Data to the Rescue:
PENGUINS NEED OUR HELP!

for Afterschool Programs and STEM Clubs

FACILITATOR GUIDE

RUTGERS THE STATE UNIVERSITY OF NEW JERSEY
POLAR LITERACY
NSF

Use the story of the penguins to build young learners data and science communication skills in an engaging and fun informal learning environment.

Whether you are part of an afterschool club, hybrid learning program, or even an independent adventurer, we invite you to join our research team!

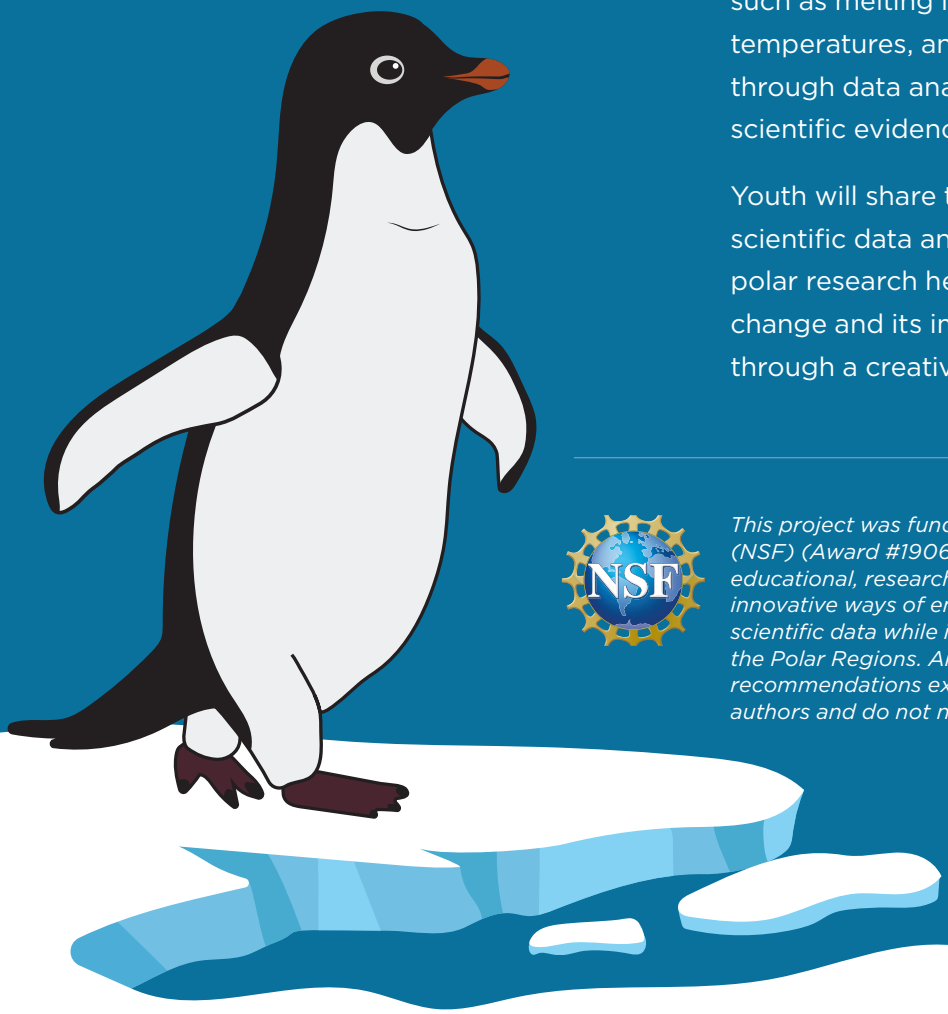
You're invited ... to join a polar expedition.

Although remote from much of human society, the Polar Regions are facing unprecedented change that will have significant consequences for us all. Scientists are studying and documenting the impacts of climate change and how they are unfolding at an accelerated rate in the Polar Regions compared to other areas of the earth.

Youth are invited to join the seabird research team of the Long-Term Ecological Research (LTER) program to explore the penguins at Palmer Station, located on the Western Antarctic Peninsula.

Learn how penguin data is collected and analyzed and help explore the impacts of climate change—such as melting ice sheets, increasing ocean water temperatures, and changing animal populations—through data analysis and interpretation of scientific evidence.

Youth will share their understanding of the scientific data and communicate to others how polar research helps us understand climate change and its impact, both globally and locally, through a creative project called a Data Jam.



This project was funded by the National Science Foundation (NSF) (Award #1906897 and OPP-2026045) as an educational, research-based program designed to develop innovative ways of engaging young learners in exploring scientific data while increasing their understanding of the Polar Regions. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the NSF.

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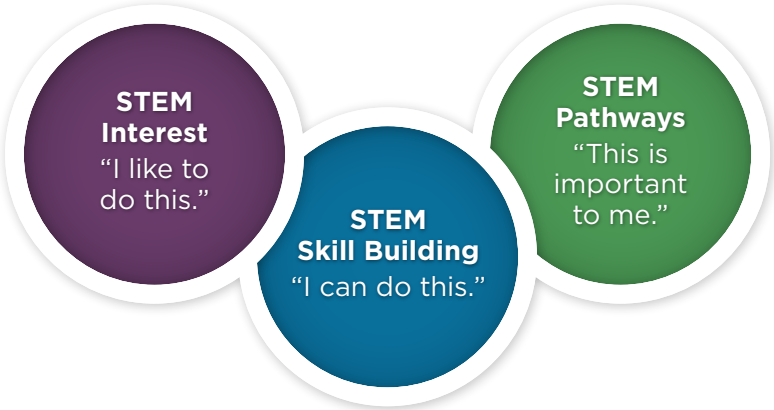
SCAN TO GO TO THE WEBSITE

FACILITATING *DATA TO THE RESCUE: PENGUINS NEED OUR HELP!*

This guide supports educators, parents, and afterschool providers in facilitating *Data to the Rescue: Penguins Need Our Help!* with young Explorers grades 5 to 8.

Facilitators help youth follow their natural curiosity while they gain important STEM skills in collaborating, asking questions, analyzing data, and sharing ideas.

OUTCOMES FOR INFORMAL **STEM** PROGRAMS

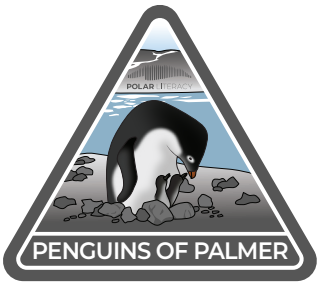


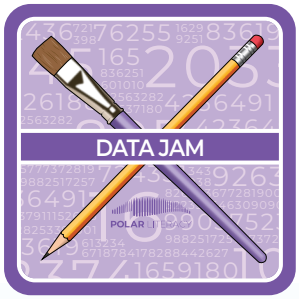
Afterschool Alliance Defining Youth Outcomes for STEM Learning in Afterschool. Web 20. Jan 2016. http://www.afterschool alliance.org/STEM_Outcomes_2013.pdf

This program encourages learners to actively participate in science, including working with actual scientific data and addressing the real-world problems of climate change.

This program is:

- ✓ **Fun, flexible and educational:** There are eight club meetings (of about 45 minutes each) with supporting online materials. The sessions are designed to be presented in order but can be flexible in both time frame and content. Meetings build on each other, but a child who misses one or more club meetings will still enjoy and learn from each session's activities.
- ✓ **Adaptable:** The postcards engage youth in self-guided, online learning. Support materials and facilitator tips make the meetings more or less challenging, depending on your activity selection. Some of the activities listed in the Facilitator Guide are hands-on versions of the activities presented in the online modules. The repetition of lessons can help youth to better grasp complex topics.
- ✓ **Accessible:** The complementary website provides a rich resource to encourage youth to follow their interests at their own pace. In addition to club meeting activities, the online modules engage with videos of glaciers melting, penguins foraging, and polar scientists explaining their research. (Facilitators: Please note most of the activities in this program require internet access.)





Visit the project page for additional resources, web links and online student materials for each club meeting

https://polar-ice.org/data-to-the-rescue-club/

SCAN TO GO TO THE WEBSITE

LEARNING OBJECTIVES

This *Data to the Rescue* program focuses on four STEM-related goals.

1. **Youth learn how the Antarctic ecosystem is transforming due to climate change.**
   The Western Antarctic Peninsula is the fastest winter warming place on Earth. This project provides opportunities for youth to fundamentally connect what they learn about the Polar Regions to similar concepts while learning about local impacts and solutions.

2. **Youth practice STEM skills, including graph making, analyzing, and interpreting data and asking scientific questions.**
   There is an ever-increasing expectation for workforce competencies in data literacy. By building Explorers' skills in collecting, analyzing, and interpreting large datasets, we encourage them to enter a workforce equipped to benefit society through better decision making (Ridsdale et al., 2015). By encouraging inquiry, we support meaning making and the development of a deeper understanding of the phenomenon of climate change (Langen et al., 2014; Schultheis and Kjelvik, 2020).

Data Skills by Session

DATA TASK	DATA SKILL (Grade Level)	MEETINGS 1 & 2 *investigate the Polar Regions.*	MEETING 3 *Learn how data can be displayed with different types of graphs.*	MEETINGS 4 & 5 *Learn about the sea ice, penguins, and climate change. Practice creating, reading and analyzing line graphs.*	MEETING 6 *Practice asking scientific questions and make connections between data variables.*	MEETING 7 *Discuss the impacts of climate change in Antarctica through the identification of data trends.*	MEETING 8 *Develop a creative project using ratios and share with your community.*
Realm: Get Data							
Connect data, questions, and predictions	Pursue questions to investigate with the available resources. (7-8th)				X		
Realm: Explore Data							
Grasp the attributes/ variables	Consider how two attributes might relate to each other in the context of the dataset (e.g. one influences another, but not the other way around). (7-8th)		X	X		X	
Read graphs & maps	Grasp the structure of and read information from pictographs, box plots, histograms, dot plots (1 dimensional), bar charts, pie charts, line graphs and/or maps. (6th)	X	X	X			
	Recognize that the colors in a graph or map represent attribute values or categories, not actual colors. (7-8th)			X			

DATA TASK	DATA SKILL (Grade Level)	MEETINGS 1 & 2 *investigate the Polar Regions.*	MEETING 3 *Learn how data can be displayed with different types of graphs.*	MEETINGS 4 & 5 *Learn about the sea ice, penguins, and climate change. Practice creating, reading and analyzing line graphs.*	MEETING 6 *Practice asking scientific questions and make connections between data variables.*	MEETING 7 *Discuss the impacts of climate change in Antarctica through the identification of data trends.*	MEETING 8 *Develop a creative project using ratios and share with your community.*
Create graphs & maps	Create graphs and scale axes using interactive technology. (6th)			X			
	Put suitable attributes on the axes for a given question. (7-8th)			X			
Describe visual patterns	Compare and contrast data values represented in a graph (e.g., is more than, less than). (3-5th)			X			
Interpret patterns in context	Describe features or patterns of graphs and maps that say something about a stated question or prediction. (6th)	X	X	X	X	X	X
Realm: Infer Meaning from Data							
	Make a conjecture or write a claim that is based on patterns in data. (6th)	X	X			X	X
Follow through with an action	Consider implications of results in a broader context (self, community, or broader understanding). (6th)					X	X
	Communicate findings in informal oral, written, visual, or kinesthetic presentations to peers. (6th)						X

3. **Youth create a sense of STEM identity by learning from real scientists involved in climate change research.**

   By providing children and parents with the tools to broaden their definitions of scientists—as individuals who are dedicated to science but not to the exclusion of other interests—we help build a vision of science that truly is accessible and for all (Dewitt et al., 2012). Videos from the "Polar Scientist Spotlight" series represent a diversity of young polar researchers. Facilitators can use these videos as virtual mentors and role models for Explorers to build their STEM identities. The related polar scientist cards help students understand the importance of an interdisciplinary team.

4. **Youth experience a sense of belonging among peers and support by adult facilitators who encourage positive emotions and hopeful purpose.**
   This program is designed to help youth thrive! It is important to provide youth with a sense of belonging among peers and support by adult facilitators (Arnold, 2020). Social-emotional learning (SEL) activities such as "What Penguin are You Today?" are central to *Data to the Rescue* and can be found in the "Facilitator Tips" and various activity sections.

What Penguin are You Today? is an example of an SEL activity where learners are encouraged to pick which image they most relate to that day and provide a 1-word or short description of why. For in-person engagement, they can share it out loud to the whole group, in a think-pair-share. For virtual, they can share in the chat box. Facilitators should acknowledge all answers and provide their own response to help build a sense of community and emotional support.

