# Slide Blocks Rock

**Outdoor Activity**

## Teacher Information:

**Time Commitment:** 2 Hours and 30 minutes

**Location:** Hummocks Trail

**Group Size:** Not recommended for groups larger than 30. Larger groups will NOT be able to see the features at each stop along the trail.

**Materials Needed:** Pencil, clipboard or notebook to write on, download copies of the '*Slide Blocks Rock*' worksheet for students and copies of '*Slide Block Rocks Answer Sheets*' for chaperones.

**Materials Provided:** A lock box behind the trailhead bulletin board contains basalt, andesite and dacite rock samples, and visual aids. Return these items to the lock box when you conclude the trailhead activities. A combination for the lock box will be provided when you register your field trip.

Student worksheet stop locations are marked with by numbered stakes along the trailside. Note stakes with letters designate stop locations for a self-guided brochure for the general public.

## Purpose:

Students examine and identify factors that influenced the deposition and erosion of slide block features from the May 18, 1980 landslide.

## Goal:

1) Students will identify topographic features, hummocks, rocks and slide block features from the May 18, 1980 landslide.

## Objectives:

1) Students will analyze facts on provided on student worksheets and observe landscape features on the Hummocks Trail to identify May 18, 1980 landslide slide blocks, rocks, hummocks and factors that influenced the movement of the landslide.
2) Students will observe and identify erosion features on the landslide deposit, and hypothesize how eroded sediment impacts and degrades downstream communities and river systems.

**Required Vocabulary:**

1) **Landslide:** The sliding or flowage of unsorted masses of rock and other material moving under the force of gravity
2) **Hummock:** large mounds of rock deposited by a landslide.
3) **Slide Block:** Enormous sections or segments of earth that slide downward during a landslide. Three large slide blocks fell from Mount St. Helens on May 18, 1980.
4) **Lateral Blast:** At Mount St. Helens this includes two components: 1) a large explosion directed out of the side of a volcano and turbulent mixture of hot gas, ash, and rock that flow over the ground at high speeds under the influence of gravity.
5) **Basalt** a volcanic rock characteristically dark gray to black in color, containing 45 to 54% silica, and is generally rich in iron and magnesium. Shield volcanoes like Kilauea in Hawaii typically erupt basalt lava.
6) **Andesite** a volcanic rock characteristically dark to medium gray in color, containing 54 to 62% silica, rich in aluminum and moderate amounts of calcium and sodium.
7) **Dacite:** a volcanic rock usually light in gray color, containing 62 to 69% silica, includes aluminum and moderate amounts of sodium and potassium. Dacite erupted explosively from Mount St. Helens on May 18, 1980.
8) **Viscosity:** the resistance of any liquid to flow.
9) **Erosion:** The process in which soil and rock are removed from the Earth's surface by natural processes such as wind and water, and then transported and deposited to new locations.
10) **Terrace:** Step-like flat areas along the sides of river valleys. Terraces are the remains of flood plains that existed at a time when a river was flowing at a higher elevation, before it down cut and created a new floodplain at a lower elevation.

# Slide Blocks Rock Fact Sheet

Hummocks Trail Outdoor Activity

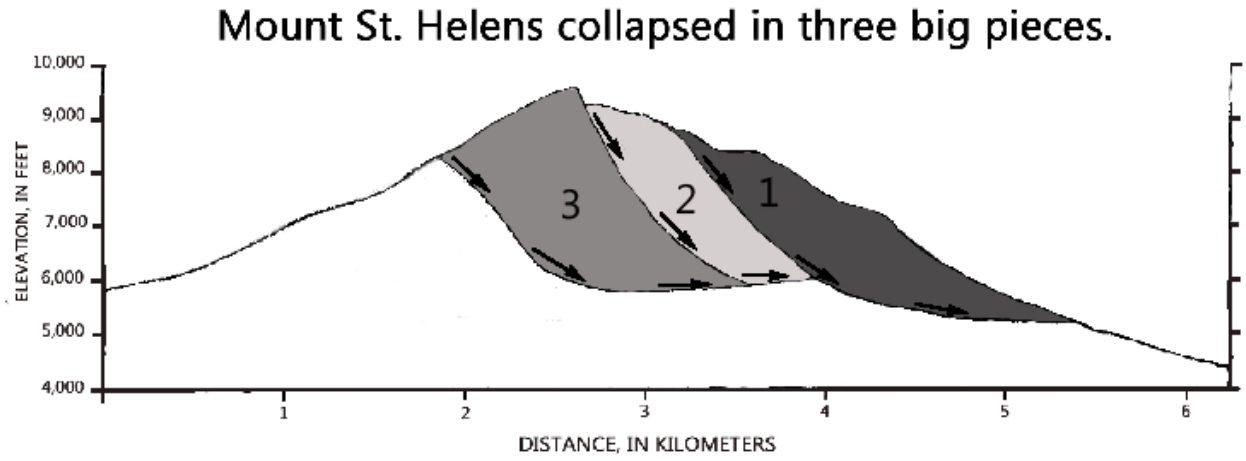
## Directions:

*Begin at the trailhead by a bulletin board. Stop at the wood posts numbered 1-5. At each stop read the facts listed below and observe landscape features to answer the questions.*

## Fact:

1. From March 20, 1980 until May 18, 1980 rising magma pushed the north side of Mount St. Helens out sideways 300 to 450 feet. This swollen mountainside was called the "bulge".

2. The May 18, 1980 eruption began when a huge **landslide** fell from the bulging north side of Mount St. Helens. Three enormous slabs of rock, called **slide blocks** fell downward in quick succession.




3. **Slide Block I** is dominated by dark gray andesite lava rocks and black or red basalt lava rocks from the north flank of the volcano. It also contains minor amounts of light gray dacite rocks from the summit.

4. **Slide Block II** is dominated by light gray dacite rocks from the former summit.

5. Moments after **Slide Block I** came to rest, **Slide Block II** pushed it out of the way like a gigantic snow plow. Due to this violent collision, slide block I is largely found along the sides of the valley, while side block II dominates the center of the valley.

6. The large mounds of rock on the valley floor, called **hummocks**, are enormous pieces of the volcano carried down in slide blocks I & II. Clearly defined rock layers visible in some hummocks reveals that they came down as an intact piece. Scientists have identified 675 hummocks and understand approximately where they would fit back inside the crater.

7. **Slide Block III** was dominated by tan dacite lava rocks from the interior of the volcano. This slide block was violently shoved outward by a lateral blast, pushing the landslide 13 ½ miles down valley (4 miles past slide blocks I and II). Few intact hummocks from this slide block are found west of the hummocks trail—they were broken apart and mixed together during their turbulent journey.

## Slide Blocks Rock Worksheet Name: _____

### STOP 1:

1) Turn slowly a full revolution and observe the color of the rocks as you turn. Use your observation skills and the fact sheet to determine which slide block these rocks came from. Circle your answer.

    a. Slide Block I

    b. Slide Block II

### STOP 2:

2) The landslide began on the north side of the volcano, but only traveled 5½ miles *north*. However, the landslide traveled 13½ miles *westward*. Circle the answer that best explains why this happened.

    a. Johnston Ridge blocked or prevented most of the landslide from traveling further north.

    b. The landslide was deflected westward by Johnston Ridge.

    c. The Toutle River Valley funneled the landslide westward.

    d. All of the above.

3) Observe the rocks along each side of the trail at this stop. Use your observation skills and the fact sheet to determine which slide block these rocks came from. Circle your answer.

    a. Slide Block I

    b. Slide Block II

### STOP 3:

4) Look at the hummock that is half-light tan and half blackish-red. Based on the color, name the type of rocks that might be found on each side of this hummock?

    a). _____

    b). _____

5) Face Mount St. Helens and look at the hummocks in the canyon on each side of the Toutle River. Circle the answer that best explains which slide blocks these rocks came from.

a. Slide Block I

b. Slide Block II

6) What evidence did you use to support this answer?

_____

_____

## STOP 4:

7) Face the canyon then turn right and look down canyon. Note the multi-colored hummocks and hummocks with bands of color on the sides of the canyon walls. Use your fact sheet to determine what types of hummocks are visible in the canyon walls. Circle "T" for true or "F" for false.

T or F The colorful rocks are intact hummocks from Slide Blocks I and II.

T or F The colorful rocks are fragments of hummocks broken apart in slide block III.

8) The North Fork of the Toutle River lies 165 feet below you. It was completely buried beneath slide blocks I, II and III. A new river formed after the eruption and carved out most of this canyon between 1980 and 1985. Circle the answer that best describes which factors may have contributed to the rapid creation of this canyon.

a. The Pacific Northwest's climate produces abundant rain and snowfall.

b. The eruption destroyed vegetation that normally helps reduce erosion rates.

c. Ash and loose rock within the landslide deposit is highly erodible.

d. Answers A and B.

e. All of the above.

