Welcome to Data to the Rescue:
PENGUINS NEED OUR HELP!

RESEARCH JOURNAL

RUTGERS THE STATE UNIVERSITY OF NEW JERSEY

POLAR LITERACY

NSF

Why do penguins need our help?

Most of us have not been lucky enough to have a direct experience with a penguin. Maybe you have been fortunate to visit an aquarium or zoo where you have seen penguins in person.

In this STEM Club we are going to focus on penguins that live in the Southern Hemisphere in Antarctica. Although far away and hard to get to, the Polar Regions (north and south poles) are facing big changes due to climate change. Climate change is occurring at a faster rate in the Polar Regions compared to other areas of the earth. As a result, many habitats are changing and causing scientists to be concerned.

Scientists are learning more about the Polar Regions every day. The data they collect can help us better understand the environmental shifts impacting penguin species in the region.

In this program, you will have an opportunity to explore your interest in STEM by studying Antarctica. You will join the science team, learn more about penguins, and take action to help fight climate change.

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.

CONTENTS

CLUB MEETING 1

Let's Pack Our Bags and Go to the Poles

Complete all the tasks on Postcard #1 and record your notes here in the Research Journal.

Preparing for Exploration: WHAT ITEMS WILL YOU PACK?

Record the three items you packed. Remember, you should select one item for living, one science tool, and one luxury item.

Tools for Science

Items for Living

Luxury and Mental Wellness

Explain why you are packing these three items.

Preparing for Exploration: TOOLS FOR RESEARCH

Which video did you pick? Why?

Describe how the scientist uses that tool to conduct their research.

Club Exploration: TOOLS FOR RESEARCH

What questions does your group have about Antarctica?

Community Exploration: CLIMATE CONNECTION

Our research mission is focused on understanding climate change in Antarctica and the impacts on the animals that live there.

You can be a role model for climate-friendly behaviors. We encourage you to consider these ideas and share with your family and friends.

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.**

YOUR LOCAL CHALLENGE:

Create a list of ways you and your family can start saving energy.

CLUB MEETING 2

Join the Team!

Complete all the tasks on Postcard #2 and record your notes here in the Research Journal.

Preparing for Exploration: LEARN ABOUT THE TEAM

Congratulations, you have now completed your training! You packed your bags with the important tools you need and have practiced your data skills. Before we depart, there is one last thing to do: learn about your team! No one is good at everything, so it is important to evaluate your own strengths and weaknesses to better work with others. The Save the Penguins team has a lot of jobs so there is a place for everyone!

Fill out this chart to share some things about you.

Pick three words or phrases that describe you!

- ❑ Problem solver
- ❑ Good at explaining things to others
- ❑ Impulsive
- ❑ Creative
- ❑ Team player
- ❑ Patient
- ❑ Logical
- ❑ Likes routine
- ❑ Pays attention to details
- ❑ Focuses on the big picture
- ❑ Adventurous
- ❑ Analytical
- ❑ Good at asking questions
- ❑ Collaborative
- ❑ Curious
- ❑ Risk taker
- ❑ Good at communicating
- ❑ Leader
- ❑ Organized
- ❑ Adaptable
- ❑ Good listener

What is something you are proud of?

What do you enjoy doing?

Pick one word or phrase from the list that you DID NOT choose that you would like to get better at.

Club Exploration: CREATING THE TEAM

Look at the jobs needed on the penguin team. Answer the questions in this chart and share with your fellow researchers in your next meeting.

Saving penguins takes a big team with a lot of jobs:

- Measure penguins
- Catch krill (penguin prey)
- Write about the data
- Use microscopes to analyze samples
- Work with satellites to understand ice
- Weigh penguins
- Collect water to get a better idea of habitat conditions
- Use drones to find penguin colonies
- Analyze data
- Use underwater robots to study habitat
- Count penguins
- Teach others why saving penguins is important
- Manage and organize the lab
- Captain a boat

Think about your skills, what is important to you, and what you enjoy. Which two jobs do you think you would be best at?

