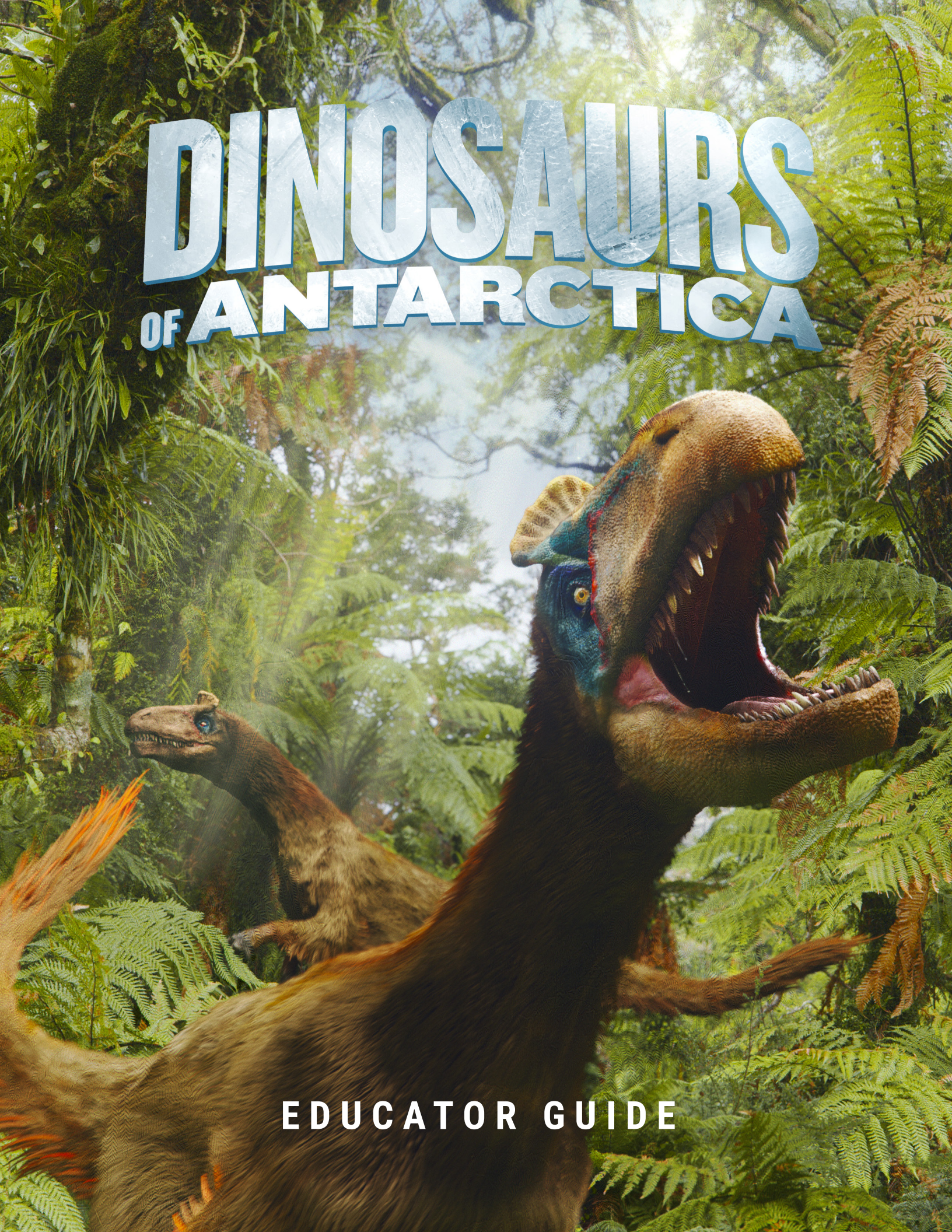
DINOSAURS
OF ANTARCTICA
EDUCATOR GUIDE

DINOSAURS OF ANTARCTICA

EDUCATOR GUIDE

DISCOVERY PLACE

Educator Guide written by Candice Wilson-McCain, Ed.S.

Dinosaurs of Antarctica is a production of Giant Screen Films.
Major Funding was provided by The National Science Foundation.

GIANT SCREEN FILMS

dinosaursofantarctica.com

Dinosaurs of Antarctica Educator Guide

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Dinosaurs of Antarctica Educator Guide

INTRODUCTION TO GUIDE

The ***Dinosaurs of Antarctica*** Educator Guide, created by Discovery Place Education Studio in Charlotte, North Carolina, in partnership with Giant Screen Films, is appropriate for students in grades kindergarten through eighth. The guide is most beneficial when used as a companion to the film but also useful as an independent resource. Educators are encouraged to modify the learning activities included in this guide to meet the needs of their students' functional level and to support specific state standards. Activities developed for this guide support the Next Generation Science Standards (NGSS) and national Common Core ELA and math standards. However, educators will find that the ***Dinosaurs of Antarctica*** film and guide align with other content areas such as geography. This guide focuses on the scientific understanding of Antarctica's geological and ecological history while exploring the career understandings of scientists who studied Antarctica. Students will examine the roles of a climatologist, paleontologist, and geologist by completing hands-on activities related to work in the field. This guide consists of sixteen engaging lessons that have been approved by teachers.

Dinosaurs of Antarctica is a story about Antarctica's geological and ecological history, specifically focusing on the Permian and Triassic extinction and Antarctica's climate transition from Icehouse to Greenhouse, creating a connection to present-day climate science. The film highlights the expedition to Shackleton Glacier featuring scientists from the Natural History Museum of Los Angeles and Field Museum, Chicago, along with other academic institutions. During the exploration, scientists uncover Antarctica's past through the discovery of ancient animal and plant fossils. Utilizing computer-generated imagery, ***Dinosaurs of Antarctica*** brings to life the eras of Antarctica's history and utilizes attributes of the giant screen to convey challenging scientific concepts such as plate tectonics, geological time, climate processes, etc. During the film viewers will shadow a team of scientists as they encounter extreme weather conditions to excavate fossils that will deepen our understanding of life on Earth.

Dinosaurs of Antarctica is a production of Giant Screen Films, directed by Dave Clark. The film has a run time of 40 minutes.

BACKGROUND

ABOUT ANTARCTICA

Antarctica is the coldest, windiest, and driest southernmost continent near the South Pole and contains 90% of all of the ice on Earth. Antarctica is a desert because it only receives two inches of rain per year. The small amount of rainfall received each year does not soak into the ground, causing it to accumulate as ice and snow. The Antarctic ice sheet is the largest single piece of ice in the world, covering more than 5 million square miles. Although Antarctica's temperature makes it difficult for many animals to survive, it is still home to some animals such as seals, whales, penguins, fish, and krill. Also, organisms such as algae and moss can survive the icy conditions. No permanent residents are living in Antarctica. However, Antarctica attracts thousands of scientists each year during the summer months to conduct research. Scientists and early explorers have been researching Antarctica since the late 1800's and each century uncovers new findings.

Although 98% of Antarctica is covered in snow and ice making it an icehouse, 200 million years ago, it was a greenhouse with wooded, lush habitat where dinosaurs and other living things thrived. Scientists have discovered fossils and other data that confirm the theory of plate tectonics, the movement of continents over time, and the impact on Antarctica's climate. Fossil records provide paleontologists a global perspective to dinosaur origin, enhancing their understanding of the End-Permian and End-Jurassic extinction events.

BACKGROUND

ANTARCTIC GEOLOGICAL TIMELINE

Geologists have divided Earth's history into a series of time intervals known as a geological time scale. The geological time scale consists of three eras: Cenozoic, Mesozoic, and Paleozoic. Each era splits into periods. Fossils found in Antarctica provide clues to the changing climate and position of the continent during each phase of the geological time scale.

ERA	PERIOD	ABOUT ANTARCTICA	TIMEFRAME
Paleozoic	Permian	The continents were connected as Pangaea. Scientists found fossils of the same species on all continents, including Antarctica.	299-252 million years ago
Mesozoic	Triassic	Antarctica plants and animals experienced climate patterns similar to today, consisting of sunlight in the summer and darkness in the winter.	252-201 million years ago
	Jurassic	Over time, Pangaea split into two supercontinents, Gondwana and Laurasia. Antarctica became part of Gondwana.	201-145 million years ago
	Cretaceous	Antarctica split away from Africa but was still connected to South America and Australia which created a gap filled by the ocean over time.	145-66 million years ago
Cenozoic	Paleogene	Antarctica began transitioning from a greenhouse to an icehouse.	62-23 million years ago

BACKGROUND

ANTARCTIC EXPEDITIONS

Antarctica has been an area of interest for explorers for hundreds of years. Antarctica was the last of the seven continents discovered, and early explorers were interested in learning more about the continents' natural resources. Some early explorers hoped to find new locations to hunt for whales and seals, while others wanted the glory of being the first to visit the continent. Regardless of the reason for expeditions to Antarctica, explorers faced incredible hardships, and many lost their lives in the process. Modern scientists utilize early explorers' findings to conduct further research to understand the history of Earth.

THE EARLY 1900S EXPEDITIONS

to Antarctica focused on competition to reach the South Pole.

1900

1901

British Discovery Expedition: Captain Scott and his team led their first Antarctic expedition with the goal of reaching the South Pole. The scientists turned around due to the extreme weather they encountered.

1907-1909

Ernest Shackleton led an expedition to the South Pole but was forced to turnaround after he runs out of supplies.

1910

1910-1912

Norwegian Antarctic Expedition: Roald Amundsen and his team became the first group of people to reach the South Pole.

1910-1913

Terra Nova Expedition: Captain Robert Falcon Scott, along with his team, set out to reach the South Pole again, hoping to be the first people to accomplish the task, but they found out they were a couple of months too late. Scott and his team reached the South Pole but perished during the return trip home.

1915-1917

Endurance Expedition: Ernest Shackleton and his team set out on a journey to reach Antarctica again with the goal of crossing the continent. However, his ship was crushed by ice and destroyed. The team was rescued five months later.

1920

BACKGROUND

THE MID 1900'S EXPEDITIONS

to Antarctica focused on research and scientific exploration.

1950

1957-1958

McMurdo Station, the first permanent research station in Antarctica, was built by the U.S. military to support the scientific study of over sixty nations.

1959

The Antarctic Treaty was established to make Antarctica a scientific preserve that banned military activity but supported freedom of research.

1960

THE LATE 1900'S & EARLY 2000'S EXPEDITIONS

1990

to Antarctica focused on understanding Antarctica's past and present environment and excavating fossils.

1990

Geologist, David Elliot, and his team discovered a set of large bones on Mount Kirkpatrick in Antarctica.

1994

Dr. William Hammer, along with other scientists, began excavating Mount Kirkpatrick and retrieved a skull and thigh bone of a dinosaur described as *Cryolophosaurus ellioti*.

2000

2003

Scientists continued to excavate *Cryolophosaurus* bones but ended the expedition early due to harsh weather.

2010

2011

Dr. Nate Smith and Dr. Pete Makovicky, along with other scientists, retrieved the remaining fossils of the dinosaur, *Cryolophosaurus*, and discovered new dinosaur fossils.

ABOUT THE SCIENTISTS IN THE FILM

DR. NATHAN SMITH

Paleontologist, Associate Curator, Dinosaur Institute
Natural History Museum of Los Angeles County

Originally from Crystal Lake, Illinois, Nate grew up fascinated with dinosaurs, science, and baseball. He received his B.A. in Biology from Augustana College, a M.S. in Geoscience from the University of Iowa, and a Ph.D. in Evolutionary Biology from the University of Chicago. Nate also served as a Postdoctoral Research Scientist at the Field Museum of Natural History and an Assistant Professor of Biology at Howard University before joining the Natural History Museum of Los Angeles County in 2015.

Nate conducts paleontological research for the museum's Dinosaur Institute, focusing on the evolution and biogeography of Triassic–Jurassic dinosaurs, among other topics. He has made many significant finds in Antarctica and is responsible for naming *Glacialisaurus* (featured in ***Dinosaurs of Antarctica***). Nate's work has taken him to Antarctica, Argentina, China, and the southwestern and western United States, and he appeared in the giant screen film Dinosaurs Alive, featuring his collaborative dinosaur dig at Ghost Ranch in New Mexico.

Dr. Nathan Smith.
Photo courtesy of Akiko Shinya.

LIBBY IVES

PhD Student, Geosciences—Physical Sedimentology
University of Wisconsin—Milwaukee

Libby grew up in Wisconsin and always had a strong love of the outdoors. She spent many summers camping and exploring wilderness areas as a counselor at YMCA camps. She completed a B.S. in Earth Science at Northern Michigan University, and holds an M.S. in Geology from Iowa State University. She has studied geological formations across the world, from volcanoes in Russia to Ice Age deposits in Argentina. Libby is trained as a Wilderness First Responder, a special type of medical certification that's useful for remote field work expeditions.

As a PhD student, Libby is studying the sedimentology and stratigraphy of Late Paleozoic (320 – 250 million year old) Ice Age deposits at sites in Antarctica (Transantarctic Mountains), Tasmania (Wynyard Formation), and Argentina (Tepuel Basin). Her aim is to better understand the type, timing, and extent of glaciation during the Late Paleozoic.

Libby Ives.
Photo courtesy of Dr. John Isbell.

BACKGROUND

DR. PATRICIA RYBERG

Paleobotanist, Associate Professor of Biology; Honors Academy Director
Park University

Although she was on a pre-med career track as an undergraduate student, Dr. Ryberg found her passion for paleobotany on a biology class field trip in Nebraska, where on an excursion to find fossil shark teeth, she also discovered fossil plants. She realized that field research would allow her to travel and spend time outside, discovering plants that are totally unlike anything that exists today. Dr. Ryberg's bachelor's degrees are in biological sciences and history from the University of Nebraska, and she completed her doctoral degree in botany at the University of Kansas.

Dr. Ryberg specializes in studying *Glossopteris*, an extinct plant species from about 260 million years ago. She's especially interested in ecology and the evolution of plant life at high latitudes, and what the ancient past might signal about the future. Her work has taken her on research adventures around the world, from South Africa to Australia to Antarctica.

Dr. Patricia Ryberg

DR. PETER MAKOVICKY

Paleontologist, Professor, Department of Earth and Environmental Sciences, University of Minnesota

Dr. Makovicky is a paleontologist whose research focuses on dinosaur evolutionary history. He received his PhD in Earth and Environmental Sciences from Columbia University, and spent 18 years as a Curator of Paleontology at the Field Museum in Chicago, where he was the lead curator of the Antarctic Dinosaurs exhibition. Prior to that he received his BSc and MSc degrees from Copenhagen University in Denmark, where he grew up.

He has conducted fieldwork on four continents and described more than 15 new dinosaur species from the US, China, Mongolia, Argentina, and Antarctica. Dr. Makovicky uses dinosaurs as model systems to study broader topics in evolutionary biology. His current research focuses on understanding how carnivorous dinosaurs evolved herbivory, and how dinosaur evolution and biogeography were shaped by major geological events. He has also studied biomechanics, scaling, dinosaur trackways, and behavior.

Dr. Peter Makovicky

LESSON 1.1

DISCOVERING ANIMALS

GRADE LEVEL K-1

DINOSAURS OF ANTARCTICA EDUCATOR GUIDE

Dinosaurs of Antarctica Educator Guide

LESSON 1.1
DISCOVERING ANIMALS

GRADE LEVEL K-1
(1) 60 MINUTE LESSON

STANDARDS:

- Use observations to describe patterns of what plants and animals (including humans) need to survive.

FROM THE FILM:

In the film ***Dinosaurs of Antarctica,*** scientists found the remains of plants and animals that no longer exist today. Paleobotanists like Dr. Patty Ryberg examine fossil remains of dead plants to learn about different periods of time in Earth's history. We are able to use paleobotanists' research findings along with evidence from other scientists - such as paleontologists, who study prehistoric animals - to discover why certain animals and plants become extinct over time.

LESSON OVERVIEW:

All animals need food to live and grow. They obtain their food from plants or other animals. Living things need water, air, and resources such as shelter to survive. They live in places that have the things they need. In this activity, students will explore what animals need to survive by matching animals to their particular needs.

MATERIALS:

- Animal Needs Student Resource Sheets 1.1, 1.1b and 1.1c cards (per group)
- Antarctica Animal Needs Student Resource Sheet 1.1d (per student)
- Technology to show the following videos:
  http://bit.ly/BlueWhaleAmazingAnimals
  http://bit.ly/AntarcticAnimalKrill
  http://bit.ly/AntarcticAnimalPenguins
- Optional: Crayons
- Optional: Chart paper

LESSON 1.1
DISCOVERING ANIMALS

EDUCATOR PREP:

Split the class into groups of four. Print a set of "Animal Needs Student Resource 1.1, 1.1b and 1.1c cards" for each group. Cut each set of cards and place them in an envelope for each group. Print a copy of the "Antarctica Animal Needs Student Resource Sheet 1.1d" for each student.

EDUCATOR GUIDE:

1. In the film ***Dinosaurs of Antarctica***, students will learn that dinosaurs and various types of plants once survived in Antarctica. Explain to students that millions of years ago, Antarctica was free of ice, allowing various kinds of plants and animals, including dinosaurs to live. Share with the students that as the climate changed due to natural occurrences, it made it difficult for animals and plants to survive.

2. Introduce the vocabulary word habitat to students. Ask students to raise their hand if they remember hearing the word habitat before.

What does the word habitat mean?
Habitat is the place or environment where a plant or animal naturally or normally lives and grows.

What do you notice about our habitat?
A particular habitat may have water, rain, air, snow, sand, and trees.

Explain to students that our planet has many unique habitats such as oceans, forests, rivers, deserts, lakes, and wetlands. Ensure that students understand that living organisms may have a different habitat depending on their needs.

3. Remind students that living things need particular resources to survive. Ask students:

Who has a pet?

Do you know someone who has a pet?

What kind of pet is it?

What does your pet need to survive?

4. Show students the six animal cards from the "Animal Needs Student Resource 1.1 cards."

Ask students to name all of the animals to confirm their knowledge about particular animals. Listen to student responses and clarify misunderstandings when necessary.

A male Cryolophosaurus – meaning 'frozen crested lizard' stalks through the fern foliage of Gondwana, flashing vivid facial colors and a large head crest.

LESSON 1.1
DISCOVERING ANIMALS

(4. Continued)
Explain to students that each group will receive a card with a picture of an animal that are common pets. Their role is to pretend that their chosen animal is their new pet. They have to purchase items to increase the likelihood of their pet surviving.

5. Give each group of students a set of "Animal Needs Student Resource 1.1, 1.1b and 1.1c cards." Tell students that as a group their role is to match each pet animal to their needs by stacking the cards into groups. Explain to students that they should have four stacks. Model an example to ensure students understand the expectations. Recall which students shared that they have a pet dog if applicable.

6. Hold up the card with a picture of a dog. Ask students to think about a typical dog's needs and choose two cards that may meet that requirement. Students should choose the dog food card and the dog house/bed. Direct students to place the three cards in a stack. Tell students to do the same strategy with the other animals. Circulate to provide assistance when needed and to check for understanding. Attempt to guide students to the appropriate choices by asking questions to push their thinking versus immediately sharing that their answers are incorrect.

7. Ask students to brainstorm at least one additional item that the pets may need. Each group will have six blank cards which should be enough for each student to draw one picture. Tell students that they will use the blank cards to draw a picture of at least one additional need for each pet. Ask students to raise their hand when they decide what their group will draw. Circulate to confirm that each student has a picture to draw.

8. Tell students that as a class, they will summarize the findings they explored about various animals using a Venn diagram. Explain to students that Venn diagrams are used to show relationships between a set of objects or ideas.

9. Make a Venn diagram on chart paper or the board for students to view. Write animals above the left circle and plants above the right circle.

Based on the activity you recently completed, what do living things need to stay alive?
Living things such as your pet need water, food, air/oxygen, appropriate temperature and a habitat to survive.

Based on your knowledge, what do plants need to survive?
Plants need many things to grow such as nutrients, air, water, light, temperature, space and time.

Be prepared to lead the discussion detailing what plants may need to survive if students have not been introduced to the concept.

Educator Notes:

LESSON 1.1
DISCOVERING ANIMALS

10. As you compare and contrast the needs of plants and animals, record students' thoughts in the Venn diagram. Explain to students that while living things can have different characteristics such as animals versus humans, we all have a few basic needs for survival. We all need water, habitat, and food. Ask students:

Thinking about rabbits that live in the wild, what might they need that's different and similar to a pet rabbit? Why?

Looking at the list of things plants and animals need to survive, do we as humans need any of these items? If so, which ones?