HOW IT WORKS

The following materials are included in this *Data to the Rescue* kit (12 kids/club):

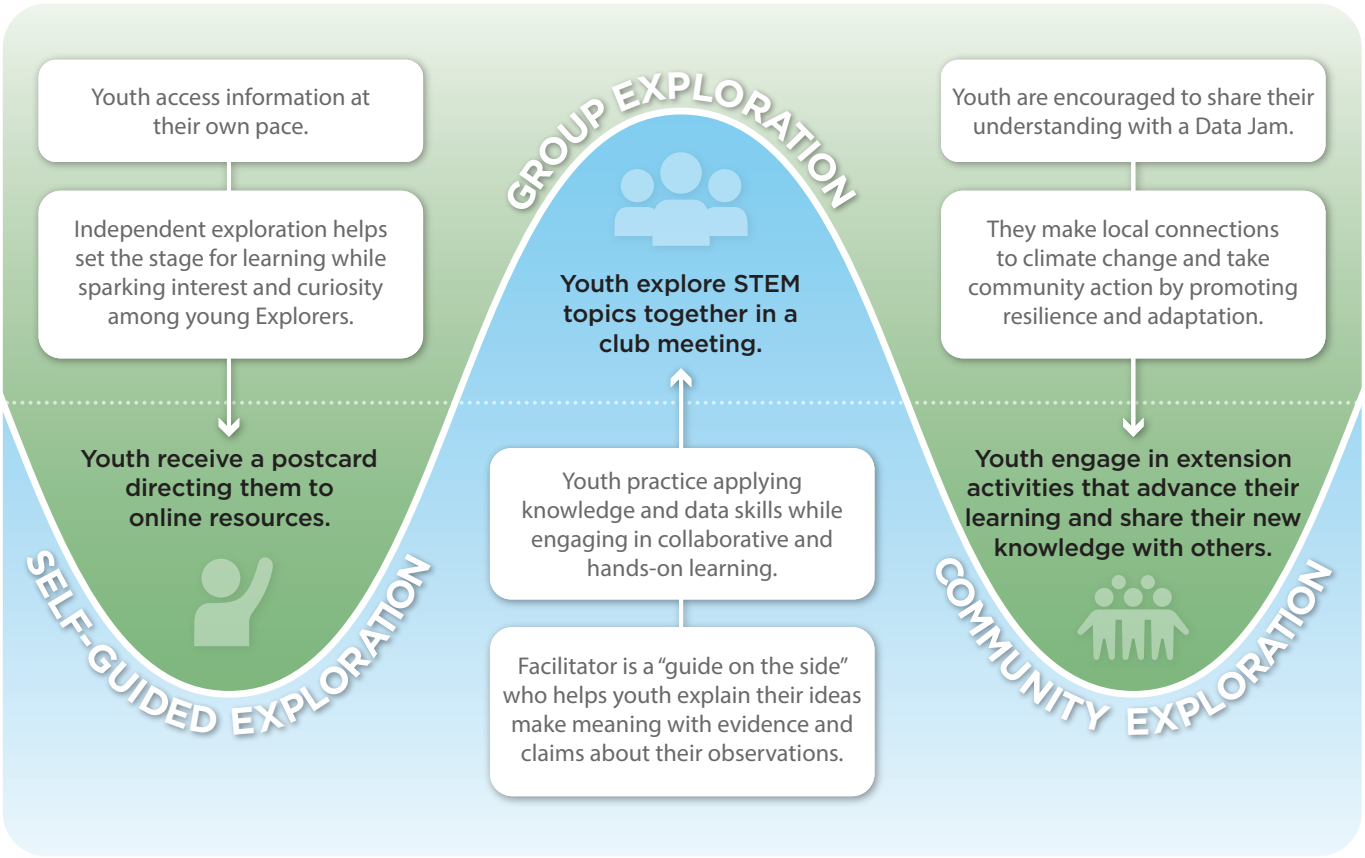
- ✓ Facilitator Guide (1 copy)
- ✓ Research Journal (12 copies)
- ✓ Youth postcards (8 cards, 12 sets)
- ✓ Common Online Data Platform (CODAP) guide and checklist (6 copies)
- ✓ Polar scientist cards (7 cards, 12 sets)
- ✓ Stickers of badges (6 stickers, 12 sets)
- ✓ Online materials:
  - » Program homepage: https://polar-ice.org/data-to-the-rescue-club/
  - » Youth postcards: https://polar-ice.org/data-to-the-rescue-club/postcards/
  - » Facilitator links and resources: https://polar-ice.org/data-to-the-rescue-club/facilitators-guide/

Hybrid Learning Model

Each club meeting in this curriculum includes the following three components.

Preparing for Exploration (Self-guided)	Club Exploration (Group)	Community Exploration
Youth are given postcards from the lead researcher, Dr. Megan Cimino, that direct their online learning about Antarctica. Youth record their work in their Research Journals.	In-person club meetings provide social interaction and collaboration among Explorers. Youth earn a Polar Explorer badge for each club meeting they attend.	Explorers are encouraged to become role models for climate-friendly behaviors and participate in "Local Challenge" projects that extend their learning.

RESEARCH CLUB MODEL



Complementary Materials

The program includes a Research Journal for Explorers that extends the lessons provided in the Facilitator Guide.

Facilitator Guide	Youth Research Journal
Preparing for Exploration (Self-guided): Facilitators open club meetings by reviewing the advance work done by Explorers.	*Preparing for Exploration:* provides space for students to record their ideas from online activities.
Club Exploration (Group): Facilitators guide Explorers through engaging (and fun) STEM activities that build on and enhance online learning.	*Club Exploration:* provides space to record the results of hands-on activities and discussions focused on data literacy and climate change.
Community Exploration: Facilitators lead discussions on the causes of climate change and ways in which Explorers can take action in their communities to address its impact.	*Community Exploration:* includes a "Climate Connection" that ties learning to personal efforts and a "Local Challenge" to engage others.

Club Meetings at a Glance

Through eight club meetings, Explorers will learn about the penguins of the Western Antarctic Peninsula and how climate change is impacting the Polar Regions and our planet.

#1: Let's Pack Our Bags and Go to the Poles Plan the research expedition.
#2: Join the Team! Review scientists' jobs and how they are studying climate change.
#3: Dive into Data Learn basic data skills to support the science mission.
#4: Penguins Need Our Help! Identify species of penguins and analyze habitat maps.
#5: Penguins of Palmer Explore population data of penguin populations.
#6: Questionland Generate questions about what is happening to the penguins.
#7: Exploring Ice as Habitat Learn about sea ice and how to analyze and explain change**s.**
#8: Communicate Science with a Data Jam Demonstrate understanding through a creative project called a Data Jam.

Note, if you are viewing the PDF digitally, you can click on the blue links in the document.

SCAN TO GET LINKS TO ALL VIDEOS AND ONLINE CONTENT NEEDED TO HELP CONDUCT YOUR CLUB MEETINGS.

SCAN TO ACCESS THE ONLINE YOUTH POSTCARDS FOR EACH MEETING.

Preparing for Exploration: provides space for students to record their ideas from online activities.

Club Exploration: provides space to record the results of hands-on activities and discussions focused on data literacy and climate change.

Community Exploration: includes a "Climate Connection" that ties learning to personal efforts and a "Local Challenge" to engage others.

CLUB MEETING 5

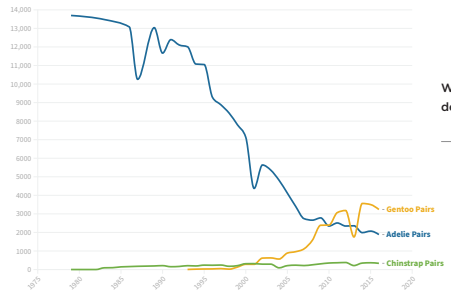
Penguins of Palmer

Complete all the tasks on Postcard #5 and record your notes here in the Research Journal.

Preparing for Exploration: PENGUIN DATA STORY

Summarize what you learned about the penguins of Palmer.

PENGUIN POPULATIONS



What species is declining over time?

_____

What questions do you have about what you have learned?

_____

_____

_____

Club Exploration: EXPLORE PENGUIN POPULATION DATA USING CODAP

As time increases what happens to each penguin's population? (circle one for each)

Adelie:	Increases	Decreases	Stays Steady
Gentoo:	Increases	Decreases	Stays Steady
Chinstrap:	Increases	Decreases	Stays Steady

Write down some ideas about why this might be true.

_____

_____

Community Exploration: CLIMATE CONNECTION

Help prevent one less piece of garbage getting into a storm drain or being eaten by a hungry fish or bird. Here are some more things you can do to help fight climate change.

Reuse

The more we can reuse items in our lives the better! You can get creative with ways to repurpose items you might typically throw away.

- Use old candle jars as drinking glasses, flower vases, or storage containers.
- You can use parts of plastic bottles, containers, paper plates, CDs, etc., to make art such as decorations, jewelry, wind chimes, and instruments.
- Use unneeded printouts for scrap paper for other things, such as grocery store lists or more artwork.
- Use old shirts as cleaning rags, old windows as picture frames, or magazines as wrapping paper.
- When possible, donate your old items to thrift stores.

YOUR LOCAL CHALLENGE:

Next time you need to buy something, visit a thrift store instead of buying it new.

Congratulations!
You have earned your THIRD badge.

Explorer Badges:
After six of the activities, Explorers earn badges that can be attached to their certificate on the last page of their youth guide.

ACTIVITY POSTCARDS

Prepare your Explorers for the expedition! Youth are given post cards from the lead researcher, Dr. Megan Cimino, that directs their on-line learning.

SCAN TO ACCESS THE ONLINE YOUTH POSTCARDS

Support to Lead a Research Club

You do not need prior experience with STEM to facilitate a Data to the Rescue Research Club. Organize lessons and activities during your club meetings using the helpful information in this Facilitator Guide.

Facilitator Tips support activity implementation, including checking in on socio-emotional health of learners.

Suggested Script provide context-setting materials you can read to the entire group to facilitate discussion.

Key Vocbulary highlights background reference terms for your convenience.

Climate Connections relate learning from polar scientists about Antarctica to local impacts and solutions to climate change.

Study Location: Palmer Station on the Western Antarctic Peninsula

Palmer Station is on Anvers Island on the Western Antarctic Peninsula. Built in 1968, Palmer is one of three NSF-funded stations on the continent of Antarctica. There, researchers have been documenting the long-term changes in sea ice and marine life populations (including whales, phytoplankton, zooplankton, and penguins) since 1971.

The Western Antarctic Peninsula is habitat for a broad range of marine life, including three penguin species: Gentoo, Adélie, and Chinstrap.

Gentoo

Adélie

Chinstrap

The Western Antarctic Peninsula is changing ...

Mid-winter surface atmospheric temperatures have increased by 6 degrees Celsius, which is 5.4 times the global average!

Increased air and water temperatures are causing glaciers in the area to melt. This, coupled with increased precipitation, contributes to the flooding of the Antarctic rocky shores, which is where all three penguin species lay their eggs.

The sea ice season along the peninsula has dramatically shortened during the last 44 years. The sea ice now starts growing much later in winter and melts much earlier in spring.

Sea ice forms annually along the surface of the ocean around Antarctica. This happens during the dark and cold winter months (roughly March to August), when the days become much shorter. In summer (September to February), with longer days and more sunlight, the sea ice melts as temperatures warm.

Decreases in sea ice affect every part of the ecosystem—from water properties to weather and plants and animals—and may even be a key factor leading to declines in Adélie penguin populations in the Western Antarctic Peninsula.

During winter, Adélie penguins migrate to the ice edge, which is an important resting platform and area where they can find food that gathers under the ice. A shorter ice season also impacts organisms that use the ice edge as an underwater refuge and feeding ground.

CLUB MEETING 1

Let's Pack Our Bags and Go to the Poles

Preparing for Exploration: 15 minutes

- Distribute Postcard #1.
- Explorers complete the online activities, plus pages 2–5 of the Research Journal, in advance of the first club meeting.

Club Exploration: 35 minutes

- The focus is to get youth participants excited about their trip to the Polar Regions.
- Encourage discussion on what Explorers hope to discover about Antarctica.
- At the end of the group meeting, distribute Postcard #2 in preparation for your next scheduled meeting.

Community Exploration: 10 minutes

- Explorers watch videos from the "Polar Scientist Spotlight" series to understand the range of skills and tools used by researchers.
- Lead a discussion on the causes and impacts of climate change in your community.
- Help students brainstorm ways to make a positive change.

Objectives

Explorers will:

- Help the scientist team pack and prepare for the expedition; and
- Understand the roles of various scientists and their tools.

Data Skills

- This session provides background information and does not develop any specific data skills.

Materials

- Three different-color packets of sticky notes
- Colorful markers

SCAN FOR FACILITATOR RESOURCES AND WEB LINKS FOR MEETING 1.

SCAN FOR PRE-MEETING POSTCARD FOR SELF-GUIDED YOUTH EXPLORATION.

ACTIVITY 1: LET'S PACK OUR BAGS RECAP

(7 minutes)

1. Explorers sorted different items to pack and selected a research tool and watched a video about a scientist who uses it.
2. Have a volunteer summarize for the group what they did online.
3. Show Explorers the "What Polar Researcher are You Today?" slide and ask them to decide which researcher they feel like today. This is a SEL check-in that will help you gauge how your Explorers are feeling.
4. Ask Explorers to think of one word that describes how they feel and have volunteers share their words with the group.

ACTIVITY 2: I'M GOING ON A TRIP

(8 minutes)

Remind Explorers of the theme of the session by reading the letter from Dr. Megan Cimino. Share this profile on Dr. Cimino and her research with your Explorers.

Dear Explorers:

My name is Dr. Megan Cimino. I would like to welcome you to our research team. I need your help to learn more about the penguins at Palmer Station in Antarctica. To prepare, we are going to identify different species of penguins; analyze data; ask scientific questions; make a hypothesis about how climate change is impacting the penguin populations; and finally communicate about our work through something called a Data Jam. First, we have to get ready for our research expedition by packing our research equipment and personal items. It takes a lot of planning to go so far away to such a remote place on Earth. So glad you are joining the birder team. Let's get started!

Next, have explorers figure out how they will "Pack Their Bags" for the expedition, with the following activity.