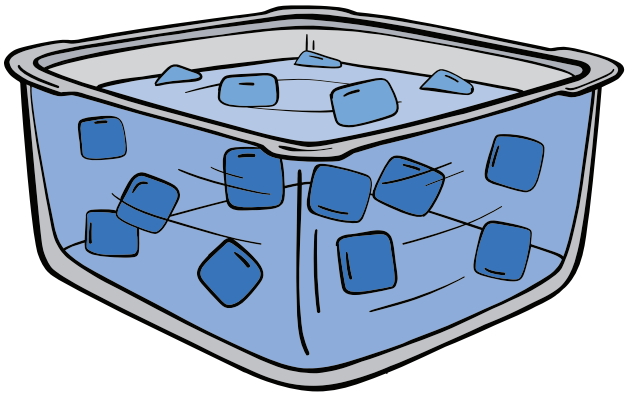
1. _____

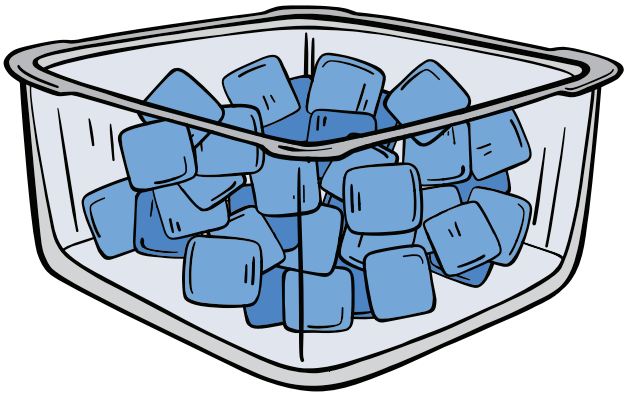
2. _____

Which job would help you practice the skill you want to get better at?

Talk to other Explorers in the group. What skills do they have? What is important to them? What do they enjoy? Which jobs will they be good at?

Club Exploration:
MELTING GLACIAL ICE





What contributes to sea level rise?

What difference does contact with water make to ice cubes in the container?

Community Exploration: CLIMATE CONNECTION

Our research mission is focused on understanding climate change globally. We must do our part to avoid the serious consequences of climate change. Think about adopting these practices and share with your family and friends.

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.**

YOUR LOCAL CHALLENGE:

Start a garden, look into volunteering with a community garden, or talk to your school about creating one.

Congratulations!

You have earned your FIRST badge.

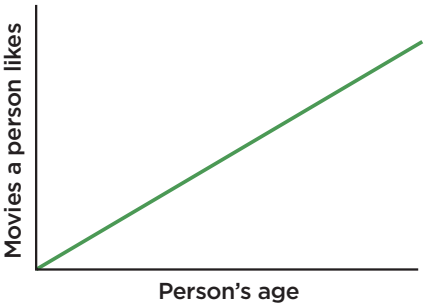
CLUB MEETING 3

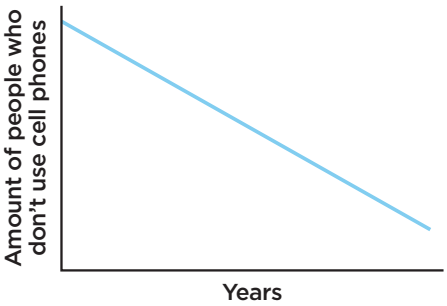
Dive into Data

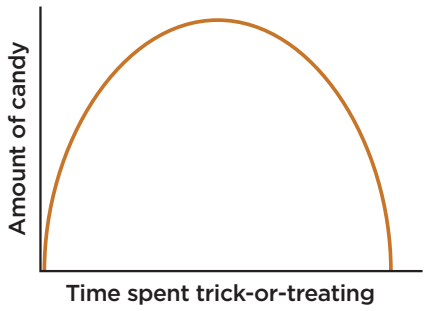
Complete all the tasks on Postcard #3 and record your notes here in the Research Journal.

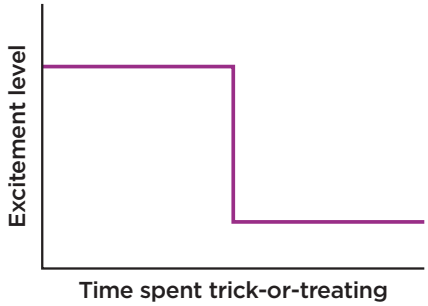
Preparing for Exploration: CARD GAME

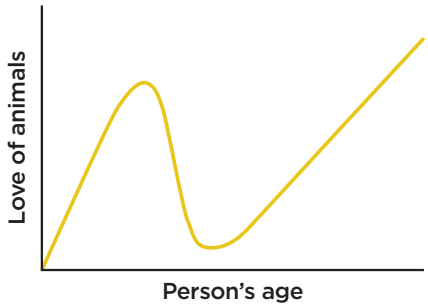
Did you play the virtual card game? If so, what funny stories did you come up with to describe these graphs? Write them down here to share with your research club team members. Funniest story wins!



