

GLACIERS: MOVERS AND SHAPERS

GRADES 5-8
JANIECE MISTICH

TIME ALLOTMENT:

Introductory Activity: 15-20 minutes
 Learning Activity #1: 30 minutes
 Learning Activity #2: Two 45 minute periods
 or one 90 minute period
 Culminating Activity:
 30 minutes per group at a computer
 15 minutes to discuss answers

OVERVIEW:

Glaciers are large masses of moving ice that are often called rivers of ice. They form slowly and some take over 100 years to reach their maximum size. Glaciers form because the annual snowfall in an area does not melt completely in the summer, and accumulates over time. As the snow accumulates, it slowly compresses under its own weight into a huge mass of ice. When a glacier's size reaches about 18 meters thick, its weight and the pull of gravity cause it to move slowly over land changing the land's surface features. Valley glaciers are found on land that slopes and flow downhill, while continental glaciers are on flat land and move out from their edges.

Glaciers either retreat or advance depending upon the amount of snow accumulation and melting. The rate of glacial movement can be slow or glaciers may move several hundreds of feet in a season resulting in a glacial surge. Glaciers are heard cracking and grinding as they move. Photographs of a glacier taken over a period of time show the rate of its advance or retreat. As glaciers move they pick up rocks and debris underneath them and carry them along, eroding the landscape. Glaciers can either wear down the earth's surface or build up new landforms by depositing debris as they move.

In this lesson, students will learn how glaciers form, what types of landforms they create, and how they move.

SUBJECT MATTER: Environmental Science,
Physical Science

LEARNING OBJECTIVES:

- Students will be able to:
- Explain how glaciers are created
 - Identify landforms created by glacier movement
 - Describe how glacier landforms are created
 - Create models of glacier landforms
 - Describe glacial movement using "created glacier oobleck"
 - Compare differences between the movement of alpine glaciers and continental glaciers

STANDARDS:

National Science Education Standards

<http://bob.nap.edu/html/nses/html>

Content Standard B: Physical Science *Motions and Forces*

Content Standard D: Earth and Space Science *Earth's History*

Content Standard F: Science in Personal and Social Perspectives *Natural Hazards*

Geographic Standards

<http://www.ncge.org/publications/tutorial/standards/>

Element III: Physical Systems

Standard 7: Physical processes that shape the patterns of Earth's surface.

Element VI: The Uses of Geography

Standard 17: How to apply geography to interpret the past.

Excellence in EE—Guidelines for Learning

http://naaee.org/npeee/learner_guidelines.php

Strand 2: Knowledge of Environmental Processes and Systems

1. Processes that Shape the Earth



Louisiana Science Frameworks:

State Standards for Curriculum Development

<http://www.doe.state.la.us/doe/assessment/standards/SCIENCE.pdf>

SI-M-A1: Identifying questions that can be used to guide a scientific investigation;

SI-M-A7: Communicating scientific procedures, information, and explanations;

SI-M-B4: Using data and logical arguments to propose, modify, or elaborate on principles and models

ESS-M-A7: Modeling how landforms result from the interaction of constructive and destructive forces

ESS-M-B3: Understanding that earth processes such as erosion and weathering affect the Earth today and are similar to those which occurred in the past;

PS-M-B1: Describing and graphing the motions of objects;

PS-M-B2: Recognizing different forces and describing their effects (gravity, electrical, magnetic)

MEDIA COMPONENT:**Video:****Enviro-Tacklebox™— *Glaciers: Movers and Shapers***

Examines the force exhibited by glaciers as they shape the landscape of the North American continent. Now found at high elevations and latitudes, massive glaciers once were natural tools carving out U-shaped valleys, laying down various moraine deposits and leaving lakes as they retreated northward at the end of the Pleistocene Ice Age. Viewers learn about the glaciers on Mt. Ranier, as well as other glaciers, and see how scientists study use glacial ice to study the climate of previous time periods. Global warming and its predicted effects on glaciers is discussed.

Web sites:

Enviro-Tacklebox™ <http://www.envirotacklebox.org> This is Louisiana Public Broadcasting's Web site providing teaching information, films, articles and student activities involving environmental science.

