DAY 6
Activity #1

HOW GLACIERS MOVE

OBJECTIVE After going through 3 mock glacier experiments, students will understand the various processes involved with glacial movement and flow.

GRADES Middle or High School students

DURATION 25 minutes

MATERIALS

- Copies of the *How Glaciers Move* worksheet for each student
- *Glaciers Experiments* PowerPoint presentation
- Computer connected to a large classroom screen

KEY CONCEPTS Glacial movement: basal slip, internal flow

KEY TERMS Zone of accumulation, zone of ablation, extending flow, extreme extending flow, compressive flow

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NATIONAL EDUCATION STANDARDS

Science:

NS.5-8.1 Science as Inquiry

- **Abilities necessary to do scientific inquiry**
- **Understandings about scientific inquiry**

NS.5-8.4 Earth and Space Science

- **Structure of the earth system**

NS.5-8.6 Personal and Social Perspectives

- **Populations, resources, and environments.**

NS.5-8.7 History and Nature of Science

- **Science as a human endeavor**
- **Nature of science**

NS.9-12.1 Science as Inquiry

- **Abilities necessary to do scientific inquiry**
- **Understandings about scientific inquiry**

NS.9-12.6 Personal and Social Perspectives

- **Natural resources**

NS.9-12.7 History and Nature of Science

- **Science as a human endeavor**
- **Nature of scientific knowledge**

Name:

HOW GLACIERS MOVE

EXPERIMENT #1: A VIEW FROM ABOVE

Background:

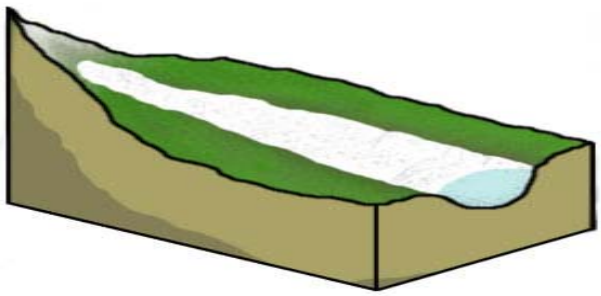
One of the main criteria for being a glacier is that it must move or flow. Glaciers internally flow as a result of the snow inside buckling and deforming under its own weight. At the center of a glacier, where the ice is thickest, the deformation is greatest. Therefore, the glacier flows more rapidly at the center than at the edges where the glacier isn't as thick.

Experiment:

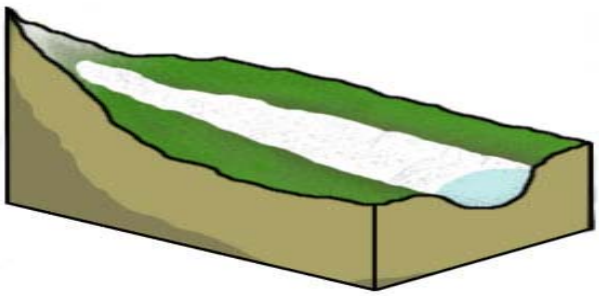
Suppose stones are placed in a straight line across the surface of a valley glacier. After a year or two, the line of rocks would no longer be straight. Where do you think the rocks would be after 1, 2 or 3 years?

1. ***Draw where the stones would be at the start and during the first, second, and third year.***

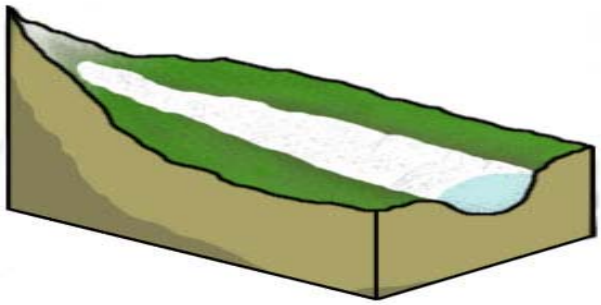
Start



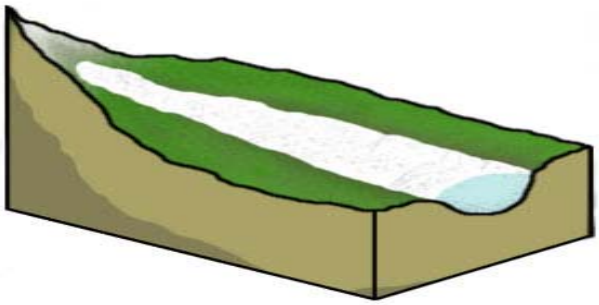
Year 1



Year 2



Year 3



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EXPERIMENT #2: A SLICED VIEW