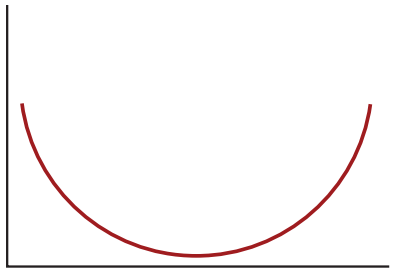








Club Exploration: CREATE A UNIQUE GRAPH



Make up your own axes and story!

Club Exploration:
M&MS AS DATA WORKSHEET

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

If you have a snack size bag of M&Ms, record your M&M data in this chart.

M&M Tally

Sort and place your M&Ms in a vertical line in the corresponding color column.

Red	Orange	Yellow	Green	Blue	Brown
TOTAL	TOTAL	TOTAL	TOTAL	TOTAL	TOTAL

What do you think causes differences in numbers of M&M colors from one bag to another?

If you were going to continue, what other questions would you have?

Community Exploration: CLIMATE CONNECTION

Don't forget: You can help fight climate change. Here are some more things you can do.

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.

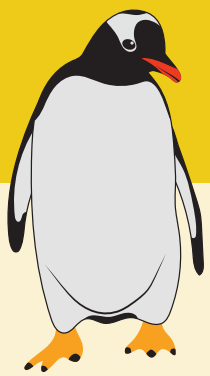
- **Turn off the water when you brush your teeth, shave, and while putting soap on your hands.**
- **Don't take long showers.**
- **Water plants with cooled, unsalted cooking water.**

YOUR LOCAL CHALLENGE:

Talk to your family and friends about saving water.

Congratulations!

You have earned your SECOND badge.



CLUB MEETING 4

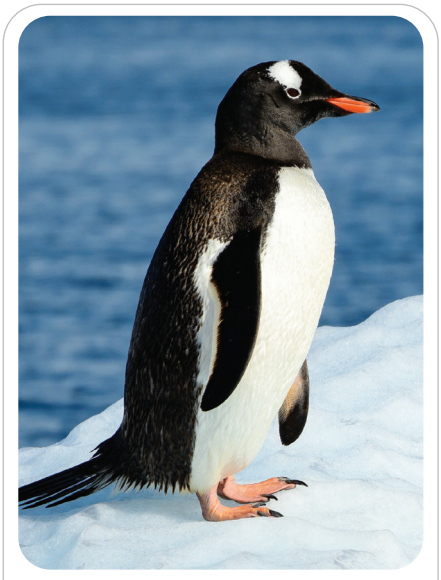
Penguins Need Our Help!

Complete all the tasks on Postcard #4 and record your notes here in the Research Journal.

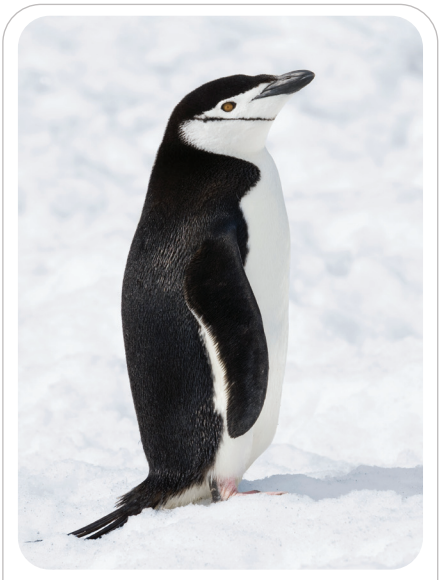
Preparing for Exploration: PENGUIN IDENTIFICATION

Summarize what you learned about our study subject...penguins! You can interpret the graphs and maps and answer the questions. Summarize your thoughts below.

What penguin species is this?



What penguin species is this?



What penguin species is this?

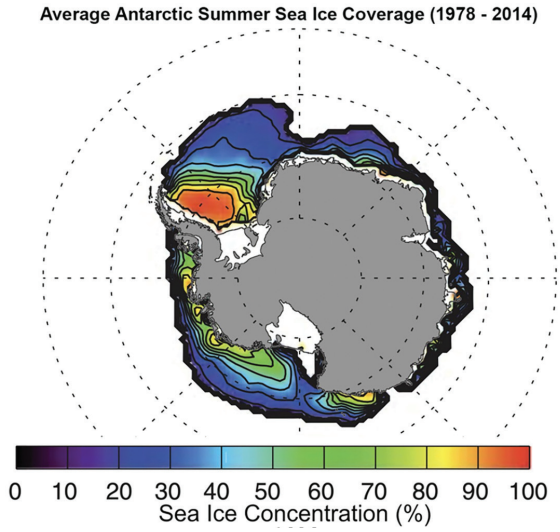
Which species is your favorite? Why?