## STOP 5:

9) Seasonal weather changes affect the amount of water in the river and its ability to erode, transport and deposit the landslide deposit. Find the series of step-like flat areas along each side of the river. Circle "T" for true or "F" for false for the answer that best describes how the flat terraces formed.

T or F The flat terraces reveal different levels the North Fork of the Toutle River once flowed as it eroded this canyon.

10) The elevation of the North Fork of the Toutle River at this site before the eruption was 2,173 feet above sea level. The current elevation of the river is 2,319 feet. How many feet of rock must the Toutle River erode to reach the pre-eruption elevation? Show your work

11) The North Fork of the Toutle River drains into the Cowlitz River, which in turn drains into the Columbia River. Since 1980, 13% of the landslide deposit has eroded away. Circle the answer that best describes how sediment eroded from this canyon might impact areas down river.

a. Sediment fills river channels, which increases flooding hazards.

b. Sediment creates shipping hazards in the Columbia River adversely affecting economies.

c. Sediment degrades habitat for salmon, steelhead and other fish.

d. Answers A and B.

e. All of the above.

## STOP 6:

12) The rock on the edge of the left side of the trail is part of a ridgeline that extends further out into the Toutle River Valley. The landslide buried the tip of this ridgeline under 250 feet of rock. At the parking lot the landslide deposit is 400 feet deep. Read case fact 5 and hypothesize why the depth of the deposits varies so much between here and the parking lot.

_____

_____

13) Speed = *Distance* divided by *Time*. If the landslide traveled 13.5 miles down the Toutle River Valley in 10 minutes, what was the landslide's speed in miles per hour? Show your work and formula.

14) Time = *Distance* divided by *Speed*. You are approximately 7.5 miles from the crater. How long did it take the landslide to reach this site in seconds? Show your work and formula.

