LESSON 4

EARTH WATER DELIVERY: CANCELLED!

GRADE LEVEL 3-5

ARCTIC: *Our Frozen Planet*

ARCTIC: Our Frozen Planet

LESSON 4

EARTH WATER DELIVERY: CANCELLED!

GRADE LEVEL 3-5

90 minute lesson

STANDARDS (NGSS):

5-ESS2-2 Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

FROM THE FILM:

In the film, The *ARCTIC: Our Frozen Planet*, we learn about the important role of both fresh and salt water in the region to support the lives of polar bears, seals, and humans. Water provides everything from a frozen surface on which to travel for the Inuit to a place to live for narwhals, polar bears, and seals. So, where does that water come from and how does it cycle around the globe?

LESSON OVERVIEW:

The Arctic contains approximately 20% of Earth's freshwater supply. In general, the water cycle is driven by Earth's gravitational pull and energy provided by the sun.

After learning about how the water cycle shows up across the globe, students will select a product (comic strip, paper slide, video, song, or poster) to present the cycling of water through Earth's systems with examples of how that looks from the perspective of the Arctic. They will share their model with each other and discuss the benefits and advantages of each.

EDUCATOR PREP:

- Collect materials
- Prepare the technology to show the video
- Print the Activity Sheet (1 sheet per pair of students)

MATERIALS LIST:

- ***Earth Water Delivery: Cancelled!*** *activity sheet*
- *Globe or image of Earth from space.*
- *Construction paper*
- *Colored pencils*
- *Card stock paper*
- *Glue sticks*
- *Assorted science or nature magazines*
- *Additional art supplies students may require or request*
- *Technology to show the video* ***How the Hydrologic Cycle Works****:*

https://www.youtube.com/watch?v=al-do-HGuIk

LESSON 4

EARTH WATER DELIVERY: CANCELLED!

LESSON GUIDE

Part I – Overview of the Water Cycle

1. Prompt students to think about planet Earth. What does it look like? If available, use the globe to spark student's thinking.

If one is not available, ask them to close their eyes and picture Earth in their minds:

What makes up planet Earth?

Students will most likely respond by describing continents or land masses along with oceans and other water.

As you look or imagine the planet, which is there more of – land or water?

Help students to understand that the earth is mostly covered in water. Even though our maps/globes often focus on landmasses, when we take the planet in consideration as a whole, we see that it's 71% or almost 3/4th is covered in water.

Where does the planet get its water?

Student responses should confirm that water is already on the planet. Their responses also may reflect confusion about the question, since this is not something that we often talk about overtly.

So if the water is already on the planet and we are not getting any water delivered to our planet, where does it come from?

This is a semi-rhetorical question intended to get young people thinking about how the water that exists on our planet is the same water that has always existed. Responses may reflect this line of thinking or may illuminate some misconceptions (we have an endless supply!) about how kids think about water.

2. Let students know what in today's activity they are going to be looking at the **water cycle** and specifically how the Arctic influences the water on Earth.

To gauge students' background knowledge on the water cycle, ask them to work in pairs to complete the first two columns of the **Arctic Water Knowledge Chart** on the activity sheet. For the first column, they should fill in what they already know about the water cycle and water in the Arctic. For the second column, they should create at least two questions that they have about water in the Arctic.

Beluga whales, seen here from above, often travel in pods, or large groups.

3. Show students the video, *The Water Cycle: How the Hydrologic Cycle Works,* and ask them to jot down three new things they have learned about the water cycle that they didn't know before, under the **What I Learned** column on their sheet.

Part II – Water Distribution across the World

4. Share with students that although water is found all over the planet, it is not distributed evenly. We are going to look at some data from the United States Geologic Survey about where water is found across the globe.

5. Direct students to complete the activity sheet, **Water in the Arctic,** with a partner, including examining the data about water distribution, drawing a bar graph to show the data visually, and writing an explanation for why water is distributed in this way.

6. Review the answers to the activity sheet with the whole group and answer any questions they may have about what they have done up to this point.

7. Have students look at the Arctic Region Map and ask the whole group about the conclusions that we can draw about how water is distributed in the Arctic knowing about how it's distributed across the planet.

Where is most of the water in the Arctic located?

Student answers should reflect their observation that similar to the rest of the planet, water in the Arctic is mostly found in the ocean and in the icecaps, glaciers, and sea ice that is around the Arctic.

As the sea ice, glaciers, and ice caps are melting, where does that water go?

The melting ice in the Arctic goes into the Arctic Ocean, which is connected to the Atlantic and Pacific Oceans as well. Since so much of the planet's water is found in this part of the world, as it melts, it increases ocean levels and reduces the ocean's salinity.

Let's talk about Salinity for a second. Salinity is the amount of salt in water. Glaciers are made up of frozen fresh water, meaning no salt, and the ocean has a lot of salt.

What happens when the glaciers melt into the water?

Student responses should reflect their understanding that mixing salt water with fresh water makes the ocean less salty, or lowers its salinity.

EDUCATOR NOTES:

Part III – Communication to the World

8. Let students know that one of the most important parts of science is communicating what you have learned to other scientists and people who aren't.

In this final activity, we will create something that will communicate what we have learned about the water cycle and how water is distributed across the globe.

9. Divide students into groups of four and then pass out the cards to assign one of four roles (listed below). Make sure that each student has a role in the group. Note, depending on your students, you may also let them select their roles once they are in groups.

Researcher - responsible for collecting the information that the group will need to complete their project, and tracking the sources from where the content originates.

Graphic Designer – responsible for creating, finding, or leading the artwork for the project.

Writer- takes the lead on writing the text, including script or copy for the project.

Project Manager – Coordinates the timeline of the project, leads the group in brainstorming, and communicates the project to other groups during the sharing process.

10. Introduce the different **Science Communication Product** options to students and explain that they will pick one product to communicate what they learned about the water cycle.

Comic Strip / Paper Slide Video / Song / Poster

11. Give students 30 minutes to work in groups to create their Science Communication Product. Remind them that they will share what they have created before the end of the period.

12. As the groups are working, float around the room to check in with the students to ensure that they stay on task and on time.

13. Once students have finished, give each group a chance to share their product depicting the water cycle and what they learned.

14. As a wrap up have students fill out the **What I Learned** section of their activity sheet and then share with their group.