Club Exploration: MAKING AND MELTING ICE

What was the difference between the frozen fresh water and salt water?

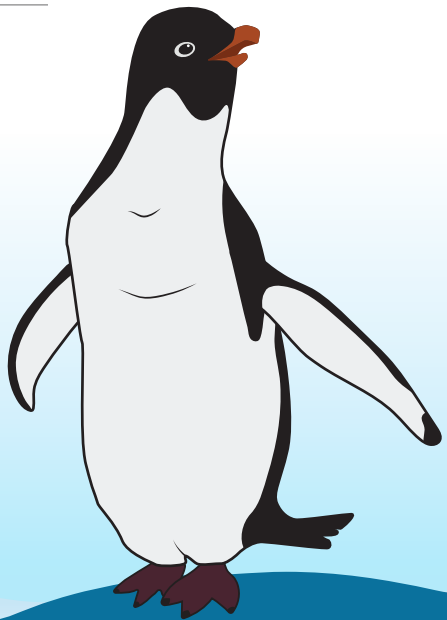
Why is this important?

Club Exploration:
PENGUIN HABITAT INVESTIGATION



What can we conclude about penguin habitat and sea ice?

What penguin relies the most on sea ice?



Community Exploration: CLIMATE CONNECTION

You have the power to make change! Every day, young people around the world are standing up and rolling up their sleeves to make change and improve the health of our planet.

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.**

YOUR LOCAL CHALLENGE:

Avoid using single-use plastics (bags, food utensils, water bottles, cups from takeout places, etc.) for one week. Encourage your family to do it, too!

Was it easy? Could you do it? Can you do it all the time?

You are halfway there to earning your third badge!

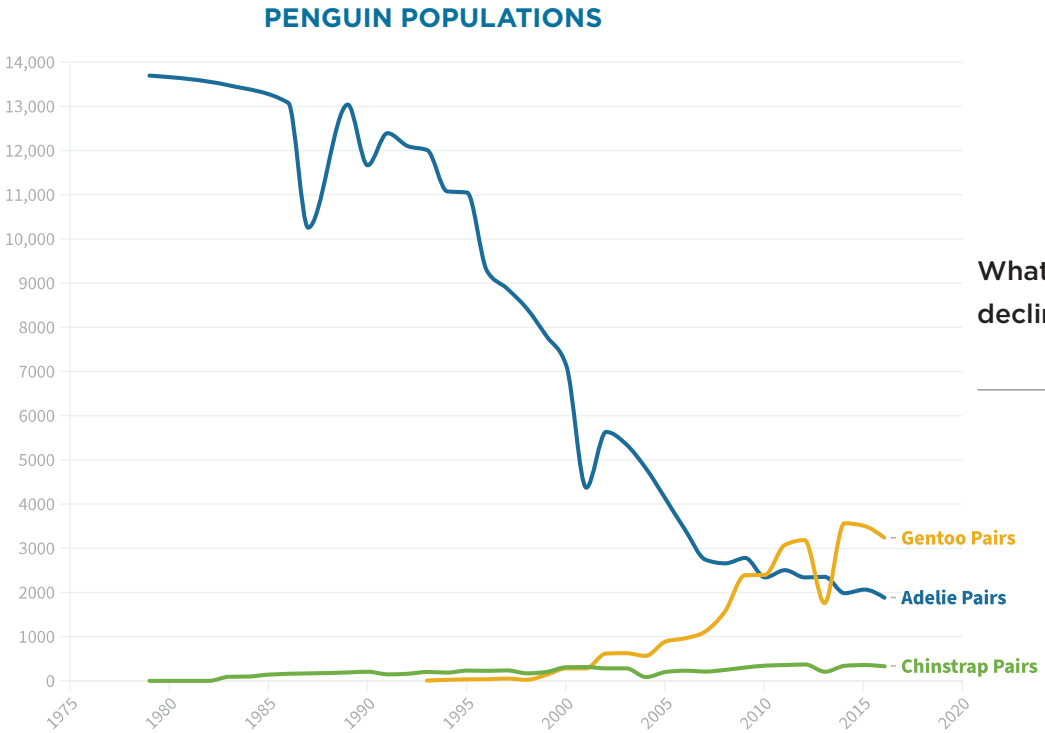
CLUB MEETING 5

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.



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.

CLUB MEETING 6

Questionland

Complete all the tasks on Postcard #6 and record your notes here in the Research Journal.

