Glaciers: Here Today, Gone Tomorrow?

Glacial Theory and Earth's Systems

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Grade Level	7th – 8th Grade	**Time Frame**	230 minutes
Subject	Science	**Duration**	4-5 class periods

Essential Question

What is happening to modern-day glaciers?

Summary

In this lesson, students will create models to simulate glacial movement. Students then will compare and contrast real glaciers with their models, learn about glacial theory, and research modern-day glaciers to find out what is happening to them.

Snapshot

Engage

Students watch a clip from *Ice Age* and record their prior knowledge using the Tip of the Iceberg strategy.

Explore

Students use models to simulate glacial movement and determine flow rate. Students also view a time-lapse video of a real glacier flow over a 10-year period. Then, students create T-charts to compare and contrast their simulated glacial movement with a real glacier's movement.

Explain

Students learn new vocabulary when deconstructing what happened with their glacier models, examine how scientists study glaciers, and play a Kahoot! game of glacier trivia.

Extend

Students research a U.S. glacier and use this information in an "About & Obit" project. In the group presentation, students share what they learned about the glacier. In the individually written obituary, students write what they would say about the life and legacy of the glacier, should it meet its end.

Evaluate

Student groups share their presentations with the class. Students then use the Spend a Buck strategy to "donate" fake money to at least one organization listed in an obituary of their choice. Finally, students use their new knowledge to complete the Tip of the Iceberg handout from the beginning of the lesson.

Standards

Next Generation Science Standards (Grades 6, 7, 8)

MS-ESS2-1: Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

Oklahoma Academic Standards (7th Grade)

7.ESS3.1 : Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.
7.ESS3.3.1: Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.

Attachments

- Gak-Recipe-Glaciers-Here-Today-Gone-Tomorrow - Spanish.docx
- Gak-Recipe-Glaciers-Here-Today-Gone-Tomorrow - Spanish.pdf
- Gak-Recipe-Glaciers-Here-Today-Gone-Tomorrow.docx
- Gak-Recipe-Glaciers-Here-Today-Gone-Tomorrow.pdf
- Glacier-Simulation-Glaciers-Here-Today-Gone-Tomorrow - Spanish.docx
- Glacier-Simulation-Glaciers-Here-Today-Gone-Tomorrow - Spanish.pdf
- Glacier-Simulation-Glaciers-Here-Today-Gone-Tomorrow.docx
- Glacier-Simulation-Glaciers-Here-Today-Gone-Tomorrow.pdf
- Lesson-Slides-Glaciers-Here-Today-Gone-Tomorrow.pptx
- Spend-a-Buck-Glaciers-Here-Today-Gone-Tomorrow.docx
- Spend-a-Buck-Glaciers-Here-Today-Gone-Tomorrow.pdf
- T-chart-Glaciers-Here-Today-Gone-Tomorrow - Spanish.docx
- T-chart-Glaciers-Here-Today-Gone-Tomorrow - Spanish.pdf
- T-chart-Glaciers-Here-Today-Gone-Tomorrow.docx
- T-chart-Glaciers-Here-Today-Gone-Tomorrow.pdf
- Tip-of-the-Iceberg-Glaciers-Here-Today-Gone-Tomorrow - Spanish.docx
- Tip-of-the-Iceberg-Glaciers-Here-Today-Gone-Tomorrow - Spanish.pdf
- Tip-of-the-Iceberg-Glaciers-Here-Today-Gone-Tomorrow.docx
- Tip-of-the-Iceberg-Glaciers-Here-Today-Gone-Tomorrow.pdf

Materials

- Lesson Slides (attached)
- Tip of the Iceberg handout (attached; one per student)
- Glacier Simulation handout (attached; one per group)
- T-chart handout (attached; one per student)
- Spend a Buck handout (attached; one bill per student)
- Gak Recipe (attached; makes 3 cups; ½–1 cup per group)
- White school glue (8 oz. bottle)
- Borax (sodium borate, a powdered soap found in the grocery store)
- Safety Data Sheet for sodium borate (linked)
- Gloves
- Goggles
- Large mixing bowl
- Plastic cup (8 oz. size works well)

- Spoon
- Measuring cup
- Food coloring (at least two different colors)
- Water
- Paper towel tubes (begin saving these in advance; one per group)
- Rulers (one per group)
- Foil (one sheet per group)
- Small rocks or gravel (aquarium gravel works well; about 10–20 pieces of gravel per group)
- Food coloring
- Black permanent markers (one per group)
- Books (two to five per group)
- Student devices with time-lapse capabilities
- Envelopes (one per student)

10 minutes

Engage

Introduce the lesson using the attached **Lesson Slides**. Display **slide 3** to show students the essential question.