The Arctic region is made up of all three: ice, water, and land.

Earth Water Delivery – CANCELLED!

Arctic Water Knowledge Chart

In this activity, we are going to examine how the water cycle occurs in the Arctic and how that leads to the distribution of water across the region. We will examine all three states of water – frozen, liquid, and water vapor.

Part I: Using the chart below, fill in the first two columns about your knowledge and curiosity as it relates to water in the Arctic region of Earth.

What I Know	What I Want to Learn	What I Learned

Earth Water Delivery – CANCELLED!

Activity Sheet

Part II: Take a look at the chart from the USGS showing the distribution of water across the globe and answer the questions below.

1. Where is most of the water on earth located?

2. Where is the second most water located?

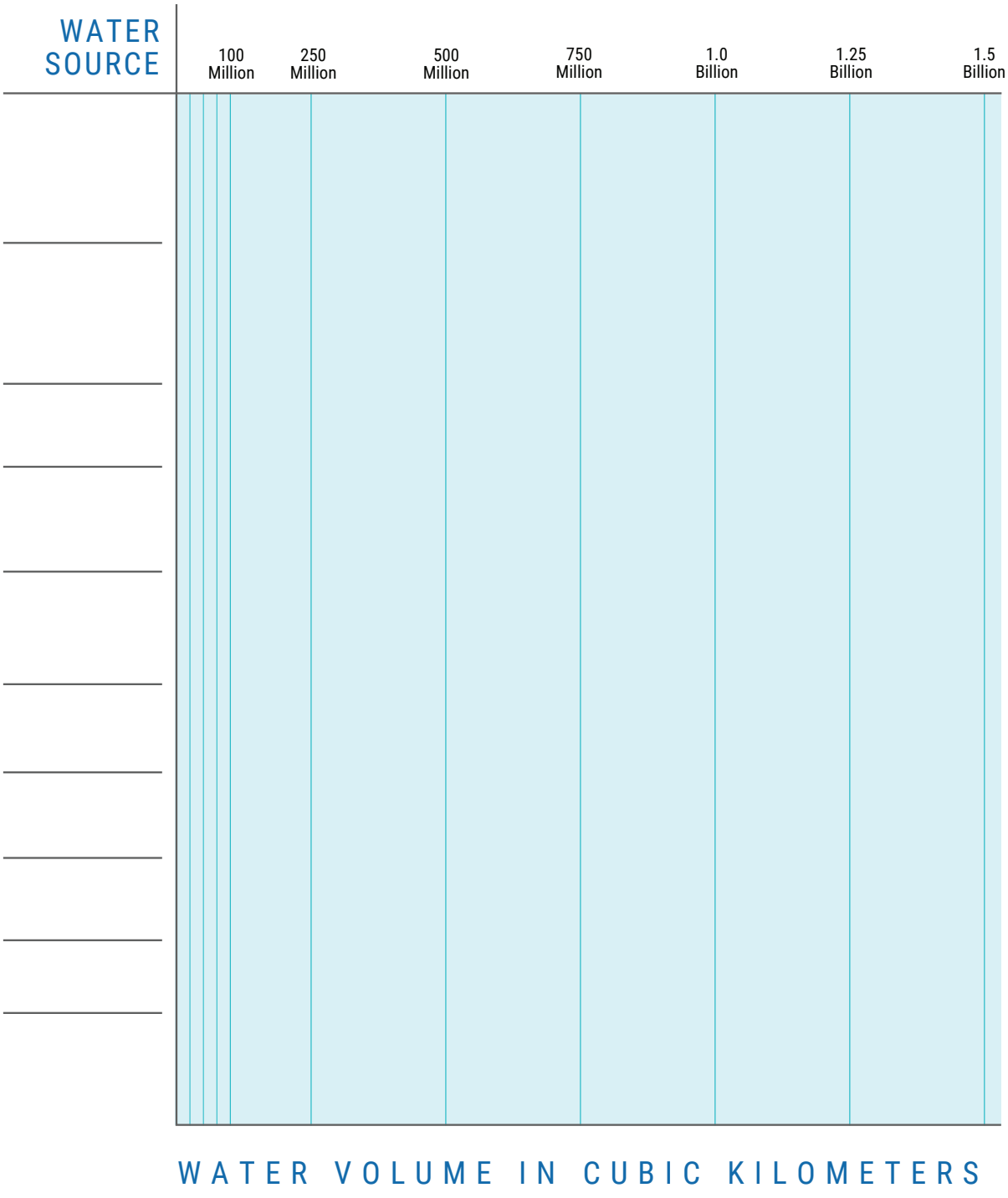
3. Do rivers or lakes contain more water?

Water Source	Water Volume in cubic kilometers	Percentage of Freshwater	Percentage of Total Water
Oceans, Seas, & Bays	1,338,000,000	0.00%	96.54%
Ice caps, Glaciers, & Permanent Snow	24,064,000	68.7%	1.74%
Groundwater *Fresh* *Saline*	23,400,000 *110,530,000* *12,870,000*	0.00% 30.1% 0.00%	96.54% 0.76% 0.93%
Soil Moisture	16,500	0.05%	0.001%
Ground Ice & Permafrost	300,000	0.86%	0.022%
Lakes *Fresh* *Saline*	176,400 *91,000* *85,400*	0.00% 0.26% 0.00%	0.013% 0.007% 0.006%
Atmosphere	12,900	0.04%	0.001%
Swamp Water	11,470	0.03%	0.0008%
Rivers	2,120	0.006%	0.0002%
Biological Water	1,120	0.003%	0.0001%
Total Water	**1,409,560,910**	**100%**	**100%**

Earth Water Delivery – CANCELLED!

Water in the Arctic

4. Using the data from the previous page, draw a bar graph below to show how water is distributed around the planet. Label each bar with the name of the source and the amount of water.



Earth Water Delivery – CANCELLED!

Activity Sheet

5. Describe in 2-3 sentences how water is distributed around the Earth, as if you were describing it to someone who has not yet seen the data above.