Preparing for Exploration: ASKING QUESTIONS

Whether you used Common Online Data Platform (CODAP) or reviewed the graph in the module, you now know what is happening with penguin populations around Palmer Station. Asking questions is one of the most important jobs of a scientist. Think for three minutes about the population data of the three penguin species and write your ideas/questions here.

Club Exploration: PRIORITZING QUESTIONS

What are your top three questions?

1. _____

2. _____

3. _____

Community Exploration: CLIMATE CONNECTION

Be an influencer! Help your neighbors, family, and friends understand climate change. Here are some more things you can do.

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.**

YOUR LOCAL CHALLENGE:

Look up the location of your closest farmers market. If possible do some grocery shopping there.

Congratulations!

You have earned your FOURTH badge.

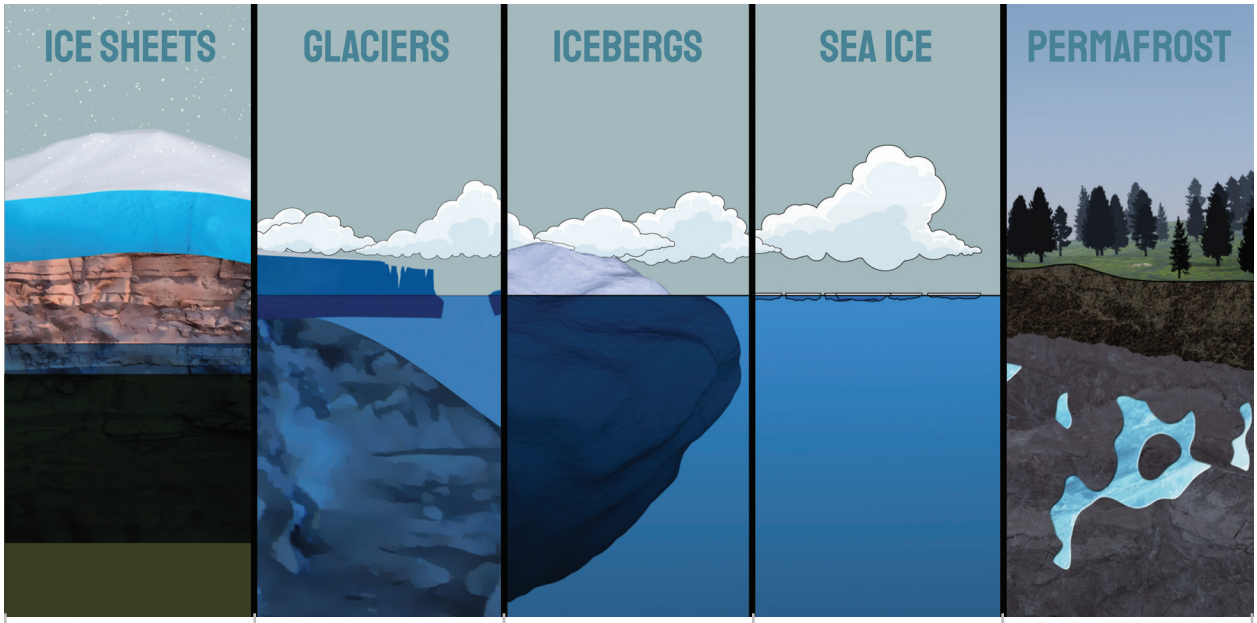
CLUB MEETING 7

Exploring Ice as Habitat

Complete all the tasks on Postcard #7 and record your notes here in the Research Journal.

Preparing for Exploration: LET'S TALK ABOUT ICE

In this club meeting, we will be talking about ice. Use the table below to write one fun fact about each type of ice to share with your club members.



Which ice form is most interesting to you? Why?

