i.e. pores in pumice)
8) **Viscous/Viscosity:** the ability of a liquid (e.g. molten rock) to resist flowing

Procedure: Identify the igneous rocks in the 'Box-O-Rox' according to distinguishing characteristics. The 'Box-O-Rox' contains numbered and lettered samples (rocks). Your group may have only one rock at a time with which to work. Observe each rock and describe it according to gray scale and texture in the corresponding square at the bottom of the page. Use the information provided by the ranger and the gray scale/texture chart to identify six rocks.

Sample #____ _____ *Identity* Gray Scale: _____ **Texture**: _____	Sample #____ _____ *Identity* Gray Scale: _____ **Texture**: _____	Sample #____ _____ *Identity* Gray Scale: _____ **Texture**: _____
Sample #____ _____ *Identity* Gray Scale: _____ **Texture**: _____	Sample #____ _____ *Identity* Gray Scale: _____ **Texture**: _____	Sample #____ _____ *Identity* Gray Scale: _____ **Texture**: _____

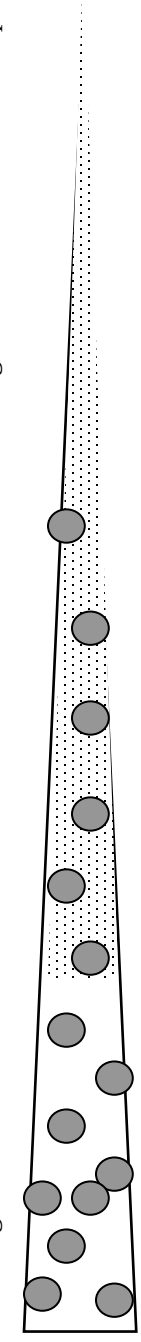
Group members: _____ , _____ , _____ ,

_____ , _____ , _____,

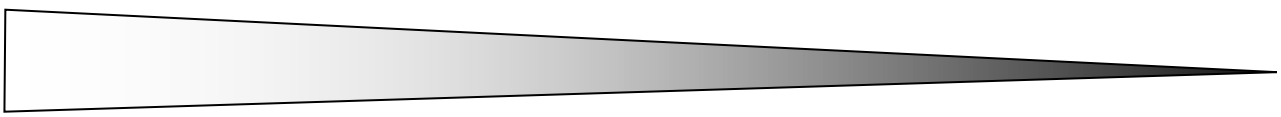
_____ , _____ , _____

Volcanoes Rock
Percent Silica and Texture Continuum

Where do your rocks fit on the silica/color and texture continuums?



Dacite Pumice • **Texture**: porous • % **Silica**: 62-68% • Viscosity: high **Extrusive**	*Andesite Pumice* • **Texture**: porous • % **Silica**: 55-61% • Viscosity: medium **Extrusive**	*Basalt Pumice (Scoria)* • **Texture**: porous • % **Silica**: 45-54% • Viscosity: low **Extrusive**
Dacite • **Texture**: fine grain • % **Silica**: 62-68% • Viscosity: high **Extrusive**	*Andesite* • **Texture**: fine grain • % **Silica**: 55-61% • Viscosity: medium **Extrusive**	*Basalt* • **Texture**: fine grain • % **Silica**: 45-54% • Viscosity: low **Extrusive**
Granodiorite • **Texture**: Coarse • % **Silica**: 62-68% • Viscosity: high **Intrusive**	*Diorite* • **Texture**: Coarse • % **Silica**: 55-61% • Viscosity: medium **Intrusive**	*Gabbro* • **Texture**: Coarse • % **Silica**: 45-54% • Viscosity: low **Intrusive**
Gray	**Dark Gray**	**Black**



Gray Scale determined by % Silica

Ranger Program Box-O-Rox

(Porphyritic and rhyolitic rocks should be removed before teaching Elementary program)