Communicating the Hydrosphere Project

Science Communication Product Goals: Create a product that will communicate how the water cycle works and distributes water across the planet. Be sure to describe the different parts of the water cycle as well as the locations for water across the globe. Your product can be:

Comic Strip / Paper Slide Video / Song / Poster

Roles: You will be assigned one of these roles which you will take on to ensure that the project moves forward successfully:

Researcher - responsible for collecting the information that the group will need to complete their project, and tracking the sources from where the content originates

Designer – responsible for creating, finding or leading the artwork for the project

Writer - takes the lead on writing the text, including script or copy for the project

Project Manager – Coordinates the timeline of the project, leads the group in brainstorming coordinates among the different members, and communicates the project to other groups during the sharing process.

Earth Water Delivery – CANCELLED!:

Arctic Region Map

Earth Water Delivery – CANCELLED!

Arctic Water Knowledge Chart / ACTIVITY EDUCATOR KEY

In this activity, we are going to examine how the water cycle occurs in the Arctic and how that leads to the distribution of water across the region. We will examine all three states of water – frozen, liquid, and water vapor.

Part I: Using the chart below, fill in the first **two** columns about your knowledge and curiosity as it relates to water in the Arctic region of Earth.

What I Know	What I Want to Learn	What I Learned
Answers may vary.	Answers may vary.	Answers may vary.

Earth Water Delivery – CANCELLED!

Activity Sheet / ACTIVITY EDUCATOR KEY

Part II: Take a look at the chart from the USGS showing the distribution of water across the globe and answer the questions below.

1. Where is most of the water on earth located?

   Oceans, seas, and bays.

2. Where is the second most water located?

   Ice caps, glaciers, and permanent snow.

3. Do rivers or lakes contain more water?

   Lakes contain more water.

Water Source	Water Volume in cubic kilometers	Percentage of Freshwater	Percentage of Total Water
Oceans, Seas, & Bays	1,338,000,000	0.00%	96.54%
Ice caps, Glaciers, & Permanent Snow	24,064,000	68.7%	1.74%
Groundwater *Fresh* *Saline*	23,400,000 *110,530,000* *12,870,000*	0.00% 30.1% 0.00%	96.54% 0.76% 0.93%
Soil Moisture	16,500	0.05%	0.001%
Ground Ice & Permafrost	300,000	0.86%	0.022%
Lakes *Fresh* *Saline*	176,400 *91,000* *85,400*	0.00% 0.26% 0.00%	0.013% 0.007% 0.006%
Atmosphere	12,900	0.04%	0.001%
Swamp Water	11,470	0.03%	0.0008%
Rivers	2,120	0.006%	0.0002%
Biological Water	1,120	0.003%	0.0001%
Total Water	**1,409,560,910**	**100%**	**100%**

Earth Water Delivery – CANCELLED!

Water in the Arctic / ACTIVITY EDUCATOR KEY

4. Using the data from the previous page, draw a bar graph below to show how water is distributed around the planet. Label each bar with the name of the source and the amount of water.

Earth Water Delivery – CANCELLED!

Activity Sheet / **ACTIVITY EDUCATOR KEY**

5. Describe in 2-3 sentences how water is distributed around the Earth, as if you were describing it to someone who has not yet seen the data above.

Much of the water on Earth is found in the oceans and seas and then ice caps and glaciers, and groundwater. The water is not nearly as much in rivers, lakes, and the atmosphere.

Communicating the Hydrosphere Project

Science Communication Product Goals: Create a product that will communicate how the water cycle works and distributes water across the planet. Be sure to describe the different parts of the water cycle as well as the locations for water across the globe. Your product can be:

Comic Strip / Paper Slide Video / Song / Poster

Roles: You will be assigned one of these roles which you will take on to ensure that the project moves forward successfully:

Researcher - responsible for collecting the information that the group will need to complete their project, and tracking the sources from where the content originates

Designer – responsible for creating, finding or leading the artwork for the project

Writer - takes the lead on writing the text, including script or copy for the project

Project Manager – Coordinates the timeline of the project, leads the group in brainstorming coordinates among the different members, and communicates the project to other groups during the sharing process.

LESSON 5

CAN YOU SURVIVE IN THE ARCTIC?

GRADE LEVEL 3-5

***ARCTIC:** Our Frozen Planet*

ARCTIC: Our Frozen Planet

LESSON 5

CAN YOU SURVIVE IN THE ARCTIC?

GRADE LEVEL 3-5

45 minute lesson

STANDARDS (NGSS):

3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

FROM THE FILM:

In the film, *ARCTIC: Our Frozen Planet,* we see animals over a variety of habitats – this activity reinforces the idea that different animals have adapted to live in different habitats. Polar bears for example, have been living in the Arctic for hundreds of years – and have adapted to living in the cold, Arctic climate.

LESSON OVERVIEW:

In this lesson students will learn about the differences between animals that can survive in different areas of the Arctic, and what properties can help them survive.

Students will play a card game where the goal is to place animals in the correct environments. Each animal is assigned points, based on being a consumer/producer/decomposer, and a unique "ability", which enables them to thrive in different environments. The student with the most points wins.

EDUCATOR PREP:

Print and trim out one set of cards and a game board **per pair of students** and assemble kits with one coin, one game board and one set of cards.

MATERIALS LIST:

- ***Can You Survive in the Artic?*** *trimmed playing card printouts*
- ***Can You Survive in the Artic?*** *game board*
- *Coins*
- *Paper*

LESSON 5

CAN YOU SURVIVE IN THE ARCTIC?

LESSON GUIDES:

1. To begin, remind students that we saw that in the film, ***ARCTIC: Our Frozen Planet***, there were many different areas within the Arctic biome where animals can survive.

2. Ask students to consider the following questions to activate their prior knowledge and what they may have learned in the film.

Allow students to pick an animal and gather in groups based on the first animal that comes to mind. What animals did they think of first?

What animals live in the ocean in the Arctic?

Answers should include the animals seen in the film, including: plankton, whales, narwhals.

What animals live on the ice in the Arctic?

Answers should include the animals seen in the film, including: seals, polar bears, walruses.

What animals live on the land in the Arctic?

Answers should include the animals seen in the film, including: wolves, bison, bees.

What are the different roles of organisms in an ecosystem to transfer energy?

Producers - convert sunlight to edible energy (sugar)

Consumers - Feed on producers and other consumers to get energy.

A lone polar bear stands out against the rocky landscape.

3. Take a moment to remind students know that there are many different animals all of whom live in various parts of the Arctic. They have adapted to enable them to survive in different areas.

Adaptions are traits that help animals thrive in their environments. There are two distinct types of adaptations, behavioral and biological.