How Do Glaciers Affect the Land? <http://nsidc.org/glaciers/questions/land.htm>

This Web site provides information about how different landforms are created by glacier movement and includes pictures of these landforms.

A Tour of the Life of a Glacier <http://nsidc.org/glaciers/story/>

This website provides information about how glaciers form, move forward, and retreat.

Glacier Power: An Earth Science Curriculum Element <http://www.asf.alaska.edu:2222/>

This Web site gives students basic facts about glaciers, their anatomy, and why they move. Included on the site are student activities and stories about glaciers. Also included are Quick Time movies and animations.

MATERIALS:*Per Group:*

- Video: **Enviro-Tacklebox™—*Glaciers: Movers and Shapers***
- **For each group of 4-6 students:**
 - Box of cornstarch*
 - Measuring cup*
 - Water*
 - Spoon for mixing*
 - Bowl*
 - ½ cup of soil*
 - 5-6 small rocks*
 - Cookie sheet or shallow aluminum pan*
 - Box of clay*
 - Newspaper*
 - Tape*
 - Drawing paper (one sheet for each student in the group)*
 - Colored markers*

PREP FOR TEACHERS:

1. Prior to teaching the lesson, preview the video *Glaciers: Movers and Shapers* in its entirety.
2. **CUE** the video to the segment **right after** you a large bird of prey flying over glacial ice and deer eating the grass, and hear the words, "Wildlife can range from those hardy enough to withstand the ice and cold of the glacier itself, to a parade of migrating or hibernating creatures in the meadow."
3. Bookmark the Web Sites used in the lesson for each computer in your classroom or in the computer lab.
4. Divide students into groups of 4-6. (Try to have all groups the same size, if possible.)
5. Gather the materials for each group.
6. When using media, provide students with a **FOCUS FOR MEDIA INTERACTION**, a specific task to complete and/or information to identify during or after viewing of video segments, Web sites or other multimedia elements.

INTRODUCTORY ACTIVITY:

1. Review the terms, **weathering** and **erosion**, with students.
2. Ask students, "What forces in nature cause changes to the landscape? (*wind, moving water, moving ice, earthquakes, hurricanes, tsunamis*)"
3. Show students pictures of land that has been shaped by glaciers. Be sure to include at least one picture of each: moraine, u-shaped valley, horn, arêtes, erratic, slender lake, fjord, plain, and other types of landforms created by glacier movement. (**You can find pictures of these glacial landforms on the Web sites listed in the Materials section.**) Ask students, "What force in nature do you think created all of these landforms?" (*glacier movement*)
4. Show each picture individually and ask, "How do you think a glacier created **this** landform?" (**Accept all responses without comment.**) Ask, "Can you still see the glacier that created this landform? If it is no longer in the picture, ask students, "If a glacier created this landform, where is it now?" (*It has melted or retreated.*)
5. Ask students, "Where on earth can we find glaciers today?" (**Possible answers include: at the North and South poles, at the top of high mountains, on Greenland, etc.**)
6. Tell students that in this lesson they will learn how glaciers are created, how they can shape and reshape the land, and where they can be found today.

LEARNING ACTIVITIES:**Activity 1**

1. **Provide students with a Focus for Media Interaction**, instructing them to view the video to see some types of landforms that have been created by glaciers. **Play** the video until **right after** you see Greg Grandy and the scientist from Mt. Ranier looking at the valley created by a glacier and hear the words, "This entire area was once probably covered in several hundred feet, a massive sheet of glacial ice and it got worn off and polished by the smooth, sort of hilly undulations that you see there." **Pause** the video.
2. **Ask** students, "How do you think a glacier could have created those hilly undulations? (As the glacier moved, rocks underneath scraped the surface of the ground and smoothed protruding rocks, creating the slightly hilly formations.) What are some types of landforms that were created by glaciers?" (sharp, jagged peaks, valleys, lakes, rolling hills and plains) **Ask**, "How do you think glaciers created these landforms?" (Lead students to understand that as the glacier moved across the land, it took some of the land with it, leaving the landforms just seen.)
3. **Ask** students, "How do you think glaciers form?" (Accept all reasonable responses.) **Provide students with a Focus for Media Interaction**, asking them to view the next segment of the video to learn about the two types of glaciers and how each one of them forms. **Resume** the video and play it until you see huge cracks in glacial ice and hear the words, "That makes glaciers a moving and ever-changing part of the environment." **Pause** the video.
4. **Ask** students, "What causes a glacier to form?" (when more snow falls than melts, accumulates in large amounts and then turns to ice) **Ask**, "What causes a glacier to begin moving?" (The size and weight of it causes gravity to begin pulling it down the slope.)