1. Have Explorers stand in a circle.
2. Ask them to think about the items they "packed" and listed in their Research Journal while completing the online activity. Discuss with the kids how far away and what the weather might be like there. Challenge them to collectively plan their trip and pack important items they will need on the journey.
3. Have one volunteer Explorer start by saying, "I'm going on a trip and I'm bringing (item name)." They can choose an item from the online game or think of an additional item they would want to bring on the trip.
4. They will then point to another Explorer in the circle who will take a turn.
5. This second Explorer will say, "I'm going on a trip and I'm bringing (first Explorer's item *plus* their item)."
6. Continue until all Explorers have taken a turn.

    Examples:

    # 1: I'm going on a trip and I'm bringing sunscreen.

    # 2: I'm going on a trip and I'm bringing sunscreen and measuring tape.

    # 3: I'm going on a trip and I'm bringing sunscreen, measuring tape, and nets.

ACTIVITY 3: TOOLS FOR RESEARCH

(20 minutes)

1. Show Explorers the "Location" video.
2. Divide students into three groups and have them work in separate areas in the room.
3. Give each group one colored packet of sticky notes and some markers.
4. Assign each group a question(s):

    Group #1: What are three things you find interesting about the poles?

    Group #2: What are three questions you have about the Polar Regions?

    Group #3: Which scientist did you/would you pick? What is their tool? Why do you think this tool is useful for science?

5. Allow each group five minutes to write down answers on their sticky notes.
6. Then, rotate the groups so each one answers each question set.
7. After all rotations have been completed, ask for a volunteer from each group to read some of the sticky notes.
8. Encourage the Explorers to discuss their thoughts.

Conclude your club meeting by passing out Postcard #2 and introducing the "Community Exploration."

COMMUNITY EXPLORATION

(10 minutes)

Have the group watch videos from the "Polar Scientist Spotlight" series (as time allows):

- Meet Dr. Chris Gardner
- Meet Dr. Ellyn Enderlin
- Meet Dr. Bianca Rodriguez-Cardona

You can use this suggested script to lead discussion among the group.

It is important to bring a diverse team of scientists to the Polar Regions. A problem such as climate change needs a lot of people from various backgrounds to help. You can help right now by learning how to save energy. The amount of carbon dioxide (CO_2) in our atmosphere has been rising for more than a century. The major contribution of this excess CO_2 is from the fossil fuels we use to power our homes, businesses, and cars. Excess CO_2 in the atmosphere acts like a blanket around our planet—trapping heat and causing global temperatures to increase. Your local challenge is to create a list of ways you and your family can start saving energy.

CLIMATE CONNECTION

Save Energy

The energy in electricity, heating, cooling, etc., often comes from fossil fuels, which are non-renewable and add carbon to the atmosphere that contributes to climate change. By reducing our energy consumption, we can reduce the carbon added to the atmosphere. Here are a few ideas:

- **Turn off lights and electronics such as printers, computers, and video game consoles when you don't need them;**
- **Use cold water as much as possible when doing laundry;**
- **Run the energy-saver mode on appliances; and**
- **Keep doors and windows closed when you have heat or air conditioning running in your home.**

CLUB MEETING 2

Join the Team!

Preparing for Exploration: 15 minutes

- Explorers complete the online activities, plus pages 6–11 of the Research Journal.

Club Exploration: 35 minutes

- The focus of the meeting is to join the team and orient Explorers to climate change at the Western Antarctic Peninsula.
- At the end of the group meeting, distribute Postcard #3 in preparation for your next scheduled meeting.

Community Exploration: 10 minutes

- Explorers should watch a video of a melting glacier and learn about Antarctic scientists.
- Lead a discussion on the causes and impacts of climate change in your community.
- Help students brainstorm ways to make a positive change.

Objectives

Explorers will:

- Help the scientist team pack and prepare for the expedition;
- Become part of the Antarctic science team and learn what life is like at Palmer Station; and
- Understand the roles and skill sets of various scientists and their tools.

Data Skills

- This session provides background information and does not develop any specific data skills.

Materials

- Paper
- Colorful markers, pencils, and crayons
- Two identical plastic containers
- Ice cubes
- Water (room temperature)
- Food coloring (optional)
- Timer or stopwatch

SCAN FOR FACILITATOR RESOURCES AND WEB LINKS FOR MEETING 2.

SCAN FOR PRE-MEETING POSTCARD FOR SELF-GUIDED YOUTH EXPLORATION.

ACTIVITY 1: JOIN THE TEAM

(10 minutes)

1. Explorers should have watched a video about a scientist in Antarctica and completed the "Join the Team" personality activity in their Research Journals.
2. Explorers should form small groups (three to five per group) to discuss the following questions.
   - Are you all good at the same things?
   - Do you enjoy the same things?
   - Which jobs will everyone be good at?
3. Remind Explorers that a good team involves people with different skills, interests, and positions to fill on the research team.

Remind Explorers that a good team involves people with different skills, interests, and positions to fill on the research team.

ACTIVITY 2: QUESTIONS ONLY

(10 minutes)

1. Choose a participant to start and instruct them to formulate and ask a question about weather to a fellow participant.
2. The next participant must answer the question with another question.
3. If a participant hesitates for five or more seconds or accidentally answers the question with a statement, the facilitator calls, "Next!" and they are replaced with another participant. Below is a sample conversation.

   Participant A: Do you know what the weather forecast is for the weekend?

   Participant B: Have you checked the weather report?

   Participant A: When would I have had time to check the weather report?

   Participant B: Before school.

   Facilitator: Next!

   Participant C: Will it snow today?

   Participant A: What season is it?

Weather is what you are experiencing today; it determines what you will wear today.

Climate is weather conditions you expect long-term. Climate determines what clothes you have in your closet for the season and year.

This is a great time to have youth explore the difference between weather and climate. Visit this NOAA website for more information: https://www.ncei.noaa.gov/news/weather-vs-climate

ACTIVITY 3: MELTING GLACIAL ICE

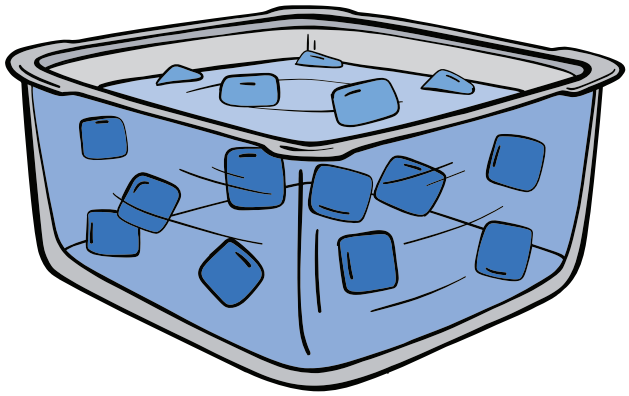
(15 minutes)

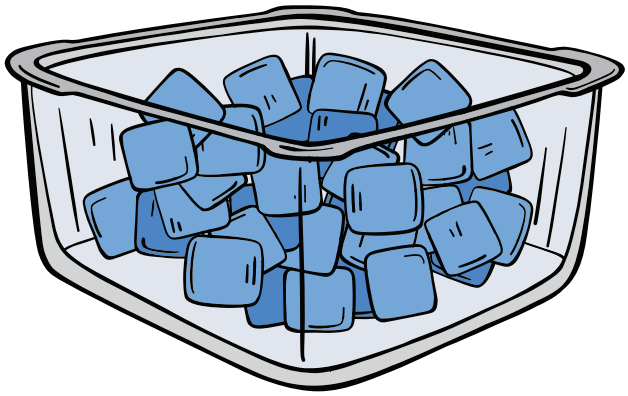
Adapted from the New Zealand Science Learning Hub: https://www.sciencelearn.org.nz/resources/2279-melting-glacial-ice

During the last 40 years, warmer temperatures have been causing the glacier near Palmer Station in Antarctica to retreat or recede. Pictures from year to year show this decline in the ice cover and change in the landscape at Palmer Station. Warming temperatures also mean some areas will get rain, rather than snow, further lessening ice accumulation.

In this activity, Explorers will investigate how contact with water affects melting glacial ice. They will predict what they think will happen in one container that has a small amount of water and ice vs. another container that has just ice. Explorers will learn water causes ice to melt more quickly, which can cause ice cliffs to calve or split from land.

We are going to explore how air and water affect ice melting. We are going to use these containers to represent a Polar Region of the world, ice cubes to represent a glacier; and water to represent a stream, river, or lake at the terminus of a glacier. Let's predict what we think will happen in each container, one filled with just ice cubes and one that has a little water with ice cubes. What do you think will happen?





1. Place an equal number of ice cubes in each of two containers. You can use either regular ice cubes or ice cubes frozen with food coloring dye. Note there is no difference in melting rates, the color just makes it easier to see the ice as it melts.
2. Add a small amount of water to one of the containers as your variable in the experiment.
3. Set the timer or stopwatch. Check the containers every few minutes to see what is happening.
4. While the ice is melting, show Explorers videos on:
    - » Climate change at the poles; and
    - » Differences between the Arctic and Antarctic.
5. Ask the following questions to encourage group discussion.
    - » What does a warmer climate lead to at the poles? *Potential answers: Carbon dioxide and methane production, thawing of permafrost, melting glaciers, more precipitation in the form of snow and rain, rising sea levels, forest fires, and destruction of habitat*
    - » Is the Arctic an ice-covered ocean surrounded by land or ice-covered land surrounded by the ocean? *Answer: Ice-covered ocean surrounded by land*
    - » Is the Antarctic an ice-covered ocean surrounded by land or ice-covered land surrounded by the ocean? *Answer: Ice-covered land surrounded by ocean*
    - » What contributes to sea level rise? *Answer: Warmer temperatures lead to glacial ice melting, which increases sea level*
6. Record the time it takes for the ice in each container to melt.
7. Ask the Explorers to discuss the following question, either in pairs or small groups or as a full group: What difference does contact with water make to ice cubes in the container?

A variable is any factor, trait, or condition that can exist in differing amounts or types. They can be independent (one that is changed by the scientist), dependent (one the scientist observes to see how it responds to a change made to the independent variable), or control (quantities that a scientist wants to remain constant).

The experiment shows that contact with water causes ice to melt more quickly. When ice comes into contact with warmer air or water, it absorbs the surrounding energy (heat). Water is denser than air, so its molecules transfer heat at a faster rate than air.

Extension Discussion

When ice encounters warmer air or water, it absorbs the surrounding energy (heat). Water is more dense than air, so its molecules transfer heat at a faster rate than air. Changes of state always involve a transfer of energy. On a molecular level, when ice melts, heat energy causes the frozen water molecules to move faster. The ice absorbs the surrounding energy or heat when it encounters warmer air or water. The air and water molecules then bump against the ice molecules and transfer some of their energy. The increased energy causes the ice molecules to break away, and the water changes state from a solid to a liquid. Therefore, we can see that ice melts more quickly in water than air because water is denser—has a greater concentration of molecules than air.

Conclude your club meeting by passing out Postcard #3 and introducing the "Community Exploration." Don't forget to share the "Pack Your Bags" badge with your Explorers!

COMMUNITY EXPLORATION

(10 minutes)

Have the group watch this video of a melting glacier and read about the work of two polar scientists.

- Watch the "Chasing Ice" video
- Meet Dr. Michael Paul Meredith
- Meet Dr. Carlos Moffat

You can use this suggested script to lead discussion among the group.

Scientists from all over the world are coming together to solve the issues we are learning about in our club. We can help by getting reflective. We know that bright-white (ice) surfaces reflect much of the sun's energy back into space, while deep-blue ocean water and dark rocks on land absorb heat from the sun. Ice melt (from rain and increased temperatures) affects glaciers and snow on land and sea ice on the ocean. The melting of all three types of ice causes a less bright, white reflective surface and more heat absorption both on land and in the ocean. Your local challenge is to start or get involved in a local garden to reduce absorption of heat in our environment.

CLIMATE CONNECTION

Get Reflective

The warming of polar oceans has powerful implications for organisms living there—and for us. Polar ice (glaciers and sea ice) plays an important role in regulating Earth's climate. Since large volumes of ice appear to be white, the ice reflects much of the sun's energy back into space. Large volumes of water appear to be blue, much darker than white; the water absorbs more of the solar energy. With less sea ice, the ocean absorbs more solar radiation, warming the ocean and the air. Here are some ideas to create more spaces that reflect or effectively use solar radiation instead of absorb it.

- Install white crushed stone in driveways or parking lots instead of using black pavement.
- Install gardens or plant trees instead of dark surfaces in a lawn.
- Install roofing that is lighter in color to help reflect solar energy.
- Turn off lights and electronics such as printers, computers, and video game consoles when you don't need them.
- Use cold water when doing laundry as much as possible. And use appliances on energy-saver mode.
- Keep doors and windows closed when you have heat or air conditioning on.

CLUB MEETING 3

Dive into Data

Preparing for Exploration: 15 minutes

- Explorers complete the online activities, plus pages 12–15 of the Research Journal.

Club Exploration: 35 minutes

- The focus of this meeting is to orient youth to interpreting data.
- They will collect, graph, and interpret data using M&M candies.
- At the end of the group meeting, distribute Postcard #4 in preparation for your next scheduled meeting.

Community Exploration: 10 minutes

- Explorers should find data in their everyday lives and then learn how a polar scientist uses data.
- Lead a discussion on the causes and impacts of climate change in your community.
- Help students brainstorm ways to make a positive change.

Objectives

Explorers will:

- Learn how data can be displayed with different types of graphs;
- Orient to and learn to read line graphs and bar charts;
- Practice reasoning skills; and
- Understand the importance of comparing data.