A **biological adaptation** is a physical change in an organism that results over time from a reaction to its environment. An example would be the wolf, and their highly developed sense of smell.

A **behavioral adaptation** is the way an organism acts to survive in its environment. An example would be wolves working in packs to be more successful when hunting for prey.

4. Share with students that today, through a card game, we will demonstrate the ways in which animals work in the Arctic, and show how they can each survive in their environment.

5. Ask the students to select a playing partner, then explain to students the rules of the game:

- Students will pair off, with each pair getting one game board. They will face it towards them. Each pair of students will also get one set of cards and a coin.
- First, students will shuffle and each draw 5 cards.
- Next, they will flip a coin to see who goes first.
- Students will alternate placing a card in corresponding areas until they have played all of their cards.
- After all cards have been played, use the information on the cards to tally up the number of points earned by each person. Record the score for the round. Some cards will have special abilities, and some cards will affect how much each card is worth.
- Collect the cards, shuffle, and play again. The person with the highest score after three rounds wins.

EDUCATOR NOTES:

6. Once the game is over, have students discuss in a group what advantages the different animals have in different environments.

Would the ice animals survive in the ocean? What about on the land?

Student conversations should reflect their understanding that animals are adapted to live in their environment and would struggle to live in others. Encourage them to use specific examples to make their case as to why and examine any possible exceptions.

7. To conclude the lesson, have students reflect on what they learned about how animals are adapting to the changing environment because of climate change. Ask them to answer the following questions in a notebook or online journal:

How will polar bears survive without ice?

Student responses will vary, but should reflect something that they learned in this activity or in the film.

What changes can we make to help lesson the effects of climate change?

Student responses will vary, but should reflect something that they learned in this activity or in the film.

Perhaps surprising, but the Arctic is also home to bees and wildflowers.

Can You Survive in the Arctic?

Card Set 1

Bee
Consumer
LAND
1

Arctic Bees have special muscles that allow for them to warm up their bodies.

Bee
Consumer
LAND
1

Arctic Bees have special muscles that allow for them to warm up their bodies.

Bee
Consumer
LAND
1

Arctic Bees have special muscles that allow for them to warm up their bodies.

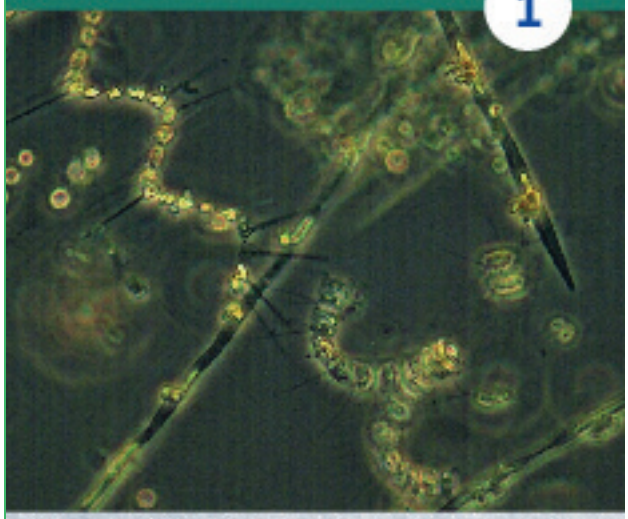
Bee
Consumer
LAND
1

Arctic Bees have special muscles that allow for them to warm up their bodies.

Can You Survive in the Arctic?

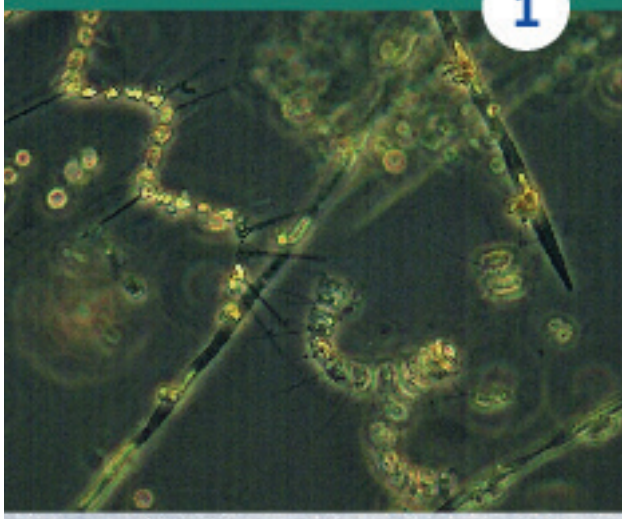
Card Set 2

Plankton
Producer
OCEAN
1



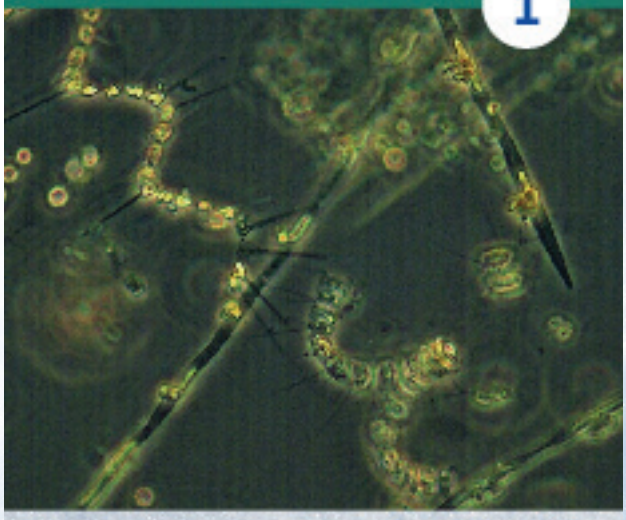
When plankton bloom in the summer, it can be seen from space!

