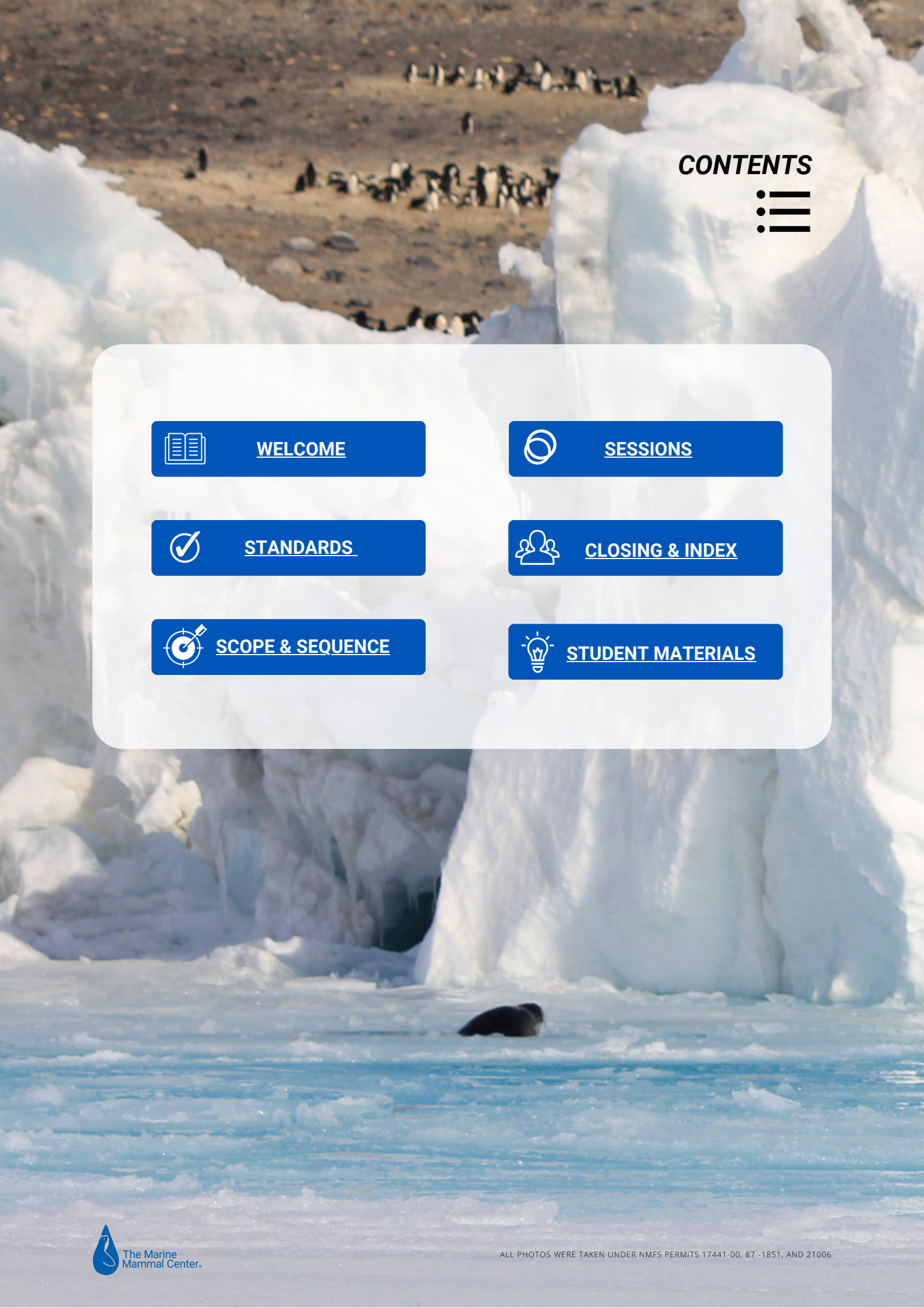
The Marine Mammal Center®

EDUCATOR GUIDE

GROWING UP ON ICE

GRADES 6 - 8



CONTENTS

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WELCOME!

The Growing Up on Ice project is a collaborative study of Weddell seal development in some of the harshest environments on our planet. In addition to partnering on the research project in Antarctica, the Growing Up on Ice research team and award-winning educators from The Marine Mammal Center have come together to translate the experiences and data from this research into a hands-on learning journey for middle school classrooms.