Go to **slide 4** and inform students that it is field trip time! Their destination is the Ice Age about 18,000 years ago. Show students the *Ice Age* movie clip, but be sure to stop the video at 2:06, as the end of the video is not relevant to the glacial movement described in this lesson.

Go to **slide 5** and pass out the attached **Tip of the Iceberg** handout. Have students use a modified version of the Tip of the Iceberg strategy to assess their prior knowledge and think about what they want to know about glaciers.

On the handout, ask students to write what they already know about glaciers above the waterline. They should write anything they want to know about glaciers along the waterline. Let students know they will save the space below the waterline for later in the lesson.

Teacher's Note: Context

For context, read the following to students before they fill out the Tip of the Iceberg handout:

"Only about 1/8 of an iceberg is visible above the water. The rest is below the surface. Like the iceberg, learning has some aspects that are visible and many others that can only be suspected, guessed, or learned as understanding grows; the visible part of a subject is only a small part of a much larger whole."

Go to **slide 6** and review the lesson objectives with students. By the end of the lesson, students should be able to model how glaciers move, describe the role glaciers played in the formation of the Earth's surface, and predict how glaciers will determine the Earth's surface in the future.

50 minutes

Explore

Teacher's Note: Timing

The Engage portion and the first half of the Explore portion are to be completed on Day 1 of the lesson. In addition to having students prepare their glacial chutes, you may choose to have them make the Gak on Day 1 using the attached **Gak Recipe**.

Time-saving tip: If one class makes the chutes, the chutes may then be reused in other classes—just gently remove the Gak from the aluminum foil chute. Place students in groups of 2–4 depending on your available materials.

Teacher's Note: Variables

Student groups could use varying slopes and varying temperatures of Gak to test the effects of these variables. They also may choose to capture a time-lapse video of their "glacier" as it moves.

Teacher's Note: Safety

In the following glacier simulation, students must work with a slime-like material that includes Borax (sodium borate). For students' safety, please make sure students wear goggles and gloves when handling both Borax and the final product, Gak, and have students wash their hands afterward. You may reference this Safety Data Sheet (SDS) for more information on how to safely work with sodium borate.

Display **slide 7**. Present the following directions to students as they construct their glacier models:

- Cut the paper towel tube in half, lengthwise, so you have two open channels. These two chutes will serve as valleys for the simulated glaciers to travel down.
- Cover the channels with foil. This will keep the Gak from sticking to the valley.
- Using a marker, mark the sides of the foil-covered chutes in 1 cm increments from top to bottom.

Teacher's Note: Roles

The last half of the Explore portion will take all hour on Day 2 of the lesson. You may choose to assign student roles, such as gatherer of the materials, engineer of the valley, timekeeper, and data recorder.

Display **slide 8**. Present the following directions to students as they continue their simulation:

- Use books to prop up one end of the channel so that the "valley" has a gentle slope.
- Retrieve equal amounts of the two different colors of Gak.
- Put 10–15 small rocks or pieces of aquarium gravel in each color of Gak. (These rocks represent boulders that can be moved hundreds of miles by glacial flows.)
- To create the "glacier," layer the two Gaks like a stack of coins, alternating colors.

Go to **slide 9** and pass out the attached **Glacier Simulation** handout. Ask students to draw their simulated glacier setup and note the variables—such as the number of books used and the temperature of the Gak.

Next, have students start the investigation and begin timing when they place the layered Gak at the top of the valley. Remind students to jot down the starting time and then record the time (in seconds) each time the Gak moves a centimeter.

Go to **slide 10** and ask students who had the fastest glacier. Solicit a few responses from groups who believe theirs was the "fastest." Then, inform students that *speed equals distance divided by time*. Walk students through the calculations for flow rate to determine which group actually had the fastest glacier. Use the following example to demonstrate this:

Distance = 30 cm

Time = 45 min 25 sec (2,725 seconds)

Flow rate (speed) = 30 cm/2,725 sec

Flow rate (speed) = 0.011 cm/sec or 0.011 centimeters per second

On the last page of the handout, students in each group should determine how far their glacier moved in centimeters. They also should calculate how many seconds it took for the glacier to move that distance. They should then calculate the flow rate of their glacier using the *speed = distance/time* formula.