Plankton
Producer
OCEAN
1



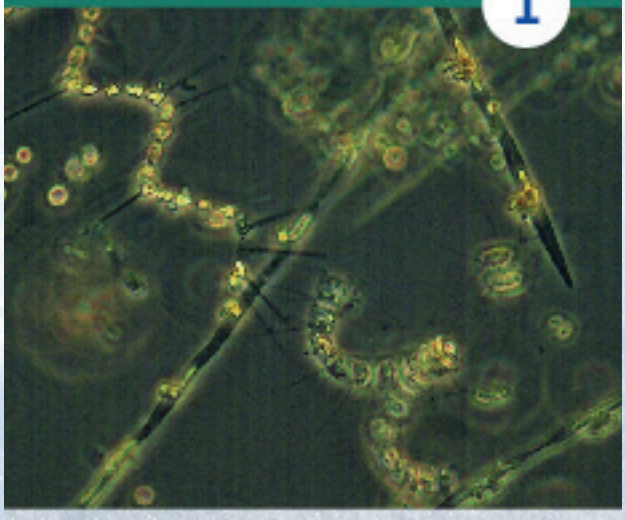
When plankton bloom in the summer, it can be seen from space!

Plankton
Producer
OCEAN
1



When plankton bloom in the summer, it can be seen from space!

Plankton
Producer
OCEAN
1



When plankton bloom in the summer, it can be seen from space!

Can You Survive in the Arctic?

Card Set 3

Wolves
Consumer

LAND

7

Arctic Wolves are carnivores. If there are 2 wolves on your board, you can take an opponent's bison.

Wolves
Consumer

LAND

7

Arctic Wolves are carnivores. If there are 2 wolves on your board, you can take an opponent's bison.

Wolves
Consumer

LAND

7

Arctic Wolves are carnivores. If there are 2 wolves on your board, you can take an opponent's bison.

Polar Bears
Consumer

ICE

10

Polar Bears are the largest bear in the world! Add 1 to your score.

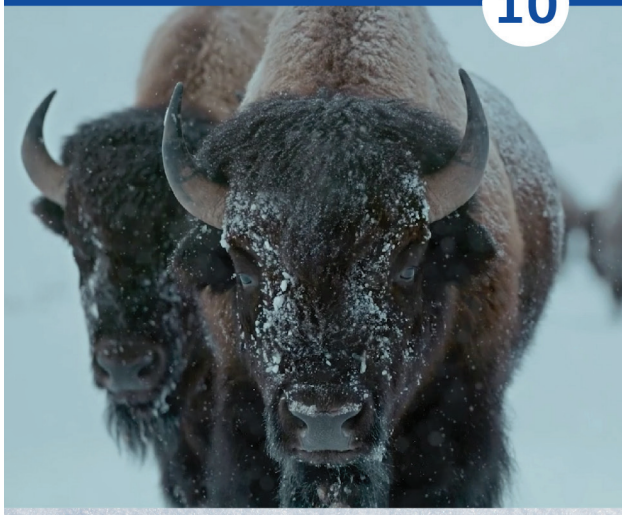
Can You Survive in the Arctic?

Card Set 4

Polar Bears
Consumer
ICE
10

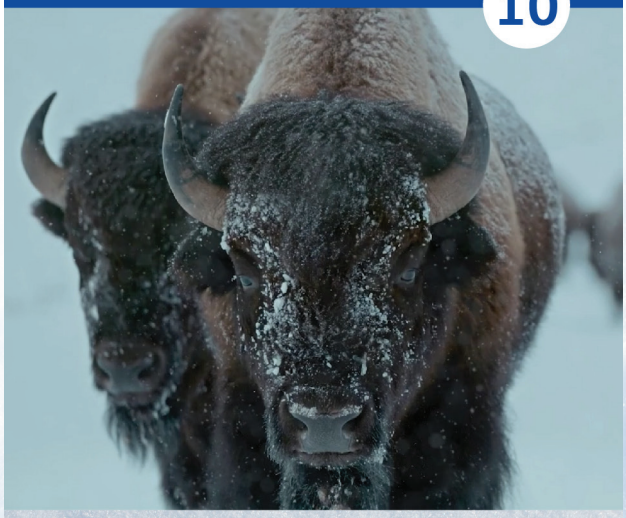
Polar Bears are the largest bear in the world! Add 1 to your score.

Bison
Consumer
LAND
10



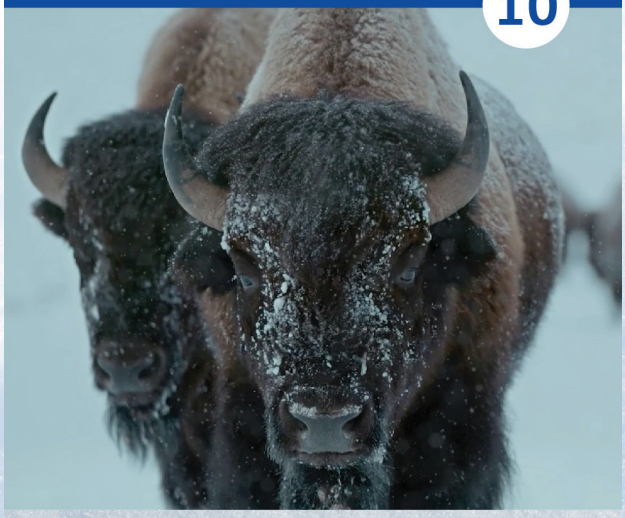
Bison can run up to 35mph, fast enough to knock the cards out of your hand. Discard 1 card after this is played.

Bison
Consumer
LAND
10



Bison can run up to 35mph, fast enough to knock the cards out of your hand. Discard 1 card after this is played.

Bison
Consumer
LAND
10



Bison can run up to 35mph, fast enough to knock the cards out of your hand. Discard 1 card after this is played.

Can You Survive in the Arctic?

Card Set 5

Bowhead Whale
Consumer
OCEAN
10

Bowhead Whales eat up to six tons of plankton a day. If there is at least 2 plankton cards in play, add 1 to this card's value.

Bowhead Whale
Consumer
OCEAN
10

Bowhead Whales eat up to six tons of plankton a day. If there is at least 2 plankton cards in play, add 1 to this card's value.

Bowhead Whale
Consumer
OCEAN
10

Bowhead Whales eat up to six tons of plankton a day. If there is at least 2 plankton cards in play, add 1 to this card's value.

Narwhals
Consumer
OCEAN
10

Narwhals' tusks is a large tooth! If there is a Walrus on the board, add a two(th) to your score.

Can You Survive in the Arctic?

Card Set 6

Narwhals

Consumer

OCEAN

10

Narwhals' tusks is a large tooth! If there is a Walrus on the board, add a two(th) to your score.

Harp Seal

Consumer

ICE

5

Seals gain about five pounds a day after they are born. Draw 2 cards after this is played.