Data Skills

- Consider how two attributes might relate to each other in the context of the data set (one influences the other) (7th-8th grade)
- Grasp the structure of and read information from pictographs, box plots, histograms, dot plots (1-dimensional), bar charts, pie charts, line graphs, and/or maps (6th)
- Recognize that the colors in a graph or map represent attribute values or categories, not actual colors (7th-8th)
- Describe features or patterns of graphs and maps that say something about a stated question or prediction (6th)

SCAN FOR FACILITATOR RESOURCES AND WEB LINKS FOR MEETING 3.

SCAN FOR PRE-MEETING POSTCARD FOR SELF-GUIDED YOUTH EXPLORATION.

Materials

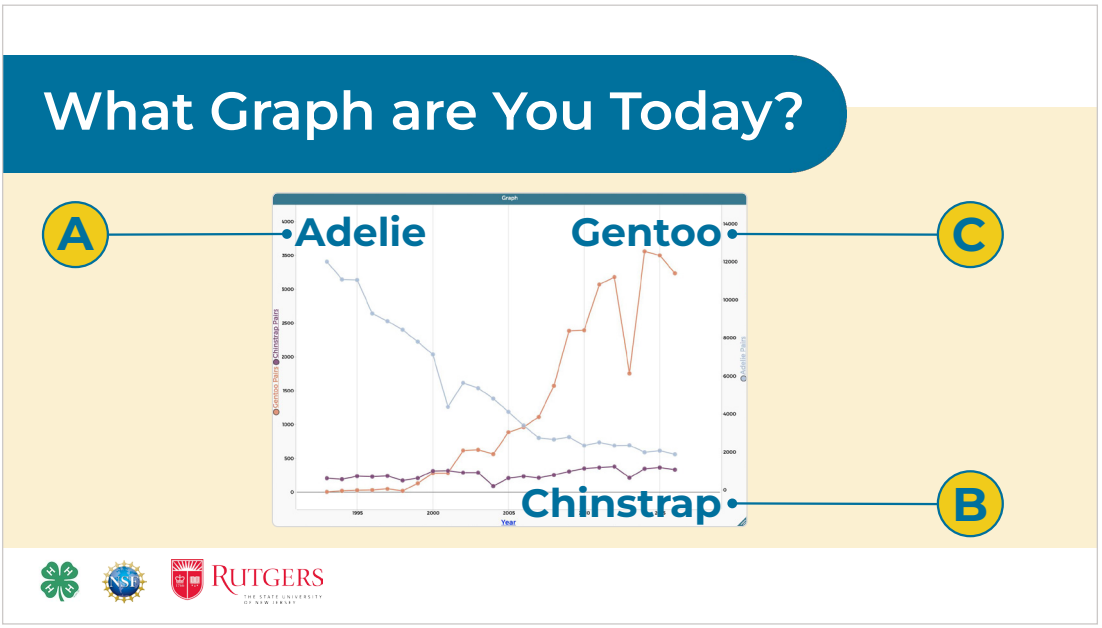
- Snack-size bags of M&Ms
- Markers
- Paper

Welcome back! In this meeting we will discuss how the birding team collects data at Palmer Station in Antarctica. It is really important that we understand the data collection and analysis process so we can be involved in figuring out how to save the Adélie penguins. We will do several activities to get us ready for the job!

ACTIVITY 1: LET'S PLAY A CARD GAME

(10 minutes)

1. Explorers completed the data card game in their Research Journals prior to this club session.
2. Have at least one volunteer read their explanation for each graph. As a group, decide if the relationship was explained correctly. If Explorers are struggling, encourage them to use the statement, "As X-axis (select one: increases/decreases) the Y-axis is (select one: increasing/decreasing) because (enter story/explanation)."
3. Give the group a few moments to complete the last open-ended graph in their Research Journals. Ask a few volunteers to share their unique graphs.
    - » Show Explorers the "What Graph are You Today?" slide to choose one type of graph and one word to describe how they feel. Have Explorers share their words with the group.



ACTIVITY 2: QUESTIONS ONLY

(25 minutes)

Explorers will work in small groups (two to three people) using M&M candies to learn how scientists collect and share data.

1. Explorers will start by engaging in a thought exercise that will allow them to practice making scientific predictions. They will predict the number and color of M&Ms found in a snack-size bag. Explorers record their predictions in their Research Journals.
2. Ask your Explorers to think about the M&M data they explored. During their observation of colors, ask them to consider a hypothesis for why they are seeing differences in the frequency of colors in the M&M bags.

Do you think we can predict the frequency of colors in an M&M bag? Is it random or is there a pattern?

3. Explorers will practice interpreting a bar graph that depicts the number of orange M&Ms collected by a group, then answer questions that help them orient and interpret the M&M data.

Review the "How Do Scientists Collect and Share Data" webpage (https://polar-ice.org/how-do-scientists) to lead this part of the activity.

1. Explorers sort M&M candies during the club meeting. Alternatively, Explorers can use the online M&M sorter to create a dataset if real candies are not available.
2. Explorers then add their M&M data to CODAP and learn how the platform works in preparation for working with penguin data in Club Meeting #5.

An observation is to note or record, a result, occurrence, or phenomenon. Observations can be been made "directly with our own eyes," (by seeing, feeling, hearing, tasting, or smelling or indirectly using science tools (e.g. thermometer to get temperature data) or proxies (brightness of a star as a estimate of temperature).

A hypothesis is a proposed explanation for a phenomenon, based on prior experience, scientific background knowledge, preliminary observation and or logic.

Using CODAP enhances the data collection and analysis experience. You can watch a short tutorial to learn more about how to use CODAP as a teaching tool for data literacy.

What do you notice or wonder about the data? When we look at just the numbers of each color, they might appear to be random. However, when we explore the frequency of each color, they reveal patterns. Scientists sort data to search for patterns, combine data to make models, form hypotheses, and make predictions about what they are studying. What do you think causes differences in the M&M data? If you were going to continue data exploration with M&Ms, what would you do next? For example, what color is most abundant on average? How would you be able to determine the most abundant color? Would you collaborate with people around the country? the world?

3. Have Explorer groups share their ideas with the whole team. As you close the activity you can share with your Explorers that this M&M data collection activity represents the same type of experimental design (including asking questions and designing an experiment) that would help scientists at Palmer Station understand what is happening to the penguin populations in Antarctica. Just as the Explorers did with M&Ms, scientists are counting and sorting penguins to understand the numbers of different penguins around the region. One scientist cannot do this alone, so teams of scientists share their penguin counts to create an understanding of penguin populations and population dynamics.

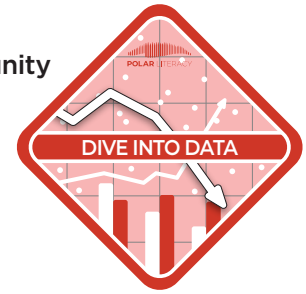
CODAP is a wonderful tool that allows your Explorers independence in their thinking and analysis of the penguin data later, in Club Meetings #5 and #6. Data skills building is important work and these activities are excellent for self-management and SEL. You can find more SEL techniques here.

Working with CODAP can feel intimidating and difficult at first. Don't be discouraged! It will become easier to use once you get the hang of it.

If you notice your Explorers struggling, you can provide a positive statement such as these.

- "I noticed that was challenging for you, but you stuck with it and didn't give up."
- "I'm proud of you and you should be proud of yourself."
- "I noticed how frustrated … made you, but you stayed calm and worked through that frustration. That must have been hard, but I'm proud of you for working through it."

Conclude your club meeting by passing out Postcard #4 and introducing the "Community Exploration." Don't forget to share the "Dive into Data" badge with your Explorers!



COMMUNITY EXPLORATION

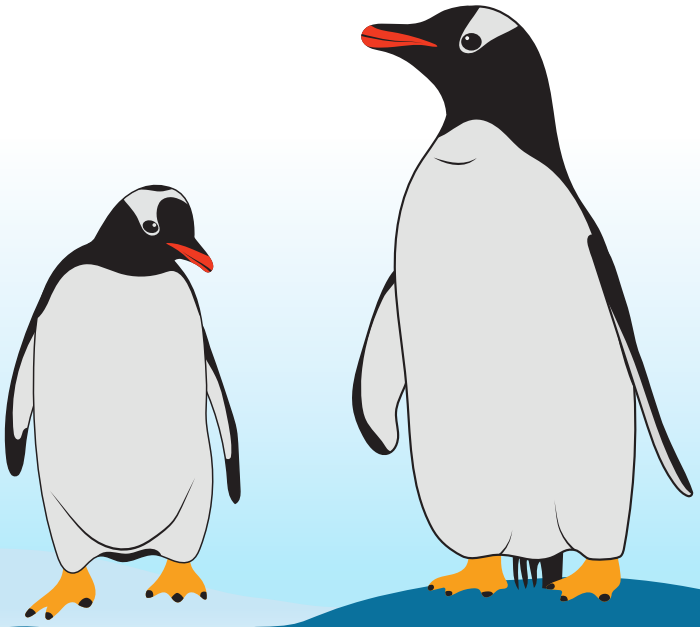
(10 minutes)

In this lesson, you will lead the group in observing the world around you and finding data in your everyday life. First, show Explorers details on the Dear Data project; brainstorm what sorts of data students might gather information on from their own lives. Then, have them read about Antarctic scientist Dr. Scott Doney, who uses various types of data to research how to make the planet healthier.

- Read about the Dear Data project
- Meet Dr. Scott Doney

You can use this suggested script to lead discussion among the group.

We can also help make a healthy planet by counting our resources. Saving water reduces carbon pollution, too. That's because it takes a lot of energy to pump, heat, and treat your water. So take shorter showers, turn off the tap while brushing your teeth, and switch to WaterSense-labeled fixtures and appliances. The U.S. Environmental Protection Agency, or EPA, estimates that if just one out of every 100 American homes were retrofitted with water-efficient fixtures, about 100 million kilowatt-hours of electricity per year would be saved—which would avoid 80,000 tons of global warming pollution. Your local challenge is to talk to your family and friends about saving water.

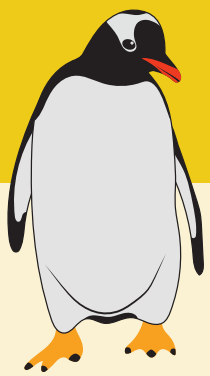


CLIMATE CONNECTION

Count Your Resources

Saving water reduces carbon pollution, too. That's because it takes a lot of energy to pump, heat, and treat your water. The U.S. Environmental Protection Agency (EPA) estimates that if just one out of every 100 American homes were retrofitted with water-efficient fixtures, about 100 million kilowatt-hours of electricity per year would be saved—avoiding 80,000 tons of global warming pollution.

- Turn off the water when you brush your teeth, shave, and while putting soap on your hands.
- Don't take long showers.
- Water plants with cooled, unsalted cooking water.



CLUB MEETING 4

Penguins Need Our Help!

Preparing for Exploration: 15 minutes

- Explorers complete the online activities, plus pages 16–19 of the Research Journal.

Club Exploration: 35 minutes

- The focus of this meeting is to understand ice as a habitat for penguins.
- At the end of the group meeting, distribute Postcard #5 in preparation for your next scheduled meeting.

Community Exploration: 10 minutes

- Explorers learn more about penguins and the research of an Antarctic scientist.
- Lead a discussion on the causes and impacts of climate change and pollution in your community.
- Help students brainstorm ways to make a positive change.

Objectives

Explorers will:

- Learn to read and map data;
- Create, read, and analyze line graphs;
- Practice asking scientific questions; and
- Learn about the connection between sea ice, penguins, and climate change.

Data Skills

- Consider how two attributes might relate to each other in the context of the dataset (e.g. one influences another, but not the other way around) (7th-8th grade)
- Grasp the structure of and read information from pictographs, box plots, histograms, dot plots (1-dimensional), bar charts, pie charts, line graphs, and/or maps (6th)
- Recognize that the colors in a graph or map represent attribute values or categories, not actual colors (7th-8th)

SCAN FOR FACILITATOR RESOURCES AND WEB LINKS FOR MEETING 4.

SCAN FOR PRE-MEETING POSTCARD FOR SELF-GUIDED YOUTH EXPLORATION.

- Describe features or patterns of graphs and maps that say something about a stated question or prediction (6th)
- Make a conjecture or write a claim that is based on patterns in data (6th)

Materials

- General craft supplies (popsicle sticks, glue, modeling clay, pom-poms, pipe cleaners, etc.)
- Water
- Two plastic containers (about the size of a shoebox) with lids
- Green and blue food coloring
- Salt
- Thermometer (optional)

ACTIVITY 1: MEET DR. CIMINO AND PENGUIN IDENTIFICATION RECAP

(2 minutes)

1. Prior to the club meeting, Explorers watched the scientist spotlight video on Dr. Cimino and identified the three penguin species at Palmer Station and recorded their results in their Research Journals.
2. Have one volunteer share a description of the three penguin species. As a group decide if the penguins have been identified correctly.
3. Have at least one volunteer share a fact they learned about Dr. Cimino and her research.

Extension Activity: It's a Penguin Party!

1. If you want to make the penguin identification more hands-on and challenging, download the "Penguin Dichotomous Key" and display it in the front of the room.
2. Have Explorers split into small groups and give each group a "Penguin Party" activity sheet.
3. Explorers should work together in their group to use the dichotomous key to identify the penguins.
4. Have each group report to the club the identification of their penguin species.
5. Answer Key: A-Adélie, B-Gentoo, C-Chinstrap, D-Macaroni, E-Austrian Little Penguin/Australian Blue Penguin, F-African

A dichotomous key is an important scientific tool used to identify different organisms, based on the organism's observable traits. Dichotomous keys consist of a series of statements with two choices in each step that will lead users to the correct identification.