11. Remind students that in the film ***Dinosaurs of Antarctica,*** dinosaurs once lived in Antarctica but most of them died due to natural occurrences. Scientists believe that a set of natural disasters such as volcanic eruptions or an asteroid colliding with the earth's surface caused a climate shift making it difficult for some animals and plants to obtain food and the necessary conditions for survival in particular parts of the world.

Ask students:

What do you think happened to the dinosaurs?

How might a change in the environment affect their ability to survive?

12. Remind students that in the previous activity, they discovered the living requirements of specific animals (also for common pets). Ask students:

Which type of animals do you think make good pets?

Which type of animals do you think may not make a good pet? Why?

Do you think a dinosaur would have been a good pet? Why?

13. In the film ***Dinosaurs of Antarctica***, students learned that although some animals and plants that once existed in Antarctica may no longer exist, the continent is still home to some animals. Remind students that in the previous activity they explored what animals and plants need to survive. Ask students:

While Antarctica is home to only 6 of the 35 species of seals, the vast majority of all seals on earth live in Antarctica and the Arctic.

LESSON 1.1
DISCOVERING ANIMALS

(13. Continued)

What do living things need to survive?
Most living things need food, water, light, temperatures within particular limits, and air.

What animals currently live in Antarctica?
Some animals that live in Antarctica are whales, seals, krill and many birds such as penguins and petrels.

14. Explain to students that they will use what they know about Antarctic animals to determine their requirements for survival. Provide each student a copy of the "Antarctica Animal Needs Student Resource Sheet 1.1d."

15. Tell students that the learning task is to match the Antarctic animal to their habitat, food source, environmental needs, etc. Explain to students that they may not know a lot about some animals such as the Antarctic krill so they will watch a short video. Play the two-minute video "Animals of the Ice: Antarctic Krill" by Ocean Today for the class. *http://bit.ly/AntarcticAnimalKrill*

After showing the video, "Animals of the Ice: Antarctic Krill," ask students:

What do you think would happen if all of the Antarctic krill disappeared?
Many animals such as whales, ice fish, seals, and penguins would have limited amounts of food because they depend on krill as a food source.

What does the Antarctic krill eat?
Krill eat small plants under the surface of the sea ice.

Using the "Antarctica Animal Needs Student Resource Sheet 1.1d," instruct students to draw a line to match the Antarctic Krill with their particular needs for survival.

16. Share with students that they will watch another video about penguins. Play the two-minute video "Animals of the Ice: Emperor Penguins" for the class. *http://bit.ly/AntarcticAnimalPenguins*

After showing the video, "Animals of the Ice: Emperor Penguins," ask students:

How does the size of the emperor penguin keep them warm?
Their bodies can maintain more heat and they have a lot more feathers than any other bird.

Educator Notes:

LESSON 1.1
DISCOVERING ANIMALS

(16. Continued)

How do penguins travel in Antarctica?
Penguins slide around on their bellies. They also know how to climb ice cliffs using their claws and beaks.

17. The video does not mention penguins' food sources. Share with students that penguins eat seafood (ex: krill and fish) and they drink salt water. Ask students:

What do you think will happen if all of the fish in Antarctica disappeared?
Other animals such as penguins, whales, and seals will have a limited food source.

Using the "Antarctica Animal Needs Student Resource Sheet 1.1d" instruct students to draw a line to match the Emperor Penguin with their particular needs for survival.

18. Share with students that they will watch another video about blue whales. Play the one-minute video "Blue Whale Amazing Animals" by National Geographic Kids for the class.
http://bit.ly/BlueWhaleAmazingAnimals

19. After showing the video, "Blue Whale Amazing Animals," ask students:

How large is the blue whale?
The blue whale is the largest mammal living today and can grow up to 98 feet long and weigh up to 180 tons (larger than a truck).

Where can you find a blue whale?
Blue whales can be found in every ocean.

Using the "Antarctica Animal Needs Student Resource Sheet 1.1d" instruct students to draw a line to match the blue whale with their particular needs for survival. Tell students to complete the rest of the worksheet. Review the correct responses for each animal to ensure student mastery of the content.

20. Conclude the lesson by restating that all living things have particular requirements to survive. Explain to students that in the film ***Dinosaurs of Antarctica***, they will learn more about the ancient and current animals of Antarctica and how the continents' environment impact their survival.

An Emperor Penguin with chick at the Emperor Penguin Colony at Snow Hill, Weddell Sea, Antarctica. October 2018.

Bird

Rabbit

Dog

Cat

Match the animal on the left to their particular food and habitat needs on the right. Choices on the right side may be used more than once.

whale

penguin

krill

ocean & land

ocean

krill

fish

phytoplankton (algae)

LESSON 1.2

EXPLORING WEATHER

GRADE LEVEL K-1

DINOSAURS OF ANTARCTICA EDUCATOR GUIDE

Dinosaurs of Antarctica Educator Guide

LESSON 1.2
EXPLORING WEATHER

GRADE LEVEL K-1
(1) 30 MINUTE LESSON
(4) 20 MINUTE LESSONS

STANDARDS:

- K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time.
- CCSS.ELA-LITERACY.W.K.8/1.8. With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

FROM THE FILM:

In the film ***Dinosaurs of Antarctica***, explorers faced harsh weather conditions while conducting research. Many earlier explorers were unable to complete their Antarctic journeys due to the extreme cold. Scientists now are able to track Antarctica's weather patterns and normally take expeditions during the summer months to take advantage of warmer seasonal weather, making it easier to survive.

LESSON OVERVIEW:

In this lesson, students will identify characteristics of weather by observing, tracking, describing and predicting their local weather for six consecutive days.

MATERIALS:

- Exploring The Weather Booklet Pages
- Stapler
- Crayons or coloring pencils
- Technology to show the following video:

  Be a weather watcher by SciShow Kids
  http://bit.ly/WatchWeather

LESSON 1.2
EXPLORING WEATHER

EDUCATOR PREP:

DAY 1

Print one copy of the "Exploring The Weather Book Pages" for each student. To assemble the booklets, print the booklet pages front and back in the page order provided (ex: the cover page is the last page). Be sure that you print the pages as a booklet/tablet format to ensure the layout is correct. After printing a set of pages for each student, create booklets by folding the document in half. Based on your class size, it may be necessary to request parent or volunteer support in creating the booklets to avoid losing instructional time. Gather the necessary materials based on your class size. Create a visual display of a monthly calendar (ex: whiteboard, chart paper, bulletin board, etc.)

DAY 2

Pass out student materials (ex: flipbooks and crayons). Research the current daily temperature.

EDUCATOR GUIDE:

DAY 1

1. In the film ***Dinosaurs of Antarctica***, students learned about the harsh weather conditions many early explorers faced during their journey to the South Pole. The film also mentioned how although scientists today are more prepared for Antarctica's weather, they still find it challenging. Remind students that the weather is the way the atmosphere is behaving. Ask students:

Who can remember from the film why some early explorers didn't reach their goal of visiting the South Pole?
The weather was too harsh (bad) and it was too cold for them to continue.

Who can remember from the film, the type of clothing scientists on the expedition wore in Antarctica?
Scientists wore waterproof and windproof outerwear (ex: pants, jackets, and boots), hat, gloves, sunglasses, and thermal underclothing to keep warm.

Why should we care about the weather?
Weather tells us how we should prepare for the day (ex: how we dress, what to bring with us, whether we should attend an outdoor event, how animals might behave, etc.)

The Endurance sank to the bottom of the Weddell Sea during Sir Ernest Shackleton's expedition to Antarctica in 1914.

LESSON 1.2
EXPLORING WEATHER

2. Tell students that when scientists describe weather conditions, they are sharing what's happening in the atmosphere over a short period of time like today, this week or even this month. Tell students weather forecasters or meteorologists understand, observe, forecast and then share the earth's atmospheric behavior and how the atmosphere affects the earth and life on the planet. Tell students that a climatologist studies how the atmosphere behaves over a long period of time, such as years.

3. In the film ***Dinosaurs of Antarctica***, students learned that scientists were studying how the climate changed over time (moving from warm temperatures to extremely cold temperatures) in Antarctica and how it affected plant and animal life. Remind students that in the previous lesson, they discovered that plants and animals have certain requirements to survive and that the appropriate temperature level was one necessity.

4. Share with students that they will watch a short video about the different types of weather and how to keep track of the weather by making observations. Show students the video, "Be A Weather Watcher" by SciShow Kids. *http://bit.ly/WatchWeather*

After watching the video, lead a class discussion using the following question prompts:

What is a weather journal?
A weather journal is a document where people can record weather trends.

What is a thermometer?
A thermometer is an instrument for measuring temperature.

What type of weather might we experience in the summer?
In the summer, it might be warm and sunny.

5. Explain to students that over the next week, they will track the local weather and determine how it affects their daily life. Ask students if their parents/guardians/teachers ever had to change plans due to the weather. Students should be able to share an example such as not being able to go outside during recess because it rained or it was too cold.

6. Tell students that they will act as weather forecasters for the week. Explain to students that they will create a booklet to monitor the weather. Share with students that their booklet will have six pages and show them an example of a book. Tell students that each day, they will track the following: temperature, how it looks outside (ex: sunny or cloudy), how to dress for the weather and make a prediction about the weather for the following day. Point out that each page represents a day.

Educator Notes:

LESSON 1.2
EXPLORING WEATHER

7. Provide each student with a booklet. Tell students that they will begin tracking the weather today. Guide students through the process of completing day 1. Share the current temperature with students and share how you found this information (ex: news channel, phone app, car thermometer, etc.). Permit students to quickly share their booklet with a partner. Show students the large classroom calendar and explain that the weather for the previous two weeks has been updated. Tell students that they will update the calendar days as a class for the next week.

8. To conclude the lesson, explain to students that it's possible to retrieve weather conditions from last year, ten years ago, twenty years ago and beyond. Tell students that today's temperature will be recorded as part of history so perhaps thirty to fifty years from now scientists can track climate shifts.

Thermometer in snow marks temperatures below zero.

DAY 2- DAY 5

1. Guide students through the process of completing their daily booklet page. Share the current temperature with students. Permit students to quickly share their booklet with a partner. Show students the large classroom calendar and update it with the daily weather forecast. To check for understanding, choose a couple of questions below.

Did you notice a difference in the weather during the morning, afternoon and evening?

Why do you think the weather is cooler at night?

Did you notice a difference in the weather today compared to yesterday?

What do you think the temperature will be like tomorrow?

How did the weather affect your plans or decision making this week?

How does the season affect the weather?

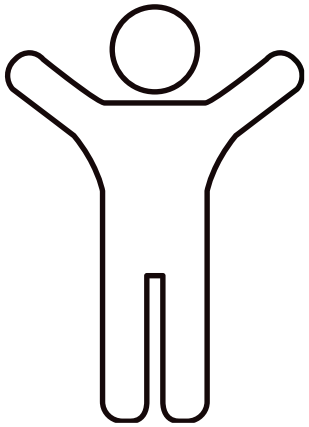
What kinds of problems might we face if we had a lot of rain in a short period of time?

2. To conclude the series of lessons, allow students to take their weather booklet home. Encourage them to track the weather on Saturday with their parents/guardians.

MONDAY

1. Today is _____ .
   date
2. The temperature today is _____ .
3. It looks like this outside. Circle one.

4. Children should dress like this today. Draw a picture.

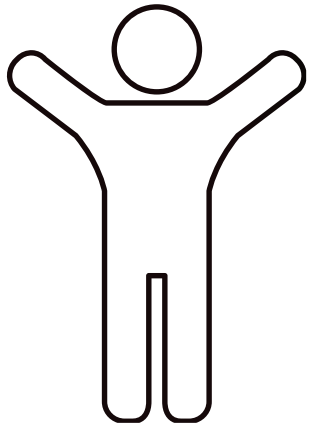


5. Tomorrow, I think it will look like this. Circle one.

TUESDAY

1. Today is _____ .
   date
2. The temperature today is _____ .
3. It looks like this outside. Circle one.

4. Children should dress like this today. Draw a picture.

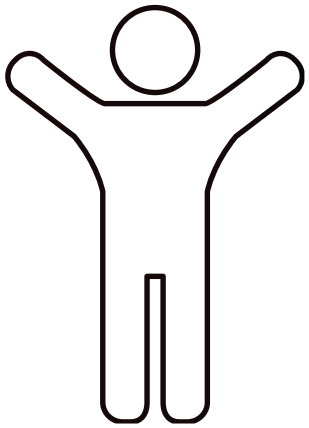


5. Tomorrow, I think it will look like this. Circle one.

WEDNESDAY

1. Today is _____ .
   date
2. The temperature today is _____ .
3. It looks like this outside. Circle one.

4. Children should dress like this today. Draw a picture.

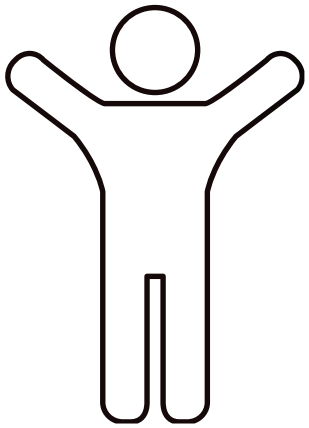


5. Tomorrow, I think it will look like this. Circle one.

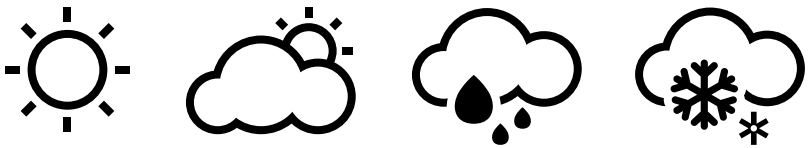
THURSDAY

1. Today is _____ .
   date
2. The temperature today is _____ .
3. It looks like this outside. Circle one.

4. Children should dress like this today. Draw a picture.



5. Tomorrow, I think it will look like this. Circle one.

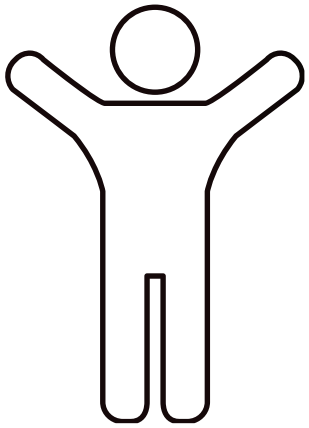


FRIDAY

1. Today is _____ .
   date
2. The temperature today is _____ .
3. It looks like this outside. Circle one.

sunny cloudy rainy snowy

4. Children should dress like this today. Draw a picture.



5. Tomorrow, I think it will look like this. Circle one.

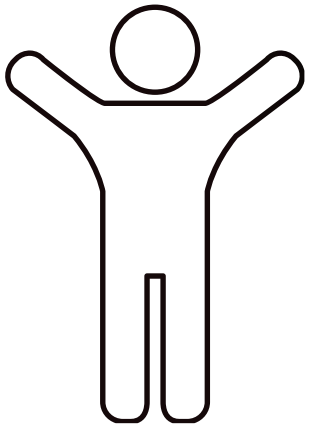
sunny cloudy rainy snowy

SATURDAY

1. Today is _____ .
   date
2. The temperature today is _____ .
3. It looks like this outside. Circle one.

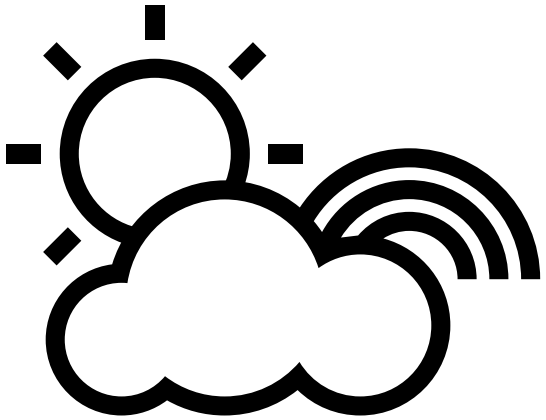
sunny cloudy rainy snowy

4. Children should dress like this today. Draw a picture.



5. Tomorrow, I think it will look like this. Circle one.

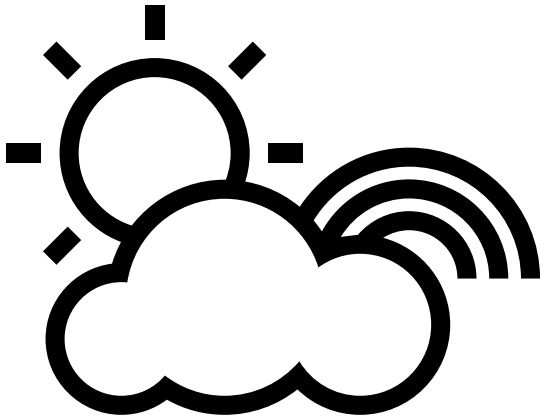
sunny cloudy rainy snowy



EXPLORING THE WEATHER

A BOOK BY

_____



EXPLORING THE WEATHER

A BOOK BY

_____

LESSON 1.3

PREPARING FOR ANTARCTICA

GRADE LEVEL K-1

DINOSAURS OF ANTARCTICA EDUCATOR GUIDE

Dinosaurs of Antarctica Educator Guide

LESSON 1.3
PREPARING FOR ANTARCTICA

GRADE LEVEL K-1
(1) 45 MINUTE LESSON

STANDARDS:

• CCSS.ELA-LITERACY.SL.K.1.A. Follow agreed-upon rules for discussions (e.g., listening to others and taking turns speaking about the topics and texts under discussion).

FROM THE FILM:

In the film ***Dinosaurs of Antarctica***, students learned that scientists had a limited amount of time to conduct research in the field due to weather conditions. Due to extreme weather conditions, explorers visiting Antarctica had to wear specific clothing to stay warm.

LESSON OVERVIEW:

In this lesson, students will determine the clothing requirements that explorers should consider to ensure a safe trip to Antarctica and create a stick puppet to represent their idea.

MATERIALS:

- Student Resource Sheet 1.3 (for every six students)
- Student Resource Sheet 1.3A (per partner)
- One craft stick (per student)
- Glue (per partner)
- Scissors (per student)
- Crayons

LESSON 1.3
PREPARING FOR ANTARCTICA

EDUCATOR PREP:

Print the "Preparing to Explore Student Resource Sheet 1.3 and 1.3a" and gather the necessary supplies based on your class size. "Preparing to Explore Student Resource Sheet 1.3A" provides six stick figures per sheet. Therefore, each sheet provides enough stick figures for six students. "Preparing to Explore Student Resource Sheet 1.3A" can be utilized by two students.

EDUCATOR GUIDE:

1. In the film ***Dinosaurs of Antarctica***, students learned that scientists had a limited amount of time to conduct research in the field. Explain to students that sometimes scientists call the area where they conduct hands-on research "the field" versus when they analyze their findings in the lab. Remind students that in a previous lesson, they learned how the weather can impact their decisions. Ask students if they can recall the reason scientists in Antarctica had a limited amount of time to excavate dinosaurs or conduct research in the field. Students should be able to share that scientists needed certain weather conditions (ex: not too windy or too much snow) to safely fly to the field site. Students should be able to connect that it was necessary for the researchers to plan to work under particular weather conditions to ensure their safety.

2. Explain to students that over the next couple of days, they will explore how scientists retrieve dinosaur fossils. Ask students:

What type of clothing do you think scientists wore when working at the field site in Antarctica?
Example: Scientists wore a lot of clothes to keep them warm such as boots, hats, long sleeve shirts, pants, and gloves.

What do you think might happen if someone wore shorts and sandals in Antarctica?
Example: They might become too cold or become really sick.

Scientists on Shackleton Glacier used helicopters to reach remote field sites. Weather often determines their research plans.
Photo courtesy of Dr. John Isbell.