Harp Seal

Consumer

ICE

5

Seals gain about five pounds a day after they are born. Draw 2 cards after this is played.

Climate Change

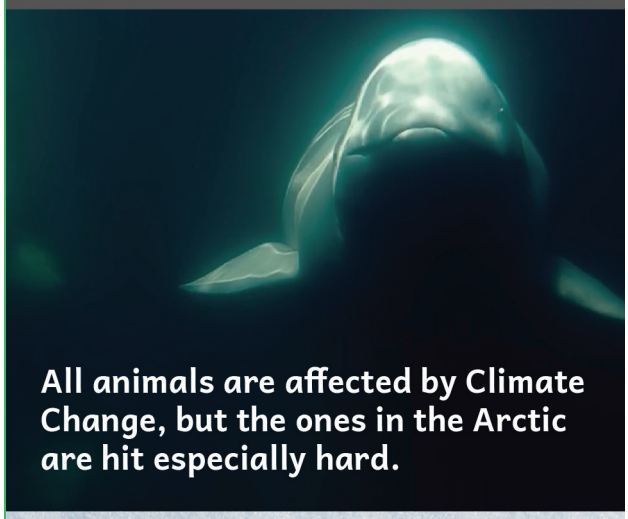
All animals are affected by Climate Change, but the ones in the Arctic are hit especially hard.

Reduce all of your opponent's cards by 1.

Can You Survive in the Arctic?

Card Set 7

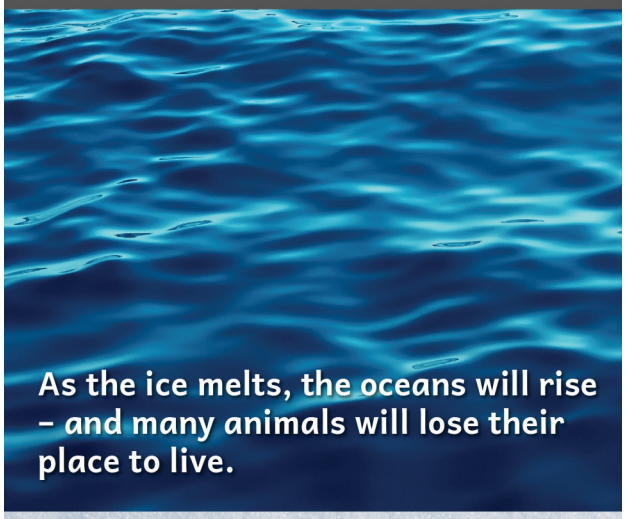
Climate Change



All animals are affected by Climate Change, but the ones in the Arctic are hit especially hard.

Reduce all of your opponent's cards by 1.

Ocean Rising



As the ice melts, the oceans will rise – and many animals will lose their place to live.

Remove 1 card from your opponent's Ice or Ocean rows.

Bee

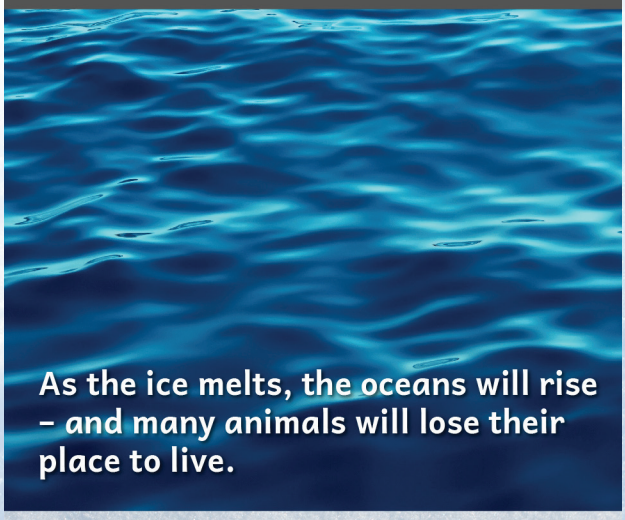
Consumer

LAND

1

Arctic Bees have special muscles that allow for them to warm up their bodies.

Ocean Rising



As the ice melts, the oceans will rise – and many animals will lose their place to live.

Remove 1 card from your opponent's Ice or Ocean rows.

Can You Survive in the Arctic?

Card Set 8

Walrus
Consumer
ICE
7

Walrus' tusks can be used to break holes in ice. Draw 1 card.

Walrus
Consumer
ICE
7

Walrus' tusks can be used to break holes in ice. Draw 1 card.

Walrus
Consumer
ICE
7

Walrus' tusks can be used to break holes in ice. Draw 1 card.

Queen Bee
Producer
LAND
10

Queen bees lay all the eggs for the hive. If there are no bee cards down, play 2.


SEA
ICE
LAND

LESSON 6

CARVING EARTH

GRADE LEVEL 3-5

ARCTIC: *Our Frozen Planet*

ARCTIC: Our Frozen Planet

LESSON 6

CARVING EARTH

GRADE LEVEL 3-5

45-60 minute lesson

STANDARDS (NGSS):

4-ESS2-1 Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

FROM THE FILM:

In the film, *ARCTIC: Our Frozen Planet,* we saw how powerful a force water can be as it melts and channels through ice. In this activity, we will explore each of these forces, how they carved the Earth we know today, and make estimates of what our future Earth will look like if these same forces continue acting on our earth at the same rate they are today.

LESSON OVERVIEW:

Students will conduct a series of tests to explore geologic concepts that shape the Earth's surface, discuss signs of weathering and erosion, and generate a prediction of what our future earth might look like based on current ice movement. Students will be able to explain how the Earth's surface changes on a large scale over a period of time by the movement of water, ice, and wind.

EDUCATOR PREP:

Add sand into foil pans, providing one pan per pair or one per group. Each pan should have enough sand for teams to build a small mound or sandcastle. In advance, freeze ice cubes for students to use.

MATERIALS LIST:

- ***Carving Earth*** *activity sheet*
- *Sand / 50 lb. bag / 2-4 cups of sand per group*
- *Rocks*
- *Trays/aluminum pans (one per pair or one per group)*
- *Ice cube / One per group*
- *Water / One cup per group*
- *Paper or plastic cup / One per group*
- *Hand-held fan (preferred), or a box fan*
- *Raised globe or relief map*
- *(Optional) Samples of limestone, coquina, or other sedimentary rocks that show evidence of impact and erosion from glaciers/water/wind*

LESSON 6

CARVING EARTH

LESSON GUIDES:

1. Begin by leading a class discussion about what students learned in watching In *ARCTIC: Our Frozen Planet*. Use the following questions to focus the conversation and have students follow along on their Activity Sheet:

What were some powerful geologic or water-based forces we saw in the movie?