ACTIVITY 2: WHAT PENGUIN ARE YOU TODAY?

(8 minutes)

1. Show Explorers the "What Penguin are You Today?" slide and ask them to decide which penguin they feel like today.
2. Ask Explorers to think of one word that describes how they feel.
3. Next, set a timer for five minutes and have Explorers create a craft representing their feeling of the day and which penguin they chose.
4. Ask volunteers to present their craft to the group and explain how their art represents the penguin and their word.

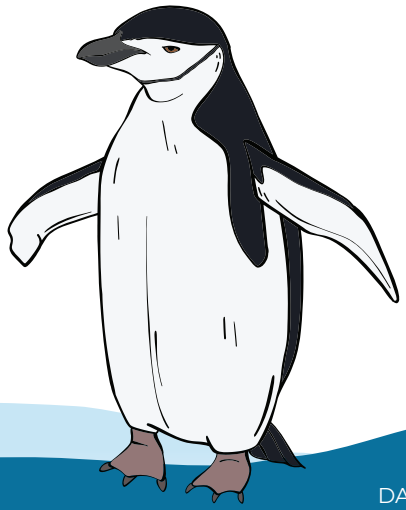
ACTIVITY 3: MAKING AND MELTING ICE

(10 minutes, freeze time in between)

1. Show the "Circulation" video.
2. Measure and pour 1 cup of water into two small cups or containers. Drop 1-2 drops of green food coloring in one container and 1-2 drops of blue food coloring in the other container.
3. Mix 1 1⁄2 teaspoons of salt into the green water container. Leave the blue container as freshwater.
4. Put a lid on each container and shake to mix ingredients.
5. Place the sealed containers in the freezer for two hours. After two hours, take the containers out of the freezer and remove the lids.
6. While the ice is freezing, complete Activity #4 (below).
7. Remove the containers from the freezer and observe and jot down some notes on what you notice. How does the ice in the blue container look compared to the green?
8. If you have a thermometer, measure and record the temperature of each water sample. How does the salty green solution compare to the freshwater blue solution? Why do you think there are these differences?

This activity was adapted from Saltwater is Cool, by NASA Earth Observatory. You may need to do the freezing part of the activity in advance to complete it in your 45-minute club meeting. Alternatively, you can have your Explorers do this at home and report back to the group.

This experiment shows us that saltwater freezes at a lower temperature than freshwater. Our saltwater sample is close to the salinity of real seawater in the ocean (3.5 percent). In your observations, did you notice the ice formed on the top of the water in both containers? That's because ice is less dense than water, so it floats. We can see saltwater freeze at a lower temperature. If the temperature is above -2° C (28.4° F), the saltwater will remain a liquid. Freshwater freezes at 0°C (32° F), which is warmer than the freezing point of saltwater.

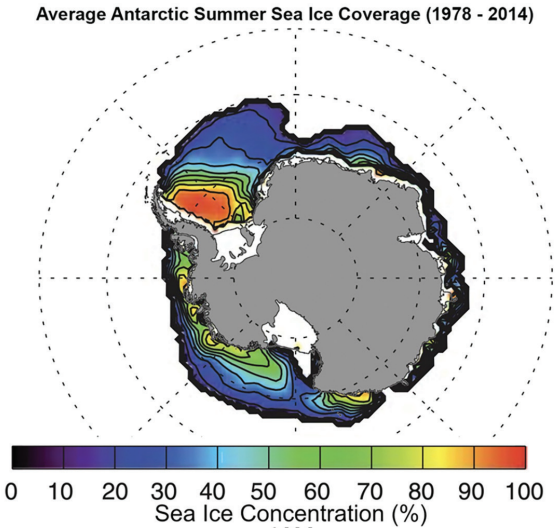


ACTIVITY 4: PENGUIN HABITAT INVESTIGATION

(15 minutes)

1. Have Explorers view the "Penguin Habitat Map Investigation" online (https://polar-ice.org/penguin-habitat-maps).
2. Ask the group to follow the online questions and share their conclusions about penguin habitat and sea ice. Ask Explorers to explain their answers.
3. Have them record this information in their Research Journals.

Explorers will investigate penguin winter habitat, including the sea ice environment. The legend shows the colors that represent sea ice coverage around the continent. A common misconception is that the color represents temperature; however, in the map below, red areas have the greatest sea ice concentrations, while dark purple and blue areas have little sea ice.



Credit: Dr. Megan Cimino

This map (left) shows an average of summer sea ice coverage. Note that sea ice increases in the Antarctic winter as temperatures drop. Explorers will also find habitat maps for each of the three penguin species, such as this map (right) of Adélie penguin concentrations.

Conclude your club meeting by passing out Postcard #5 and introducing the "Community Exploration."

COMMUNITY EXPLORATION

(10 minutes)

Encourage students to continue learning about penguins by visiting a local zoo, science center, or aquarium or watching a documentary in school or at home. As a group, you can also look for penguins using the webcams at Palmer Station that are available from November to February. Then, learn about an Antarctic scientist, Dr. Ari Friedlaender, who studies marine mammals such as whales.

- Watch webcams at Palmer Station
- Meet Dr. Ari Friedlaender

You can use this suggested script to lead discussion among the group.

We can help whales by preventing plastic from entering the ocean and reducing our use of plastic. Plastic can come in many shapes and sizes and is a part of our everyday lives. It is convenient—but also dangerous to our environment. Plastic production takes a lot of energy and releases carbon dioxide, a greenhouse gas, into the atmosphere. Researchers estimate that 8 million metric tons of plastic entered the ocean in a single year! That is the weight of nearly 90 aircraft carriers. All of this plastic can harm wildlife and marine life in a variety of ways, so it is important to limit our plastic usage. Your local challenge is to avoid using single-use plastic for one week.

CLIMATE CONNECTION

Reduce Plastic

Plastic can take a lot of energy to produce and a very long time to decompose. Whether it is a large container, a piece of glitter, or tiny particles we can't even see, plastics are polluting the environment. As scientists work to find ways to remove plastics from the environment, we can do our part by limiting the amount of single-use plastic we use.

- **Use laundry balls to prevent clothing microfibers from entering the ocean.**
- **When possible, buy products that don't have unnecessary plastic packaging and products made out of recycled plastic.**
- **Use reusable water bottles, grocery bags, straws, and other everyday items. Recycle as many plastic items as you can.**
- **Participate in local cleanups in your area.**

CLUB MEETING 5

Penguins of Palmer

Preparing for Exploration: 20 minutes

- Explorers complete the online activities, plus pages 20–21 of the Research Journal.

Club Exploration: 35 minutes

- The focus of this meeting is to learn more about the penguin population dynamics and impacts of climate change.
- At the end of the group meeting, distribute Postcard #6 in preparation for your next scheduled meeting.

Community Exploration: 10 minutes

- Explorers learn more about an Antarctic scientist.
- Lead a discussion on the causes and impacts of climate change and pollution in your community.
- Help students brainstorm ways to make a positive change.

Objectives

Explorers will:

- Create, read, and analyze line graphs;
- Practice asking scientific questions; and
- Ask questions and explore the connection between sea ice, penguins, and climate change.

Data Skills

- Consider how two attributes might relate to each other in the context of the dataset (e.g. one influences another, but not the other way around) (7th-8th grade)
- Grasp the structure of and read information from pictographs, box plots, histograms, dot plots (1 dimensional), bar charts, pie charts, line graphs and/or maps. (6th)

SCAN FOR FACILITATOR RESOURCES AND WEB LINKS FOR MEETING 5.

SCAN FOR PRE-MEETING POSTCARD FOR SELF-GUIDED YOUTH EXPLORATION.

- Recognize that the colors in a graph or map represent attribute values or categories, not actual colors (7th-8th)
- Create graphs and scale axes using interactive technology (6th)
- Put suitable attributes on the axes for a given question (7th-8th)
- Compare and contrast data values represented in a graph (e.g. more than, less than) (3rd-5th)
- Describe features or patterns of graphs and maps that say something about a stated question or prediction (6th)
- Make a conjecture or write a claim based on patterns in data (6th)

Materials

- Access to internet and CODAP; ideally enough laptops to allow Explorers to work in pairs
- Copies of the CODAP booklet and/or checklist

ACTIVITY 1: DATA STORY RECAP

(2 minutes)

1. Explorers have completed the "Penguin Populations Over Time" data story, where they used the online data interactive to manipulate historical penguin population data.
2. They also answered the questions online and recorded questions they still have about penguin populations in their Research Journals.
3. Have an Explorer volunteer summarize what they did and what they learned.
4. Ask another volunteer what a breeding pair is.

Review CODAP tutorials to prepare for the club meeting:

- CODAP Penguin Activity Introduction
- How to use CODAP to analyze penguin data
- CODAP Fixes and Hints

In many cases, there is more than one way to look at something. Also, when you look at something more than once, you can better understand and ask questions about it. Today we are going to create our own graphs of the penguin population data to really explore the population changes.

ACTIVITY 2: EXPLORE PENGUIN POPULATION DATA USING CODAP

(33 minutes)

Explorers will build graphs of the penguin population data in CODAP and practice their graphing and sense-making skills.

1. Either distribute the CODAP guide or checklist that came with this kit or have Explorers download them.

2. Have Explorers work in paris on laptops, and ask them to open up the "Penguin Populations" activity webpage (https://polar-ice.org/penguin-populations).Periodically check for understanding to make sure everyone is getting through the booklet and taking time to answer the questions. Pause at these points in the CODAP guide to check in with students
    - Page 4: How many Chinstrap penguins were counted in 1984? *Answer: 200 Chinstrap penguins in 1984.*
    - Page 8: Does everyone have a graph that looks like the one on the page? *Confirm everyone is progressing with the activity.*
    - Page 10: Was everyone able to create that graph? What do you notice about the axes? Why do you think that might be helpful? *Answer: The new axis for the Adélie penguins has much larger numbers than the axis for Gentoo and Chinstrap penguins. Separating the species helps us see what is happening to each penguin species better because measuring Gentoo and Chinstrap on an axis in the 1,000s alludes to relatively constant populations.*
    - Page 13: Was everyone able to add in lines? *Confirm everyone is progressing with the activity.*
    - Page 15: What is happening to each penguin and why do you think so? *This is the most important part of the exercise: Adélie Decreases; Gentoo Increases; Chinstrap Steady.* Ask Explorers to fill in this information on page 21 of their Research Journals.
    - Pages 16-18 are optional if there is time. It is a challenge to create a different graph with the same data to see that there are many ways to visualize data. *Both graphs should remain consistent.*

CODAP Troubleshooting and Common Questions

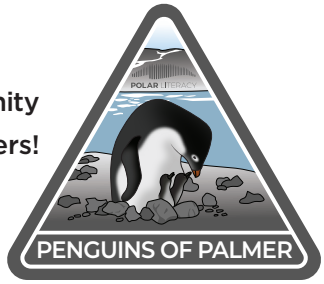
1. We don't recommend using CODAP on cell phones and tablets due to their small screens.
2. Occasionally there are issues with loading CODAP in some browsers. Type or paste the URL in the search bar. If your Explorer clicks the link and no graph or table is present, instruct them to:
    a. Click the "Tables" icon in the top left corner of the screen, then choose the "Palmer Data" option from the dropdown to display the chart.
    b. Click on the "Graph" icon in the top left corner of the screen to display the graph.
3. CODAP line colors: The colors do not have to match those in the booklet; the lines just have to show the correct trends.
4. Adding lines to the graph: Sometimes there is a glitch in adding lines for all the penguin populations. This can be fixed by unchecking the connecting lines box, clicking in the graph box but not on a line or data point, and then repeating the step. Sometimes refreshing the page and remaking the graph is the only option.
5. Adding penguin data to the graph: On pages 7 and 8 of the CODAP guide, the instruction is to add another penguin species to the Y-axis. If the Explorer drags the second penguin to the Y-axis, it will automatically replace the penguin species that is already there. To *add* the penguin (and not replace), the user must drag the second (and third) penguin species to the top of the graph.
6. Saving in CODAP: Since you do not make an account to save progress, every time the user exits and reenters the link, they must start over. Encourage Explorers to take screenshots of their progress.

Extension Activity: Penguin Behavior

Explorers can learn more about where and how penguins feed by participating in this interactive and physical game. Note: This game requires a lot of space.

1. Explorers will act out foraging patterns of Adélie penguins and then analyze their data. Students brainstorm what factors could influence the locations of penguin foraging.
2. Students can relate this to where they get food—and how far they are willing to travel to get what they want and need.
3. Watch this video to learn more about food hotspots in the ocean and how they compare to the ways we get food from farms to cities.

Conclude your club meeting by passing out Postcard #6 and introducing the "Community Exploration." Don't forget to share the "Penguins of Palmer" badge with your Explorers!



COMMUNITY EXPLORATION

(10 minutes)

For this meeting's "Community Exploration," we will learn more about scientist Dr. Ben Van Mooy, who studies ocean chemistry and the molecules that plankton create. Plankton and other marine life are threatened by climate change and pollution. We can help these ocean creatures by reusing stuff! Reducing the amount of trash in landfills and nature is important. Garbage causes risks to animals on land and in the ocean. Imagine a world without garbage on the sides of roads, in the ocean, or on hiking trails. One way to help achieve this goal is to reuse products we already have. Your local challenge is to visit a thrift store the next time you need to buy something.