LESSON 1.3
PREPARING FOR ANTARCTICA

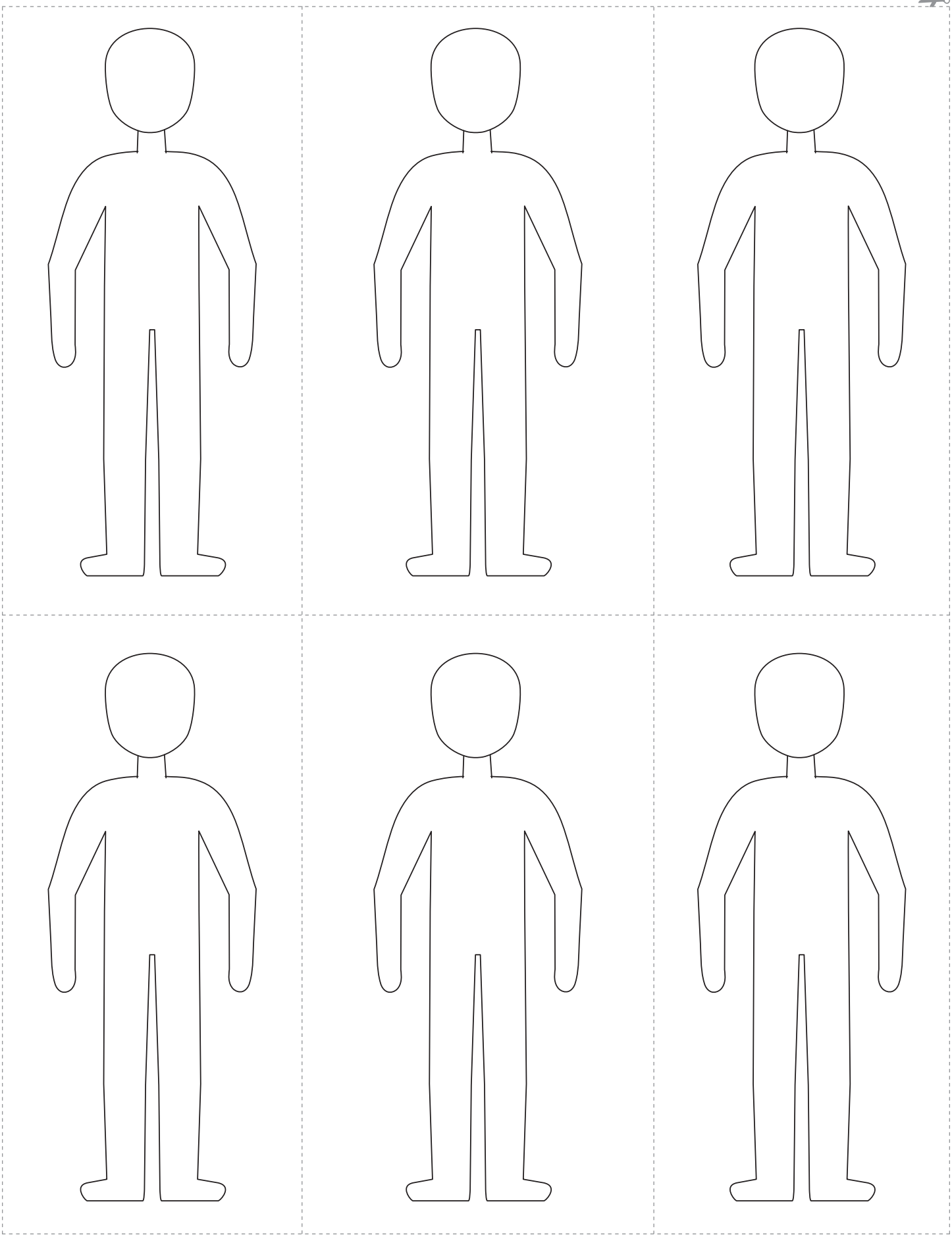
3. Share with students that they will pretend to dress an explorer or scientist in Antarctica and they need to choose appropriate clothing based on what they know about the continents' climate. Provide students with materials and supplies (ex: crayons, scissors, craft sticks, and glue) to complete the assignment. Guide students to complete the following steps:

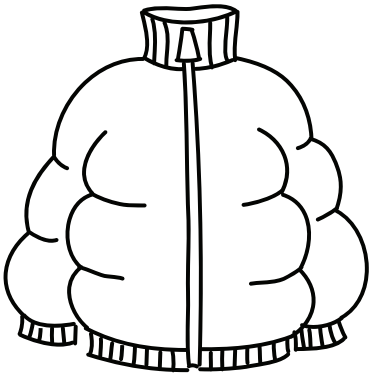
- Choose paper clothing for their explorer puppet
- Color the paper clothing for their explorer puppet
- Cut out the paper puppet
- Cut out the chosen paper clothing for their explorer puppet
- Glue the paper clothing to the paper puppet
- Glue the dressed paper puppet to a craft stick
- Circulate to provide individual assistance when necessary

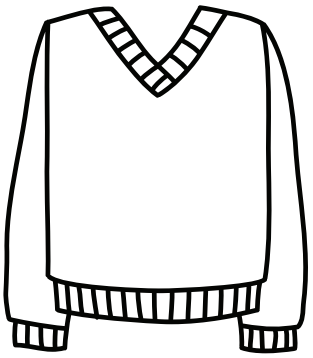
4. Split students into groups of four and allow ten minutes for them to create a play with their stick puppets. Provide students with the following prompt: Pretend you and your group mates are explorers in Antarctica and someone finds a dinosaur fossil. Using your puppet, create a scene or story detailing what happened. Circulate to hear the stories students create.

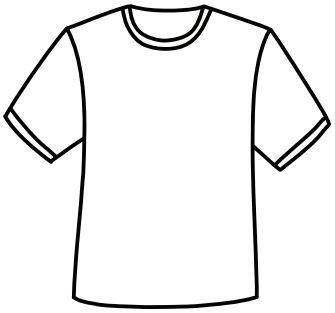
5. Conclude the lesson by permitting students to share their stick puppets with other groups and encourage them to explain their choice of clothing. Connect the lesson to the film ***Dinosaurs of Antarctica*** by asking students: How might scientists determine which type of clothing to bring to Antarctica?

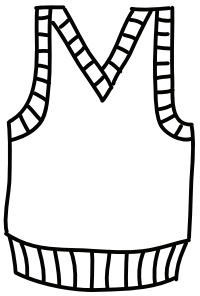
Educator Notes:

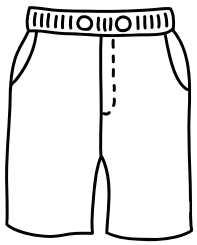


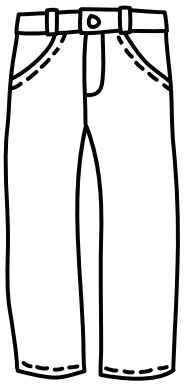


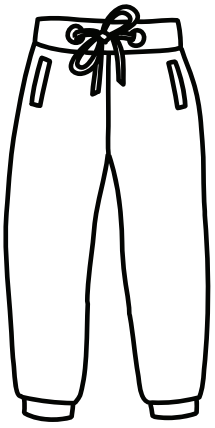


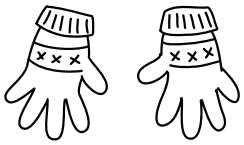


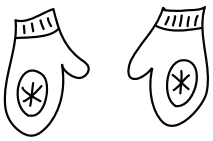


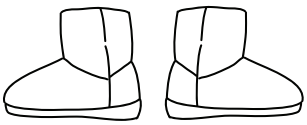


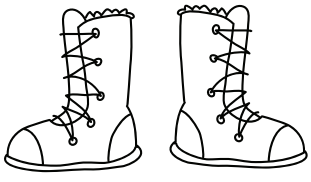












LESSON 1.4

EXCAVATING DINOSAURS

GRADE LEVEL K-1

DINOSAURS OF ANTARCTICA EDUCATOR GUIDE

Dinosaurs of Antarctica Educator Guide

LESSON 1.4
EXCAVATING DINOSAURS

GRADE LEVEL K-1
(1) 20 MINUTE PREP
(1) 45 MINUTE LESSON

STANDARDS:

- CCSS.ELA-LITERACY.SL.K.3. Ask and answer questions in order to seek help, get information, or clarify something that is not understood.
- CCSS.MATH.CONTENT.1.MD.C.4. Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.

FROM THE FILM:

The film ***Dinosaurs of Antarctica*** discusses how it can take decades and multiple expeditions to excavate dinosaur fossils. The *Cryolophosaurus* fossil was first discovered in 1990 and wasn't fully retrieved until years later in Antarctica. Paleontologists such as Dr. Nate Smith and Dr. Pete Makovicky study ancient life such as prehistoric mammals, fish, and even dinosaurs. Using fossil evidence, paleontologists can understand how organisms and our planet change over time.

LESSON OVERVIEW:

In this lesson, students will explore how excavating dinosaur fossils from rock in Antarctica is a lengthy process by retrieving "dinosaur fossils" from hard material using a variety of tools.

MATERIALS:

- One balloon (per partner)
- One mini toy dinosaur (per partner)
- One rectangle bin to melt iced dinosaurs (per partner)
- One turkey baster or small squeeze bottles (per partner)
- One handheld scrubber (per partner)
- Optional: kid-size plastic gloves (per student)
- Warm water
- Technology to show the following video:

  Dig In To Paleontology by SciShow Kids
  http://bit.ly/Huntfordinos

LESSON 1.4
EXCAVATING DINOSAURS

EDUCATOR PREP:

Split your class into partners. Gather enough materials to accommodate the class size. For example, if there are twenty students in the class, you will need materials for each set of partners (ex: ten). To prepare the lab, place a miniature dinosaur inside each balloon. Fill the balloon with water, tie the top and place it in the freezer overnight. Based on your class size, it may be necessary to request parent or volunteer support in preparing the balloons.

EDUCATOR GUIDE:

1. Reintroduce the vocabulary word *excavate* to students. Ask students to raise their hands if they remember hearing the word excavate in the movie.

What does the word excavate mean?
Excavate means to make a hole or channel by digging to remove pieces of Earth that are covering old objects buried in the ground to discover things about the past.

Can you remember a time when you had to dig into something to find an object?
[Acknowledge students responses]
Example: Some children like to bury items in the sand or dig for items in the sand such as rocks or shells.

2. Remind students that there are many people such as scientists who may excavate or dig for old objects and remains. In the movie, we learned about the role of a paleontologist and how it took a long time to dig up dinosaur remains in Antarctica.

Who is a paleontologist?
They are scientists who study ancient life such as prehistoric mammals, fish, and dinosaurs. Paleontologists use fossil evidence to determine how organisms and our planet changed over time.

Let's talk about the word fossil. Fossils are the remains or traces of remains of aged animals and plants. In the movie, some scientists were looking for dinosaur fossils.

From the movie, who remembers how long it took to dig up the largest meat-eating dinosaurs?
It took about twenty years to retrieve the entire remains of the *Cryolophosaurus*. So they started digging for this dinosaur before you were born.

Example of a plant fossil.

LESSON 1.4
EXCAVATING DINOSAURS

(2. Continued)

Do you think it's easier to dig in sand or rock? Why does it take so long to dig up the dinosaur remains in Antarctica?
Since it's so cold in Antarctica, the rock doesn't have the opportunity to thaw so it remains extremely hard. Unlike when you have probably dug in the dirt, the ground was softer so depending on how deep the object was located, it impacted the length of time it took to retrieve.

3. Over the next couple of days, we will attempt to explore how scientists excavate dinosaur fossils.

Why might some people think scientists dug into Antarctica's ice instead of rock to find dinosaur remains?
Since most people know that Antarctica landscape is covered in sheets of ice, they often assume scientists are digging in ice to find remains. Actually, they are drilling into frozen rock. While we will use frozen ice in our hands-on experiment, remember that the frozen ice is modeling the toughness of frozen rock.

4. Tell students that they are going to prepare for a fun experiment. Place students in their respective pairs or groups to prep for the experiment. It's suggested that students at least work in pairs to complete the activity. Be sure that each student understands their role and expectations for partner work before moving forward.

5. Show students a balloon, a cup of water and a toy dinosaur. Tell students that you placed the toy dinosaur inside the balloon and filled it with water. Afterward, you placed the balloon in the freezer overnight. Ask students:

What do you think happened to the water inside the balloons?
The water inside the balloons froze.

What do you think happened to the toy dinosaur inside the balloon?
The toy dinosaur should appear frozen inside the balloon.

Tell students that in a few minutes we will determine if our predictions were correct.

Educator Notes:

LESSON 1.4
EXCAVATING DINOSAURS

6. Explain to students that they will watch a video to learn more about how paleontologists find and remove dinosaur fossils. Show students the video, "Dig In To Paleontology" by SciShow Kids [4 minutes]. After students view the video, facilitate a discussion using the following question prompts:

How do paleontologists remove fossils from rocks and sand?
Scientists use tools such as shovels, big diggers and picks.

Where do paleontologists take the fossils they find?
Scientists take the fossils back to the lab to analyze their findings.

What is one way paleontologists share their findings?
Scientists' work can be found in museums.

Why is the role of a paleontologist important?
They study how life on planet Earth changed over time.

7. Remind students that in the movie ***Dinosaurs of Antarctica,*** scientists found a large dinosaur called *Cryolophosaurus* from the frozen rock of the Transantarctic Mountains. Ask students:

What did we say will happen to the water and toy dinosaur inside the balloon after being placed in the freezer overnight?
We predicted that the water inside the balloon would freeze and that the toy dinosaur may look like it's frozen.

8. Remove the balloons from the freezer. Give each set of partners a rectangle bin with 2 cups of warm water, a frozen balloon, handheld scrubber, gloves (optional) and a turkey baster or squeeze bottle.

9. Cut a circular section of the balloon near the tie point. Tell students to peel or remove the balloon, exposing the ice. Ask students to share their observations. Students should be able to share how their predictions were true or untrue.

10. Tell students the goal is to use the tools provided to excavate the dinosaur out of the "frozen rock" without removing it from the rectangle bin. Explain to students that you will set a timer so they can determine how long it took to retrieve the dinosaur. Use an anchor chart to record the amount of time it took for each group to "find" their dinosaur using a bar graph. Allow the groups to color in their time on the bar graph when they finish. Be sure to explain how to read and understand a bar graph if students are unfamiliar with the concept.

Nate Smith uses a saw to excavate a fossil on Shackleton Glacier. Photo courtesy of Akiko Shinya.

LESSON 1.4
EXCAVATING DINOSAURS

11. After every group retrieves their dinosaur, debrief the experience with the following question prompts:

What did you think about the activity?

Looking at the bar graph, which group took the shortest amount of time to find the dinosaur?

Which group took the longest amount of time to find the dinosaur?

Ask each group to share their method and have students discuss why one method might have worked quicker than the other method.

12. Conclude the lesson by connecting the activity to what they learned in the film about paleontologists' role in excavating buried remains. Be sure to emphasize that it can take years for scientists to recover dinosaur fossils.

Educator Notes:

Animals of Antarctica Puzzle

Use the pictures and the word bank to solve the puzzle.
If correct, the word will fit in the puzzle.

Word Bank:

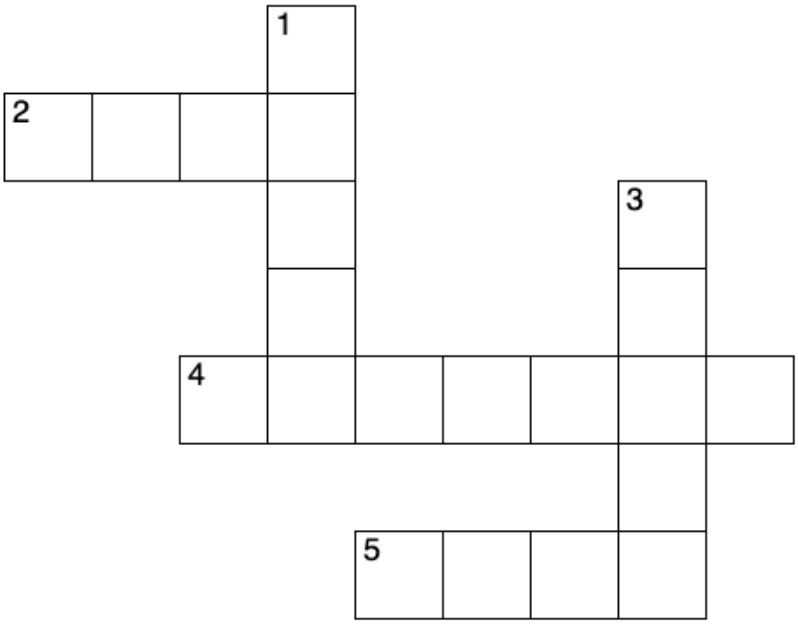
whale

penguin

seal

krill

fish



Across

2.

4.

5.

Down

1.

3.

Animals of Antarctica Puzzle

Use the pictures and the word bank to solve the puzzle.
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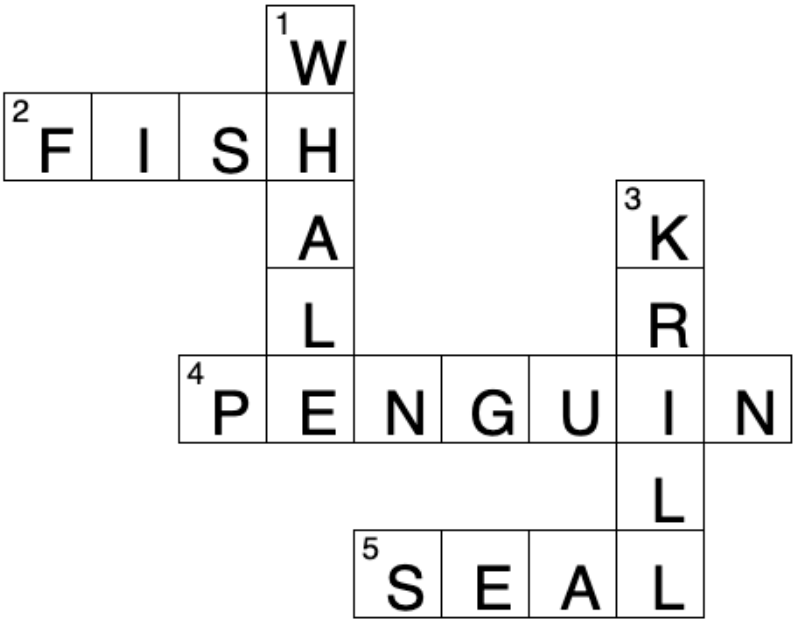


Across

2.

4.

5.

Down

1.

3.

LESSON 2.1

EXPLORING DINOSAURS

GRADE LEVEL 2-3

DINOSAURS OF ANTARCTICA EDUCATOR GUIDE

Dinosaurs of Antarctica Educator Guide

LESSON 2.1
EXPLORING DINOSAURS

GRADE LEVEL 2-3
(1) 45 MINUTE LESSON

STANDARDS:

• CCSS.ELA-LITERACY.RI.3.3. Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.

FROM THE FILM:

In the film ***Dinosaurs of Antarctica***, you will learn that Antarctica has been an area of interest for hundreds of years. The film provides several timelines, a representation of important events in the order in which they occurred, to help viewers understand more about research efforts in Antarctica. We are able to use explorers' research to make new discoveries about Antarctica.

LESSON OVERVIEW:

In this lesson, students will explore the purpose of documenting important events by creating a timeline of historical moments.

MATERIALS:

- My life: Great Things That Happened Student Resource Sheet 2.1
- Exploring Dinosaurs in Antarctica Timeline Student resource Sheet 2.1A
- Exploring Dinosaurs in Antarctica Student Resource Sheet 2.1B
- Cover of the Educator Guide

LESSON 2.1
EXPLORING DINOSAURS

EDUCATOR PREP:

Based on your class size, print copies of "My life: Great Things That Happened Student Resource Sheet 2.1" and "Exploring Dinosaurs in Antarctica Timeline Student Resource Sheet 2.1A" for each student. To save paper, print both documents double-sided on one sheet. Print a copy of the "Exploring Dinosaurs in Antarctica Student Resource Sheet 2.1B" for students. It's possible for two students to share one document. To save paper, utilize technology to display "Exploring Dinosaurs in Antarctica Student Resource Sheet 2.1B" for students to view as a class.

EDUCATOR GUIDE:

1. In the film ***Dinosaurs of Antarctica,*** students will learn that Antarctica has been an area of interest for explorers for hundreds of years. Explain to students that Antarctica was the last of the seven continents discovered and that early explorers were interested in learning more about the continents' natural resources. Tell students that some early explorers hoped to find new locations to hunt for whales and seals while others wanted the honor of being the first to visit the continent. Ask students: Based on the title, ***Dinosaurs of Antarctica,*** and the picture what do you think scientists in the film were researching in Antarctica? Show the cover of the educator guide.

2. Tell students that scientists and explorers often participate in expeditions, a journey or voyage taken by a group of people with a particular purpose to research something. Introduce the vocabulary word *explore* to students. Ask students to raise their hands if they remember hearing the word explore before.

What does the word explore mean?
To explore means to investigate, study, test or experiment with the goal of learning something new about the subject.

What does the word explorer mean?
An explorer is a person who investigates unknown regions in search of geographical or scientific information.

3. Explain to students that scientists sometimes participate in explorations, expeditions or field observations with the goal of learning something new or to prove something they believe to be true. Ask students to name a situation when they have conducted research with the goal of learning something new. Students may share school-related research experiences such as work done in science and language arts class. Encourage students to provide examples of when they engaged in research outside of class.

Frank Wild and Ernest Shackleton during the Imperial Trans-Antarctic Expedition.