Rock Number	*Case Evidence Letter*	*Rock Type*	*Distinguishing Characteristics*
2.	**B**	Fine Andesite	Dark gray rock with crystals of similar size. Note small vesicles which may contain sediment. White minerals are feldspar, black are hornblende.
3.	**C**	Fine Dacite	Medium gray rock with crystals of similar size. Try to pick out the needles and blocks of black hornblende and the glassy, gray quartz. Feldspar is there, just very small.
5.	**E**	Dacite Pumice	Medium gray. Light-weight, some vesicles show glassy strands, tiny black needles are hornblende minerals.
6.	**F**	Basalt Pumice	Black color, light weight, many vesicles, may be oxidized and vesicles may contain dirt.
10.	**J**	Andesite Pumice	Medium gray rock with some vesicles, lightweight.
12.	**L**	Granodiorite	Medium-to-small crystals. Dark green minerals (hornblende) make up half the rock, weathered off-white minerals make up other half (quartz & feldspar).
13.	**M**	Diorite	Medium sized crystals with slightly more dark crystals than white (hornblende and feldspar).
14.	**N**	Gabbro	Large crystals with different shades of gray. Largest crystals are blocky and black (hornblende). White crystals are only small grains (quartz & feldspar).
16.	**P**	Fine Basalt	Black rock with flow marks and vesicles. Groundmass is so fine, that there are no crystals, glassy.

Teacher's Instructional Sequence for 'Volcanoes Rock':

Pre-visit: The purpose of this activity is to give students an introduction to how geologists identify rocks. The activity at Johnston Ridge is best served when the students are prepared with the following information.

1) The purpose of the activity. (1) Students will learn how and why geologists identify rocks, and (2) use their observation skills to conduct rock analyses. Different rocks have different characteristics. The characteristics of rocks produced at a certain locale, e.g. volcano, give us an idea not only of the volcano's history, but also of how it might erupt in the future. A volcano that produces **silica** rich rock like dacite, has a strong likelihood of producing an explosive eruption. A volcano that produces low **silica** rock like basalt is less like to erupt explosively. Large grained rocks indicate that magma cooled slowly underground, while a fine-grained **texture** indicates that rocks cooled quickly on the surface.

2) The relevant vocabulary: **Igneous, Intrusive**, **Extrusive, Minerals**, **Silica**, **Texture**, **Vesicular**, **Viscosity**. (See page 1 for definitions).

3) The Case Facts (see page 1).

4) Group Organization: Divide your class into groups of three to seven. Each chaperone should expect to assist one group of students. Each group should be equipped with worksheet, clipboard, and pencil (sharpened).

Ranger's Instructional Sequence for 'Volcanoes Rock':

Materials needed:
- Wheeled cart with shelf
- Rock samples (until collections are complete, get sample G (gabbro) from the Bingo Rocks and sample #6 (basalt pumice/scoria) from Box O' Rox
- Picture of basalt lava flow
- One copy of the laminated texture/gray scale chart per group
- Rock identification table

Optional materials
- Plastic honey bear
- Tube of toothpaste
- Bottle of soda

This activity can be conducted inside (near the blasted stump by the theatre exit) or outside on the plaza deck. Introduce the activity to the entire group (students and chaperones). Provide opportunities for the students to participate by answering questions and describing the rocks you show to them. After completing introduction, have students break into their groups. Have each group send one person to the front to get: (1) a rock/set of rocks, (2) a copy of the 'Volcanoes Rock' worksheet, (3) a pencil, (4) a clipboard on which to write, and (5) a laminated copy of the texture/gray scale chart.

Introduction (10 – 15 minutes)

Main Message – *The color and texture of a rock tell its story*

1. Explain that all **igneous** rocks begin deep underground and form from cooling magma or cooling lava. These rocks tell us the volcano's story. We learn the story by reading the rocks. The color and **texture** of a rock tell us its story.

Rocks can be sorted by the **minerals** present and the general **texture** of the rock.

Percent Silica Composition

Sub-message 1 – *The color of the rock can reveal the amount of silica*

1. Explain that **silica** is a glass-like building block of **minerals**. Each **igneous** rock contains at least 45% **silica** (*if they don't understand percents, explain that for igneous rocks half of the material is silica).* When a rock contains only a little **silica,** the **minerals** that form in it tend to be darker in color. **Q:** What shade of gray would you expect a rock with little **silica** to be? **A:** BLACK (P*ick up a basalt rock, and place on the rock cart shelf.)* Basalt has the lowest amount of **silica**, which is why it is so dark. Because the amount of **silica** is so low, its ability to resist flowing, or its **viscosity** is also low. Often when we think about volcanoes we imagine flowing red rivers of lava (*show picture of flowing basalt).* This flowing lava is basalt, which flows like honey.