The film depicted several powerful forces, including ice breaking off from glaciers and crashing into the ocean, water that had melted from the glaciers carving channels through the ice, water and ice vortexes, evidence of glacier-formed landscapes.

What are forces that cause erosion?

Water, Ice, Wind, Gravity

With enough time and force, how can water, ice, wind, and gravity cause erosion?

Rocks and sediment get picked up and moved by streams, ice, or wind.

Water gets into cracks in rocks and expands as it freezes, causing rocks to break apart. A steady stream of water landing on a rock over time can create enough pressure to carve through the rock.

Glaciers can shrink and grow depending on the climate, and as they change shape, they also move across the landscape crushing the earth beneath them, carrying rocks and sediment with them, and pushing deposits off to the side.

Wind blows sediment and can alter landscapes where the sand or soil is loose. Gravity can cause rocks to break apart, especially if they are already fragile and cracked.

Huskies are well adapted to life in the Arctic.

2. Let's look at a raised globe or a relief map as a class.

What are some geologic processes that can alter the Earth?

- Volcanoes
- Shifting tectonic plates
- Erosion

Can you identify areas on the map that were created by glaciers?

Glaciers can create geological features called cirques, moraines, paternoster lakes, and kettles. The Great Lakes around Michigan were all created by glaciers.

In Montana, you can visit **Glacier National Park** and witness all the different geologic features and processes firsthand.

Why is it important to understand how glaciers shape landscapes?

Clues of glacial erosion can give us an idea of what past climates looked like. Understanding the past can help us determine what our future Earth might look like.

3. Now we are going to explore the ways in which different types of erosion shape the land that we see. Remember, land is always continuing to be shaped by erosion, so we are always seeing something in progress of being shaped, and never the finished product.

4. Pass out a tray of sand to each pair or group. Remind students that sand must stay inside the tray!

5. Ask students to build a small mountain, hill, or sandcastle with their sand.

6. Once students have finished building their sandcastle, walk around the room with a handheld fan and gently blow the sand while having students make observations.

OPTIONAL (If handheld fan is not available, groups will need to bring their tray up to a box fan one at a time for the same demonstration. *The LOW setting is recommended*).

EDUCATOR NOTES:

7. After students have had an opportunity to make observations on what happens when wind erodes their creation, pass out one small cup of water to each group.

Students will test how water erodes their landscape and record their observations.

How did the water alter your sand creation?

Water moved down the sand creation, pushing sand out of the way and creating a pathway.

How does **Force,** *(pouring a large amount of water at once vs. a slow and steady stream,)* impact erosion?

More water results in more force. When larger quantities of water are poured at once, sand was displaced at a greater scale. A slow and steady stream created a controlled pathway and appeared less destructive than a lot of water at once.

8. Give each group one or two ice cubes. Groups should set the ice cube on the top of their mountain (they may need to push it into the sand a little). Allow their ice to sit and begin melting.

Tell students we will come back to this later.

9. As a class, go outdoors and search for signs of erosion. Students should take their **Activity Sheet** with them to record their observations.

10. As students finish the scavenger hunt, have them discuss as a group the following questions:

Are there any boulders nearby? If so, what signs of erosion do they show?

Tops of boulders may appear rounded from rainfall. There may be pockets in the boulder where rain pools in larger quantities.

Are there any nearby streams to view how water erodes the landscape?

Tops of boulders may appear rounded from rainfall. There may be pockets in the boulder where rain pools in larger quantities.

Can you find any cracks in rocks caused by water?

Students may find rocks with cracks in them or rocks that have been split into pieces. This is often a sign of erosion from rainfall and multiple freeze-thaw cycles.

An Inuit hunter traverses the ice thanks to a team of sled dogs.

11. Tell students to finish up, as the class is going back inside to check on our ice.

Has the ice in the tray moved at all?

Answers may vary. (Example) The ice melted slightly and moved down that sand mound.

What has happened to the sand around the ice?

Answers may vary. (Example) The ice pushes the sand to the side as it melts.

Does the ice create a trail or an indentation in the sand?

Answers may vary. (Example) Yes, the ice creates a trail as it melts.

Has the sand been **relocated?**

Answers may vary. (Example) It appears that sand is being relocated as the ice moves down the mound. Sand is sticking to the ice cube as it moves down the pathway.

12. Have students clean up any messes they made and put away materials.

13. Time to regroup.

We now know how wind, water, ice, and gravity can affect landscapes.

Looking at our current Earth, what do we think the world will look like 15 years from now? In 100 years? In 1000 years?

Answers will vary. (Example) The heating and cooling of Earth depends greatly on whether or not humans can ease up on the amount of carbon they release into the atmosphere. At the current rate, ice at the poles will melt in the next 15 - 100 years, causing sea levels to rise. If sea levels rise too quickly, it will cause more destruction to the coastlines and waterways than it would if it rises slowly. There would be coastal erosion on a global scale with many beachfront properties falling into the ocean. Rivers that stem from the ocean would see a rise which could also cause erosion to the surrounding landscape. As ice and glaciers at the poles melt, they will carve into any earth that they come in contact with, which may result in the formation of new valleys and lakes.

The Earth has gone through many freeze and thaw cycles and animals largely adapt. Because temperature increases are happening so quickly, it makes it particularly difficult for humans and animals to adapt. Increased global temperatures will also lead to more landscape changes as well.

EDUCATOR NOTES:

How can we affect the erosion of our beaches?

Foot traffic and tourism causes a great amount of erosion on the beaches, but the biggest threat to our beaches is the global increase in temperature which is melting the poles and causing the sea level to rise.

What strategies may work to prevent melting and what can we do?

Answers may vary. (Example) We can take better care of out planet, reduce waste, and reduce our dependence on fossil fuels. .

Ask the students to come up with 2-3 solutions that we can all implement.

We can switch to renewable energy.

We can plant more trees to absorb excess CO_2 in the atmosphere.