LESSON 2.1
EXPLORING DINOSAURS

4. If students are unable to come up with an example, lead a think-pair-share discussion about researching entertainment options. Ask students:

Take 30 seconds to think about a situation when you desired a particular toy, game, book or perhaps wanted to attend somewhere that seemed fun.

Partner with the person beside you and share what was it that you wanted and why.

Who would like to share the type of research you conducted about the topic?

For example, students should be able to share that they may have originally heard about a game from a television commercial. After becoming interested in the game, they may have asked other kids if they had the game and to share their thoughts about it. Due to positive comments, they may have visited a website to learn more about it or traveled to a game store to read a description of it. Ensure students understand that people conduct research often.

5. Share with students that they will have an opportunity to view the film ***Dinosaurs of Antarctica*** and that by now they may have guessed that scientists were interested in researching dinosaurs. Explain to students that they will complete a timeline activity to learn more about the dinosaur expeditions that occurred in Antarctica.

6. Explain to students that they will create a timeline, a tool that people use to help understand history, by showing how much time occurred between a set of events. Tell students that they will first create a timeline about their life to become familiar with the process. Provide each student a copy of "My life: Great Things That Happened Student Resource Sheet 2.1" and review how to complete the assignment.

7. The assignment instructs students to think about four important events that occurred in their life for the following years: 2016, 2017, 2018, and 2019. Students are guided to create a timeline of their life events. Tell students that they will have fifteen minutes to create their personal timeline. Circulate to provide assistance when necessary. After the designated time has expired, allow students the opportunity to share their timeline with a peer.

Educator Notes:

LESSON 2.1
EXPLORING DINOSAURS

8. Remind students about their predictions for the film ***Dinosaurs of Antarctica***. Provide each student with a copy of "Exploring Dinosaurs in Antarctica Timeline Student Resource Sheet 2.1A" and "Exploring Dinosaurs in Antarctica Student Resource Sheet 2.1B". Tell students that using the resources provided, they will create a timeline documenting dinosaur fossil findings in Antarctica. Quickly review how to complete the assignment.

9. The assignment instructs students to think about five dinosaur fossil finding events that occurred in history; however, they will only utilize four events to complete the assignment. Students are asked to organize the events by date, write a statement about what happened and draw a picture that represents the occasion. Read the events aloud for students. Tell students that they will have fifteen minutes to create the timeline with a partner. Circulate to provide assistance when necessary. After the designated time has expired, review the timeline to ensure the accuracy of sequencing events.

10. To conclude the lesson, say to students that in the film ***Dinosaurs of Antarctica***, they will learn more about the timeline of expeditions in Antarctica.

A Cryolophosaurus female sleeps in the fern forests of Gondwana – prehistoric Antarctica. These giant meat-eaters survived in an eerie world of winter polar night and summer midnight suns.

Exploring Dinosaurs in Antarctica

2011
Dr. Nate Smith and Dr. Pete Makovicky, along with other scientists, retrieved the remaining fossils of the dinosaur, *Cryolophosaurus*, in Antarctica.

1990
Geologist, David Elliot discovered a set of large bones on Mount Kirkpatrick in Antarctica.

1994
Dr. William Hammer, along with other scientists, began excavating Mount Kirkpatrick and retrieved a skull and thigh bone of a dinosaur later named *Cryolophosaurus*.

2008
Rodolfo Coria, a paleontologist and paleo technician Juan J. Molydiscovered a partial skeleton of a small beak dinosaur later named *Trinisaura*.

1986
Scientists found the first dinosaur fossils in Antarctica on James Ross Island.

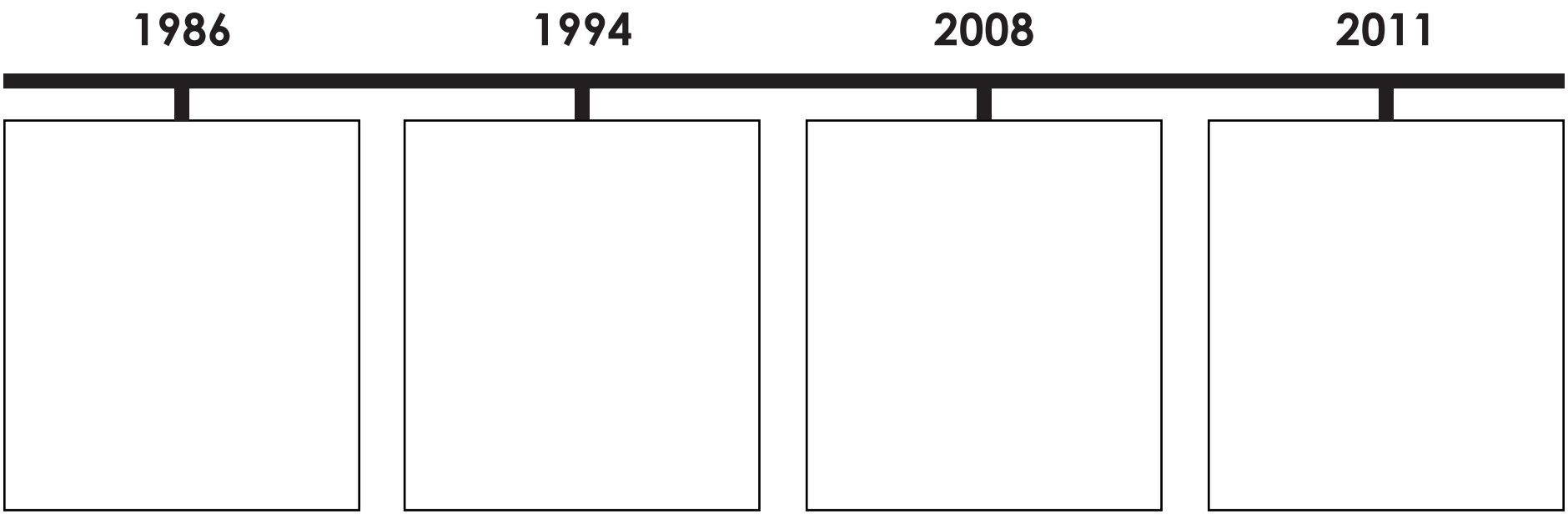
My life: Great things that happened

Think of something good that happened in your life during the years listed below.
Draw a picture that represents that memory in the box.
Write a sentence to describe the memory.

2016	2017	2018	2019

Exploring Dinosaurs in Antarctica Timeline

Using the "Dinosaur Exploration in Antarctica" resource sheet, sequence the events in the order they occurred. Draw a picture to represent that event in the box. Write a sentence to summarize what happened.



LESSON 2.2

COMPARING CONTINENTS

GRADE LEVEL 2-3

DINOSAURS OF ANTARCTICA EDUCATOR GUIDE

Dinosaurs of Antarctica Educator Guide

LESSON 2.2
COMPARING CONTINENTS

GRADE LEVEL 2-3
(1) 45 MINUTE LESSON

STANDARDS:

• CCSS.ELA-LITERACY.W.3.8. Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.

FROM THE FILM:

The film ***Dinosaurs of Antarctica*** showcases Antarctica's uncommon landscape. Antarctica is the coldest, windiest and driest southernmost continent. Scientists and tourists who visit Antarctica describe a unique experience making the continent an interesting place to visit.

LESSON OVERVIEW:

In this lesson, students will continue to learn about Antarctica's unique landscape and explore North America's scenery to discover similarities and differences between the two continents.

MATERIALS:

- Comparing Antarctica vs. North America Student Resource Sheet 2.2
- Comparing Antarctica vs. North America Venn Diagram Student Resource Sheet 2.2A
- Access to technology to show the following video clips:

  Antarctica: Destination World by National Geographic Kids
  http://bit.ly/DestinationAntarctica

  North America: Destination World by National Geographic Kids
  http://bit.ly/DestinationNAmerica

LESSON 2.2
COMPARING CONTINENTS

EDUCATOR PREP:

Based on your class size, print a copy of "Comparing Antarctica vs. North America Student Resource Sheet 2.2" and "Comparing Antarctica vs. North America Venn Diagram Student Resource Sheet 2.2a" for each student. To save paper, print the documents double-sided on one sheet. Test your visual and audio equipment to ensure students are able to view and hear the videos.

EDUCATOR GUIDE:

1. In the film ***Dinosaurs of Antarctica,*** students learned that Antarctica is the coldest and windiest place on Earth. Students discovered that Antarctica is an ice desert, making it difficult for most plants and animals to survive. Ask students to raise their hands if they remember hearing the word *climate* before.

What does the word climate mean?
Climate refers to the average condition of the weather at a place usually over a period of years as described by temperature, wind velocity, and precipitation.

What are scientists that study weather called?
Meteorologists predict the weather and study how the atmospheric conditions affect the earth and its human inhabitants.

What does the word weather mean?
Weather is what's happening in the atmosphere over a short period of time with respect to heat or cold, wetness or dryness, and clearness or cloudiness.

What are scientists that study climate called?
Climatologists study climate patterns to provide an understanding of the conditions of a particular area to help residents adapt to their surroundings.

From the film who can recall the landscape of Antarctica millions of years ago?
Antarctica was not covered in ice therefore it was a warmer place with more living creatures such as dinosaurs.

From the film what is Antarctica's landscape like now?
Antarctica is considered an icy desert and home to a few animals that mostly live near or in the water.

Antarctica is an ice desert making it difficult for most plants and animals to survive.

LESSON 2.2
COMPARING CONTINENTS

2. Tell students that today they will compare two continents: North America and Antarctica. Explain to students that they will explore the similarities and differences between the continents by learning more about both places through video. Provide each student with a copy of "Comparing Antarctica vs. North America Student Resource Sheet 2.2." During this assignment, students will watch a short video about Antarctica and a short video about North America. Students will fill in the blank spaces on the chart as they watch the videos.

3. Optional: To ensure students are able to complete their chart, it may be necessary to allow students to watch the video once without pausing. Replay the video for students and pause at key points to allow students to complete the chart.

During the video, "Antarctica: Destination World," pause at the following markers to allow students to fill in their chart.

30 seconds [land size & physical features of Antarctica]

65 seconds [average temperature of Antarctica]

2:10 minutes [animals of Antarctica]

During the video, "North America: Destination World," pause at the following markers to allow students to fill in their chart.

28 seconds [land size of North America]

60 seconds [physical features of North America]

2:18 minutes [population of North America]

3.08 minutes [popular attractions of North America]

Educator Notes:

LESSON 2.2
COMPARING CONTINENTS

4. After students complete their chart, tell students that they will summarize their findings by creating a Venn diagram, an illustration that uses circles to show the relationships among things. Tell students in a Venn diagram, circles that overlap indicates that both subjects share the same trait while circles that do not overlap mean they do not share that particular trait. Instruct students to use information from "Comparing Antarctica vs. North America Student Resource Sheet 2.2" to compare and contrast North America and Antarctica. Demonstrate how to create a Venn diagram by reviewing the example of "Comparing Antarctica vs. North America Venn Diagram Student Resource Sheet 2.2a." Permit students ten minutes to complete the assignment.
Circulate to provide assistance if needed.

5. To conclude the lesson, show an example of a completed Venn diagram. Lead a class discussion using the following question prompts:

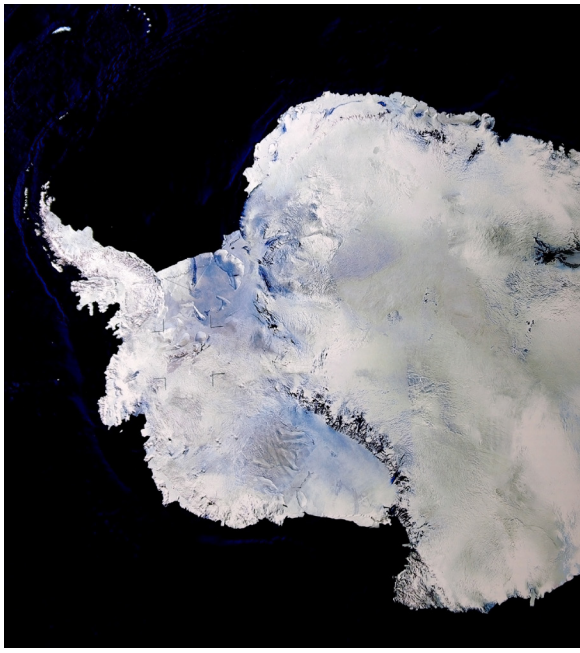
What do Antarctica and North America have in common?

What's different about Antarctica and North America?

What did you learn that surprised you?

After completing this activity, what do you wonder?

Do you want to visit Antarctica?
Why or why not?



Satellite image of Antarctica.

Comparing Antarctica vs. North America

View the videos *Antarctica: Destination World* and *North America: Destination World* and fill in the blank spaces by recording facts about the two continents.

	Antarctica	North America
Location	Southern most continent near the South Pole	Northern & Western hemisphere
Land Size	_____ largest continent 5.5 million square miles	_____ largest continent 9.5 million square miles
Physical features		
Temperature		varies by location
Population	No permanent residents but _____	
Common animals		
Popular attraction		

1. What did you learn about Antarctica that surprised you?

_____

_____

_____

_____

2. After completing this activity, what do you wonder about Antarctica?

_____

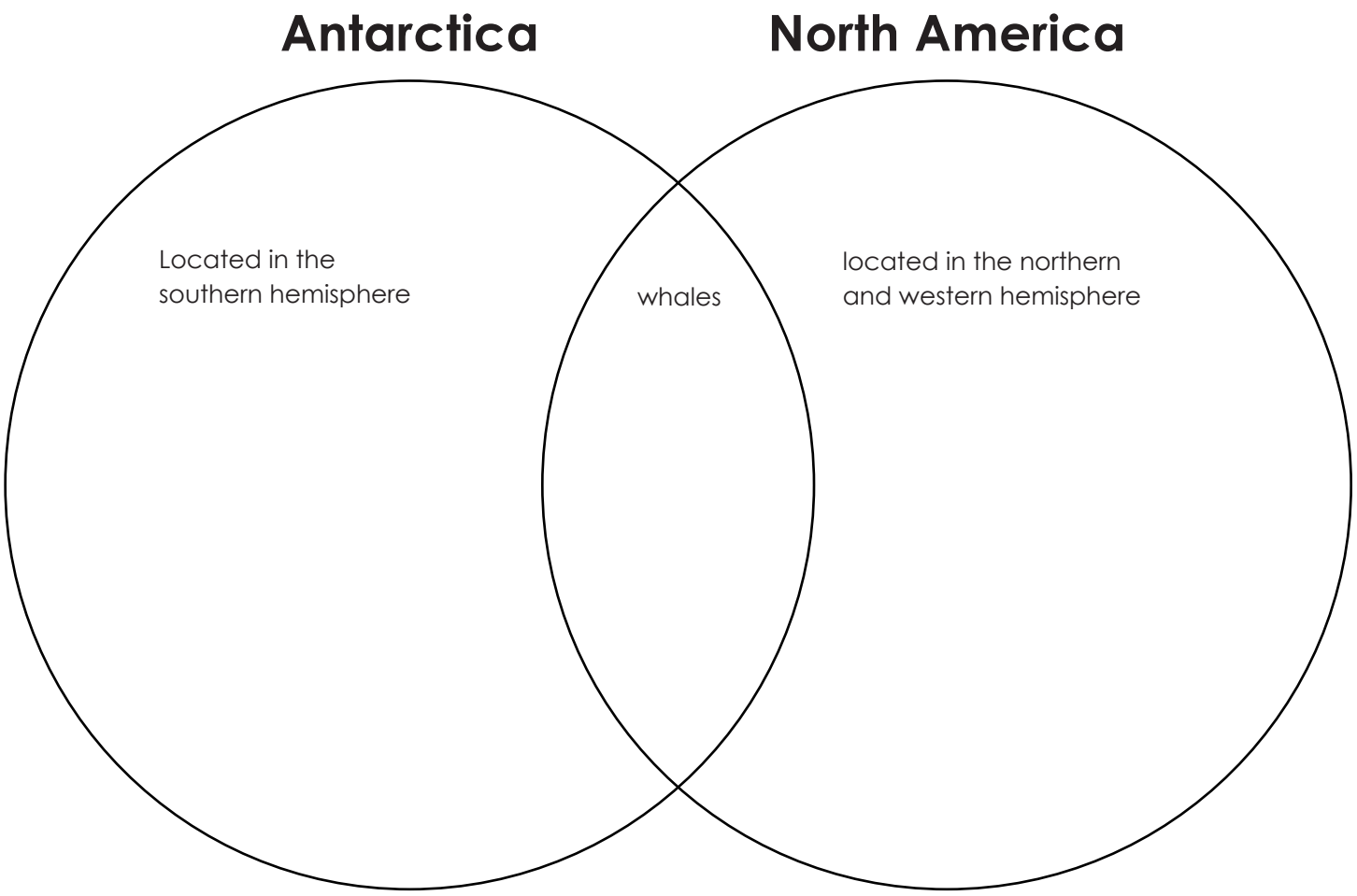
_____

_____

_____

Comparing Antarctica vs. North America Venn Diagram

Using the "Comparing Antarctica vs. North America" table, summarize your findings by creating a Venn diagram.



What do Antarctica and North America have in common?

How are Antarctica and North America different?

LESSON 2.3

CONSTRUCTING ANTARCTICA

GRADE LEVEL 2-3

DINOSAURS OF ANTARCTICA EDUCATOR GUIDE

Dinosaurs of Antarctica Educator Guide

LESSON 2.3
CONSTRUCTING ANTARCTICA

GRADE LEVEL 2-3
(1) 60 MINUTE LESSON
RESEARCH

STANDARDS:

- 2-ESS1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly
- 2-ESS2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.

FROM THE FILM:

In the film ***Dinosaurs of Antarctica,*** students learned that over time, natural occurrences changed the Earth's landscape impacting animals and plants. Antarctica transitioned from being a greenhouse to the icehouse it is today. While Antarctica has the harshest climate in the world, it is still home to some living organisms.

LESSON OVERVIEW:

In this lesson, students will develop a model to represent Antarctica's current landscape.

MATERIALS:

- Constructing Antarctica Student Resource Sheet 2.3
- Various craft or recycled materials

LESSON 2.3
CONSTRUCTING ANTARCTICA

EDUCATOR PREP:

Determine if your students will complete the assignment individually, as partners or within small groups. Print copies of the "Constructing Antarctica Student Resource Sheet 2.3" and gather enough supplies to accommodate your chosen group size.

EDUCATOR GUIDE:

DAY 1

1. In the film ***Dinosaurs of Antarctica,*** scientists were researching how the changes in the climate affected animal and plant life in ancient Antarctica. Explain to students that based on fossil findings, scientists discovered that Antarctica once had a more extensive plant and animal life suggesting that the climate was much warmer than it is today. Tell students that scientists are still working to understand how Antarctica's past climate shifted from a greenhouse to an icehouse.

2. Ask students to recall what they learned about Antarctica's previous environment from the film. Ask students:

What was ancient Antarctica's landscape like millions of years ago?
Students should be able to describe that the climate was warmer, which led to more plants, dryer land, increased sunlight, and animals that no longer exist today such as dinosaurs.

What is Antarctica's landscape like today?
Students should be able to share that the climate is much colder and the continent is covered in ice, making it difficult for most animals and plants to survive.

Tell students that scientists continue to study the causes of the climate shift in Antarctica and have found evidence that the environment changed due to a variety of natural causes.

3. Share with students the following theories:

Millions of years ago, the atmospheric carbon dioxide levels declined steadily, preventing the melting of snow and causing ice sheets to form in Antarctica.

Millions of years ago, the changes in land and ocean configurations due to the widening of the ocean between South America and the Antarctic Peninsula created a current that circulates clockwise around the continent, preventing warm water from reaching the coast.

Dinosaurs of Antarctica was filmed in New Zealand to capture a similar landscape to that of ancient Antarctica.

LESSON 2.3
CONSTRUCTING ANTARCTICA

4. Explain to students that they will create a diorama, a miniature display representing a scene from nature or a historical event. For the assignment, students should understand that they will research Antarctica's current geography. Based on their research, students will use their creativity to model the continents' landscape. Provide students with a copy of the "Constructing Antarctica Student Resource Sheet 2.3." Allow students 15 minutes to begin planning their diorama. It may be beneficial to allow time for students to conduct research. Remind students that they can also utilize "Comparing Antarctica vs. North America Student Resource Sheet 2.2" chart that they completed as a reference.

5. Offer students the opportunity to write down possible supplies they may need and have at home to create their diorama. One item you may encourage students to bring is a shoebox or large tissue box. Inform students that they will have time to create their diorama in class and that some materials will be available for them to use.