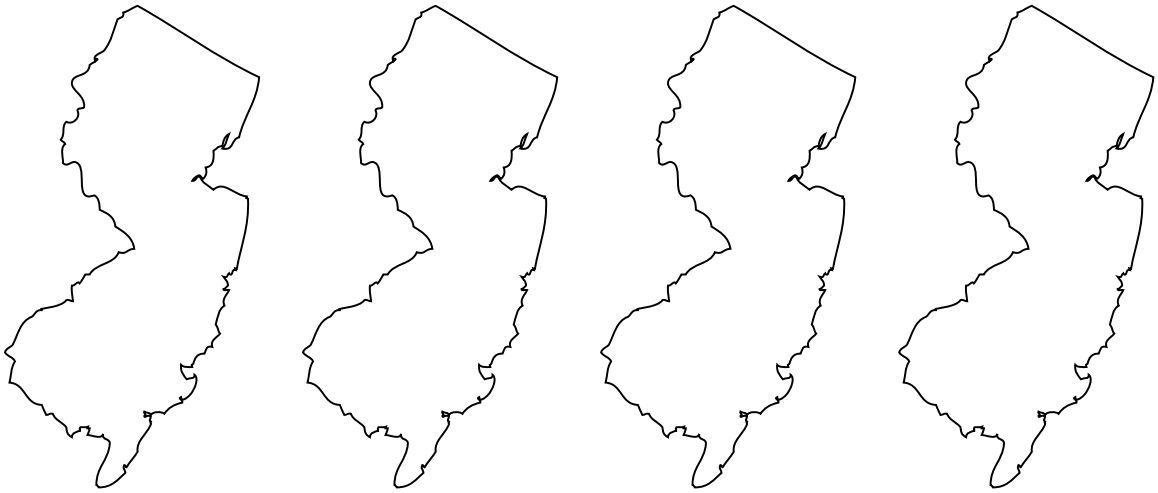
Club Exploration: "STATE" OF THE SEA ICE ON THE WESTERN ANTARCTIC PENINSULA

	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

New Jersey has an area of _____ km^2.

The sea ice extent in the Palmer Study Area along the Western Antarctic Peninsula has lost _____ km^2 between _____.

How many New Jerseys is that? Color in a representation of the amount of ice lost.



What is happening to the amount of sea ice in the Western Antarctic Peninsula? Choose one:

- ❑ It is increasing.
- ❑ It is decreasing
- ❑ It is staying the same.

Explain why you think this is happening.

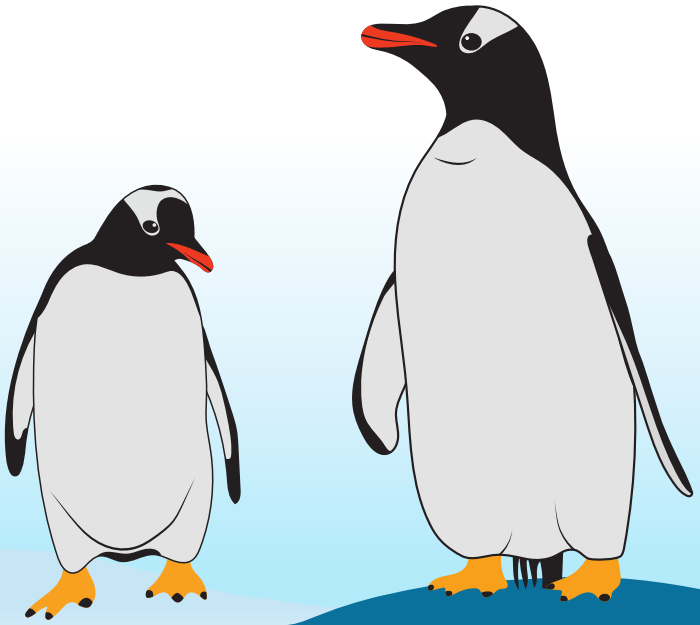
Community Exploration: CLIMATE CONNECTION

Engage your network of friends and family and discuss climate change. Scale up your discussions by reaching out to others in your community. Discuss plans for adapting and being resilient to climate change and, of course, fixing the problem for your generation and those to come.

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.**



YOUR LOCAL CHALLENGE:

Visit a local aquarium, zoo, science center, library, etc.

What did you learn?

Congratulations!

You have earned your FIFTH badge.

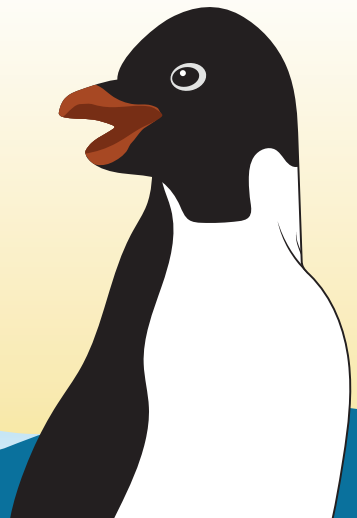
CLUB MEETING 8

Communicate Science with a Data Jam

Complete all the tasks on Postcard #8 and record your notes here in the Research Journal.

Congratulations! You have reached the most important part of the journey—it is time for you to be creative and share what you have learned. You can choose to do a Data Jam as a club or as independent club members.

Preparing for Exploration: PLAN YOUR DATA JAM



My DATA JAM Planning Sheet

For the Club Mural Project

Develop a creative and artistic interpretation of these data to present to your community. Using your creativity, communicate the trend you see in the data.