# Teacher Answer Sheet for Slide Blocks Rock

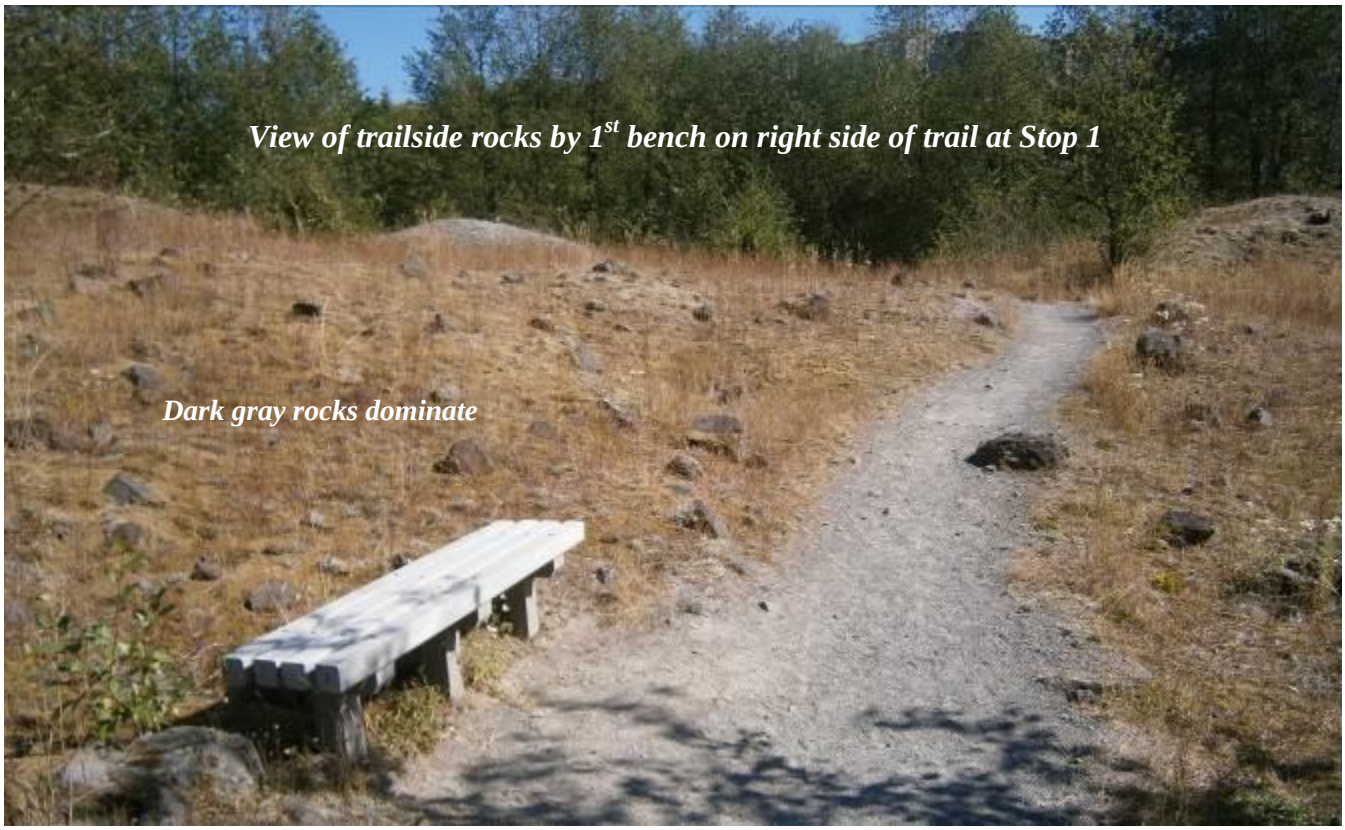
Outdoor Activity

## STOP 1:

1) Turn slowly a full revolution and observe the color of the rocks as you turn. Use your observation skills and the fact sheet to determine which slide block these rocks came from. Circle your answer.

(a.) Slide Block I

b. Slide Block II




***The rocks on each side of the trail are mostly dark gray indicating they came from slide block I***

**STOP 2:**

2) The landslide began on the north side of the volcano, but only traveled 5½ miles *north*. However, the landslide traveled 13½ miles *westward*. Circle the answer that best explains why this happened.

a. Johnston Ridge prevented or blocked the landslide from traveling further northward.

b. The landslide was deflected westward by Johnston Ridge.

c. The Toutle River Valley funneled the landslide westward.

(d.) All of the above.


3) Observe the rocks along each side of the trail at this stop. Use your observation skills and the fact sheet to determine which slide block these rocks came from. Circle your answer.

(a.) Slide Block I

b. Slide Block II

*View of rocks from the Boundary Trail Junction Stop 2*

**STOP 3:**

4) Look at the hummock that is half-light tan and half blackish-red. Based on the color, name the type of rocks that might be found on each side of this hummock.

a). **The two-toned nature of the hummock reveals intact strata layers from inside the volcano. The tan color is a dacite rock formation.**

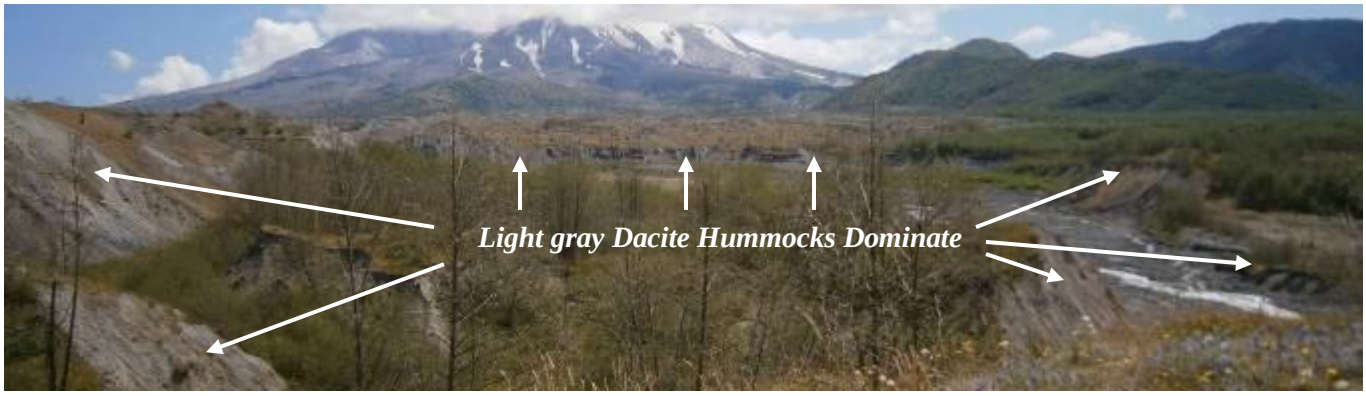
b.) **The black and red coloration indicates that this side of the hummock is an andesite or basalt lava flow (The red coloration reveals that the lava had a high water content, and as it cooled, it oxidized or rusted.).**


5) Face Mount St. Helens and look at the hummocks in the canyon on each side of the Toutle River. Circle the answer that best explains which slide blocks these rocks came from.

a. Slide Block I b. (Slide Block II)

6) What evidence did you use to support this answer?