DAY 2

1. Remind students that in the film ***Dinosaurs of Antarctica,*** they learned that Antarctica's climate was much warmer than it is today. Ask students to recall the assignment that they started the previous day which was researching Antarctica's current climate, plants, and animals so they can create a diorama of the continent. Ask students to access "Constructing Antarctica Student Resource Sheet 2.3" and review the tasks with them to ensure they understand expectations.

2. Show students an example of a completed diorama but encourage them to use their creativity to design something unique. Present the supplies and materials available to students and review expectations of usage. Using the "Constructing Antarctica Student Resource Sheet 2.3" as guidance, allow students 30 minutes to craft their model of Antarctica. Circulate to provide support when necessary.

3. After the allocated time, conclude the lesson by hosting a gallery walk. Ask students to display their diorama around the classroom. Permit students to circulate the room so they can view their classmates' creations. To keep the process organized, tell students you will play music and when the music stops, they should rotate to the next display. Continue the process until students view every model. Tell students where they can expect to see their diorama in public such as in the media center or wherever peers outside their classroom can view their work.

4. To conclude the lesson, ask students to share something new that they learned about Antarctica through research for this learning activity.

Educator Notes:

Constructing An Antarctica Diorama

Use your creativity and knowledge about Antarctica's landscape to create a diorama.

☐ **Sketch your model diorama on paper.**

Search for inspiration online if necessary. When drawing your diorama, make sure the miniatures will be appropriate to the scale of the entire scene. For example, a bird should not be the same size as a whale. The diorama should look as real as possible.

☐ **Make a list of items you will need to create your diorama based on your sketch.**

Consider common school supplies or easily accessible materials such as construction paper, cotton balls glue, paint, felt, clay, craft sticks, etc. Determine if you want miniature figures (ex: animals) or objects such as rocks, printed pictures, magazine pages, etc.

_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

☐ **Gather the materials for your diorama.**

Finalize which elements you will make and which components you can purchase (with caretaker approval). For example, you may decide to buy animal figures but create fake snow using cotton balls.

☐ **Create your diorama.**

- ☐ Configure the box in a position where it has a back, four sides, and an open front (ex: a shoebox turned on its side without the lid).
- ☐ Design a creative background to represent Antarctica's landscape by decorating all sides of the box (ex: sky, ocean, ice, etc.).
- ☐ Add details to make the scene appear realistic. Place objects and figurines in a visually appealing manner while being intentional about the scale of your design. For example, work from the back of the box to the front, placing smaller items in front of larger ones. Be sure you have the entire scene completed before you glue it to the box, allowing the option to change your mind.
- ☐ Confirm the design and glue the objects into place to ensure that it doesn't move.
- ☐ Attach a title to the box where it can be easily seen.

Word Search

Using the word bank below, find the hidden words in the puzzle.
Hint: The same letter can be used for more than one word.

V X O N Y A P M E C N O C E A N P V Q T
F L K C L I M A T E A N V A Y Q E Q V Q
F O S S I L S Z K S Q B M L Y A N Z O X
B P J G R X B H R H S B I G X I G E L O
Y U N I A N T A R C T I C A N D U K C Z
M E T E O R O L O G I S T P J A I O A H
C D Q I F O R E C A S T V O J C N F N R
V H Z B E I G S G B G P S E A L S O O J
A O Y J O N R Q R I Y S O U T H P O L E
M C L I M A T O L O G I S T W I P C A L
J A M O I S H P U N E I X F X W P L K G
C B O B O K K D I C E D E S E R T N K P
X K B P A L E O N T O L O G I S T L S U
T H O H M X F R U B G G M N I N B K C M
U G Z E V W P X I I R C P G J C D P U Y
E X P E D I T I O N Q M O U N T A I N B
E D O N Q P R E C I P I T A T I O N Q X
T C C O N T I N E N T R Z B W U Y L R G
T J J J P D I N O S A U R S S M T H G R
Y W H A L E S I W B W W E A T H E R J S

Word Bank:

- **Antarctica**
- **South pole**
- **precipitation**
- **fossils**
- **expedition**
- **continent**
- **climatologist**
- **meteorologist**
- **paleontologist**
- **dinosaurs**
- **penguins**
- **whales**
- **seals**
- **climate**
- **weather**
- **forecast**
- **ocean**
- **ice desert**
- **volcano**
- **mountain**

Word Search

Using the word bank below, find the hidden words in the puzzle.
Hint: The same letter can be used for more than one word.

Word Bank:

- Antarctica
- South pole
- precipitation
- fossils
- expedition
- continent
- climatologist
- meteorologist
- paleontologist
- dinosaurs
- penguins
- whales
- seals
- climate
- weather
- forecast
- ocean
- ice desert
- volcano
- mountain

LESSON 4.1

EXPLORING ANTARCTICA

GRADE LEVEL 4-5

DINOSAURS OF ANTARCTICA EDUCATOR GUIDE

Dinosaurs of Antarctica Educator Guide

LESSON 4.1
EXPLORING ANTARCTICA

GRADE LEVEL 4-5
(1) 45 MINUTE LESSON

STANDARDS:

- CCSS.ELA-LITERACY.RI.4.7. Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.
- CCSS.ELA-LITERACY.SL.5.2. Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.

FROM THE FILM:

In the film ***Dinosaurs of Antarctica,*** you will learn that Antarctica has been an area of interest for explorers dating back to the 1800's. The film provides several timelines, a representation of important events in the order in which they occurred, to help viewers understand more about Antarctica's past. We are able to use early explorers' successes and challenges to advance current research efforts.

LESSON OVERVIEW:

In this lesson, students will use an internet resource to review a timeline of Antarctica's explorations to summarize important events that occurred in the continents' history.

MATERIALS:

- Exploring Antarctica Timeline Student Resource Sheet 4.1
- Exploring Antarctica Timeline Student Resource Sheet 4.1a
- Technology to access the following resources:

  Website http://bit.ly/CoolAntarctica

  Video: Dr. Nate Smith Talks about Dinosaur Expeditions to Antarctica by the Natural History Museum of Los Angeles County [2:28 minutes] http://bit.ly/DrNateJourney

- Cover of the *Dinosaurs of Antarctica* Education Guide

LESSON 4.1
EXPLORING ANTARCTICA

EDUCATOR PREP:

Assign partners. Print a copy of "Exploring Antarctica Timeline Student Resource Sheet 4.1" and cut out the event cards. Be sure that you have enough event cards to provide each partner with one card. Print a copy of "Exploring Antarctica Timeline Student Resource Sheet 4.1a" for each student.

EDUCATOR GUIDE:

1. In the film ***Dinosaurs of Antarctica,*** students will learn that Antarctica has been an area of interest for explorers dating back to the 1800's. Explain to students that early explorers were interested in learning about the continents' landscape and resources. Findings from several expeditions led to more research topics that future scientists will begin to investigate. Ask students:

   Based on the title, Dinosaurs of Antarctica, and the picture, what do you think scientists in the film were researching in Antarctica?

2. Introduce the vocabulary word *expedition* to students. Ask students to raise their hands if they remember hearing the word *expedition* before.

   What does the word expedition mean?
   An expedition is a journey or voyage taken by a group of people with a particular purpose such as an exploration or scientific research.

Explain to students that participating in expeditions allows people to experience new discoveries first hand versus just reading about it in a book or online. Ask students if they have ever read about a place and then actually had the opportunity to visit. Ask students to share how the experience of reading about a place is different from visiting the location. If students are unable to come up with an example, share about a local attraction. For example, some students may have seen advertisements for a local carnival that may have sparked their interest.

Therefore, reading or hearing about the carnival may have made them curious about the rides, food, people, games, etc. Help students make the connection that explorations are often influenced by people's desire to solve a problem, to discover something new or to satisfy general curiosity.

The Endurance was one of the two ships used for the Imperial Trans-Antarctic expedition to Antarctica from 1914-1917.

LESSON 4.1
EXPLORING ANTARCTICA

3. Share with students that they will have an opportunity to view the film ***Dinosaurs of Antarctica*** and that by now they may have guessed that scientists were interested in learning about dinosaurs. It's okay if students are unable to figure out why scientists were researching dinosaurs. The aim is to prepare them for the general idea of the movie. Explain to students that they will complete a timeline activity to learn more about expeditions that occurred in Antarctica.

4. Provide students with a copy of "Exploring Antarctica Timeline Student Resource Sheet 4.1." Explain to students that they will collaborate with a partner to research an event in history using an online resource. Tell students that they will have seven minutes to read about various expeditions that occurred in Antarctica. Allow seven minutes for students to read the timeline on the website. *http://bit.iy/coolantarctica*

5. After the alloted time expires, give each set of partners one event card. Explain to students that their task is to determine when their specific event occurred in history (ex: date). They can refer back to the website for support. Allow three minutes for students to determine their event date. Circulate to provide support if needed.

6. After students determine their event date, direct students to organize themselves as a human timeline starting from the earliest date to the most recent date. After students form a human timeline, they are to quickly explain what happened that year in their own words. Turn the task into a fun challenge by telling students the goal is to get through the entire timeline in two minutes and set a timer.

7. Provide students with a copy of "Exploring Antarctica Timeline Student Sheet 4.1a." Ask students:

> *How is this timeline different from the one you just reviewed?*
> This timeline has additional exploration dates from the 1990's to 2000's whereas the other timeline stopped in the mid-1900's. Also, the timeline mentions the finding of dinosaur fossils.

Review the additional events with students. Explain to students that in the film ***Dinosaurs of Antarctica,*** they will learn more about the findings of dinosaur fossils and how the discovery has led to additional research about climate science.

Educator Notes:

LESSON 4.1
EXPLORING ANTARCTICA

8. Using "Exploring Antarctica Timeline Student Sheet 4.1a" allow students to work with their partner to record responses to the following questions:

Why did so many explorers have a difficult time reaching the South Pole?
The extreme weather conditions and lack of resources made it difficult for explorers on the journey to the South Pole.

Who was the first team credited to reach the South Pole?
Roald Amundsen and his team were credited as the first group of people to reach the South Pole.

What happened in the 1990's that had a significant impact on research in Antarctica?
Scientists began the process of excavating dinosaur fossils from Antarctica.

Why do you think researchers wanted to originally explore Antarctica?
Example: They were curious about the continents' landscape and resources.

Why do you think researchers continue to explore Antarctica?
Example: They want to learn more about the life of dinosaurs, plants or other things that lived in ancient Antarctica.

Allow students to share their responses to the questions. Clarify misconceptions when necessary.

Roald Amundsen, a Norwegian explorer and one of the first people to reach the South Pole.

9. To conclude the lesson, show students the video, "Dr. Nate Smith Talks about Dinosaur Expeditions to Antarctica" by the Natural History Museum of Los Angeles County [2:28 minutes]. Facilitate a discussion using the following question prompts:

Where did Dr. Nate Smith and other scientists conduct their field research in Antarctica?
They searched for fossils in the Transantarctic Mountains.

Where do paleontologists find fossils in Antarctica?
Although Antarctica is mostly covered in ice, scientists search for dinosaur fossils in frozen rock.

Why did Dr. Nate Smith say that Antarctica felt like being in another world?
Although the process of retrieving fossils is similar to when working in other places, Antarctica's unique weather and landscape is extremely different from anywhere else in the world.

Exploring Antarctica Timeline Cards

1901

Captain Scott and his team led their first Antarctic expedition to the South Pole. The scientists turned around due to the extreme weather they encountered.

1907-1909

Ernest Shackleton led an expedition to the South Pole but was forced to turn around after he ran out of supplies.

1912

Captain Robert Falcon Scott, along with his team, set out to reach the South Pole again, hoping to be the first people to accomplish the task, but they found out they were a couple of months too late. Scott and his team reached the South Pole but perished during the return trip home.

1911

Roald Amundsen and his team became the first group of people credited to reach the South Pole.

1915-1917

Ernest Shackleton and his team set out on a journey to reach Antarctica again to cross the continent. However, his ship was crushed by ice and destroyed. The crew was rescued five months later.

1990

Geologist, David Elliot discovered a set of large bones on Mount Kirkpatrick in Antarctica.

Exploring Antarctica Timeline

Review the timeline of Antarctica's explorations and answer the questions below.

1901
Captain Scott and his team led their first Antarctic expedition to the South Pole. The scientists turned around due to the extreme weather they encountered.

1907-1909
Ernest Shackleton led an expedition to the South Pole but was forced to turn around after he runs out of supplies.

1911
Roald Amundsen and his team became the first group of people credited to reach the South Pole.

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Captain Robert Falcon Scott, along with his team, set out to reach the South Pole again, hoping to be the first people to accomplish the task, but they found out they were a couple of months too late. Scott and his team reached the South Pole but perished during the return trip home.

1915-1917
Ernest Shackleton and his team set out on a journey to reach Antarctica again to cross the continent. However, his ship was crushed by ice and destroyed. The crew was rescued five months later.

1990
Geologist David Elliot discovered a set of large bones on Mount Kirkpatrick in Antarctica.

1994
Dr. William Hammer, along with other scientists, began excavating Mount Kirkpatrick and retrieved a skull and thigh bone of a dinosaur described as *Cryolophosaurus*.

2011
Dr. Nate Smith and Dr. Pete Makovicky, along with other scientists, retrieved the remaining fossils of the dinosaur, *Cryolophosaurus*.

Why did so many early explorers have a difficult time reaching the South Pole?

Why do you think early researchers desired to explore Antarctica?

Why do you think researchers continue to explore Antarctica?

LESSON 4.2

MODELING FOSSILS

GRADE LEVEL 4-5

DINOSAURS OF ANTARCTICA EDUCATOR GUIDE

Dinosaurs of Antarctica Educator Guide

LESSON 4.2
MODELING FOSSILS

GRADE LEVEL 4-5
(1) 45 MINUTE LESSON

STANDARDS:

• 4-EESL-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.

FROM THE FILM:

In the film ***Dinosaurs of Antarctica,*** students learned that paleontologists and paleobotanists analyze fossils of plants, animals, and rock minerals to understand Antarctica's landscape millions of years ago. Researchers in Antarctica study fossils to understand the history of life on ancient Earth.

LESSON OVERVIEW:

In this lesson, students will explore how fossils are formed by simulating molds and casts.

MATERIALS:

- Plaster of Paris
- Play Doh or modeling clay
- Paper or foam bowl
- Disposable circle-shaped tub
- Water
- Leaf
- Seashell
- Technology to show the following video:

  Dig Into Paleontology by SciShow Kids
  http://bit.ly/Huntfordinos

LESSON 4.2
MODELING FOSSILS

EDUCATOR PREP:

Assign partners. Provide each partner with materials for the lesson activity.

EDUCATOR GUIDE:

1. In the film ***Dinosaurs of Antarctica,*** students discovered that scientists have conducted numerous expeditions to excavate dinosaur fossils in Antarctica. In the previous lesson, students learned that the first set of dinosaur fossils wasn't found in Antarctica until 1986. Explain to students that today they will explore how fossils are formed.

2. Introduce the vocabulary word *fossil* to students. Ask students to raise their hands if they remember hearing the word fossil before.

What does the word fossil mean?
A fossil is any impression, remains or trace of an organism of past geologic ages that has been preserved in the earth's crust.

Explain to students that there are many types of fossils and they can form in different ways. Share with students that most fossils are modified impressions, remains, mold and casts of parts of the organism versus actual body parts. Tell students the following:

Fossils help scientists learn about plants and animals that existed long ago. Trace fossils are fossils of a footprint, trail, or other traces of an animal rather than of the animal itself. Trace fossils are formed when an organism makes an imprint in the sand or mud and it hardens over time. This type of fossil can provide information about how the animals behaved when they were alive.

Body fossils are the remains of the body parts of ancient animals and they tell researchers about the appearance of ancient life forms. Body fossils include bones, claws, and teeth.

Scientist Roger Smith shows a small amphibian fossil found in Antarctica. Photo courtesy of Akiko Shinya.

LESSON 4.2
MODELING FOSSILS

3. Split the class into partners and provide each set of partners with materials for the lesson activity. Guide students through the lesson activity.

Say: Grab a handful of clay or dough. Spread the clay across the bottom of the circular container and flatten the clay so that it's one inch deep.

Say: Using one of the objects provided, press the object into the clay. Tell students that organisms may leave an impression of their body outline in the sediment when they become buried. In this simulation, the clay represents sediment.

Say: Slowly remove the object from the clay to make a clear imprint. Tells students that in nature sometimes organisms may be eaten by bacteria and rot. In this simulation, physically removing the object represents the bacteria.

Say: Mix half of cup of plaster of Paris and pour it over the clay so that it covers the impression. Tell students that when animals decay underneath the soil, the space they once possessed become filled with minerals from groundwater. In this simulation, the plaster of Paris represents the minerals.

Say: Now it's time to let the plaster of Paris dry for thirty minutes. The deeper the impression, the longer it will take for the plaster to dry.

After 30 minutes say:

Use a spoon to pop out the piece of clay and plaster. Remove the clay to uncover the "fossil." In this simulation, the plaster represents a cast of the object and fossils are often protected as molds and casts.

4. To check for understanding, ask students:

If a dead animal was buried in the mud, what parts do you think would make good impressions?

In this simulation, what does the clay represent?

In this simulation, what does the plaster of Paris represent?

Educator Notes:

LESSON 4.2
MODELING FOSSILS

5. Share with students that they will watch a video to learn more about how paleontologists discover and excavate dinosaur fossils. Show students the video, Dig Into Paleontology by SciShow Kids [4 minutes]. After students view the video, lead a discussion using the following question prompts:

How do paleontologists remove fossils out of rocks and sand?
Scientists use tools such as shovels, big diggers, and picks.

Where do paleontologists take the fossils they find?
Scientists take the fossils back to the lab to analyze their findings.

How do paleontologists share their findings?
Scientists share their work with museums and universities among other places.

Why is the role of a paleontologist important?
They study how life on planet Earth changed over time.

6. To conclude the lesson, remind students that in the film ***Dinosaurs of Antarctica,*** scientists found fossils of early reptiles and plant materials. Explain to students that scientists take fossils found during field research back to their labs to analyze and classify them.

Scientist Pete Makovicky excavates a fossil from sedimentary rock in Antarctica. Photo courtesy of Akiko Shinya.

LESSON 4.3

MODELING ROCK LAYERS

GRADE LEVEL 4-5

DINOSAURS OF ANTARCTICA EDUCATOR GUIDE

Dinosaurs of Antarctica Educator Guide

LESSON 4.3
MODELING ROCK LAYERS

GRADE LEVEL 4-5
(1) 50 MINUTE LESSON
(1) 10 MINUTE CLEAN-UP

STANDARDS:

• 4-ESS1-1. Identify the evidence that supports particular points in an explanation from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.

FROM THE FILM:

The film ***Dinosaurs of Antarctica*** mentioned how scientists used plants, animals, and rock minerals to understand Antarctica's landscape during the early Jurassic period. Geoscientists such as Libby Ives study the Earth's composition, structure, and other physical aspects of the Earth such as physical sedimentology and glacial geology. Analyzing Earth's landscape helps scientists understand how our planet changes over time.

LESSON OVERVIEW:

In this lesson, students will investigate changes in a landscape over time by creating a model of rock layers.

MATERIALS:

- Safety mask
- Safety goggles
- Plaster of Paris
- Measuring spoon
- Sand
- 3 plastic spoons
- Food coloring (red, blue, and green)
- Paper cup
- Pebbles
- Stopwatch
- Sandpaper
- Hand lens
- Modeling Rock Layers
  Student Resource Sheet 4.3
- Modeling Rock Layers
  Student Resource Sheet 4.3a
- Technology to play the following video:

  Geology: Relative Dating of Rocks by Earth Rocks. Stop the video at 2:22
  http://bit.ly/DatingofRocks

LESSON 4.3
MODELING ROCK LAYERS

EDUCATOR PREP:

Split your class into small groups with a maximum of four students in each group. Based on your decision, gather enough materials for the group size. Decide how you want students to experience the learning activity. During a teacher-guided experience, students are led through each step of the process. During a self-guided experience, students utilize "Modeling Rock Layers Student Resource Sheet 4.3" and "Modeling Rock Layers Student Resource Sheet 4.3a" to complete the lesson activity.

EDUCATOR GUIDE:

1. In the film ***Dinosaurs of Antarctica,*** we learned that scientists worked to understand the story of Antarctica by researching how plants, animals and the climate changed over time.

What do you know about rocks?
A rock is a naturally occurring solid mineral material forming part of Earth's surface and is often found on the surface or underneath soil or oceans.

How many types of rocks can you recall?
The three main types of rock classifications are sedimentary, metamorphic, and igneous. The differences between each type of rock are based on how they are formed. Sedimentary rocks are formed from sediments such as particles of sand, pebbles, shells, and other fragments of material. Metamorphic rocks are formed under the surface of the earth due to high heat and high pressure. Igneous rocks are formed through the cooling and hardening of magma or lava.