Each session included builds toward a common objective of discovering careers and analyzing and interpreting real data in order for students to identify how they can uniquely contribute to ocean conservation and continue learning about the ocean through questions and observations.

Just as our teams have applied learning from the study and care of marine mammals in California to better understand phenomena in Antarctica, it is our hope that students will find personal relevance and connection to this special place and the species that call it home.

PURPOSE OF GUIDE

We are excited to bring Growing Up on Ice to your classroom because of the unique lens Weddell seals can provide into critical topics such as careers, climate change, and adaptations. These animals offer an entry point for students to engage with an authentic research question and real scientific data that provide us with a window into ocean health and an otherwise largely inaccessible part of our world. The challenge of working with real data elevates student engagement and self-efficacy at a critical time when middle school youth trend toward reduced interest in scientific fields*. Students are also able to explore a variety of careers in a way that is relatable and highlights the team-based and interdisciplinary nature of scientific work. We are excited to provide access to high-quality resources to support educators to capitalize on these opportunities to connect classroom learning to real-world examples for their students.

*SOURCE: DEGENHART, S.H., ET AL, MIDDLE SCHOOL STUDENTS' ATTITUDES TOWARD PURSUING CAREERS IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH, NACTA JOURNAL, VOL. 51, NO. 1 (MARCH 2007), PP. 52-59

HOW TO USE THIS GUIDE

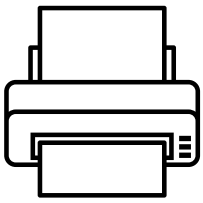
This free, comprehensive Educator Guide is designed for educators to integrate with their classroom learning and is connected with Next Generation Science Standards and Ocean Literacy Principles for learners in grades 6-8. The guide is comprised of four sessions as a unit of learning. Each session provides a warm-up, hands-on learning opportunities, and real-world data.

We recommend completing this curriculum as a unit, as each session builds upon and complements the information and resources provided. However, we also understand every classroom is different and have designed the guide with flexibility in mind such that each session is also able to stand on its own. You know your learners best, so we invite you to map these sessions to your own curriculum as appropriate while maintaining the integrity of the information provided. Please don't hesitate to reach out to us at learn@tmmc.org to share any questions or feedback. We love hearing from you and are excited to support you.

We have created this interactive PDF for you in an effort to provide easy access to all of the resources you will need with just a click. This digital version includes links directly to individual sessions through the Contents Page and to the associated resources needed in the appendix or external sources in some cases.

SESSION RUN TIME

Each session is estimated at approximately 1.5 hours, but can be extended over a longer period. We recommend budgeting at least 6 hours toward the unit.



PRINTING THIS GUIDE

When printing physical resources or if printing this educator's guide, we encourage you to consider the environment and print on recycled paper.

STUDENT MATERIALS

Easily navigate to student materials included at the end of each class session and also duplicated altogether in an appendix for easy printing or sharing.

STANDARDS

The Marine Mammal Center's mission identifies education as a significant component in advancing global ocean conservation. Ocean conservation is a complex problem requiring skillsets and knowledge of a generation to lead in creating solutions. The Next Generation Science Standards (NGSS) engage youth to participate in the conservation conversation with scientific content, mindset, and tool kit and to take action and pursue future career pathways with passion, purpose, and readiness. We envision a growing network of educators and students excited and equipped to make the standards come alive. The network will join the shared vision of a healthy ocean for marine mammals and humans alike with relevant, real-world curricula and transformative connections with teaching peers, local partners, and conservation experts. The Ocean Literacy Framework similarly promotes ocean conservation through education, and more specifically, building and mobilizing an ocean-literate society - one that understands the ocean's influence on them and their influence on the ocean. It plays a critical role of addressing the lack of ocean literacy in today's formal and informal learning environments, ranging from classrooms to museums, stemming from a lack of ocean-related content in state and national science education standards, instructional materials, and assessments.