**The dominant hummock color is light gray. Light gray hummocks dominate slide block II. Dark gray andesite and black or red basalt hummocks dominated slide block I, and few are not visible here.**




**STOP 4:**


8) Face the canyon then turn right and look down canyon. Note the multi-colored hummocks and hummocks with bands of color on the sides of the canyon walls. Use your fact sheet to determine what types of hummocks are visible in the canyon walls. Circle "T" for true or "F" for false.

(T) or F The colorful rocks are intact hummocks from Slide Blocks I and II.

T or (F) The colorful rocks are fragments of hummocks broken apart in slide block III.

7) The North Fork of the Toutle River lies 165 feet below you. It was completely buried beneath slide blocks I, II and III. A new river formed after the eruption and carved out most of this canyon between 1980 and 1985. Circle the answer that best describes which factors may have contributed to the rapid creation of this canyon.

a. The Pacific Northwest's climate produces abundant rain and snowfall.

b. The eruption destroyed almost all vegetation that helps reduce erosion rates.

c. Ash and loose rock within the landslide deposit is highly erodible.

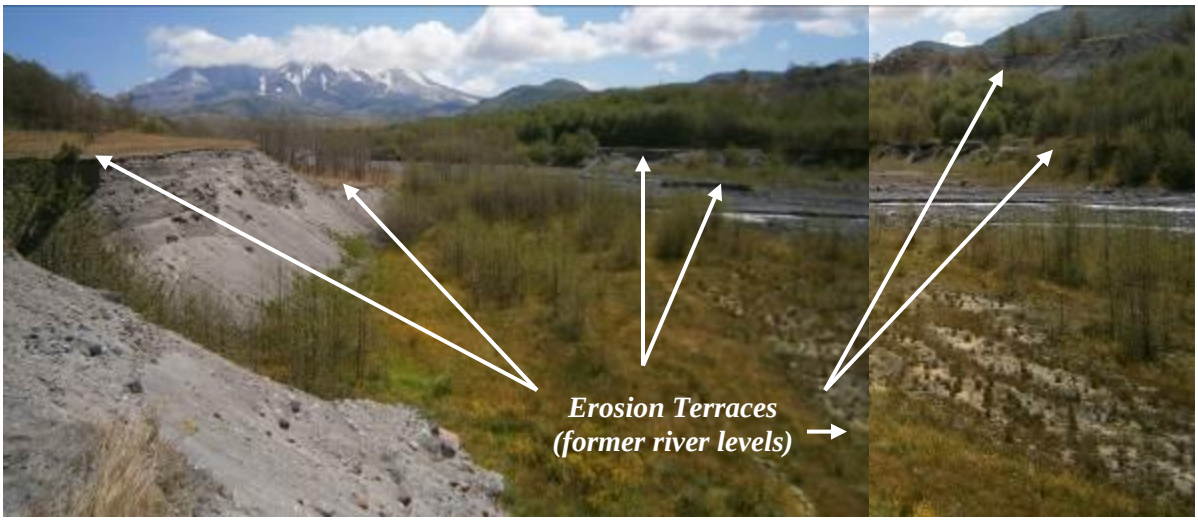
d. Answers A and B.

(e.) All of the above.

**STOP 5:**

9) Seasonal weather changes affect the amount of water in the river and its ability to erode, transport and deposit the landslide deposit. Find the series of step-like flat areas along each side of the river. Circle "T" for true or "F" for false for the answer that best describes how the flat terraces formed.

(T) or F The terraces reveal different levels the North Fork of the Toutle River once flowed as it eroded this canyon.




10) The elevation of the North Fork of the Toutle River at this site before the eruption was 2,173 feet above sea level. The current elevation of the river is 2,319 feet. How many feet of rock must the Toutle River erode to reach the pre-eruption elevation? Show your work

**2319**
**- 2173**
**146 feet**

11) The North Fork of the Toutle River drains into the Cowlitz River, which in turn drains into the Columbia River. Since 1980, 13% of the landslide deposit has eroded away. Circle the answer that best describes how sediment eroded from this canyon might impact areas down river.

a. Sediment fills other river channels, increasing flood hazards in downstream communities

b. Sediment creates shipping hazards in the Columbia River adversely affecting economies.

c. Sediment degrades habitat for salmon, steelhead and other fish.

d. Answers A and B.