5. **Provide students with a Focus for Media Interaction**, telling them to view the next segment to determine what makes the bottom layer of ice in a glacier melt and how this melting affects the way a glacier travels. **Play** the video until after you see the segment on outburst flooding and hear the words, “Or the Icelandic term for it is *jökulhlaup*.” **Pause** the video. **Ask**, “What causes ice in a glacier to begin melting?” (***the friction created as the glacier moves across the land begins to melt the bottom layer of ice or the climate becomes warmer***) **Ask**, “How does this affect the movement of the glacier?” (***The glacier advances when the ice accumulates and retreats when the ice melts.***)
6. **Provide students with a Focus for Media Interaction**, telling them to view the next video segment to see some land features that are created by glacier activity. **Resume** the video and play until you see an arrow pointing to Long Island and hear the words, “The island itself was made entirely by glacial activity.” **Pause** the video. **Ask** students, “What are some land features that were created by glacial movement?” (***crevasses, terminal moraines, falls, islands***)
7. Ask students, “Where do most glaciers form?” (***Students will probably say that they form high in the mountains. If they don’t mention forming on flat land, tell students that glaciers also form in other locations and have them suggest where these might be. Don’t give them any answers at this point.***)
8. **Provide students with a Focus for Media Interaction**, telling them to view the next video segment to learn about the two types of glaciers and where they form. **Resume** the video and play until you see a large U on the screen in front of a valley and hear the words, “Alpine glaciers can turn v-shaped river valleys into broad u-shaped ones.” **Stop** the video and be ready to resume it from this stopping point when you get to the end of Learning Activity #2. Ask, “What are the two different types of glaciers?” (***alpine and continental glaciers***) Ask, “What is different about where these two glacier types form?” (***Alpine glaciers form high in mountains and continental glaciers form on flat land.***) Ask, “Do you think glacial ice moves in the same manner or differently on these two glaciers? Why?” Tell students that in the next activity they will create one of these two glacier types to test how “glacier oobleck,” moves on each.

Activity 2

1. If this activity is done at a later date than Learning Activity #1, review what students learned about glaciers and their movement before beginning. Tell students they will create a model of one of the two types of glaciers (***alpine or continental***), and compare movement of “glacier oobleck” on each type.
2. Divide students into small groups (4-6 students) to create glacier models and give them the needed materials. Provide each group with Student Sheets #1a & b—Making a Model Alpine Glacier, **or** Student Sheets #2a & b—Making a Model Continental Glacier. Have students follow the directions on the sheet to create the underlying landform for their glacier. Once the landform has been created, students should create the “Glacier Oobleck” to use on their glaciers.
3. Have each group measure the distances across their landform, then draw a map of equal size that shows the shape, including any slopes and edges. Make enough copies of the map so that each group member has a copy.
4. Place pebbles and dirt at various locations on the landform model. Have students draw the location of the pebbles and dirt on their own maps, using a brown marker.
5. Assign each group member with a time interval to record observations. Each student should use a different color for their observation, At that specific time, the assigned group member will draw the shape and location of the glacier snout (or terminus), and the location of dirt and pebbles. If students are observing movement on a continental glacier, they should draw the circular edge of the glacier and location of dirt and pebbles.