Teacher's Note: Variables

If you had groups vary the steepness of their slope (i.e., the number of books propping up the channel) and/or the temperature of the Gak, this would be the time to talk about those differences and how they affect the speed of glacier movement.

Go to **slide 11** and inform students they will watch a real glacier's movement. Then, show them the time-lapse video of Iceland's Sólheimajökull glacier. After the video, ask students the following questions:

- Why did you have to take so many time readings while your glacier moved?
- Would you have noticed more of a difference in your glacier's movement if you had observed it two times about 10 seconds apart or if you had observed it only at the beginning and at the end?

Solicit a few answers and have students explain their reasoning.

Go to **slide 12** and pass out the attached **T-chart** handout. Have students use the T-chart graphic organizing strategy to compare and contrast their simulated glaciers with the real glacier they just viewed in the time-lapse video. If students don't make a connection right away, replay the video and ask them to note the date stamps (April 2007 to June 2016) of the time-lapse photography. You may also prompt them to look at the debris in the video.

Sample Student Responses

Both took a "long time" to move, but in reality, the real glacier took a lot longer to move than the simulated glacier (years versus minutes). Both moved rocks and gravel.

After discussing their T-charts, ask students what they think the benefits are of using simulations and models in science. Then, ask them what they think the drawbacks are.

Sample Student Responses

Models and simulations can help us see something up close and on a small scale when we are unable to study the real thing in nature due to size, proximity, time, etc. Models and simulations also help us save money and allow scientists to manipulate variables before actually trying something new out in the field.

The drawbacks are that models and simulations might not be accurate because it's hard to replicate exact environmental conditions. We can't account for unknown variables (e.g., human impact, increased climate change).

60 minutes

Explain

Display **slide 13**. Have students explain the knowledge they've accumulated so far by posing the following questions:

1. When a glacier moves, along with the rocks it carries, what does it do to the valley underneath?
2. What happens over a long period of time if the glacier continues to scratch the ground?
3. What shape is the valley that forms when a glacier moves through?

Sample Student Responses and Teacher Input

1. It scratches the ground and rocks underneath it. These scratches are called *abrasions*.

2. It carves the ground into an even deeper valley.

3. The valley is U-shaped. This is called a *trough*. It's the same shape as a water trough for horses and cows.

Go to **slide 14** to continue with the questions:

4. What causes glaciers to move and keep moving?
5. In your glacier simulation, what did the different colors of Gak represent?
6. Did you have any rocks or gravel deposited along the way as your glacier moved?

Sample Student Responses and Teacher Input

4. Gravity is pulling them down the valley slope.

5. The different Gak layers represented different layers of ice.

6. *Moraine* is the term used for all the debris (soil, rocks, boulders) that is carried and deposited by glaciers.

Teacher's Note: Academic Vocabulary

New vocabulary words are italicized in the sample student responses above. As students explain their understanding, you can reinforce their learning by revealing these academic terms to them. You may choose to have students write the words in their notes, or you could create a word wall in the classroom.

Display **slide 15**. Explain to students that, historically, scientists have used two prominent theories to explain how the Earth's surface was shaped: diluvial theory and glacial theory. Highlight the major components of each theory using the bullets on the slide. Be sure to emphasize that diluvial theory is no longer accepted and is not supported by evidence—rather, it was an early competing theory that has since been debunked and replaced by glacial theory.

Go to **slide 16**. Ask students, “How do we continue to learn about glaciers?” Students may bring up the time-lapse video they watched earlier in the lesson. Inform students that scientists called glaciologists study glaciers in a similar way—they use time-lapse photography, which includes still photos, videos, and satellite images.

Go to **slide 17** and show students the video, titled “Dramatic video shows Alaska glacier collapse near kayakers.”

Then, go to **slide 18**. Invite students to play this Kahoot! game to assess what they have learned about glaciers so far.

Teacher's Note: Kahoot!