(e.) All of the above.

## STOP 6:

12) The rock on the edge of the left side of the trail is part of a ridgeline that extends further out into the Toutle River Valley. The landslide buried the tip of this ridgeline under 250 feet of rock. At the parking lot the landslide deposit is 400 feet deep. Read case fact 5 and hypothesize why the depth of the deposits varies so much between here and the parking lot.

**Moments after Slide Block I came to rest, Slide Block II raced down valley and pushed much of Slide Block I out to the sides of the valley. The differences in the depth of the deposits may be due to this violent collision. The deposit here is thinner because it is dominated by Slide Block II. The deposit is thicker at the parking lot, because Slide Block I was shoved to the sides of the valley.**


13) Speed = *Distance* divided by *Time*. If the landslide traveled 13.5 miles down the Toutle River Valley in 10 minutes, what was the landslide's speed in miles per hour? Show your work and formula.

$$\textbf{Speed} = \frac{\textbf{Distance}}{\textbf{Time}} = \frac{\textbf{13.5 miles}}{\textbf{10 minutes}} = \textbf{1.35 miles/minute}$$

**1.35 miles/minute x 60 minutes/hour =**

**1.35 miles x 60/hour = 81 miles/hour**

14) Time = *Distance* divided by *Speed*. You are approximately 7.5 miles from the crater. How long did it take the landslide to reach this site in seconds? Show your work and formula.

$$\textbf{Time} = \frac{\textbf{Distance}}{\textbf{Speed}} = \frac{\textbf{7.5 miles}}{\textbf{81 miles/hour}} = \textbf{.0926 hours}$$

**.0926 hours x 60 minutes = 5.55 minutes**

**5.55 minutes x 60 seconds = 333 seconds**

## Instructional Sequence for Slide Blocks Rock

**In the parking lot by the trailhead:**

1) As students exit the bus divide them into 3 equal-sized groups. Make sure the students remain in the three groups in order to create a landslide simulation. Name the groups slide block 1, slide block 2 and slide block 3.

2) Use the combination provided when you registered for your field trip to open the lock box behind the trailhead bulletin board. Use the items in the box to conduct the parking lot activities.

    a. Distribute a basalt and andesite the rock sample to the slide block 1 group of students.
    b. Distribute a light gray dacite rock sample to the slide block 2 group of students.
    c. Distribute a tan/orange dacite rock samples to the slide block 3 group of students.

3) Display the light gray dacite, dark gray andesite, and black basalt rocks in a row (the dark gray andesite rock should be in the middle). Ask the group to make observations about differences and similarities in the rocks.

4) The differences in the color of lava are due to different amounts of silica. Silica is the building block of basic rock-forming minerals like quartz and feldspar. The amount of silica affects how a volcano erupts and the types of rocks produced. Mount St. Helens makes B.A.D. rocks—Basalt, andesite and dacite. Review each rock sample.

    → **Basalt**

    - Least amount of silica: 48-52%
    - Black colored rocks due to dark-colored minerals like Iron and Magnesium
    - Red-colored rocks indicate the lava was exposed to oxygen as it cooled and oxidized
    - Low viscosity—thinnest, runniest lava
    - Flows like honey or fountains upward if it contains lots of gas bubbles
    - Erupts from Hawaiian volcanoes, but less often at Mount St. Helens or in the Cascade Range

→ **Andesite**

- Silica: 52-62%, most commonly erupted lava in Cascades
- Dark gray colored rocks due to fewer dark-colored minerals like Iron and Magnesium
- Medium viscosity—between basalt and dacite.
- It can flow like basalt, but not as far, or explode like dacite.

→ **Dacite**

- Most silica: 62-68%
- Light gray colored due to abundance of silica.
- High viscosity--thickest lava. If it contains few gas bubbles, it flows like peanut butter
- If thick lava contains lots of gas, the bubbles become trapped, pressurize and explode.
- Mount St. Helens frequently erupts dacite lava, both explosively and non-explosively
- Light gray dacite often decays to a tan/orange color due to heat and water (hydrothermal).