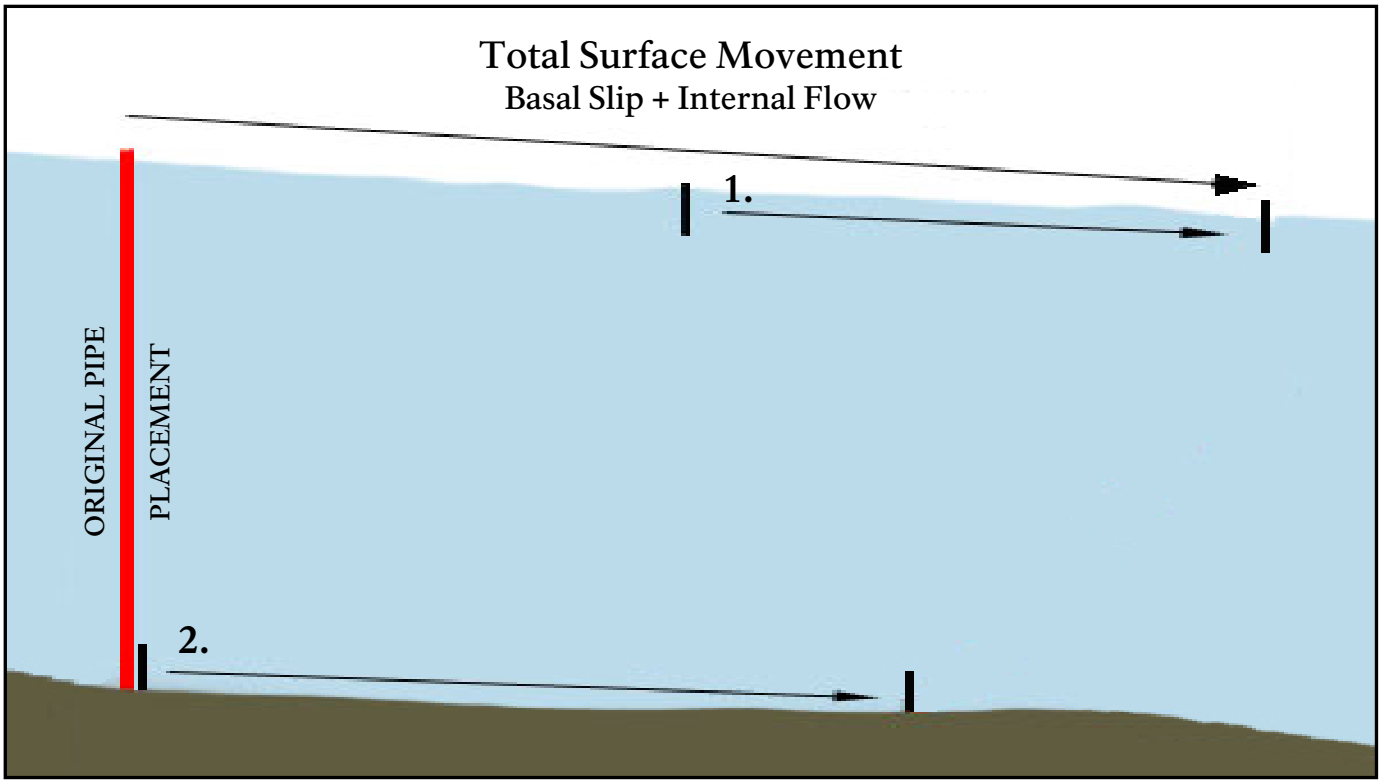
Background:

Most glaciers move too slowly for us to see. However, as a glacier slips and slides on its bed a number of mechanisms and processes are at work. One process, called **basal sliding**, occurs when a thin layer of water forms at the base of a glacier and significantly reduces the friction between the glacier and its bed. In certain situations, this may cause a glacier to float across the landscape. How does this happen? Think back to what you know about the density of water: Water is a substance that is less dense in its solid form than in its liquid form, and this property is what makes basal sliding possible.

Experiment:

Suppose a bendable pipe is inserted into a deep, narrow hole that was drilled vertically through a glacier from top to bottom. In a year or two, the inclination (slant) and position of the pipe would change. The pipe would be bent into a curve by the internal flow at the top of the glacier. In addition to the pipe bending, it would also have moved down-valley, revealing that the glacier slipped over its bed.