- Meet Dr. Ben Van Mooy

CLIMATE CONNECTION

Reuse

The more we can reuse items in our lives the better! You can get creative with ways to repurpose items you might typically throw away.

- **Use old candle jars as drinking glasses, flower vases, or storage containers.**
- **You can use parts of plastic bottles, containers, paper plates, CDs, etc., to make art such as decorations, jewelry, wind chimes, and instruments.**
- **Use unneeded printouts for scrap paper for other things, such as grocery store lists or more artwork.**
- **Use old shirts as cleaning rags, old windows as picture frames, or magazines as wrapping paper.**
- **When possible, donate your old items to thrift stores.**

CLUB MEETING 6

Questionland

Preparing for Exploration: 5 minutes

- Explorers complete the online activities, plus pages 22–23 of the Research Journal.

Club Exploration: 35 minutes

- The focus of this meeting is to learn to ask good questions.
- At the end of the group meeting, distribute Postcard #7 in preparation for your next scheduled meeting.

Community Exploration: 10 minutes

- Explorers learn more about an Antarctic scientist.
- Lead a discussion on the causes and impacts of climate change in your community.
- Help students brainstorm ways to make a positive change.

Objectives

Explorers will:

- Practice asking scientific questions using the question formulation technique (QFT); and
- Learn about the connection between sea ice, penguins, and climate change.

Data Skills

- Pursue questions to investigate with the available resources (7th-8th grade)
- Describe features or patterns of graphs and maps that say something about a stated question or prediction (6th)

Materials

- Flipchart paper
- Tape
- Sticky notes

SCAN FOR FACILITATOR RESOURCES AND WEB LINKS FOR MEETING 6.

SCAN FOR PRE-MEETING POSTCARD FOR SELF-GUIDED YOUTH EXPLORATION

ACTIVITY 1: ASKING QUESTIONS

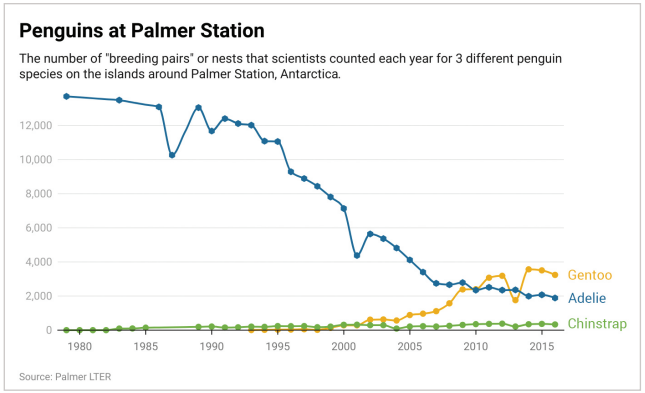
(5 minutes)

1. Explorers have completed the asking questions activity on page 22 in their Research Journals. They should come to the meeting prepared with a list of questions about the data.
2. If members of your group have not completed this, set a timer for three minutes and have them complete it at the beginning of the club meeting.

It is time for Questionland! This week's meeting is really important. We will review what we have learned about Dr. Cimino's data and what is happening with the penguins at Palmer Station. To save the penguins and complete our creative project, called a Data Jam, we first need to ask some questions and prioritize which ones we want to pursue. There are no bad questions in Questionland. This is all about asking whatever comes to mind.

ACTIVITY 2: WELCOME TO QUESTIONLAND!

(25 minutes)



1. Share an image of the penguin population graph with the club.
2. Give your Explorers three minutes to look through the lists of questions they made before the club meeting.
3. Tape flipchart paper on the wall and have Explorers write their questions on sticky notes and place them on the flipchart paper.
4. Explorers will review the questions as a group. Ask them to find at least one to label "C" for closed-ended and at least one to label "O" for open-ended. *Note: Closed-ended questions can be answered with "yes" or "no" or with one word; open-ended questions require an explanation and cannot be answered with just "yes," "no," or one word.*
5. Lead the students in a discussion of some of the advantages and disadvantages of asking each type of question.
6. Ask Explorers the following.

   What do you notice about the group's questions? Do you see any themes or groups of questions surfacing?

   - Read through all the questions posted and choose three you might want to research further. Why did you select these three questions?
   - If you were going to try to answer your three priority questions, what are some possible next steps for investigation and further exploration?
   - Share your ideas for the next step related to (a specific priority question).

In previous pilot programs, we have noticed some common question themes emerge—around prey or food sources, predators, habitat changes, illness, and impacts of climate change—as possible reasons for the historical decrease in the Adélie population and increase in the Gentoo population.

ACTIVITY 3: CHECK IN WITH DR. CIMINO

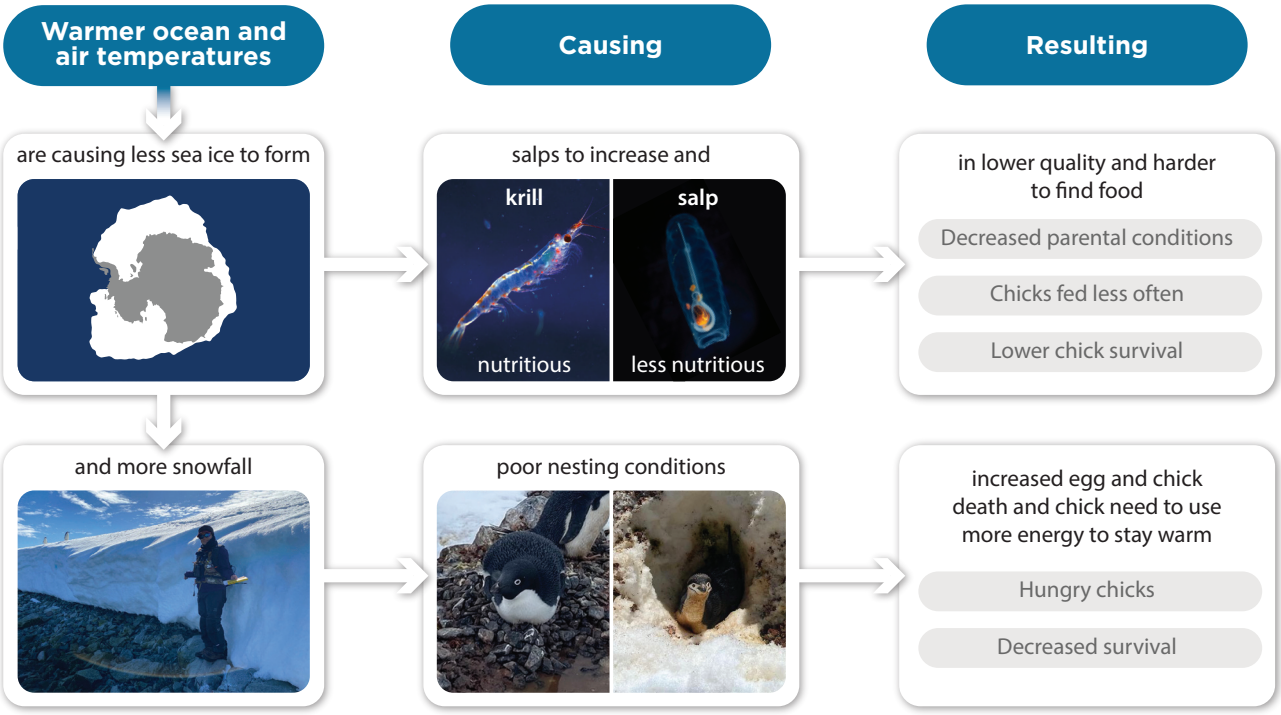
(10 minutes)

1. Play the call-to-action video for the group and remind Explorers that Dr. Cimino's research is focused on:
   - Landscape, or the amount of ice coverage;
   - Ocean conditions, including temperature and salinity; and
   - Amount of prey (krill, salps, and fish) available.
2. Ask the group what they think might be the reason for the Adélie population decrease, Gentoo population increase, and no change in the Chinstrap population. Encourage a group discussion.

Dr. Cimino's team's current hypotheses are related to less ice and increased amounts of snow/precipitation. We don't expect your Explorers to fully understand the complexities. What is important is that we inspire students to hypothesize and learn how to ask scientific questions. The diagram below shows some of the hypotheses that the team is actively researching. You can use this to help answer questions Explorers may have.

Krill are small marine crustaceans that are a "keystone," or main, source of food for many larger animals. Antarctic krill make up an estimated biomass of around 379,000,000 tonnes, more than half of which is eaten by whales, seals, penguins, seabirds, squid, and fish each year.

Salps are tubular, gelatinous animals found most abundantly in the Southern Ocean (near Antarctica), where they sometimes form enormous swarms in deep water.



Conclude your club meeting by passing out Postcard #7 and introducing the "Community Exploration." Don't forget to share the "Questionland" badge with your Explorers!

COMMUNITY EXPLORATION

(10 minutes)

For this meeting's "Community Exploration," we will learn more about Antarctic scientist Dr. Oscar Schofield, who studies primary producers in the ocean—plankton! His team of scientists studies the Antarctic food web. Most of us use grocery stores to get our food, but that means our food can come from very far away. One way we can help reduce climate change impacts in Antarctica and around the world is by reducing food miles. On average, it is estimated that food travels up to 1,500 miles to get from the farm where it is grown or raised to our homes. But what are some of the environmental impacts that transporting food has on our earth? If you're thinking about pollution and global warming, you're correct. The greenhouse gasses caused from transporting our food by plane, train, truck, and boat have a negative effect on our environment. So what are some ways you can reduce our carbon footprint and protect the earth? Your local challenge is to visit a farmers market next time you need groceries.

- Meet Dr. Oscar Schofield

CLIMATE CONNECTION

Reduce Food Miles

Food takes a lot of energy to grow and transport. It is estimated that food travels up to 1,500 miles from farms to our homes. This adds to climate change and pollution issues.

- Get food that doesn't travel too far—one great way is to grow your own food.
- Encourage your family to buy from local farmers markets or farms near you when possible.
- Look at your food labels and choose food produced locally.
- Avoid buying excess food you may not eat. Throwing away food is wasting the food and all the energy that was used to grow, package, store, and transport it.

CLUB MEETING 7

Exploring Ice as Habitat

Preparing for Exploration: 15 minutes

- Explorers complete the online activities, plus pages 24–27 of the Research Journal.

Club Exploration: 35 minutes

- The focus of the meeting is understanding data trends.
- At the end of the meeting, Explorers will share their "State of the Sea Ice" projects.
- At the end of the group meeting, distribute Postcard #8 in preparation for your next scheduled meeting.

Community Exploration: 10 minutes

- Explorers learn more about an Antarctic scientist.
- Lead a discussion with Explorers on how to share what they learned about climate change with others.
- Help students brainstorm ways to make a positive change.

Objectives

Explorers will:

- Identify a data trend; and
- Discuss effects of climate change in Antarctica and on penguin habitat.

Data Skills

- Consider how two attributes might relate to each other in the context of the data set (one influences the other) (7th-8th grade)
- Grasp the structure of and read information from pictographs, box plots, histograms, dot plots (1-dimensional), bar charts, pie charts, line graphs and/or maps (6th)
- Compare and contrast data values represented in a graph (more than or less than) (3rd-5th)
- Describe features or patterns of graphs and maps that say something about a stated question or prediction (6th)

SCAN FOR FACILITATOR RESOURCES AND WEB LINKS FOR MEETING 7.

SCAN FOR PRE-MEETING POSTCARD FOR SELF-GUIDED YOUTH EXPLORATION

- Make conjecture or write a claim that is based on pattern in data (6th)
- Consider implications of results in a broader context (self, community, or broader understanding) (6th)

ACTIVITY 1: WHAT ICE ARE YOU TODAY?

(5 minutes)

1. Review with the group which type of ice is most interesting and why. This will recap the ice video they watched in preparation for the club meeting.
2. Show Explorers the "What Ice are You Today?" slide to choose one type of ice and one word to describe how they feel. Have Explorers share their words with the group.

ACTIVITY 2: "STATE" OF THE SEA ICE ON THE WESTERN ANTARCTIC PENINSULA

(30 minutes)

Sea ice is the defining feature of the Western Antarctic Peninsula and important habitat for most of the organisms living there.

1. Explorers will interpret sea ice extent data from the Western Antarctic Peninsula. These data points represent the change in the sea ice extent measured in (km^2) in the sampling area along the peninsula from 1980 to 2020.

	1980	1990	2020
Sea ice extent (km^2) for the "New Palmer Study Area" along the Western Antarctic Peninsula	176, 839 km^2	114,668 km^2	101,659 km^2

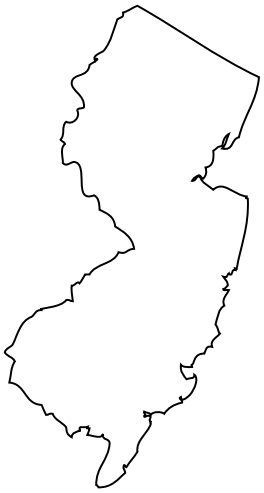
2. Ask Explorers to describe the data using the following questions.
   - What is the pattern in the data or the data trend? *The sea ice appears to be declining during these 20 years.*
   - What would it look like to visualize this table? Can you make a bar graph? What would you put on the Y-axis (time or ice extent)? What would you put on the X-axis (time or ice extent)? *Time (year) is on the X-axis and sea ice extent (km^2) is on the Y-axis.*
   - Summarize the data trend in a sentence or two. *We have lost approximately 62 km^2 of sea ice from 1980 to 1990 and 75 km^2 of sea ice from 1980 to 2020.*
   - How could we compare this trend to make it easier to understand? *Discuss with your Explorers. Encourage them to come up with analogies, such as how many football fields they think that is.*

abc

Sea ice extent is the total area of ocean inside the detected "sea ice edge." To detect sea ice, scientists use satellites with passive microwave sensors that can see through darkness and clouds and distinguish sea ice from open water based on its very different microwave signal. This allows scientists to track the daily changes in sea ice, even during months of polar darkness or heavy cloud cover.