STEP 1: What datasets are you going to use for your mural (check all that apply)?

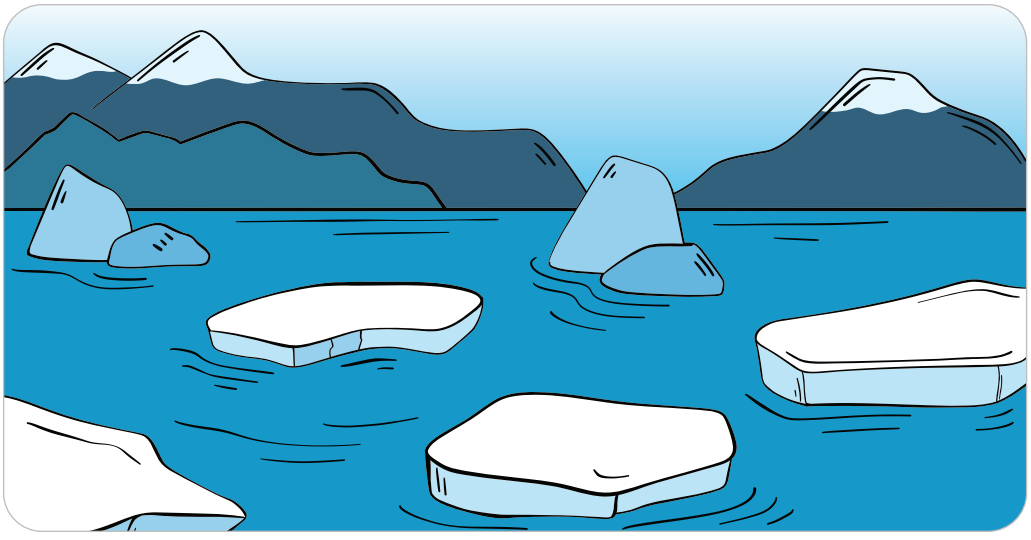
- ❑ 1995
- ❑ 2000
- ❑ 2010
- ❑ 2015

STEP 2: Determine the scale you will use to represent the data. What scale will you use to represent the numbers from the dataset?

- ❑ 1 cutout penguin = 100 breeding pairs
- ❑ 1 cutout penguin = 200 breeding pairs
- ❑ 1 cutout penguin = 300 breeding pairs

How many penguins will you need to represent this ratio? Have club members color the penguin species (Adelie, Gentoo, and Chinstrap) for each year you selected.

STEP 3: Decide which club members will design the Antarctica background. Look at a picture(s) of Antarctica and decide how you will represent the mountains, ocean, and ice cover. This will serve as the habitat to represent your penguin rookeries in the different years.



STEP 4: Design a legend so your audience can read your mural display.

STEP 5: Work together to come up with a short presentation describing what your mural is telling us about the penguins of Palmer.

My DATA JAM Planning Sheet

Individual Project

Develop your own creative and artistic interpretation of this data to present to your community. Using your creativity, communicate the trend you see in the data.

STEP 1: What datasets are you going to use for your mural (check all that apply)?

- ❑ 1995
- ❑ 2000
- ❑ 2010
- ❑ 2015

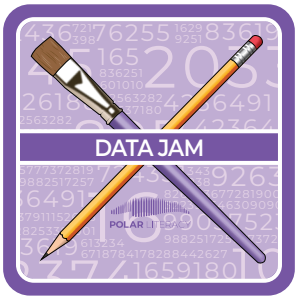
STEP 2: List your hobbies. What creative talent can you bring to your project? Do you want to:

- ❑ Write a song
- ❑ Tell a story
- ❑ Do a dance
- ❑ Create an infographic
- ❑ Make a diorama
- ❑ Create a piece of art
- ❑ Other:_____

STEP 3: Determine the scale you will use to represent the data. What scale will you use to represent the numbers from the dataset?

STEP 4: Design a legend so your audience can interpret your project.

STEP 5: Develop a short presentation describing what your project is telling us about the penguins of Palmer.



Congratulations!

You have earned your SIXTH badge.

Community Exploration: 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).

YOUR LOCAL CHALLENGE:

Plan how you are going to show off your Data Jam!

YOU DID IT!

Don't forget to attach all of your badges to your certificate to recognize your efforts.

The scientist team would love to see what you have accomplished on this exploration. Please send pictures of your Data Jams to education@marine.rutgers.edu. Thank you for joining our research team!