6. Have students apply their Glacier Oobleck to the top of the alpine glacier or the dome of the continental glacier. Using a timer or watch with a second hand, call out time in one minute intervals until the “glacier oobleck” reaches the bottom of the landform **or** the edge of the wax paper. **(Example: Group Member 1 will draw what is observed after one minute, using a red marker. Group Member 2 will draw what is observed after 2 minutes, using a green marker. Group Member 3 will draw what is observed after 3 minutes, using a purple marker. And so on... until each member has had an opportunity to draw. Each member should also record their assigned time interval on the map to assist in the next step.)**
7. After stopping, have the students arrange their maps in time order, i.e., one minute, two minutes, three minutes, ..., to compare the changes in the glacier and the movement of the dirt and pebbles. Ask students to make a statement about how the “glacier oobleck” moved. **(Students with alpine glaciers should state that the oobleck moved downward, pushing the pebbles and dirt in front of the moving “ice,” or the pebbles and/or dirt were buried under the moving oobleck and carried down the slopes underneath. Students with continental glaciers should state that the oobleck moved outward in all directions, pushing the dirt and pebbles in front of them or carried them underneath as they moved.)**
8. Students should carefully remove the “glacier oobleck” from the landform and draw any final changes they see on their own maps, using a color that they have not previously used. Discuss some of the changes in the landscape. Have students look for any scrapes or grooves that occurred in the clay as a result of the rocks and soil being dragged underneath or pushed in front of the moving glacier. Ask, “How does this type of movement create lakes, aretes, horns, u-shaped valleys, plains, etc.?”
9. Have students explain how each type of land could have formed based on their observations of ice movement. Explanations of how each type of landform is created by glacier activity along with pictures can be found at the following Web sites: <http://nsidc.org/glaciers/questions/land.html> (**How Do Glaciers Affect the Land?**) and <http://www.asf.alaska.edu:2222> (**Glacier Power**).
10. **Provide students with a Focus for Media Interaction**, telling them to view the next video segment to see how glaciers create different land forms. **Play** the video until you see Greg and Chris on the computer screen and hear the words, “Chris, thanks for the information.” **Stop** the video. Ask, “Where do alpine glaciers form?” **(on mountains at high elevations)** Ask, “Where do continental glaciers form?” **(on very large, flat areas)** “What are some land features that were created by alpine glaciers?” **(u-shaped valleys)** Ask, “What land features were created by continental glaciers?” **(smooth, flowing plains)**

CULMINATING ACTIVITIES:

1. **Provide students with a Focus for Media Interaction**, telling them to use the provided Web site to answer the questions about the life of a glacier. Provide students with Student Sheets #3a & b (The Life of a Glacier) and direct them to use the following website to answer their questions: <http://nsidc.org/glaciers/story/>
2. Review answers from the Question Sheet with students.

CROSS-CURRICULAR EXTENSIONS:**ENGLISH:**

- Have students use the information from the Web site: <http://nsidc.org/glaciers/story/> to create their own glacier story, writing the story from the point of view of a snowflake that becomes part of a glacier. Their story should include facts about how glaciers form, move forward, and retreat.

GEOGRAPHY:

- Use the Web site—**Where are Glaciers Today?** http://www.glacier.rice.edu/land/5_warmice.html to make a map showing what kinds of glaciers can be found today and where they are located.

HISTORY:

- Have students research the history of a famous glacier and its effects on the people living there or the environment.

TECHNOLOGY:

- Have students create a trading card showing a particular kind of glacier and giving facts about it. Directions for making trading cards on the computer can be located at the following Web site and adapted to use with glaciers: <http://www.lpb.org/education/classroom/opom/otherhtm/003pset.htm> Have students include the following on each trading card:

- a) Name of Glacier
- b) Picture of Glacier
- c) Location of Glacier: Continent and Country
- d) Type of Glacier: alpine or continental
- e) Size of Glacier
- f) Altitude
- g) Temperature

After completing the trading cards, students can use them to group glaciers with similar characteristics, or quiz each other on each type that is described.

COMMUNITY CONNECTIONS:

- If possible, have students observe first hand a landform that was created by a glacier. Using what was learned in the lesson, have students explain what type of glacier created the landform and describe how it was created.
- Invite a **glaciologist, meteorologist, climatologist, geologist, or geomorphologist** from a local university to class to discuss his/her career and how it relates to the study of glaciers.