We can greatly reduce the amount of carbon we put out into the atmosphere by buying products that are created sustainably, shopping local, and growing our own produce.

14. Have the students write letters to their political representatives describing what climate solutions they would like to see the government support. ***Be sure to check letters before sending.***

Walrus, sunning on the beach.

Carving Earth

Activity Sheet

Name: _____

Date: _____

1. Reflecting on The Arctic

What were some powerful geologic or water-based forces we saw in the movie?

2. Erosion

What are forces that cause erosion?

Over time, how do these forces cause erosion

3. Geologic Processes

What are some geologic processes that can alter the surface of the Earth?

Carving Earth
Activity Sheet

MAP OF THE MIDWESTERN UNITED STATES

Can you identify any areas of the map that may have been created by glaciers?

Why is it important to understand how geologic processes have shaped landscapes?

Carving Earth
Activity Sheet

4. Erosion Activity

You and your teammates will work together to build a sandcastle and test how the following forces effect the shape of your structure. **Please keep sand in the tray!**

Record your observations:

FORCE	OBSERVATIONS (what happens to your structure?)
WIND	
WATER	
ICE	

Carving Earth
Activity Sheet

5. Outdoor Erosion Scavenger Hunt

Are there any boulders nearby? What signs of erosion do they show?

Are there any streams nearby? How does water erode the landscape?

Can you find any rocks or boulders with cracks in them? How can water crack a rock?

Are there any paths made by humans? How does human activity cause erosion?

6. Make Connections

How have geologic processes historically altered the surface of Earth?

Carving Earth
Activity Sheet

Given our understanding of erosion, if the ice in the Arctic continues to melt, what will Earth look like in the future?

Explain your predictions. (Use extra paper for your response if necessary.)

Bonus: What are some possible solutions that humans can implement to help slow the rate at which ice is melting at the poles?

Take action and write a letter to your local congressman to express your concerns.

Carving Earth

Activity Sheet / **EDUCATOR KEY**

Name: _____

Date: _____

1. Reflecting on The Arctic

What were some powerful geologic or water-based forces we saw in the movie?

(Answers may vary depending on the students' perception of the film) The film depicted several powerful forces, including ice breaking off from glaciers and crashing into the ocean, water that melted from the glaciers carving channels through the ice, water and ice vortexes, and evidence of glacier-formed landscapes.

2. Erosion

What are forces that cause erosion?

Wind, water, ice, and gravity.

Over time, how do these forces cause erosion

(Answers may vary) • Rocks and sediment get picked up and moved by streams, ice, or wind. • Water gets into cracks in rocks and expands as it freezes, causing rocks to break apart. • A steady stream of water over time can create enough pressure to carve through the rock. • Glaciers move across the landscape crushing the earth, carrying rocks and sediment while pushing deposits off to the side. • Wind blows sediment where the sand or soil is loose. • Gravity can cause fragile or cracked rocks to break apart.

3. Geologic Processes

What are some geologic processes that can alter the surface of the Earth?

Volcanoes, shifting tectonic plates, erosion.

Carving Earth

Activity Sheet / **EDUCATOR KEY**

MAP OF THE MIDWESTERN UNITED STATES

Can you identify any areas of the map that may have been created by glaciers?

The Great Lakes of Michigan were formed by glaciers. The Glacier National Park in Montana was also formed by glaciers *(not pictured on map).*

Why is it important to understand how geologic processes have shaped landscapes?

Clues of geologic processes can give us an idea of what past climates may have looked like. Understanding the past can help us determine what our future Earth may look like.

Carving Earth

Activity Sheet / **EDUCATOR KEY**

4. Erosion Activity

You and your teammates will work together to build a sandcastle and test how the following forces effect the shape of your structure. **Please keep sand in the tray!**

Record your observations: Answers may vary.

FORCE	OBSERVATIONS (what happens to your structure?)
WIND	The wind displaced the sand and caused the surface of the sandcastle to shift. Higher winds caused more displacement.
WATER	Water altered the surface of the sandcastle differently depending on the amount of force behind the water. Slower, steady streams carved paths in the sand, while greater forces of water caused greater destruction.
ICE	The ice had a slower impact on the sandcastle, but as the ice melted, it moved down the side of the sandcastle at a faster rate, displaced sand, and formed a pathway as it melted.

Carving Earth

Activity Sheet / **EDUCATOR KEY**

5. Outdoor Erosion Scavenger Hunt

Are there any boulders nearby? What signs of erosion do they show?

Answers may vary. Signs of erosion could be manmade (from many people standing/sitting on it), or natural (such as water dimples on eroded limestone or cracks from water).

Are there any streams nearby? How does water erode the landscape?

Answers may vary. Water will erode the landscape depending on the amount of force – a faster river will carve away more of the earth than a slower river. Sometimes we can see signs where rivers are currently low/slow, but the pathway around it might suggest that occasionally the river has surges.

Can you find any rocks or boulders with cracks in them? How can water crack a rock?

Answers may vary. Water works its way into porous surfaces of rock causing it to grow weaker. When water freezes and thaws, it expands and contracts, which leads to cracks forming in the rocks.

Are there any paths made by humans? How does human activity cause erosion?

Answers may vary. Human activity can cause erosion from the weight of our bodies moving over a surface over a period of time (gravity).

6. Make Connections

How have geologic processes historically altered the surface of Earth?

Answers may vary. Examples: volcanoes erupting have created mountains and ocean trenches, glaciers have carved out valleys and created lakes, wind and water have eroded landscapes gradually over time from varying amounts of force.

Carving Earth

Activity Sheet / **EDUCATOR KEY**

Given our understanding of erosion, if the ice in the Arctic continues to melt, what will Earth look like in the future?

Explain your predictions. (Use extra paper for your response if necessary.)

Answers may vary. If ice at the poles continues to melt, the ice will slowly carve valleys into any land masses they encounter as well as form pools of water and lakes. Sea levels will rise, causing increased erosion along coastal regions. If the ice melts at a faster rate, the effects will be much more devastating than if they happened at a slow and steady rate.

Bonus: What are some possible solutions that humans can implement to help slow the rate at which ice is melting at the poles?

Answers may vary, but should reflect students thinking creatively about ways to address the challenges of high carbon emissions, greenhouse gases, or the hole in the ozone layer.

Take action and write a letter to your local congressman to express your concerns.

Please read students' letters before sending them.