5) Organize each of the three student groups into the following manner:
    a. Divide the slide block 1 group into two rows. Have the lead student in each row hold an andesite or basalt rock sample.
    b. Align the slide block 2 group in a single file line. Have the lead student hold a light gray dacite rock sample.
    c. Align the slide block 2 group in a single file line. Have the lead students hold a tan/orange dacite rock sample.

6) Review the read aloud the "landslide facts" and state that this information will be critical to answering all questions on the worksheet.

→ **Read Aloud Case Fact 1 from Worksheet**

- Emphasize that when Mount St. Helens awoke in 1980 that the rising magma pushed the north side of Mount St. Helens out **sideways**.
- Show the March 20, 1980 picture and April 27, 1980 bulge picture side by side.
- Explain that the swollen, unstable side of the mountain was called the bulge.

→ **Read Aloud Case Fact 2 from Worksheet**

- The May 18, 1980 eruption began when a huge **landslide** fell from the bulging north side of Mount St. Helens.
- Show the graphic entitle "*Mount St. Helens collapsed in three big pieces*" and explain that the landslide came down in three enormous slabs of rock, called **slide blocks,** which fell downward in quick succession.
- Show the first set of Gary Rosenquist pictures and identify slide block 1.

→ **Read Aloud Case Fact 3 from Worksheet**

- Show the andesite and basalt rock samples and explain that **Slide Block I** is dominated by **dark gray andesite lava rocks** and **black or red basalt lava rocks** from the north flank of the volcano. It also contains minor amounts of light gray dacite rocks from the summit.
- Explain that most of **Slide Block I** struck Johnston Ridge, was deflected westward and traveled 8-miles down the Toutle River valley.
- Create and identify the locations of an "imaginary" Mount St. Helens, Johnston Ridge and the Toutle River Valley.
- With the lead students holding andesite and basalt rock samples, instruct the slide block 1 student group to "fall" from Mount St. Helens a in two rows, strike Johnston Ridge and flow down the Toutle valley in two rows.

→ **Read Aloud Case Fact 4, 5 and 6 from Worksheet**

- Show the light gray dacite rock sample and explain that **Slide Block II** is dominated by light gray and tan dacite lava rocks from the interior of the volcano and light gray dacite rocks from the former summit.
- Moments after **Slide Block I** came to rest, **Slide Block II** pushed it out of the way like a gigantic snow plow. Due to this violent collision, slide block I is largely found along the sides of the valley, while side block II dominates the center of the valley.
- With the lead students holding a light gray dacite rock sample, instruct the slide block 2 student group to "fall" from Mount St. Helens a single file line, strike Johnston Ridge and gently push the students from slide block 1 to the sides as they flow down the Toutle valley.

- Slide block 2 traveled eleven miles down the valley so the front of this group should stop several feet past the terminus of the slide block 1 student group.
- The large mounds of rock here on the valley floor are called **hummocks.** They are enormous pieces of the volcano carried down in slide blocks I & II. Clearly defined rock layers visible in some hummocks reveals that they came down as an intact piece. Scientists have identified 675 hummocks and understand approximately where they would fit back inside the crater.

→ **Read Aloud Case Fact 7 from Worksheet**

- Show the tan dacite rock sample and explain that **Slide Block III** is dominated by tan/orange dacite lava rocks from the interior of the volcano.
- **Slide Block III** was violently shoved outward by a lateral blast, pushing the landslide 13 ½ miles down valley (4 miles past slide blocks I and II). Few intact hummocks from this slide block are found west of the hummocks trail—they were broken apart and mixed together during their turbulent journey.
- Ask the students in the slide block 1 and 2 groups to crouch down. With the lead students holding a tan dacite rock sample, instruct the slide block 3 student group to "fall and blast" from Mount St. Helens a single file line, strike Johnston Ridge and leap frog, step over and/or mingle through both student groups.
- Slide block 3 traveled thirteen and a half miles down the valley so the front of this group should stop several feet past the terminus of the slide block 2 student group.

5) Inform the students that you will lead the way because there are specific points along the trail marked with stakes numbered 1-5. At each stop they will observe geographic features and review the "landslide facts" to complete answers to questions on their worksheets. Depart on the trailhead with the bulletin board.

6) Inform the students that they will be hiking within a research area. Off trail travel, the collection of rocks, plants, and wood, and disturbing research sites (removing tags, pipes or flagging marking boundaries) is strictly prohibited ($100 fine).