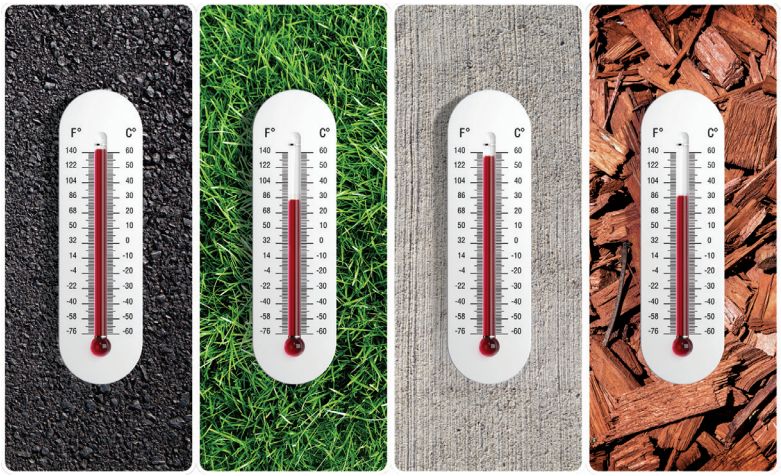
Now that we found a data trend, we need to come up with an interesting way to express it. Let your creative energy flow! Can you create an art project that communicates the trend?

3. Ask Explorers to represent the ice loss by comparing it to the area of a U.S. state. For example, New Jersey (NJ) is about 22,590 km^2. How much of NJ would represent the loss of ice?
   - *1908-2020 the Western Antarctic Peninsula has lost 175,839 – 101,659 = 74,180 km^2 of sea ice extent*
   - *If NJ is 22,590 km^2 in total, that is 74,180 ÷ 22,590 = 3.3 areas the size of NJ!*
   - *Choose another state and represent the area of sea ice loss:*
     - ❑ Oregon
     - ❑ California
     - ❑ Delaware



Extension Activities

- Help Explorers create a video "flipbook" of decades of images of sea ice extent around Antarctica and narrate the video with a voiceover explanation of what is happening to the sea ice over time. You can also work with Explorers to develop an infographic to share the data and an explanation of the trend. See this article on changes to the sea ice extent for more information.
- Conduct a sea ice and heat experiment.
  1. In this outdoor activity, Explorers observe the differences in temperature between different surfaces: the blacktop on their street, a nearby lawn, a lightly colored concrete area, or a mulched playground.
  2. Ask Explorers to report back: *What do you observe about the different surfaces? Which surface(s) feel warmer? Why do you think so?*
  3. Take it one step further with the Sea Ice and Heat: A Vicious Cycle activity from the University Corporation for Atmospheric Research (UCAR). Explorers make a simple model using satellite imagery that shows how the percentage of sea ice cover vs. open water impacts temperature.



Conclude your club meeting by passing out Postcard #8 and introducing the "Community Exploration." Don't forget to share the "Exploring Ice" badge with your Explorers!

COMMUNITY EXPLORATION

(10 minutes)

For this meeting's "Community Exploration," we will learn more about Antarctic scientist Dr. Sharon Stammerjohn. She studies ice at Palmer Station and how it is melting. When sunlight directly hits snow and sea ice, approximately 90 percent of it is reflected back into space. As global warming causes more snow, sea ice, and glacial ice to melt each summer, the dark-colored ocean underneath the sea ice is exposed, as is the darker ground under snow or glacial ice. Just as in your street or school parking lot, the dark color pavement absorbs more incoming solar radiation, reflecting less back out to space. In Antarctica, melting snow and ice causes more warming and so more snow and ice melts—a vicious cycle of melting. We can help, just like Dr. Stammerjohn and the rest of the scientists, by continuing to learn. Your local challenge is to keep learning!

- Meet Dr. Sharon Stammerjohn

CLIMATE CONNECTION

Keep Learning

The best thing you can do is better educate yourself on the scientific research about climate change, have an open mind, and keep learning so you can be a responsible citizen and continue to make good decisions. Explain the problem in your own words.

1. **Create a message—tell people why they should care about it.**
2. **Explain an innovative idea you have to solve the problem.**
3. **Think about how your idea can help restore the health of our planet.**

CLUB MEETING 8

Communicating Science with a Data Jam

Preparing for Exploration: 15 minutes

- Explorers learn about Data Jams and the creative ways to visualize data.
- Explorers complete the online activities before the first club meeting in pages 28-31 of the Research Journal.

Club Exploration: 35 minutes

- The focus of the meeting is creating (a) Data Jam(s).
- Explorers will learn about ratios and proportions.
- At the end of your club meeting, decide how to share your Data Jam(s) with others.

Community Exploration: 10 minutes

- Discuss with Explorers how to share what they learned about climate change with others.
- Submit your Explorers Data Jam(s) to local community events (4-H fairs, school events) to teach younger youth about climate change.

Objectives

Explorers will:

- Understand ratios and proportions;
- Develop a Data Jam; and
- Create a climate change-focused community project.

Data Skills

- Describe features or patterns of graphs and maps that say something about a stated question or prediction (6th grade)
- Make a conjecture or write a claim that is based on pattern in data (6th)
- Consider implications of results in a broader context (self, community, or broader understanding) (6th)
- Communicate findings in informal oral, written, visual, or kinesthetic presentation to peers (6th)

SCAN FOR FACILITATOR RESOURCES AND WEB LINKS FOR MEETING 8.

SCAN FOR PRE-MEETING POSTCARD FOR SELF-GUIDED YOUTH EXPLORATION

Materials

- Penguin paper cutouts
- Supplies to decorate penguins (markers, crayons, glitter glue, etc.)
- Large mural made of billboard paper
- Glue or tape

ACTIVITY 1: DATA JAM PREPARATIONS

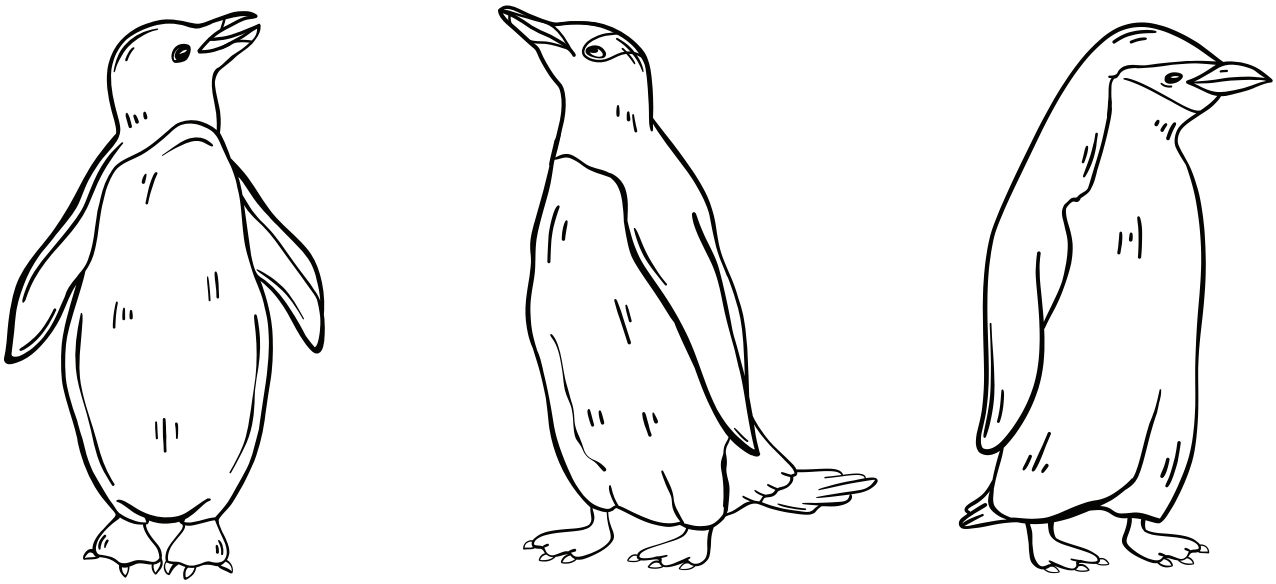
(5 minutes)

1. Explorers watched videos to introduce the idea of a Data Jam and should have started thinking about ways to share their creation.
2. Have a volunteer summarize the parts of a Data Jam and some ideas they had.
3. As a final SEL check-in, show Explorers the "What Animal are You Today?" slide. Ask them to choose one type of animal and one word to describe how they feel today.
4. Have Explorers share their words with the group.

ACTIVITY 2: CREATE A GROUP DATA JAM!

(30 minutes)

Explorers will work together to create a large mural project explaining the historical change in the penguin populations at Palmer Station.



1. Review what a Data Jam is and how we create a Data Jam. *A Data Jam is a creative expression of our understanding of the trend we see in the data. It is important to help people, including our family and friends, understand the importance of the data and how we can use it to help understand the impacts of climate change. Your mission is to develop your own creative and artistic interpretation of the data trend to present to your community.*
2. Explain how to represent the large numbers and volume of penguin data using ratios. *Since we don't want to create a literal display of 11,000 breeding pairs of penguins, we need to come up with an accurate way to show the change over time in the penguin populations. We need to develop a ratio.*

If you remember, a few sessions ago, we used M&Ms to count and compare smaller and larger "populations" by comparing the number of colors found in individual bags and collectively as a group. We could immediately see the differences between the smaller "populations" found in individual bags vs. the collective "population." When scientists are counting the numbers of individuals in a population and comparing populations, they will sometimes use ratios and proportions to make the comparisons.

A **ratio** is used to compare the quantities of two different categories, such as the ratio of Adélie penguins to Gentoo penguins. Adélie and Gentoo are the two different categories being compared.

A **proportion** is a statement of equality between two ratios. A ratio could be represented as a written statement, a fraction or two values separated by a colon. Proportions help us establish equivalent ratios and solve for unknown quantities.

3. Explain that the mural will creatively represent the change over time in the penguin populations in the Western Antarctic Peninsula. *As a club, you can choose to represent two years (1995 and 2015) or four years (1995, 2000, 2010, and 2015).*
4. Review the definitions of ratios and proportions. Show the "Math Snacks: Bad Date" video to further explain ratios. *Use the ratio examples to practice developing ratios with Explorers.*
5. Choose club members to volunteer a suggestion for a ratio for the mural's legend. *Why did you choose the ratio? How did you create it?*
6. Write down the suggested ratios in front of the group and have Explorers vote on which they should use to create their mural. Make sure the chosen ratio limits the number of paper penguins the group needs to create to a manageable amount.
7. Hand out the correct amount of each paper penguin species. Develop a background habitat for the penguins. It should have water, sky, ice-covered mountains, and sea ice. Make sure to illustrate declining sea ice and glaciers over time (as we learned in Club Meeting #7). After decorating the correct number of penguins for each year, have youth cut out their penguins and glue or tape them to the correct part of the mural.
8. Have Explorers display their project(s) and give a presentation. They should be prepared to explain how their project represents the penguin data and what it says about what is happening in Antarctica. They can use what they learned in the "Climate Connections" and "Local Challenge" activities to think about climate change and what we can do about it.

Extension Activity: Create Individual Data Jams!

Explorers will create individual or small group projects explaining the historical change in the penguin populations at Palmer Station.

1. Place Explorers into pairs, if applicable.
2. Have them think about their hobbies and interests again to decide what type of project they want to create. *Remind them of the Dear Data video that shows many creative ways to visualize data.*
3. Have youth decide how many years they want to represent in their project. *They should choose to represent at least two of the years in the dataset.*
4. Have youth compare their suggested proportions. Have them think about: Does one ratio make the numbers so small they are hard to compare? Does it result in whole numbers while another does not?
5. Youth may need to modify their ratio depending on the project they choose. *For example, 1 item = 100 breeding pairs; 1 inch of string = 100 breeding pairs; or they may need a color gradient where different colors represent different populations.*

COMMUNITY EXPLORATION

(10 minutes)

> For our final club meeting, we'll learn about scientist Dr. Deborah Steinburg, who studies zooplankton. A great way to get others involved in a topic you are passionate about is to get people talking about it. Tell your family and friends about what you have learned. Write letters to local politicians about organizing cleanups in your community. Share your Data Jam at events and talk to people about the importance of environmental conservation and saving the penguins from all the threats they face with climate change. Your local challenge is to find a place to show off your Data Jam.

- Meet Dr. Deborah Steinberg and learn more about her research into zooplankton with this "Antarctica Melting" video

CLIMATE CONNECTION

Take what you have learned about climate change and make a difference!

Submit your Data Jam to local community events (4-H fairs, school events) used to teach younger youth about climate change and the Long-Term Ecological Research (LTER) studies at Palmer Station.

Now that you know so much more about climate change in Antarctica, learn more about it locally.

- Volunteer for tree planting programs, river/creek cleanups, or trash pickups.
- Start a conservation club at school or in your community and cultivate climate behaviors in others. Talk about behaviors that you collectively can change without judgement. Share your personal journey of how you are changing behavior and what struggles you encountered.
- Get involved in research! For example, visit Iseechange.org, where you can document change in your local communities.
- Help people be more open to new, climate-friendly behaviors. You can learn more with the book *In This Together* by Marianne E. Krasny (2023).