Sedimentary rock layers in Antarctica. Photo courtesy of John Isbell.

2. Explain to students that scientists learn about Earth's history by examining records of past events that are often preserved in the rocks. Tell students that today they will investigate rock layers.

3. Provide each group with a set of lab materials and "Modeling Rock Layers Student Resource Sheet 4.3" and "Modeling Rock Layers Student Resource Sheet 4.3a." Consider assigning group roles and responsibilities for each role. To promote student voice, allow students to decide who will perform each task in advance.

4. Whether you decide that students will be teacher-led or self-guided through the learning activity, ensure that each group has "Modeling Rock Layers Student Resource Sheet 4.3." Review lab safety rules if necessary.

LESSON 4.3
MODELING ROCK LAYERS

5. Restate to students that the purpose of the lab is to investigate rock layers by making a model. Tell students that they should be able to answer the following questions after completing the lab activity.

Can you explain the process you used to create your rock layer model?

How would you describe the layers of your model?

How is your rock model similar or different from other students?

What else do you wonder about rock layers?

6. Coach or facilitate the process of creating a rock layer model.

PART 1 STUDENT DIRECTIONS

- Wearing your lab equipment (ex: mask and safety goggles), place 3 spoonfuls of plaster of Paris in the bowl using a measuring spoon for accuracy. Using a graduated cylinder, pour 20mL of water in the bowl with the plaster of Paris. Using a plastic spoon, mix the ingredients by slowly stirring the water and plaster of Paris in the bowl.
- Using the same bowl, add 5 drops of green food coloring with 10mL of sand. Mix the ingredients until it appears blended.
- Pour your mixture from the bowl into a paper cup. Use your spoon to scrape the material from the bowl.

Educator note: Circulate the room to verify that each group has completed the previous steps correctly. Assist students as necessary. Explain to students that they created the bottom layer of their model rock. Ask students the following questions:

What do you notice?

What do you wonder?

Tell students that they will use a similar procedure to create the middle and top layers.

Educator Notes:

LESSON 4.3
MODELING ROCK LAYERS

7. PART 2 STUDENT DIRECTIONS:

- Using a clean bowl and spoon, place 3 spoonfuls of plaster of Paris in the bowl using a measuring spoon for accuracy. Using a graduated cylinder, pour 20mL of water in the bowl with the plaster of Paris. Using a plastic spoon, mix the ingredients by slowly stirring the water and plaster of Paris in the bowl.
- Using the same bowl, add 5 drops of red food coloring with 10mL of pebbles. Mix the ingredients until it appears blended.
- Pour your mixture from the bowl into the paper cup. Use your spoon to scrape the material from the bowl.

Educator note: Circulate the room to verify that each group has completed the previous steps correctly. Assist students as necessary. Explain to students that they created the middle layer of their model rock. Ask students the following questions:

What do you notice?

What do you wonder?

Tell students that they will use a similar procedure to create the top layer.

A View of the Transantarctic Mountains from Shackleton Glacier. Image courtesy of The United States Antarctic Program.

8. PART 3 STUDENT DIRECTIONS:

- Using a clean bowl and spoon, place 3 spoonfuls of plaster of Paris in the bowl using a measuring spoon for accuracy. Using a graduated cylinder, pour 20mL of water in the bowl with the plaster of Paris. Using a plastic spoon, mix the ingredients by slowly stirring the water and plaster of Paris in the bowl.
- Using the same bowl, add 5 drops of blue food coloring. Mix the ingredients until it appears blended.
- Pour your mixture from the bowl into the paper cup. Use your spoon to scrape the material from the bowl.

Educator note: Students will need to wait 30 minutes for the rock model to set. Utilize the time frame by having students work on the "Modeling Rock Layers Student Resource Sheet 4.3a" with their group.

9. To further explain how geologists use relative dating principles for arranging rock layers into their order of formation, show students the first two minutes of the video, "Geology: Relative Dating of Rocks." Stop the video at 2:22 minutes. As students view the video, instruct them to complete the video reflection section on the "Modeling Rock Layers Student Resource Sheet 4.3a." Review the answers with students and allow time for corrections if necessary.

LESSON 4.3
MODELING ROCK LAYERS

10. PART 4 STUDENT DIRECTIONS:

- After 30 minutes, retrieve the rock model by tearing away the paper cup. Place the sandpaper flat on the desk and lay the rock model on its side. Rub the entire rock model across the sandpaper 6 times.
- Observe the rock model by touching it and using the hand lens to view it closely.
- Complete "Modeling Rock Layers Student Resource Sheet 4.3a" with your group.

11. Set up a rotation format and allow students to conduct a gallery walk to view their classmates' rock models. Set a timer for 5 minutes to allow students to rotate around the room. Encourage students to observe every rock model. Tell students to observe their classmates' rock model by touching it and using the hand lens to view it closely. When the timer sounds, tell students to return to their seats.

12. To conclude the lesson, lead a whole-class discussion by asking students the following questions presented at the beginning of the lesson.

Can you explain the process you used to create your rock layer model?

How would you describe the layers of your model?

How is your rock model similar or different from other students?

What else do you wonder about rock layers?

Educator Notes:

Modeling Rock Layers Lab

Use the directions below to create a model rock layer.

☐ Part 1: Student directions

- Wearing your lab equipment (ex: mask and safety goggles), place 3 spoonfuls of plaster of Paris in the bowl using a measuring spoon for accuracy. Using a graduated cylinder, pour 20mL of water in the bowl with the plaster of Paris. Using a plastic spoon, mix the ingredients by slowly stirring the water and plaster of Paris in the bowl.
- Using the same bowl, add 5 drops of green food coloring with 10mL of sand. Mix the ingredients until it appears blended.
- Pour your mixture from the bowl into a paper cup. Use your spoon to scrape the material from the bowl.

☐ Part 2: Student directions

- Using a clean bowl and spoon, place 3 spoonfuls of plaster of Paris in the bowl using a measuring spoon for accuracy. Using a graduated cylinder, pour 20mL of water in the bowl with the plaster of Paris. Using a plastic spoon, mix the ingredients by slowly stirring the water and plaster of Paris in the bowl.
- Using the same bowl, add 5 drops of red food coloring with 10mL of pebbles. Mix the ingredients until it appears blended.Pour your mixture from the bowl into the paper cup. Use your spoon to scrape the material from the bowl. Using the same bowl, add 5 drops of green food coloring with 10mL of sand. Mix the ingredients until it appears blended.
- Pour your mixture from the bowl into a paper cup. Use your spoon to scrape the material from the bowl.

☐ Part 3: Student directions

- Using a clean bowl and spoon, place 3 spoonfuls of plaster of Paris in the bowl using a measuring spoon for accuracy. Using a graduated cylinder, pour 20mL of water in the bowl with the plaster of Paris. Using a plastic spoon, mix the ingredients by slowly stirring the water and plaster of Paris in the bowl.
- Using the same bowl, add 5 drops of blue food coloring. Mix the ingredients until it appears blended.
- Pour your mixture from the bowl into the paper cup. Use your spoon to scrape the material from the bowl.

☐ Part 4: Student directions

- After 30 minutes, retrieve the rock model by tearing away the paper cup. Place the sandpaper flat on the desk and lay the rock model on its side. Rub the entire rock model across the sandpaper 6 times.
- Observe the rock model by touching it and using the hand lens to view it closely.
- Complete "Modeling Rock Layers Student Resource Sheet 4.3a" with your group.

Modeling Rock Layers Lab

Lab notes: Use the table to record your observations.

Layer	Materials Used	Observations
Bottom		
Middle		
Top		

Lab reflection: Respond to the questions below using complete sentences.

Can you explain the process you used to create your rock layer model?

How would you describe the layers of your model?

How is your rock model similar or different from other students?

What else do you wonder about rock layers?

Video reflection: As you view the "Relative dating of rocks" video, fill in the blank.

The three main types of rock classifications are sedimentary, metamorphic, and igneous. The differences between each type of rock are based on how they are formed. Each rock type tells a story. _____ rocks tell us a story about deposition. _____ rocks tell us a story about volcanic events occurring in an area. _____ rocks tell us about an area with a high temperature or pressure. _____ is a geologic record of past events. Scientists determine the order of events through _____ and _____ dating. Relative dating describes which events happen _____ or _____ another. Rock layers on the bottom will be older than layers at the top.

Modeling Rock Layers Lab

Lab notes: Use the table to record your observations.

Layer	Materials Used	Observations
Bottom	plaster of Paris and water	explanation will vary
Middle	plaster of Paris, red food coloring, pebbles and water	explanation will vary
Top	plaster of Paris, blue food coloring, and water	explanation will vary

Lab reflection: Respond to the questions below using complete sentences.

Can you explain the process you used to create your rock layer model?
explanation will vary

How would you describe the layers of your model?
explanation will vary

How is your rock model similar or different from other students?
explanation will vary

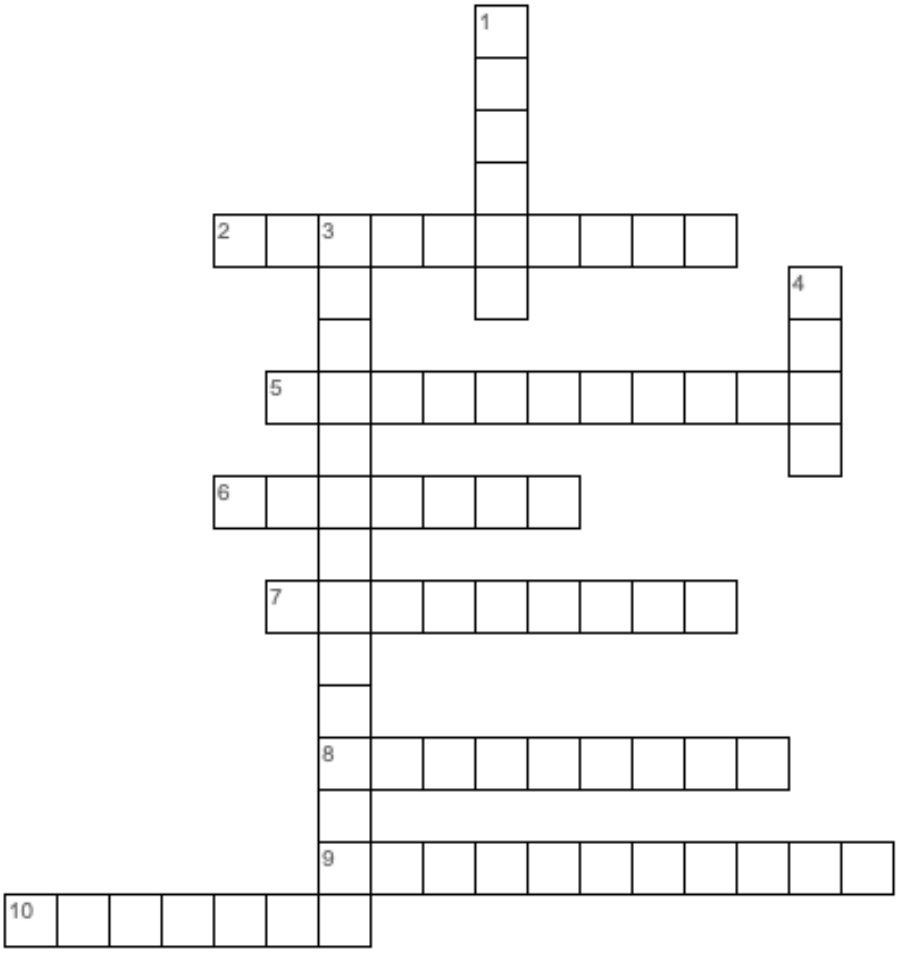
What else do you wonder about rock layers?
explanation will vary

Video reflection: As you view the "Relative dating of rocks" video, fill in the blank.

The three main types of rock classifications are sedimentary, metamorphic, and igneous. The differences between each type of rock are based on how they are formed. Each rock type tells a story. Sedimentary rocks tell us a story about deposition. Igneous rocks tell us a story about volcanic events occurring in an area. Metamorphic rocks tell us about an area with a high temperature or pressure. Stratigraphy is a geologic record of past events. Scientists determine the order of events through relative and numeric dating. Relative dating describes which events happen before or after another. Rock layers on the bottom will be older than layers at the top.

Geology Crossword Puzzle

Select a word that matches the definition below. Match the number beside the definition to the boxes placed across or down the grid. If correct, the word will fit perfectly in the puzzle.



Across

2. a journey or voyage taken by a group of people with a particular purpose

5. rocks formed by heat and pressure

6. rocks formed through the cooling of magma or lava

7. a series of processes that create and transform the types of rocks in Earth's crust

8. a scientist who studies the Earth, its history, nature, materials, and processes

9. rocks formed by years of sediment compacting together and becoming hard

10. a place or environment where a plant or animal usually lives and grows

Down

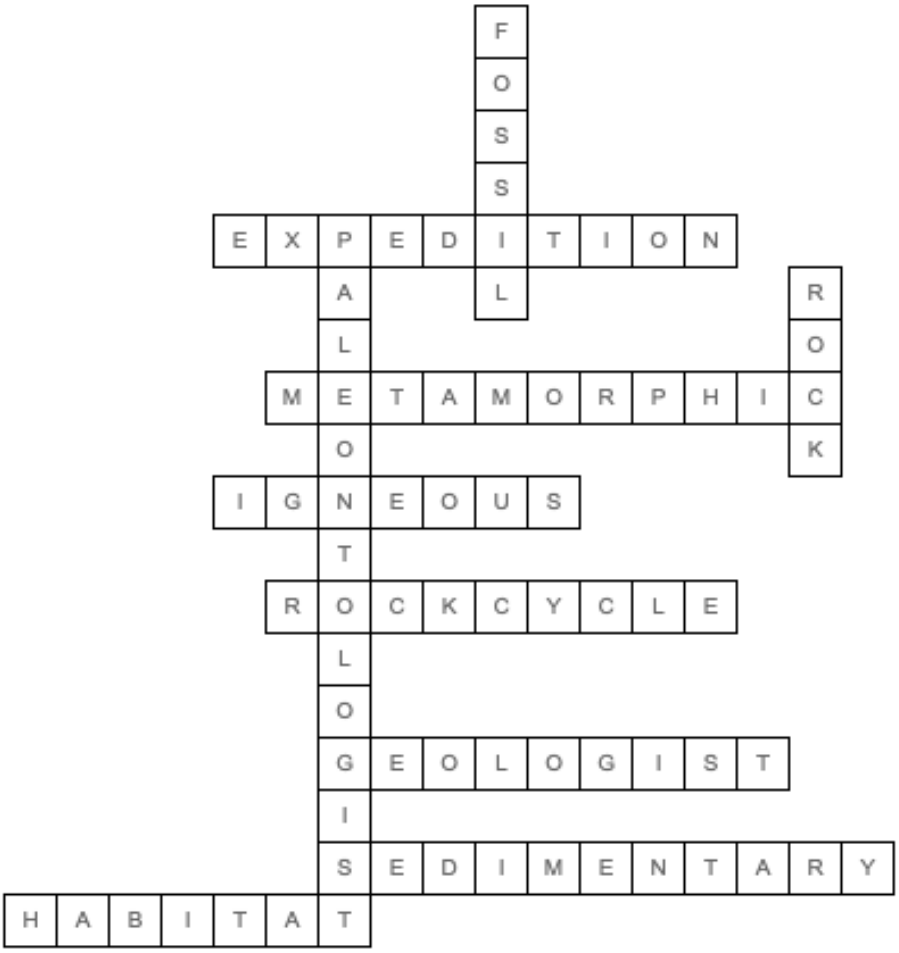
1. the preserved remains or traces of a living organism from the past

3. a scientist who studies fossils

4. a solid made up of a bunch of different minerals

Geology Crossword Puzzle

Select a word that matches the definition below. Match the number beside the definition to the boxes placed across or down the grid. If correct, the word will fit perfectly in the puzzle.



Across

2. a journey or voyage taken by a group of people with a particular purpose

5. rocks formed by heat and pressure

6. rocks formed through the cooling of magma or lava

7. a series of processes that create and transform the types of rocks in Earth's crust

8. a scientist who studies the Earth, its history, nature, materials, and processes

9. rocks formed by years of sediment compacting together and becoming hard

10. a place or environment where a plant or animal usually lives and grows

Down

1. the preserved remains or traces of a living organism from the past

3. a scientist who studies fossils

4. a solid made up of a bunch of different minerals

LESSON 6.1

STUDYING ANTARCTICA'S WEATHER

GRADE LEVEL 6-8

DINOSAURS OF ANTARCTICA EDUCATOR GUIDE

Dinosaurs of Antarctica Educator Guide

LESSON 6.1
STUDYING ANTARCTICA'S WEATHER

GRADE LEVEL 6-8
(1) 40 MINUTE LESSON

STANDARDS:

• CCSS.MATH.CONTENT.6.NS.C.5. Understand that positive and negative numbers are used together to describe quantities having opposite directions or values; use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.

FROM THE FILM:

In the film ***Dinosaurs of Antarctica,*** researchers and tourists typically visit the continent during the summer months, which occur from October to February. Due to the Earth's tilt and its orbit around the sun, Antarctica receives less heat and energy from the sun. As a result, during the summer months, it's almost always sunny, and during the winter months, it's mostly dark.

LESSON OVERVIEW:

In this lesson, students will analyze Antarctica's monthly weather pattern to determine the best time for researchers to visit the continent. Students will use data gathered from weather reports to identify weather tends by creating a line graph.

MATERIALS:

- Analyzing Antarctica's Weather Student Resource Sheet 6.1
- Technology to access the website and video:

  bit.ly/McMurdoStationWeather

- Antarctica: Destination World by National Geographic Kids

  http://bit.ly/DestinationAntarctica [2:57]

LESSON 6.1
STUDYING ANTARCTICA'S WEATHER

EDUCATOR PREP:

Print a copy of "Analyzing Antarctica's Weather Student Resource Sheet 6.1" for each student. Ensure that each student has access to technology for research purposes.

EDUCATOR GUIDE:

1. In the film ***Dinosaurs of Antarctica***, students will learn that scientists commonly visit the continent during particular seasons. However, the film does not explain in detail about Antarctica's seasons. Explain to students that due to the high elevation and large landmass of the South Pole, Antarctica is significantly colder than the north. Share with students that although Antarctica's climate is typically harsh, there are points in the year that are more suitable for humans to visit.

2. To help students make the connection between weather and its impact on people's choice of activities, solicit relevant examples based on your students' experience. For example, you could ask students:

When does someone typically go swimming in an outdoor pool? Why?

When does someone typically go ice skating? Why?

When has the weather impacted your weekend plans?

3. Tell students that they are going to explore the best time for people to visit Antarctica. Share with students the following scenario: A group of students would like to visit Antarctica. Using weather data, their task is to determine when conditions are best for students to visit the continent. Ask students:

Which months do you think would be the best time to visit Antarctica? Why?

Which months do you think would be the worst time to visit Antarctica? Why?

Why do you think it matters when people visit Antarctica?

How might Antarctica's environment affect humans?

Record students' responses. Students will revisit their ideas later in the lesson.

Adelie Penguins jump off an iceberg at Paulet Island, Antarctica.

LESSON 6.1
STUDYING ANTARCTICA'S WEATHER

4. Provide each student with a copy of "Analyzing Antarctica's Weather Student Resource Sheet 6.1." First, ask students to record their predictions about when would be the best time to visit Antarctica. Prompt students to make an educated guess about the continent's weather conditions throughout the year. Afterward, ask students to create a data table utilizing the online resource *www.timeanddate.com* to analyze the climate & weather averages in McMurdo Station, Antarctica. Allow students five minutes to record the mean temperature averages for each month. Circulate to provide support if necessary.

5. Tell students that their next task is to create a line graph using the data. Review the purpose of a line graph and how to create a line graph with students. Ask students:

Who has created a line graph before?
How do you create a line graph?
A line graph shows how something changes over time. Line graphs have an x-axis (horizontal) and a y-axis (vertical). Typically, the x-axis represents the time period, and the y-axis has numbers that represent what is being measured.

In the graph you create, what will the x-axis and y-axis represent?
The x-axis will represent the month of the year. The y-axis will represent the average temperature each month.

6. Using "Analyzing Antarctica's Weather Student Resource Sheet 6.1," review how to interpret the graph (ex: descriptive title, what each axis represents, how to record data, etc.). Tell students that due to the large size of Antarctica, the climate varies based on the location. Remind students that other large continents such as North America's climate also varies. Ask students to provide examples detailing how the weather may vary based on which part of North America they reside in. Share with students that they will analyze the weather near McMurdo Station, where most researchers visit.