To have students play the Kahoot! game, use the link above or click on the image of the iceberg on slide 18. Ask students to get out their devices, go to kahoot.it in their choice of browser, enter the game PIN, and select an appropriate nickname to play with.

You may "kick out" any students who don't select an appropriate name, but you can require students to use their given names to avoid this issue. Students may use the app to play the game if they would rather not use a browser.

50 minutes

Extend

Place students in groups of 2–3. Then, display **slide 19** and inform students they will create an "About & Obit" presentation on a U.S. glacier of their choice.

On the same slide, click again to show students the requirements for the "About" group presentation, then click once more to reveal the "Obit" individual writing project guidelines.

Optional Slide

You may choose to show **slide 20** if students need to see the project requirements in a larger font size. Instructions for how to make the slide visible to students are included in the Notes field of slide 20.

In groups, have students decide on a glacier in the United States that they are interested in researching. Parameters for the "About" group presentation are as follows:

- All information must be in students' own words.
- Students must include: the glacier's name, its location, its status, one image, and one interesting or unusual fact about the glacier.
- This portion will be presented to the class, so it should be created using an appropriate program such as Google Slides, PowerPoint, or Prezi.

Then, discuss the "Obit" portion of the assignment. Individually, each member of the group must write an obituary for their glacier, should it meet its end. Parameters for this part of the assignment are as follows:

- All information must be in students' own words.
- Students must include: the glacier's name, one image, its date of "birth" and date of "death," cause of death, the glacier's "story," list of important life events (at least one), and the name of a fund for individuals to "donate" to in lieu of flowers (can be a real organization like the Union of Concerned Scientists, NOAA, National Resources Defense Council, etc. or students can make up an organization).
- This portion of the assignment will not be presented formally, so it can be created using a program such as Google Docs, Word, or Canva.

Teacher's Note: Obituaries

If students don't know what an obituary is, you may want to share this with them: "An obituary tells the story of a deceased person's life by acknowledging the person's passing, their life accomplishments, etc."

Give students 15 minutes for glacier research. Students should use the remainder of the period to create their presentations and obituaries.

60 minutes

Evaluate

Teacher's Note: Spend a Buck

Before class begins, cut out the fake $100 bills from the attached **Spend a Buck** handout. Be sure to print enough copies of the handout to provide one bill per student.

Before the presentations, provide each student with an envelope. On the front of the envelope, have each student write the name of the organization they listed in their obituary. This is where other students can place their fake $100 bills if they decide to "donate" to that organization in memory of a glacier.

You may choose to keep these envelopes at the front of the room or at your desk—this way, you may count the funds yourself after the lesson is over so as not to hurt the feelings of students whose organizations may not have been as well funded as others. Announce to the class the next day whose organization raised the most funds in honor of its fallen glacier.

Go to **slide 21**. Have each group share its presentation for the "About" portion of the About & Obit. Each member of the group should have a part in the presentation.

Then, ask students to share their individually written obituaries with the class. The obituaries may be printed and displayed around the room, or you may have students upload their obituaries to a site where other students can view them, such as VoiceThread.

Have students use a modified version of the Spend a Buck strategy to evaluate their classmates' presentations, obituaries, and organizations. Give each student a fake $100 bill from the attached Spend a Buck handout and inform students they can donate to any organization besides their own. They may "spend" all $100 on the same organization, or they may divide their funds among organizations.

Optional Extension

Invite students who are interested to create and/or sign a petition related to the loss of glaciers on change.org.

Go to **slide 22**. Ask students to revisit their Tip of the Iceberg handout. To close the lesson, have students write what they have learned about glaciers below the waterline.

Resources

- Extreme Ice Survey. (2009, August 10). IL-05 Sólheimajökull Glacier (Iceland) Time-lapse [Video]. Vimeo. https://vimeo.com/6039933
- Flinn Scientific. (2014, March 21). Sodium borate [Safety Data Sheet]. Flinn Scientific. https://www.flinnsci.com/sds_712-sodium-borate/sds_712/
- Ichbinverrukt46. (2008, December 12). Scrat Ice Age 1 [Video]. YouTube. https://www.youtube.com/watch?v=vCTNioSW730
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- Randall, T. (2020). Glaciers [Game]. Kahoot! https://play.kahoot.it/v2/?quizId=4911091f-48ba-46aa-a0c5-3979f0294068