STUDENT MATERIALS:

- Student Worksheets #1A & B—Making a Model Alpine Glacier
- Student Worksheets #2A & B—Making a Model Continental Glacier
- Student Worksheet #3A & B—The Life of a Glacier

Student Worksheet #1A& 1B**MAKING A MODEL ALPINE GLACIER****Base Model**

Materials Needed:

- Cookie sheet or flat piece of cardboard*
- Several sections from a newspaper*
- Masking tape*
- Modeling clay*
- Pictures of mountain valleys with aretes, horns, cirques, sharp ridges, u-shaped valleys, and other glacial landforms*
- Large sheet of butcher paper*
- Pack of colored markers*
- 4-5 rocks of various sizes*
- ½ cup of soil*
- Ruler*

1. *Look at the pictures of glacier landforms to select one for your model.*
2. *Crumple pieces of newspaper into loosely-compacted balls of four or five different sizes. Arrange the balls into the selected mountainous shape and tape them to each other and the cookie sheet or cardboard. The mountain should be approximately 18 inches in height.*
3. *Once you are satisfied with the mountainous shape you want, layer the news paper model with a thin layer of clay, emphasizing the aretes, cirques, horns, valleys, or other sharp ridge.*
4. *This will be your underlying base model for the glacier activity.*
5. *Sprinkle a layer of soil on several parts of the mountain side, especially in the valleys.*
6. *Place rocks in several locations on the slopes of the mountain*

Glacier Oobleck

Materials Needed:

- 1 cup of Elmer's Glue*
- 2 tsp Borax Powder*
- ¾ cup of warm water*
- ½ cup of warm water*
- 2 large cups*
- Spoon*
- Sheet of wax paper*
- Scotch or masking tape*

Procedure:

1. *Tape the wax paper to the top of a desk, securely taping all four ends.*
2. *Prepare the two mixes below.*
3. *In the first large cup, add ¾ cup warm water and 1 cup glue. Stir until well mixed. Set aside.*
4. *Pour ½ cup of warm water into the second cup. Add 2 tsp. of Borax powder and stir until dissolved.*
5. *Pour the Borax powder mix into the glue mix. Stir until a glob forms and most of the water is mixed in. This should take less than a minute. Pour the mix onto the wax paper. Knead and work the mix for 2 – 3 minutes until all of the water is incorporated. The "glacier oobleck" can be stored in a ziplock bag until needed.*
6. *Use the Glacier Oobleck for the glacier movement activity.*

*Student Worksheet #2A& 2B***MAKING A MODEL CONTINENTAL GLACIER****Base Model**

Materials Needed:

- Cookie sheet or flat piece of cardboard*
- 1 box of modeling clay*
- Pictures of continental glaciers or ice sheets*
- Large sheet of butcher paper*
- Pack of colored markers*
- 4-5 rocks of various sizes*
- ½ cup of soil*
- Ruler*

- 1. Look at the pictures of continental glacier landforms to help you create your model.*
- 2. Using the clay, create a land surface that is slightly domed in the middle, but mostly flat along the outer areas. Your shape should be more circular in shape than rectangular and should be at least 12 inches across in all directions. Create a few ridges in one area of the land surface with the clay.*
- 3. This will be your underlying base model for the glacier activity.*
- 4. Sprinkle a layer of soil on several parts of the land surface.*
- 5. Place rocks in several locations about 2-4 inches from the edge of the model.*
- 6. Draw a diagram of the model on your butcher paper. Make it as close to the actual model in size as possible. Label the dome area and the location of the ridges, rocks and soil. Make copies of the original map for each student in the group.*

Glacier Oobleck

Materials Needed:

- 1 cup of Elmer's Glue*
- 2 tsp Borax Powder*
- ¾ cup of warm water*
- ½ cup of warm water*
- 2 large cups*
- Spoon*
- Sheet of wax paper*
- Scotch or masking tape*

Procedure:

- 1. Tape the wax paper to the top of a desk, securely taping all four ends.*
- 2. Prepare the Glacier Oobleck by following the directions that follow.*
- 3. In the first large cup, add ¾ cup warm water and 1 cup glue. Stir until well mixed. Set aside.*
- 4. Pour ½ cup of warm water into the second cup. Add 2 tsp. of Borax powder and stir until dissolved.*
- 5. Pour the Borax powder mix into the glue mix. Stir until a glob forms and most of the water is mixed in. This should take less than a minute. Pour the mix onto the wax paper. Knead and work the mix for 2 – 3 minutes until all of the water is incorporated. The "glacier oobleck" can be stored in a ziplock bag until needed.*
- 6. Use the Glacier Oobleck for the glacier movement activity.*

GLACIERS: MOVERS AND SHAPERS

Student Activity Sheets #3A & B

Use the Web site: <http://nsidc.org/glaciers/story/> to answer the following questions about glaciers.