7. At this grade level, students should be familiar with the concept of negative numbers. Draw a number line to display negative and positive numbers. Remind students that standard numbers, anything greater than zero, are characterized as 'positive' numbers. Numbers that are less than zero are described as 'negative' numbers. Tell students that on a number line, negative numbers are placed to the left of zero and positive numbers are placed to the right of zero.

Educator Notes:

LESSON 6.1
STUDYING ANTARCTICA'S WEATHER

8. Explain to students that when analyzing temperatures in Antarctica, negative numbers represent colder temperatures than positive numbers. For example, -8 degrees is colder than 27 degrees. Remind students that freezing occurs at 32 degrees. Model how to create a line graph for students by reviewing the data for January. Using the "Analyzing Antarctica's Weather Student Resource Sheet 6.1" allow students ten minutes to make a line graph of the data. Circulate to provide assistance if needed.

9. After the allotted time has expired, allow students to share their line graph with a peer. Revisit student predictions regarding the best and worst time to visit Antarctica and compare their earlier thoughts to their current findings. Ask students:

Based on the data, which months do you think would be the best time to visit Antarctica? Why?
Example: The warmest temperature occurs between November and February. The best time to visit is in January since it's usually the hottest month.

Based on the data, which months do you think would be the worst time to visit Antarctica? Why?
Example: The coldest temperature occurs between March and October. The worst time to visit is in July since it's usually the coldest month.

How is Antarctica's temperature different from where you live?
Example: It appears that our seasons are different. Our warm months occur between June to August but Antarctica's warm months occur from October to February.

Wooden Thermometer in the snow with freezing temperatures.

LESSON 6.1
STUDYING ANTARCTICA'S WEATHER

10. To help students learn more about Antarctica, show the video "Antarctica: Destination World" by National Geographic Kids. After showing the video, ask students:

Why do we describe Antarctica as a desert?
A desert is an area of landscape where little precipitation occurs and Antarctica only receives about two inches of rain per year.

Who has the largest ice sheet in the world?
What would happen if it melted?
The Antarctic Ice Sheet is the largest ice sheet in the world and if it melted, sea levels would rise by 200 feet.

What type of animals can survive the cold weather of Antarctica?
Antarctica is home to penguins, seals, whales, and octopuses to name a few.

Why do scientists and explorers visit Antarctica?
Since the early 1900's, explorers have been interested in Antarctica to research the landscape, climate change, space meteors, etc.

11. To conclude the lesson, explain to students that Antarctica has two seasons: summer and winter. Since it's located in the southern hemisphere, Antarctica's summer is from October to February and during this time, it's almost always sunny. Tell students that most research occurs during Antarctica's summer months.

Educator Notes:

Analyzing Antarctica's Weather

Record and study Antarctica's monthly weather pattern to determine the best time for researchers to visit.

My Predictions

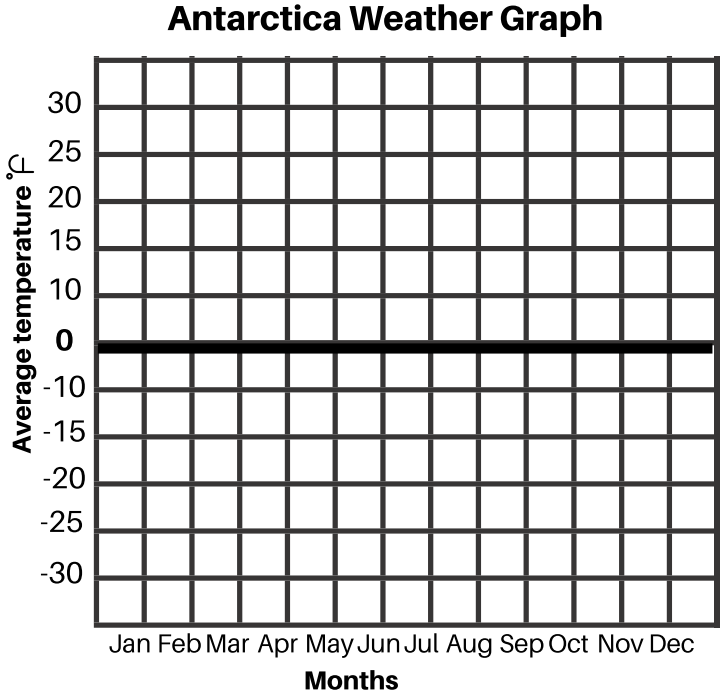
I predict that the best month to visit Antarctica is _____ .

I predict that the worst month to visit Antarctica is _____ .

Actual Weather Averages in McMurdo Station in Antarctica

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Based on weather reports gathered from years 2005-2015.



Discussion Questions

Based on the graph, when is the best month to visit Antarctica? Why?

_____

Based on the graph, when is the worst month to visit Antarctica? Why?

_____

Why does it matter which month researchers visit Antarctica?

_____

_____

Analyzing Antarctica's Weather

Record and study Antarctica's monthly weather pattern to determine the best time for researchers to visit.

My Predictions

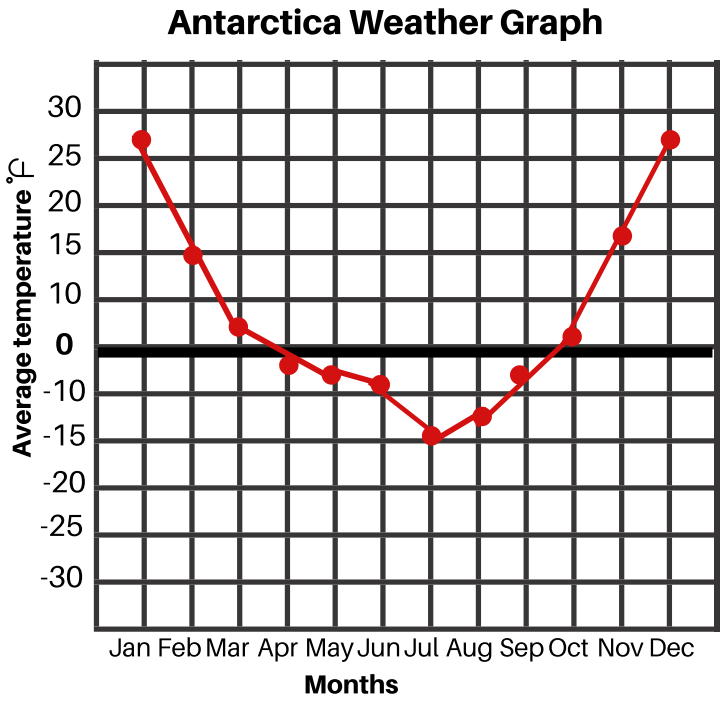
I predict that the best month to visit Antarctica is answers may vary .

I predict that the worst month to visit Antarctica is answers may vary .

Actual Weather Averages in McMurdo Station in Antarctica

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
28°F	15°F	1°F	-7°F	-8°F	-9°F	-15°F	-12°F	-8°F	°1F	16°F	27°F

Based on weather reports gathered from years 2005-2015.



Discussion Questions

Based on the graph, when is the best month to visit Antarctica? Why?
Example: The best time to visit is in January since it's usually the hottest month.

Based on the graph, when is the worst month to visit Antarctica? Why?
Example: The worst time to visit is in July since it's usually the coldest month.

Why does it matter which month researchers visit Antarctica?
answers may vary

LESSON 6.2
ANALYZING GLOBAL WARMING

GRADE LEVEL 6-8

DINOSAURS OF ANTARCTICA EDUCATOR GUIDE

Dinosaurs of Antarctica Educator Guide

LESSON 6.2
ANALYZING GLOBAL WARMING

GRADE LEVEL 6-8
(1) 50 MINUTE LESSON
(1) 10 MINUTE CLEAN UP

STANDARDS:

- MS-ESS3-5: Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
- SP2: Develop and use a model to describe phenomena.

FROM THE FILM:

In the film ***Dinosaurs of Antarctica,*** students learned that scientists discovered more clues that proved the climate of the continent changed over millions of years. Despite its harsh weather, some animals, such as penguins, have been able to adapt to Antarctica's environment. Changes in temperature can influence the environment and thus make it difficult for some living things to survive. Scientists are using clues from Antarctica's past to predict how climate change can impact the future.

LESSON OVERVIEW:

In this lesson, students will explore global warming by modeling the greenhouse effect.

MATERIALS:

- Clean sand
- 4 clear, plastic cups (10 oz)
- 2 cups of water
- 2 empty soda bottles (1 liter)
- Scissors
- Tray of ice cubes
- Plastic wrap
- Rubber band
- Ruler
- Clip-on spotlight or light source with at least 100-watt bulb
- Analyzing Global Warming Lab Student Resource Sheet 6.2
- Analyzing Global Warming Student Resource Sheet 6.2a (each student)

LESSON 6.2
ANALYZING GLOBAL WARMING

EDUCATOR PREP:

Assign each student a lab partner. Based on your group size, gather enough materials to accommodate each set of partners. Print a copy of the "Analyzing Global Warming Lab Student Resource Sheet 6.2" for each set of partners. Print a copy of "Analyzing Global Warming Student Resource Sheet 6.2a" for each student. This lesson can also be taught as a whole class demonstration.

EDUCATOR GUIDE:

1. In the film ***Dinosaurs of Antarctica,*** scientists discovered more clues that proved the climate shifted over the years transitioning the continent into an icehouse. While Antarctica's weather is bleak, it is still home to seals, whales, penguins and other animals that have the ability to adapt to the conditions. Changes in temperature can influence the environment and thus make it difficult for some living things to survive.

2. To activate prior knowledge, facilitate a discussion using the following question prompts:

What happened when you got into a car that had been left in the sun on a hot day with the windows rolled down?
Example response: When you leave the car windows rolled up, the car becomes very hot causing someone to immediately roll down the window to cool it off. Sometimes the seat belt buckle is so hot it almost burns your hand. However, when you leave the windows down, the car feel cooler.

Ask students:

Why do you think the temperature in a car with the windows rolled up is higher than the temperature in a car with the windows rolled down?
Example response: The air in the car is trapped inside and is unable to circulate.

Crabeater seals resting on icebergs in Antarctica.

LESSON 6.2
ANALYZING GLOBAL WARMING

3. Share with students that the experience they described getting into a car placed in the sun with the windows rolled up is how the greenhouse effect works. Ask students:

Have you ever heard of the greenhouse effect?
The greenhouse effect is a process that occurs when gases such as carbon dioxide in Earth's atmosphere trap the Sun's heat.

Have you ever seen a greenhouse?
What is the purpose of a greenhouse?
A greenhouse is a building with glass walls and a glass roof often used to grow plants. A greenhouse stays warm inside because sunlight shines into the greenhouse and warms the plants and air inside because the glass walls of the greenhouse trap the Sun's heat.

Have you ever heard of greenhouse gases? What is it?
Gases in the atmosphere trap heat just like the glass roof of a greenhouse. These gases are called greenhouse gases and they allow sunlight to pass through the atmosphere, but they also prevent the heat that the sunlight brings from leaving the atmosphere making the Earth warmer.

Can you explain global warming?
Global warming is the long-term warming of the Earth's overall temperature.

4. Tell students that today they will explore global warming by modeling the greenhouse effect. Provide each group with a set of lab materials, the "Analyzing Global Warming Lab Student Resource Sheet 6.2" and "Analyzing Global Warming Student Resource Sheet 6.2a" Review lab safety rules if necessary. Circulate to provide assistance when needed but encourage students to utilize their partners for support.

Educator Notes:

LESSON 6.2
ANALYZING GLOBAL WARMING

5. PART 1 STUDENT DIRECTIONS:

- Carefully cut both one-liter soda bottles approximately 4 inches from the bottom.
- Place 1 inch of sand at the bottom of each bottle.
- Carefully, using scissors, cut four wide vertical slits in the bottom half of two clear, plastic cups. The purpose of the slits is to allow melted ice water to flow out of these cups. Make sure the slits are wide and reach the bottom of the cups.
- Place one of the plastic cups without slits upside down on a flat surface and place one of the plastic cups with slits facing up on top so that the bottoms of each cup touch. Without covering the slits on the top cup, tape both cups together to prevent movement. Repeat the process using the remaining two unused plastic cups.

6. PART 2 STUDENT DIRECTIONS:

- To create your "island" place one set of cup structures in each soda bottle on top of the sand. Make sure the plastic cup with slits is still on top.
- Pour water in each soda bottle until the water level is approximately 1 inch above the sand. If you accidentally over pour water in one bottle simply adjust the other bottle by adding more water until both bottles' water level is the same.
- Add "glaciers" to the "island" by placing ice cubes in both bottles. Choose the same number of ice cubes to place in each of the plastic cups with slits.
- Using plastic wrap, cover the opening of one of the soda bottles and secure it tightly with a rubber band. Label the bottle, "greenhouse."
- Leave the other soda bottle top uncovered. Label the bottle, "control."

Educator note: Circulate to check for accuracy.

7. PART 3 STUDENT DIRECTIONS:

- Record the water level in each bottle.
- Place the heat source in a position to shine on the two bottles.
- Wait 6 minutes and then measure the water level in each bottle.
- Check back every 6 minutes and record data for the next 24 minutes.

Educator note: The ice in the bottle covered with plastic should melt faster indicating warmer temperatures than the uncovered bottle.

Humpback whale in Antarctica.

LESSON 6.2
ANALYZING GLOBAL WARMING

8. After students record the initial set of data, reiterate how global warming impacts our environment by showing the video, "Cause and effects of climate change' by National Geographic [3:00 minutes]. As students view the video, using the "Analyzing Global Warming Student Resource Sheet 6.2a" instruct them to complete the guided notes sections of the document. After the video, allow students to collaborate with their partners to fill in missing notes. Ask for volunteers to share their responses and encourage students to make corrections if necessary.

9. Instruct students to measure the water level of their bottles again and record the data. At this stage of the lab, students should have recorded water levels twice.

10. Share with students that the cause of global warming is controversial in the scientific community. Explain that some scientists believe that humans are the main contributors to the shift in climate while others believe that it's a natural process that occurs and humans have little effect on global warming. Antarctica was once a warm continent but shifted to a cold continent making it difficult for many animals to survive in such extreme conditions. Facilitate a discussion using the following question prompts:

> *Should humans continue to release more carbon dioxide or other greenhouse gases in the atmosphere and hope scientists are wrong? Or should we reduce the production of greenhouse gases and hope it's not too late?*

11. After the discussion, remind students to measure the water level of their bottles again and record the data. At this stage of the lab, students should have recorded water levels three times.

Educator Notes:

LESSON 6.2
ANALYZING GLOBAL WARMING

12. While students wait to observe their bottles for the last time, instruct them to record their observations and complete the reflection questions using the "Analyzing Global Warming Student Resource Sheet 6.2a" with their partner.

Why do scientists use models to understand phenomena?
Scientists use models to try to understand ideas that may be too hard to test in nature or a laboratory because they are too far away, take too long to measure, too small, etc. A model is used to help scientists visualize things they may not actually see.

Was there a difference in the warming rate of the greenhouse bottle and the control bottle? If so, described what you noticed.
In the greenhouse (covered) bottle, the warm air couldn't escape so it became warmer quicker than the control bottle.

What might be the effect of placing the bottles different distances from the light source?
Example response: We may document unreliable data because one bottle may receive more heat than the other causing it to warm quicker and skew our results.

How did the change in Antarctica's climate impact the environment?
Antarctica's climate was much warmer and wetter millions of years ago but it's now covered in ice and receives very little rain. Excavations in Antarctica revealed dinosaur fossils that proved the climate changed over time. A shift in climate millions of years ago is believed to be caused by natural occurrences impacting Earth.

13. To conclude the lesson, ask students: How might understanding Antarctica's past help humans on Earth today?

Neko Harbor Glacier calving at Andvord Bay on the Antarctic Peninsula in Antarctica.

Analyzing Global Warming Lab

Use the directions below to explore global warming by modeling the greenhouse effect.

☐ Part 1: Student directions

- Carefully cut both one-liter soda bottles approximately 4 inches from the bottom.
- Place 1 inch of sand at the bottom of each bottle.
- Carefully, using scissors, cut four wide vertical slits in the bottom half of two clear, plastic cups. The purpose of the slits is to allow melted ice water to flow out of these cups. Make sure the slits are wide and reach the bottom of the cups.
- Place one of the plastic cups without slits upside down on a flat surface and place one of the plastic cups with slits facing up on top so that the bottoms of each cup touch. Without covering the slits on the top cup, tape both cups together to prevent movement. Repeat the process using the remaining two unused plastic cups.

☐ Part 2: Student directions

- To create your "island" place one set of cup structures in each soda bottle on top of the sand. Make sure the plastic cup with slits is still on top.
- Pour water in each soda bottle until the water level is approximately 1 inch above the sand. If you accidentally over pour water in one bottle simply adjust the other bottle by adding more water until both bottles' water level is the same.
- Add "glaciers" to the "island" by placing ice cubes in both bottles. Choose the same number of ice cubes to place in each of the plastic cups with slits.
- Using plastic wrap, cover the opening of one of the soda bottles and secure it tightly with a rubber band. Label the bottle, "greenhouse."
- Leave the other soda bottle top uncovered. Label the bottle, "control."

☐ Part 3: Student directions

- Record the water level in each bottle.
- Place the heat source in a position to shine on the two bottles.
- Wait 6 minutes and then measure the water level in each bottle.
- Check back every 6 minutes and record data for the next 24 minutes.

Analyzing Global Warming

I. Lab notes: Use the table to record your observations.

Label	Starting height of water level	Height of water after 6 minutes	Height of water after 12 minutes	Height of water after 18 minutes	Height of water after ice melts
Greenhouse Effect					
Control					

Why do scientists use models to understand phenomena?

Was there a difference in the warming rate of the greenhouse bottle and the control bottle? If so, described what you noticed.

What might be the effect of placing the bottles different distances from the light source?

How did the change in Antarctica's climate impact the environment?

II. Video reflection: As you view the "Cause and effects of climate change" video, fill in the blanks.

Human activities such as _____ and _____ are contributing to the increase in the Earth's temperature. The _____ occurs when gases in the atmosphere allow the sunlight in and prevent some of the heat from _____ like glass walls of a greenhouse. Human activities such as _____ have increased the amount of carbon dioxide in the atmosphere causing the planet to warm at a faster rate. Climate change has consequences for our _____, _____, _____, and _____ . Water from melting glaciers causes _____ . Climate change can cause _____ impacting our _____ and _____ . In areas with high amounts of smog, health problems can occur such as _____, _____, and _____ . Humans can reduce the rate of climate change by replacing _____ with _____ energy sources that don't produce greenhouse gases.

Analyzing Global Warming

I. Lab notes: Use the table to record your observations.

Label	Starting height of water level	Height of water after 6 minutes	Height of water after 12 minutes	Height of water after 18 minutes	Height of water after ice melts
Greenhouse Effect					
Control					

Why do scientists use models to understand phenomena?

Scientists use models to try to understand ideas that may be too hard to test in nature or a laboratory because they are too far away, take too long to measure, too small, etc. A model is used to help scientists visualize things they may not actually see.

Was there a difference in the warming rate of the greenhouse bottle and the control bottle?
If so, described what you noticed.

In the greenhouse (covered) bottle, the warm air couldn't escape so it became warmer quicker than the control bottle.

What might be the effect of placing the bottles different distances from the light source?

Example response: We may document unreliable data because one bottle may receive more heat than the other causing it to warm quicker and skew our results.

How did the change in Antarctica's climate impact the environment?

Antarctica's climate was much warmer and wetter millions of years ago but it's now covered in ice and receives very little rain. Excavations in Antarctica revealed dinosaur fossils that proved the climate changed over time. A shift in climate millions of years ago is believed to be caused by natural occurrences impacting Earth.

II. Video reflection: As you view the "Cause and effects of climate change" video, fill in the blanks.

Human activities such as population and overpopulation are contributing to the increase in the Earth's temperature. The greenhouse effect occurs when gases in the atmosphere allow the sunlight in and prevent some of the heat from escaping like glass walls of a greenhouse. Human activities such as burning of fossil fuels have increased the amount of carbon dioxide in the atmosphere causing the planet to warm at a faster rate. Climate change has consequences for our weather, oceans, food, and health. Water from melting glaciers causes rising sea levels. Climate change can cause extreme weather impacting our food and health. In areas with high amounts of smog, health problems can occur such as asthma, heart disease, and lung cancer. Humans can reduce the rate of climate change by replacing fossil fuels with renewable energy sources that don't produce greenhouse gases.

LESSON 6.3

INVESTIGATING SEA LEVELS

GRADE LEVEL 6-8

DINOSAURS OF ANTARCTICA EDUCATOR GUIDE

Dinosaurs of Antarctica Educator Guide

LESSON 6.3
INVESTIGATING SEA LEVELS

GRADE LEVEL 6-8
(1) 60 MINUTE LESSON
(1) 10 MINUTE CLEAN UP

STANDARDS:

- MS-ESS3-5: Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
- SP2: Develop and use a model to describe phenomena.