Thank Explorers for joining the team. Don't forget to have them attach all of their badges to their certificate!

SUPPLEMENTAL RESOURCES

- *Data to the Rescue: Penguins Need Our Help!* website: https://polar-ice.org/data-to-the-rescue-club/
- Polar Scientist Spotlight video series: https://youtube.com/playlist?list=PLBZPYh04KhVoGfv3V8x5IGl-y3YilGbSN&si=73Ap_9-_aAJyPJmc
- Polar Scientist in the Spotlight cards: https://polar-ice.org/scientist
- "What are You Today?" Social-emotional learning (SEL) Check-in slides https://polar-ice.org/sel-slides
- CODAP Activity Videos
  - » Instructions for the M&M activity https://youtu.be/IwbydIkTio0
  - » Introduction to Penguin activity https://youtu.be/k2AMJscT1SM
  - » Instructions for the Penguin Data activity https://youtu.be/5ryuZ52yjRI
  - » CODAP Fixes and Hints https://youtu.be/iJECHFfNcqU
- Reference on SEL Techniques: "STEM Activities are Ideal for Social Emotional Learning" https://medium.com/the-foundry10-voice/stem-activities-are-ideal-for-social-emotional-learning-79b981946abf

Club Meeting #1: Let's Pack Our Bags and Go to the Poles

- SEL Check-in: What Polar Researcher are you today? https://polar-ice.org/sel-slides
- Scientist Card: Dr. Megan Cimino https://polar-ice.org/scientist/megan-cimino
- Video: Polar Location https://www.youtube.com/watch?v=8-ODzx3_s-w

Community Exploration

- Video: Dr. Chris Gardner https://www.youtube.com/watch?v=xAgXRyHmveA
- Video: Dr. Ellyn Enderlin https://www.youtube.com/watch?v=eDnyqS5PVd8
- Video: Dr. Bianca Rodriguez-Cardona https://www.youtube.com/watch?v=cP2iMyjXrjg

Club Meeting #2: Join the Team!

- • Reference: What's the Difference Between Weather and Climate? – From NOAA NCEI
  https://www.ncei.noaa.gov/news/weather-vs-climate
- Melting Glacial Ice Activity, from the Science Learning Hub
  https://www.sciencelearn.org.nz/resources/2279-melting-glacial-ice
- Video: Climate at the Poles
  https://www.youtube.com/watch?v=_ZBI0YErYFU
- Video: Polar Connections – A quick intro comparing the Arctic and Antarctic
  https://www.youtube.com/watch?v=QckWG7lN1cs

Community Exploration

- Chasing Ice – Video of a melting glacier
  https://www.youtube.com/watch?v=hC3VTgIPoGU
- Scientist Card: Dr. Michael Paul Meredith
  https://polar-ice.org/scientist/michael-paul-meredith
- Scientist Card: Dr. Carlos Moffat
  https://polar-ice.org/scientist/carlos-moffat

Club Meeting #3: Dive into Data

- SEL Check-in: What Graph are you today?
  https://polar-ice.org/sel-slides
- How Do Scientists Collect and Share Data (M&M activity)
  https://polar-ice.org/how-do-scientists
- M&M CODAP Activity Instructions Video
  https://www.youtube.com/watch?v=IwbydIkTio0
- Reference on SEL Techniques: "STEM Activities are Ideal for Social Emotional Learning"
  https://medium.com/the-foundry10-voice/stem-activities-are-ideal-for-social-emotional-learning-79b981946abf

Community Exploration

- Dear Data project
  http://www.dear-data.com/theproject
- Scientist Card: Dr. Scott Doney
  https://polar-ice.org/scientist/scott-doney

Club Meeting #4: Penguins Need Our Help!

- SEL Check-in: What Penguin are you today?
  https://polar-ice.org/sel-slides
- Video: Circulation at the Poles
  https://www.youtube.com/watch?v=u6g1vYicVIk

- Saltwater vs. Freshwater Melting Activity, from NASA Earth Observatory
  https://earthobservatory.nasa.gov/blogs/eokids/wp-content/uploads/sites/6/2020/03/25_Sea-Ice_508.pdf
- Penguin Habitat Map Investigation
  https://polar-ice.org/penguin-habitat-maps

Extensions

- Penguin Dichotomous Key
  https://polar-ice.org/wp-content/uploads/2023/09/Penguin-Dichotomous-Key.pdf
- Penguin Party Activity
  https://polar-ice.org/wp-content/uploads/2023/09/Penguin-Party-Activity.pdf

Community Exploration

- Palmer Station Webcams
  https://www.usap.gov/videoclipsandmaps/palwebcam.cfm
- Scientist Card: Dr. Ari Friedlaender
  https://polar-ice.org/scientist/ari-friedlaender

Club Meeting #5: Penguins of Palmer

- CODAP Penguin Activity Introduction Video
  https://www.youtube.com/watch?v=k2AMJscT1SM
- CODAP "Penguin Population" Guide
  https://polar-ice.org/wp-content/uploads/2022/11/CODAP-Graphing-Guide_070821_FULL-GUIDE_Chronological.pdf
- CODAP "Penguin Population" Checklist
  https://polar-ice.org/wp-content/uploads/2022/11/CODAP-Checklist-.pdf
- CODAP "Penguin Population" Activity webpage
  https://polar-ice.org/penguin-populations
- Optional Video: How to use CODAP to analyze penguin data
  https://www.youtube.com/watch?v=5ryuZ52yjRI
- Optional Video: CODAP Fixes and Hints
  https://www.youtube.com/watch?v=iJECHFfNcqU

Extensions

- Penguin Foraging Game
  https://polar-ice.org/wp-content/uploads/2020/12/L3-Converge-Penguins-Foraging.pdf
- Video: Food hotspots in the ocean
  https://youtu.be/G0g_g-oGLMA

Community Exploration

- Scientist Card: Dr. Ben Van Mooy
  https://polar-ice.org/scientist/ben-van-mooy

Club Meeting #6: Questionland

- Penguin Population Graph
  https://polar-ice.org/penguin-graph
- Video: Dr. Megan Cimino's "Call to Action"
  https://www.youtube.com/watch?v=C40EHZQP0c4

Community Exploration

- Scientist Card: Dr. Oscar Schofield
  https://polar-ice.org/scientist/oscar-schofield

Club Meeting #7: Exploring Ice as Habitat

- SEL Check-in: What Ice are you today?
  https://polar-ice.org/sel-slides

Extensions

- "Antarctic sea ice extent sets a new record low." National Snow & Ice Data Center, February 14, 2023.
  https://nsidc.org/arcticseaicenews/2023/02/antarctic-sea-ice-extent-sets-a-new-record-low
- "Sea Ice and Heat: A Vicious Cycle" from UCAR
  https://scied.ucar.edu/learning-zone/climate-change-impacts/sea-ice-and-heat-vicious-cycle

Community Exploration

- Scientist Card: Dr. Sharon Stammerjohn
  https://polar-ice.org/scientist/sharon-stammerjohn

Club Meeting #8: Communicate Science with a Data Jam

- SEL Check-in: What Animal are you today?
  https://polar-ice.org/sel-slides
- Penguin coloring pages, for use in a creative mural
  https://polar-ice.org/penguin-cutouts
- Video: "Math Snacks: Bad Date" – A good overview of ratios
  https://www.youtube.com/watch?v=BZ1M01YBKhk

Community Exploration

- Scientist Card: Dr. Deborah Steinberg
  https://polar-ice.org/scientist/deborah-steinberg/
- Video: "Antarctica Melting – Act 2: A small world after all" – Learn how Dr. Steinberg's team researches krill in Antarctica
  https://www.youtube.com/watch?v=Q52FI3ASnrM

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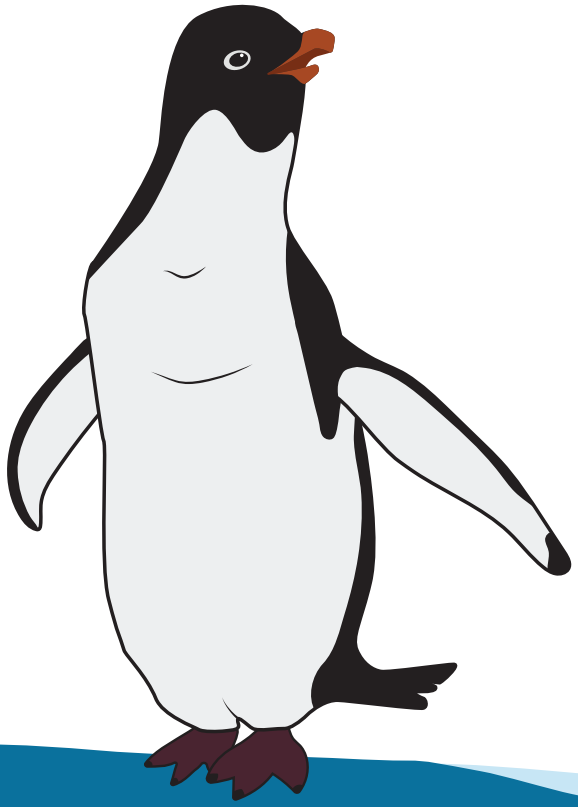

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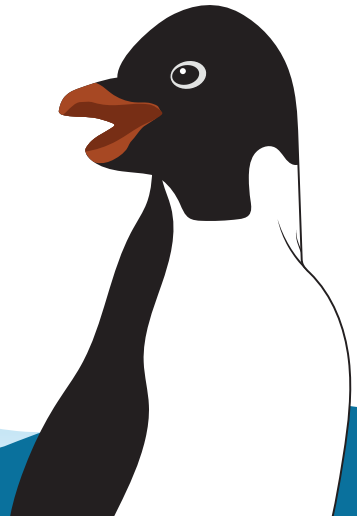

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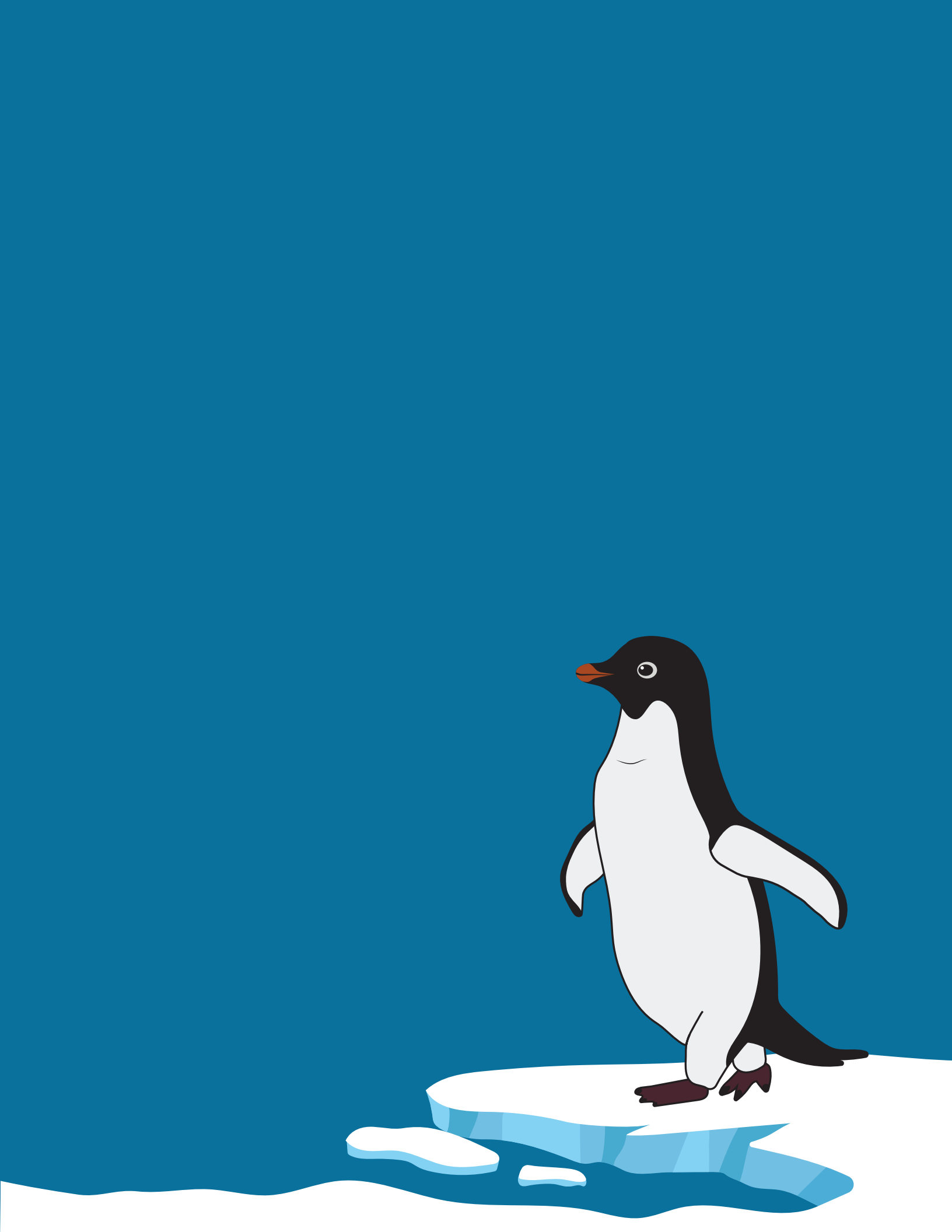
NOTES

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