CONGRATULATIONS, EXPLORER

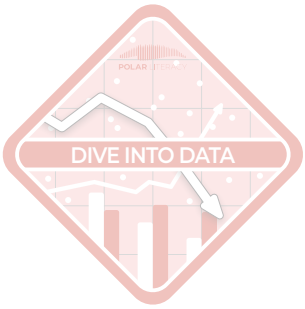
_____!

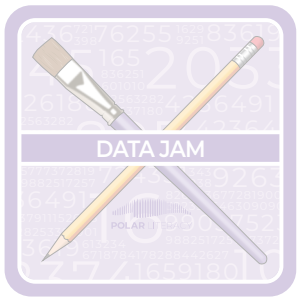
You prepared for an expedition, practiced using data, and created a unique project all to save the penguins.

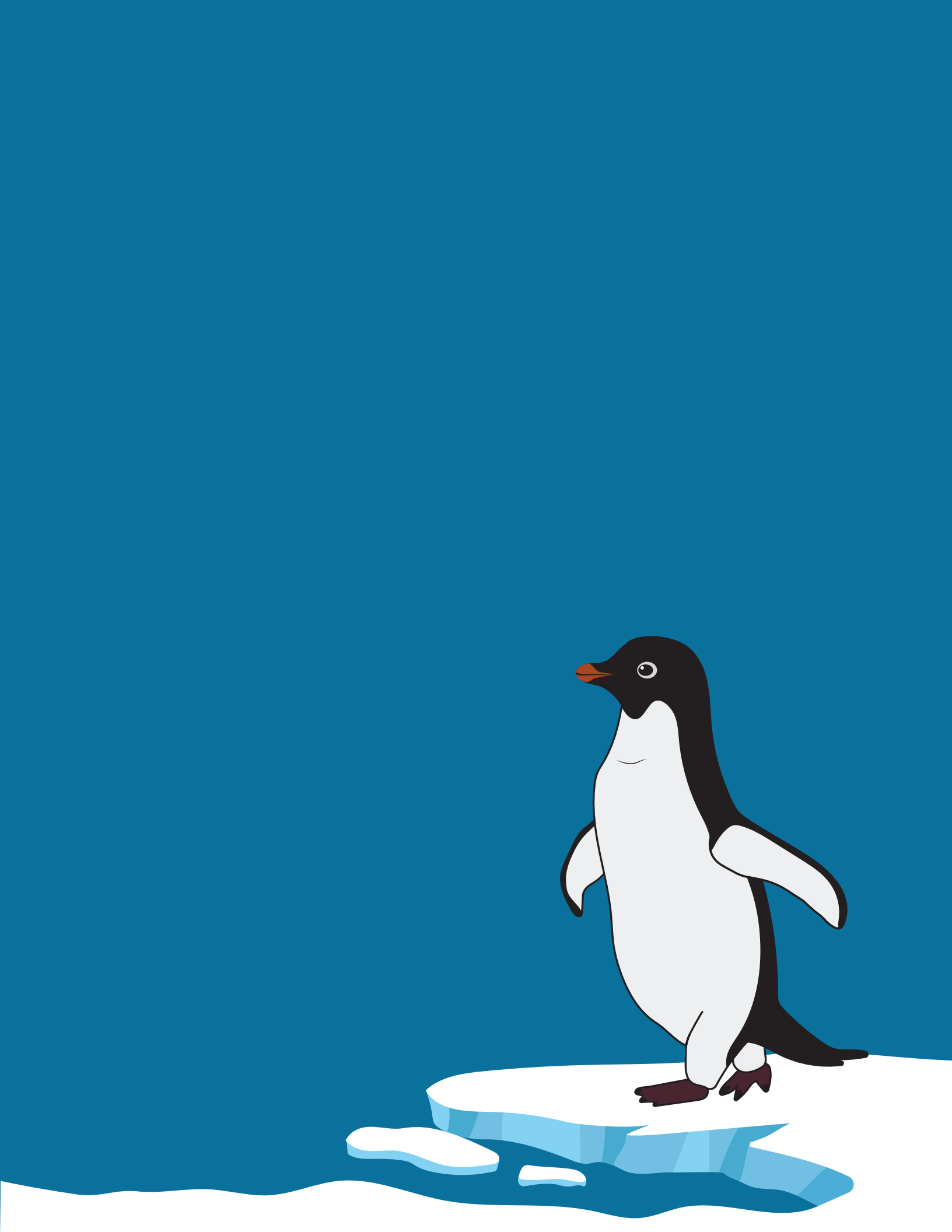
Remember your community exploration climate connections. Saving the penguins starts with making changes in your own home and community.

Everyone can work together to help the world, so keep learning and exploring!

Place your badges here.





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