2. Towards the far end of the **silica** scale there is a rock called dacite. *(Place the dacite sample on the end of the rock cart on the opposite end from basalt—leave enough space between the two rocks to place one more rock sample between them.)* dacite rocks have a lot of **silica**. **Minerals** that form in the presence of so much **silica** tend to be lighter in color. **Q:** With so much **silica**, what gray scale description could they make for dacite? **A:** LIGHT GRAY. Explain to students that lava with more **silica** does not flow easily. If basalt flows like honey, then dacite with lots of **silica** flows like toothpaste *(pick up toothpaste)* or explodes violently like Mount St. Helens did on May 18, 1980.

3. **Q:** Between the two rocks on the platform is an intermediate rock; what color would we expect it to be? **A:** GRAY.

4. Now that there are three samples on the rock cart, ask the students to compare them according to shades of gray. Direct students to identify *(pick up each rock as you announce it)* that basalt is black, andesite is gray, and dacite is light gray. An easy way to remember this is that MSH produces B.A.D rocks.

Texture

Sub-message 2 – *Rock texture tells us where and how quickly a rock formed*

1. *(Remove all rocks from the front of the rock cart except the **dacite** rock.)* Explain that each of the three rocks we just examined can take different **textures** depending on how quickly they cool from molten to solid rock. The initial distinction between volcanic (**extrusive**) and plutonic (**intrusive**) rocks is made on the basis of **texture** (fine-grained volcanic vs. coarse-grained plutonic). Our remaining dacite and the next two samples will help us sort rocks according to **texture**.

2. Explain that they will be looking at three of the four primary **textures** for **igneous** rocks. **Texture** refers to the size of crystals in the rocks. Magma contains many kinds of **minerals**, water, and gasses. *(Pick up soda bottle.)* When magma approaches the earth's surface *(begin shaking bottle)* gasses contained in the magma can begin to expand, because there is decreasing pressure on the magma. This produces foam

(point to soda foam). During an eruption both lava foam and lava rock are erupted out and cool quickly on the surface. These are **extrusive** rocks *(pick up **dacite** rock, sample, and **dacite pumice**, and place them on the viewing platform)*. Direct students to compare the dacite rock and pumice. Except for **texture** all characteristics about these two rocks are the same. **Q:** What is the major difference in **texture** between these two? **A:** The pumice has pores (small holes), and the rock does not. *(Place the dacite rock at the 'fine-grained' portion of the **texture** scale, and the dacite pumice at the porous portion.)*

3. Finally, the last rock in this scale *(granodiorite)*. Explain that this rock cools completely in the ground, which allows **minerals** to grow large crystals to form a rock we call Granodiorite. **Q:** Where on our **texture** scale should this rock be placed? **A:** COARSE GRAINED. All the rocks in this series *(pick up each rock as you announce it)* dacite pumice, dacite, and granodiorite have the same **silica** content but different **texture**s.

NOTE: The rocks chosen for this activity have been selected to show trends and variations from rock to rock in order for students to see and feel the differences between them. In actuality, igneous rocks are often not limited to a singular texture.

Activity Directions

4. With these two scales, we can distinguish between 9 kinds of **igneous** rocks in the Ranger Program Box-O-Rox. Each group must successfully identify 6 rocks. *Groups are not allowed to share the identity of rocks with another group.* Each group is allowed one rock at a time (*if there are less than 6 groups, allow them to take two so that they can compare them*), so one student will come up and get a rock and bring it back to the group. The group will describe the rock according to both **texture** and gray scale. After describing the rock, write down the sample number, the rock's name, **texture** and gray scale. When finished with the rock, one student may exchange it for another rock. While the students are working the ranger should circulate and answer any questions.

Wrap-up

5. When most groups appear to have finished six samples, review the various rocks with the students and ask them to explain how they determined the rock types. Collect the clipboards, pencils and gray scale/texture charts. They can take the worksheet home with them.

BONUS - Bring out a breadcrust bomb. Have students describe what they see (color, textures) and apply their new knowledge to explain what kind of rock it is.