1. ***Label the: <u>Basal Slip</u> and <u>Internal Flow</u>***
2. ***Draw where you think the pipe will be after a couple years.***



http://www.nature.nps.gov/views/

Name:

EXPERIMENT #3: MYSTERIOUS MOVEMENT

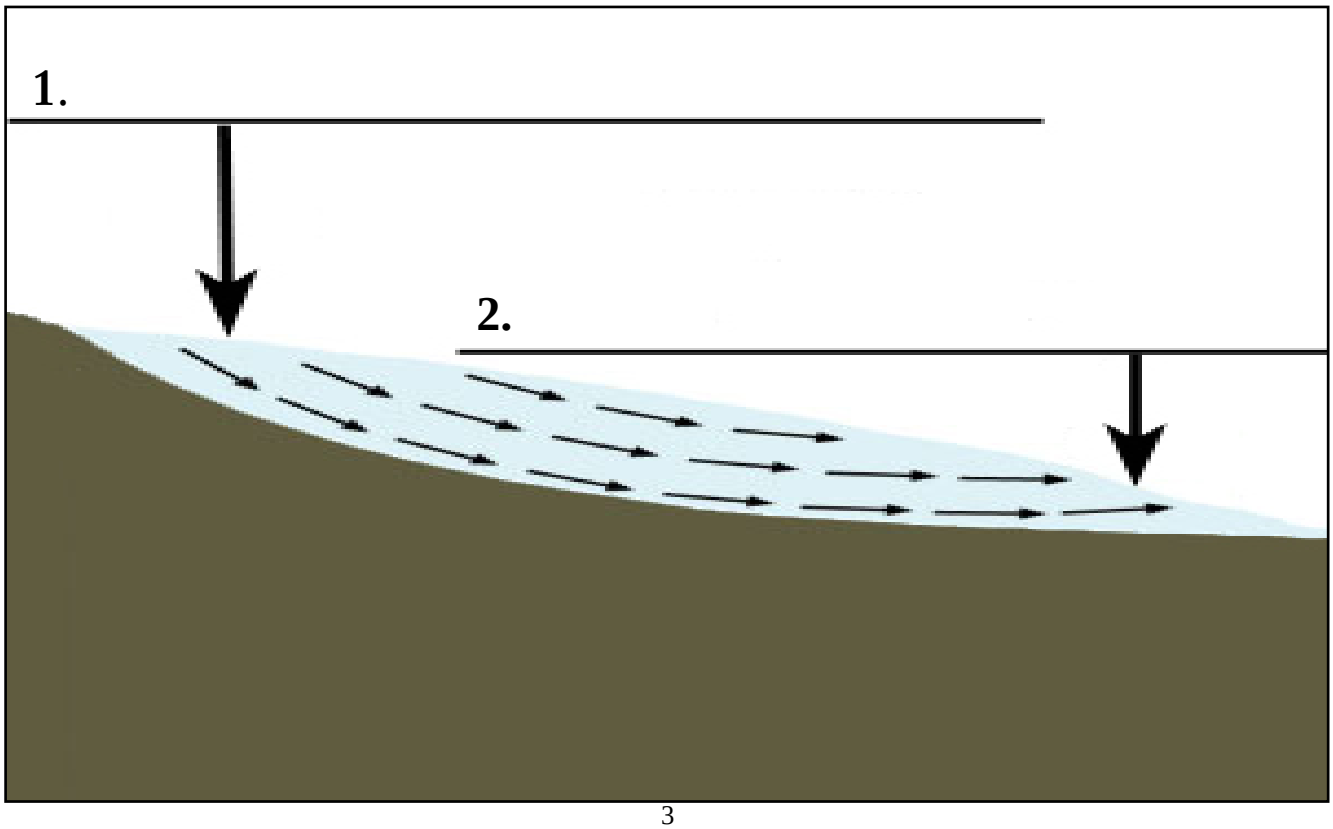
Background:

For this experiment you need to understand the difference between the ablation zone and the accumulation zone of a glacier. Glacial ablation refers to the reduction of a glacier due to melting or evaporation. Therefore, the ablation zone refers to the part of a glacier's surface over which ablation (wastage) exceeds accumulation each year. The accumulation zone is the part of a glacier's surface over which more snow is deposited than is ablated (wasted away) each year. The basic pattern of flow in the accumulation zone is downward, but it changes to upward in the ablation zone. This is due to variations in ice movement, which we will learn about next.

Experiment:

Suppose a child broke their mother's favorite vase while playing baseball indoors and foolishly wished to dispose of the pieces in a glacier. The child would eventually realize the error of not taking into consideration the vertical component of glacial movement. If the vase is buried in the accumulation zone, it will ultimately emerge in the ablation zone and the mother would find it.