FROM THE FILM:

In the film ***Dinosaurs of Antarctica,*** geoscientists such as Libby Ives study the Earth's composition, structure, and other physical aspects such as physical sedimentology and glacial geology. Analyzing Earth's landscape helps scientists understand how our planet changes over time. For example, if scientists can understand the process of how melting glaciers and ice sheets contribute to sea-level rising, they can create solutions to minimize human and animal impact.

LESSON OVERVIEW:

In this lesson, students will investigate the relationship between climate change and sea-level rise.

MATERIALS:

- 2 plastic rectangle containers of the same size (per group)
- 8 sticks of modeling clay (per group)
- 1 tray full of ice cubes (per group)
- 1 liter of water (per group)
- Ruler (per group)
- Technology to show the following videos:

  "How Glaciers Changed The World" by SciShow Kids [5 minutes]

  http://bit.ly/aboutglaciers

  "NASA's Earth Minute: Sea Level Rise" [1:30]

  http://bit.ly/aboutsealevels

- Investigating Sea Levels Lab Student Resource Sheet 6.3
- Investigating Sea Levels Student Resource Sheet 6.3a

LESSON 6.3
INVESTIGATING SEA LEVELS

EDUCATOR PREP:

Split your class into groups of four. Gather enough materials to accommodate each group. Print copies of "Investigating Sea Levels Lab Student Resource Sheet 6.3" and "Investigating Sea Levels Student Resource Sheet 6.3a." The day before the class, place one ice tray for each group in the freezer. Remove the ice tray from the freezer five minutes before starting the lab.

EDUCATOR GUIDE:

1. In the film ***Dinosaurs of Antarctica,*** students learned how scientists worked to understand the story of Antarctica by researching how climate changed over time impacting the landscape, plants, and animals. Antarctica was once a warm continent with lush plants and various animals such as dinosaurs. However, as the climate began to shift, the environment changed as well. Currently, Antarctica is a desert with large sheets of ice, glaciers, and icebergs. Scientists are studying the causes of the previous climate shift in Antarctica to predict what might happen in the future.

2. Share with students that they will investigate the relationship between climate change and rising sea levels by simulating what happens to floating ice and ice on land when it melts. Explain to students that the thermal expansion of seawater is one of the main causes of rising sea levels that result from a warming climate. Tell students that they should be able to answer the following question after completing the lab activity:

Which type of melting will cause a greater increase in sea level?

3. Provide each group with a set of lab materials, the "Investigating Sea Levels Lab Student Resource Sheet 6.3" and "Investigating Sea Levels Student Resource Sheet 6.3a." Allow a few minutes for students to decide on group roles. Review lab safety rules if necessary. Circulate to provide assistance when needed but encourage students to utilize their group for support.

Scientists Explore Antarctic Icebergs by boat.

LESSON 6.3
INVESTIGATING SEA LEVELS

4. PART 1 STUDENT DIRECTIONS:

- Make a prediction using the following question prompt:
  Which type of melting will cause a greater increase in sea level?
- Use your hands to combine four sticks of clay together.
- Place the clay on one side of the plastic container. Make sure the top of the clay is flat so that your ice cubes (glaciers) can balance. Label this container "Glacier."
- Use your hands to combine the remaining four sticks of clay together.
- Place the clay on one side of the second plastic container. Label this container "Iceberg."
- Add one cup of water to each container. Make sure the top of your clay (island) is above the water level. You may have to adjust the amount of water utilized based on the size of the container.
- Make a prediction based on your model.

  What might happen if you place an ice cube directly in the water?

  What might happen if you place an ice cube on top of the clay (island)?

  What does an ice cube represent in this experiment?

5. PART 2 STUDENT DIRECTIONS:

- Using the container labeled "Glacier," place six ice cubes (glaciers) on top of the clay (island).
- Use the ruler to measure and record the water level before the ice cubes (glaciers) melt on your data chart.
- Using the container labeled "Iceberg," place six ice cubes (icebergs) near the clay (island).
- Use the ruler to measure and record the water level before the ice cubes (icebergs) melt on your data chart.
- Place both containers in a sunny area if possible.

6. Remind students that Antarctica is surrounded by water. Tell students that today they will explore the relationship between climate change and rising sea levels. Show students the video, "How Glaciers Changed The World" by SciShow Kids [5 minutes]. Instruct students to complete the "Investigating Sea Levels Student Resource Sheet 6.3a" as they watch the clip.

Educator Notes:

LESSON 6.3
INVESTIGATING SEA LEVELS

7. After showing the video, permit two minutes for students to work with their partner to fill in any missing sections on their video reflection guide. After the time allowed expires, ask volunteers to share their responses to check for accuracy. Encourage students to correct their guides if necessary.

8. Facilitate a discussion using the following question prompts:

What are glaciers?
A glacier is a large mass of ice that moves slowly over land.

Where is the largest glacier in the world?
The largest glacier is found in Antarctica.

How do glaciers form?
Glaciers form when snow remains in the same area over time and accumulates to transform into ice.

What does it mean to have a glacier retreat?
When a glacier melts more ice in the summer than it builds up in the winter, it will retreat or move back.

Why do scientists study glaciers?
When glaciers move, it indicates something in the environment changed like temperature. Scientists can use this information to guess what the Earth was like a long time ago. Scientists and engineers have used the energy from melting glaciers to in useful ways, such as turning the energy into electricity. Scientists also study glaciers because if too many glaciers melt it can cause sea levels to rise which may impact how humans live.

How might a melting glacier impact sea levels?
Melting glaciers on land add more water to the oceans causing the sea level to rise. When the ocean becomes warmer, it takes up more space also causing the sea level to rise.

9. Tell students that over the next hour, they will monitor the water levels in both containers.

Scientists researching a frozen lake in Antarctica.

PART 3 STUDENT DIRECTIONS:

- After 15 minutes, measure the water in both containers again and record the data on your chart.
- After 30 minutes, measure the water in both containers again and record the data on your chart.
- After 45 minutes, measure the water in both containers again and record the data on your chart.

LESSON 6.3
INVESTIGATING SEA LEVELS

10. Check for understanding by reading the following statements aloud and ask students to complete the following sentences.

The plastic containers represent an ocean basin.

The ice cubes represent glaciers or icebergs.

The water represents ocean water.

The clay represents an island.

The ruler represents a sea-level gauge.

11. Lead a class discussion using the following question prompts:

How does this experiment describe sea-level rising in the real world?
The experiment simulated what happens when icebergs and glaciers melt. Glaciers contribute to the rising of sea level because water is being removed from the land and placed in the water to the ocean basin. Icebergs don't cause the sea level to rise because they are already in the water. Therefore, the volume of an iceberg has already impacted the sea level.

Describe how the iceberg and glacier impact sea level during this simulation.
After reviewing my data chart, I noticed that when the glaciers melted, there was a rise in the water level. When the iceberg melted, the water level stayed the same.

12. To ensure that students understand why scientists monitor the sea level, show the following video clip NASA's Earth Minute: Sea Level Rise [1:30]. Instruct students to complete the "Investigating Sea Levels Student Resource Sheet 6.3a."

13. To conclude the lesson, lead a whole-class discussion using the following question prompts: How do you think rising sea level will affect people where you live? What if all of the ice in Antarctica melted, what do you think would happen? Why might scientists want to understand the relationship between glaciers and climate in Antarctica?

Educator Notes:

Investigating Sea Levels Lab

Use the directions below to investigate the relationship between climate change and rising sea levels by simulating what happens to floating ice and ice on land when it melts.

☐ Part 1: Student directions

- Make a prediction using the following question prompt: Which type of melting will cause a greater increase in sea level?
- Use your hands to combine four sticks of clay together.
- Place the clay on one side of the plastic container. Make sure the top of the clay is flat so that your ice cubes (glaciers) can balance easily. Label this container "Glacier."
- Use your hands to combine the remaining four sticks of clay together.
- Place the clay on one side of the second plastic container. Label this container "Iceberg."
- Add one cup of water to each container. Make sure the top of your clay (island) is above the water level. You may have to adjust the amount of water utilized based on the size of the container.
- Make a prediction based on your model.

  What might happen if you place an ice cube directly in the water?

  What might happen if you place an ice cube on top of the clay (island)?

☐ Part 2: Student directions

- Using the container labeled "Glacier," place six ice cubes (glaciers) on top of the clay (island).
- Use the ruler to measure and record the water level before the ice cubes (glaciers) melt on your data chart.
- Using the container labeled "Iceberg," place six ice cubes (icebergs) near the clay (island).
- Use the ruler to measure and record the water level before the ice cubes (icebergs) melt on your data chart.
- Place both containers in a sunny area if possible.

☐ Part 3: Student directions

- After 15 minutes, measure the water in both containers again and record the data on your chart.
- After 30 minutes, measure the water in both containers again and record the data on your chart.
- After 45 minutes, measure the water in both containers again and record the data on your chart.

Investigating Sea Levels

I. Lab notes: Use the table to record your observations.

"Iceberg"

Time	Water Level	Observations
immediately		
15 minutes		
30 minutes		
45 minutes		

"Glacier"

Time	Water Level	Observations
immediately		
15 minutes		
30 minutes		
45 minutes		

II. Video reflection: As you view the "How Glaciers Changed The World" video, fill in the blanks.

When snow accumulates over days, it can turn into layers of _____ like a _____ . Glaciers hold a frozen supply of the Earth's _____ water. They grow and _____ . Sometimes they _____ around. The process of layers of snow can take a long time, such as _____ years. The world's biggest glacier is _____ in Antarctica. Glaciers cover _____ of the Earth. When a glacier becomes large, the ice on the bottom can no longer hold up the ice _____ it. The ice at the bottom will float out and _____ . When a glacier melts more ice in the summer than it builds up in the winter, it will _____ or move back. When glaciers move, it tells scientists that something in the Earth is _____ . Over the past 100 years, the Earth has become warmer, causing some glaciers to _____ or _____ . Sometimes melting glaciers can be helpful. Water from melting glaciers often flows into rivers. _____ , _____ , and _____ use water from rivers. However, if glaciers melt too fast, it causes the sea level to _____ .

III. Video reflection: After viewing the "NASA's Earth Minute: Sea Level Rise" video, answer the following questions.

How do you think rising sea level will affect people where you live?

_____

_____

What if all of the ice in Antarctica melted, what do you think would happen?

_____

_____

Why might scientists want to understand the relationship between glaciers and climate in Antarctica?

_____

_____

Investigating Sea Levels

I. Lab notes: Use the table to record your observations.

"Iceberg"

Time	Water Level	Observations
immediately		
15 minutes		
30 minutes		
45 minutes		

"Glacier"

Time	Water Level	Observations
immediately		
15 minutes		
30 minutes		
45 minutes		

II. Video reflection: As you view the "How Glaciers Changed The World" video, fill in the blanks.

When snow accumulates over days, it can turn into layers of ice like a glacier . Glaciers hold a frozen supply of the Earth's fresh water. They grow and shrink . Sometimes they move around. The process of layers of snow can take a long time, such as 100 years. The world's biggest glacier is Lambert Fisher in Antarctica. Glaciers cover one-tenth of the Earth. When a glacier becomes large, the ice on the bottom can no longer hold up the ice above it. The ice at the bottom will float out and advance . When a glacier melts more ice in the summer than it builds up in the winter, it will retreat or move back. When glaciers move, it tells scientists that something in the Earth is changing . Over the past 100 years, the Earth has become warmer, causing some glaciers to shrink or disappear . Sometimes melting glaciers can be helpful. Water from melting glaciers often flows into rivers. Plants , people , and animals use water from rivers. However, if glaciers melt too fast, it causes the sea level to rise .

III. Video reflection: After viewing the "NASA's Earth Minute: Sea Level Rise" video, answer the following questions.

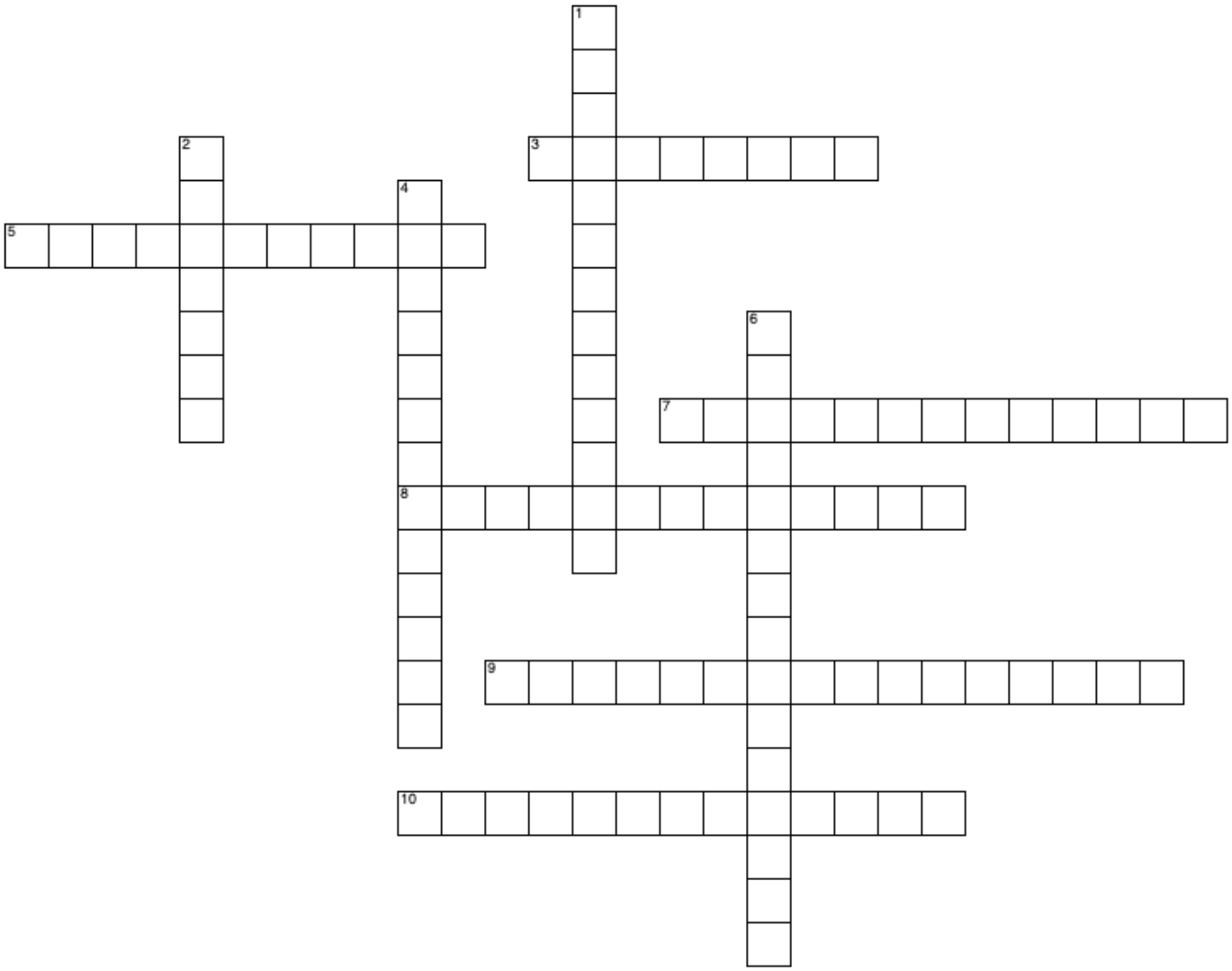
How do you think rising sea level will affect people where you live?
answers will vary

What if all of the ice in Antarctica melted, what do you think would happen?
answers will vary

Why might scientists want to understand the relationship between glaciers and climate in Antarctica?
answers will vary

Word Search

Select a word that match the definition below. Match the number beside the definition to the boxes placed across or down the grid. If correct, the word will fit perfectly in the puzzle.



Across

3. the average height of the sea's surface

5. a fuel (such as coal or oil) that is formed in the Earth from dead plants or animals

7. a colorless, odorless gas that is released from the burning of fossil fuels

8. a person who studies climate patterns to provide an understanding of the conditions of an area

9. the warming of the Earth's atmosphere often caused by air pollution

10. an increase in the Earth's average temperature that causes changes in the climate

Down

1. a natural or human-made gas that traps heat in the atmosphere

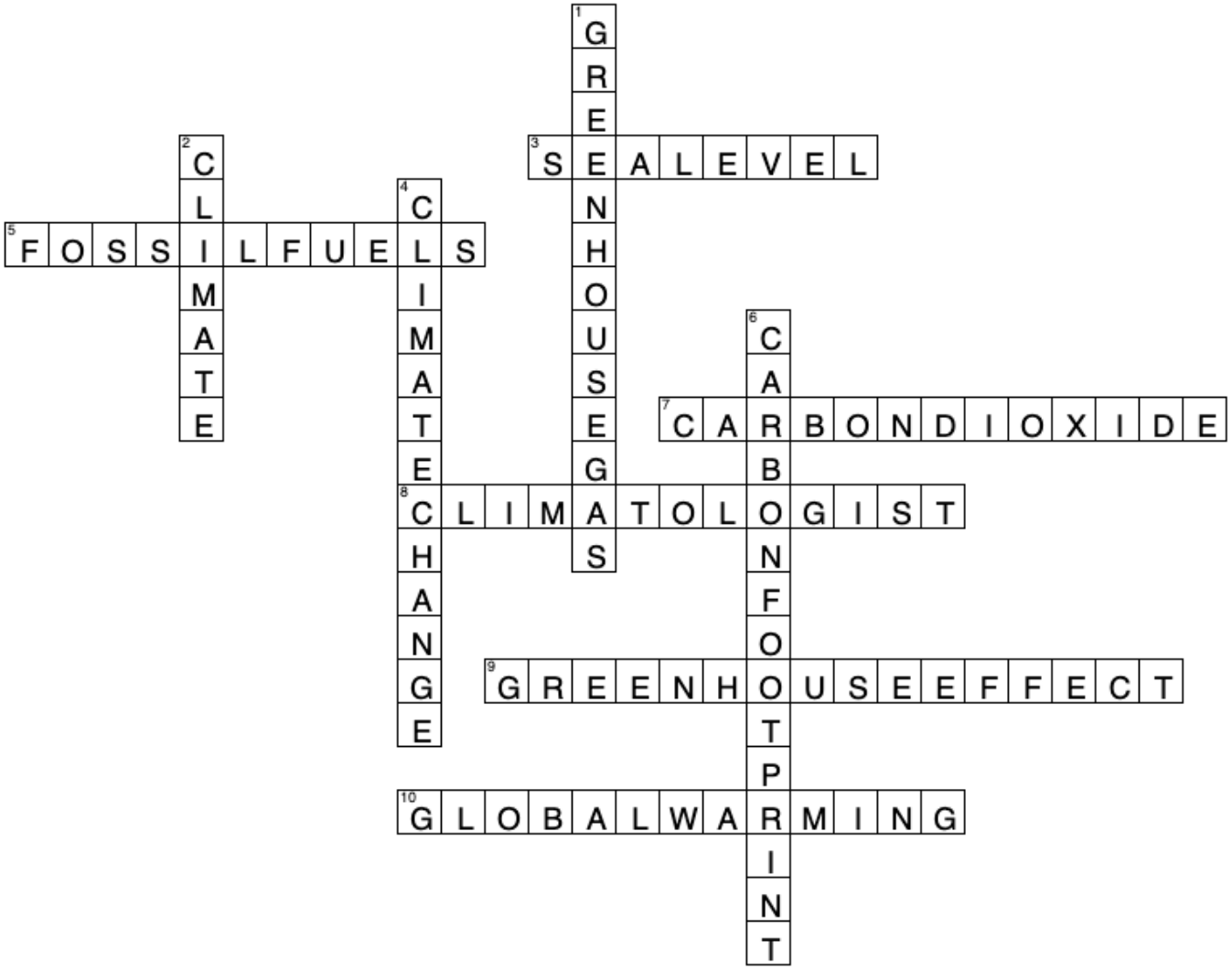
2. the pattern of weather over a long period of time

4. a significant shift in the climate over time

6. the amount of greenhouse gases released by a person, family, or company each year

Word Search

Select a word that match the definition below. Match the number beside the definition to the boxes placed across or down the grid. If correct, the word will fit perfectly in the puzzle.



Across

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1. a natural or human-made gas that traps heat in the atmosphere

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Dinosaurs of Antarctica Educator Guide

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DISCOVERY PLACE

GIANT SCREEN FILMS

DINOSAURS OF ANTARCTICA