I. A Tour of the Life of a Glacier

Where can glaciers be found?

What type of climatic conditions are needed for glaciers to form?

What are the two main types of glaciers?

What is needed in order for glaciers to survive and grow?

II. The Growing Years

Put these steps of glacier formation into the correct order:

___ It begins to flow outwards and downwards under the pressure of its own weight.

___ The snow turns to ice.

___ Snow falls

___ Falling snow accumulates over time.

What is snow that survives one melt season called?

What causes snow and firn to be compressed into a mass of ice?

Snow that is compacted by overlying layers turns into _____

What color does some glacial ice look? _____

III. Moving Forward

What causes a glacier to begin moving?

In which direction to valley (alpine) glaciers move? _____

In which direction to continental glaciers move? _____

What are two ways that glaciers move?

What force causes a glacier to move by internal deformation? _____

What must be present for a glacier to slide? _____

How are crevasses created? _____

How do glaciers impact their surrounding environment? _____

What objects can a glacier move as it travels outward or downward? _____

What does the glacier do with these objects that it moves?

Name three depositional features created by glacier activity.

IV. In Retreat

When a glacier retreats, is it moving backwards? _____

How do glaciers retreat? _____

What causes a glacier to begin to melt?

What are three landforms created by glaciers that have retreated or disappeared?

GLACIERS: MOVERS AND SHAPERS (Answer Key)

Use the Web site: <http://nsidc.org/glaciers/story/> to answer the following questions about glaciers.

I. A Tour of the Life of a Glacier

Where can glaciers be found?

Near the poles, and on all of the world's continents except Australia

What type of climatic conditions are needed for glaciers to form?

Must have high snowfall in winter and cool temperatures in summer

What are the two main types of glaciers?

Valley glaciers and continental glaciers (also known as ice sheets)

What is needed in order for glaciers to survive and grow?

High precipitation and low temperatures

II. The Growing Years

Put these steps of glacier formation into the correct order:

- 4 It begins to flow outwards and downwards under the pressure of its own weight.
- 2 The snow turns to ice.
- 1 Snow falls
- 3 Falling snow accumulates over time.

What is snow that survives one melt season called? ***Firn***

What causes snow and firn to be compressed into a mass of ice?

They are compressed by the overlying snow

Snow that is compacted by overlying layers turns into ***ice***.

What color does some glacial ice look? ***It looks blue.***

III. Moving Forward

What causes a glacier to begin moving? ***The pressure of its own weight and gravity***

In which direction do valley (alpine) glaciers move? ***Flow down valleys***

In which direction do continental glaciers move? ***Outwards in all directions from a central point***

What are two ways that glaciers move? ***Internal deformation (spreading out) and sliding***

What force causes a glacier to move by internal deformation? ***Gravity***

What must be present for a glacier to slide? ***Water***

How are crevasses created?

Internal stresses build up in the ice which cannot be relieved by deformation alone.

How do glaciers impact their surrounding environment? ***They reshape the underlying and surrounding landscape as they move, through both erosion and deposition.***

What objects can a glacier move as it travels outward or downward?

Rocks and soil

What does the glacier do with these objects that it moves? ***It pushes the rocks and soil in front of it and dumps it to the side along the way or at the end of the glacier.***

Name three depositional features created by glacier activity.

Moraines, drumlins, and eskers

IV. In Retreat

When a glacier retreats, is it moving backwards? ***NO***

How do glaciers retreat? ***More ice is being ablated (lost through evaporation or melting) at the terminus than is being transported by flow into that region.***

What causes a glacier to begin to melt? ***Increasing temperature, evaporation, and wind scouring***

What are three landforms created by glaciers that have retreated or disappeared?

Moraines, eskers, and drumlins