Label the: ***<u>Zone of Accumulation</u>*** ***and*** ***<u>Zone of Ablation</u>***



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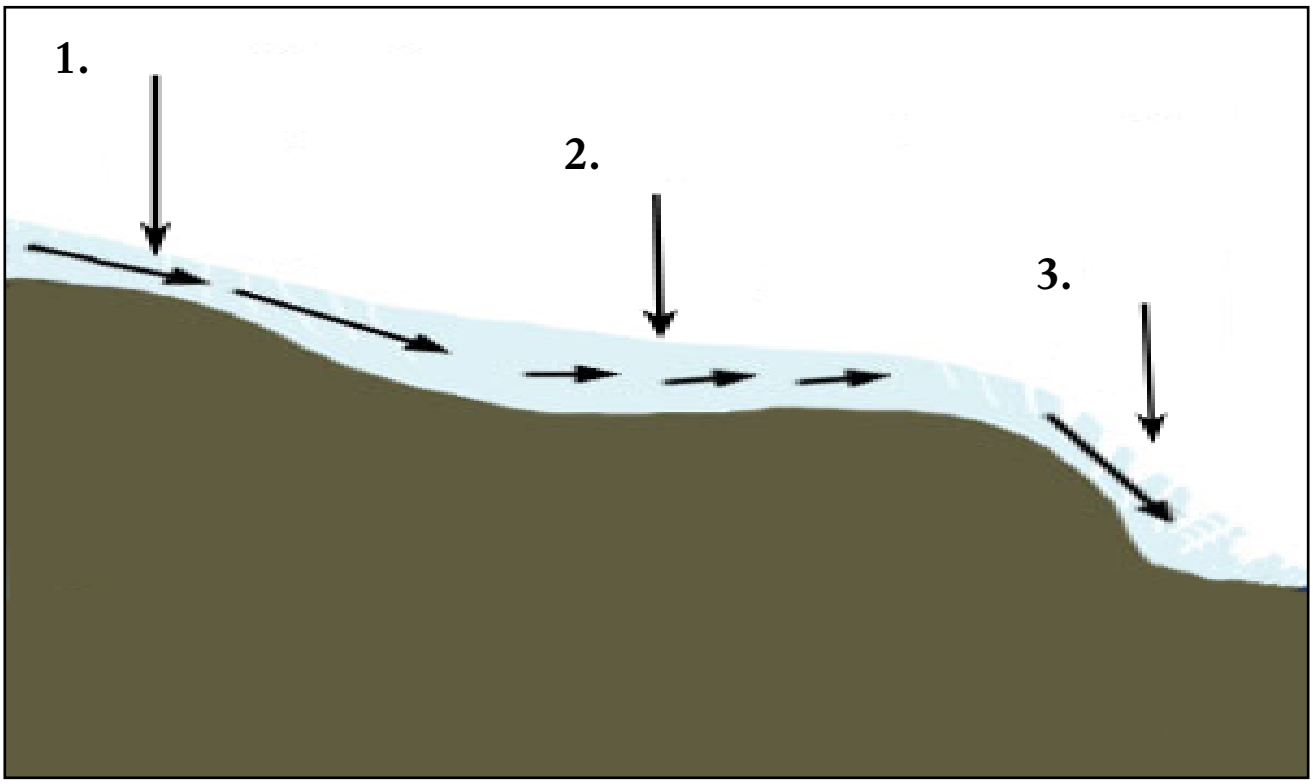
Background:

Variations in ice movement are associated with two different types of flow within a glacier: extending flow and compressive flow. In extending flow, a glacier is spread out and thinned because it is accelerating and does not have an opportunity to build up. When the flow is greatly accelerated, like in an icefall, the glacier is even more extended and thinned. This is called an extreme extending flow. The opposite occurs when the flow is decreasing. Slower flows allow the glacier to build up, in turn causing the glacier to compress under its own weight. This is called a compressive flow.

1. ***Label the:***
    a. ***<u>Extending Flow</u>***
    b. ***<u>Extreme Extending Flow</u> (Icefall)***
    c. ***<u>Compressive Flow</u>***



Name:

Questions:

1. **Where is ice thickest in a glacier?**

2. **Does ice move faster in the center of a glacier or at its edges?**

3. **What are the 2 main types of glacial movement?**

4. **What is the basic pattern of flow in the accumulation zone?**

5. **What is the basic pattern of flow in the ablation zone?**

6. **What is the name for an extreme extending flow?**

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ANSWER KEY

Questions: Answer Key

1. Where is ice thickest in a glacier?

   Ice is thickest at the center of the glacier.

2. Does ice move faster in the center of a glacier or at its edges?

   Ice moves the fastest at the center of the glacier.

3. What are the 2 main types of glacial movement?

   Basil Slip and Internal Flow

4. What is the basic pattern of flow in the accumulation zone?

   Downward

5. What is the basic pattern of flow in the ablation zone?

   Upward

6. What is the name for an extreme extending flow?

   Icefall