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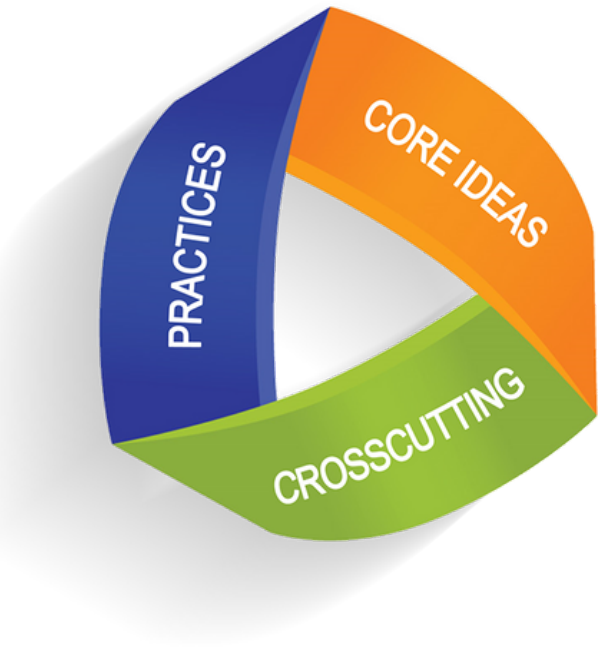
NEXT GENERATION SCIENCE STANDARDS

The sessions included in this guide have been designed in connection with Next Generation Science Standards such that they provide a real-world context to support classroom learning and conceptual understanding. Sessions support the following Disciplinary Core Ideas, Science & Engineering Practices, and Crosscutting Concepts, but alone do not achieve mastery of Performance Expectations. We have identified the following essential standards (listed below) that are reinforced throughout each session in complementary ways and represented most consistently. Through different approaches to curriculum mapping, connections, and emphasis, different or additional standards are also represented including many with Common Core State Standards.



DISCIPLINARY CORE IDEAS:

- *LS4.C: Adaptation*
- *ESS3.D: Global Climate Change*

SCIENCE AND ENGINEERING PRACTICES:

- *Analyzing and Interpreting Data*
- *Using Mathematics and Computational Thinking*

CROSSCUTTING CONCEPTS:

- *Patterns*
- *Structure and Function*

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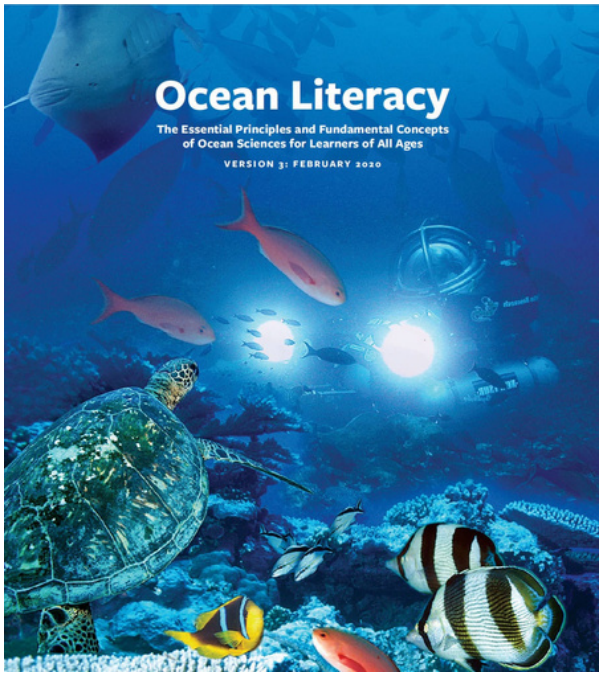
LOGO BY NEXT GENERATION SCIENCE STANDARDS (WWW.NEXTGENSCIENCE.ORG)

OCEAN LITERACY PRINCIPLES

Ocean Literacy means understanding the ocean's influence on you and your influence on the ocean. There are seven principles of Ocean Literacy, each with their own corresponding fundamental principles — ideas scientists and educators agree everyone should understand about the ocean. The Ocean Literacy Campaign is a collaboration of hundreds of educators and scientists to create a more ocean literate society. The Ocean Literacy Framework serves as a roadmap for educators to build robust learning experiences for K-12 students centered around ocean science. Growing Up on Ice references these principles and concepts as one guiding resource for curriculum development. As with the Next Generation Science Standards, essential principles and concepts have been identified below which are reinforced throughout each session in complementary ways and represented most consistently. Additional principles and concepts are also dependent upon how you choose to integrate these sessions with your curriculum.



Ocean Literacy Principle #7: The ocean is largely unexplored.

Fundamental Concept (f) Ocean exploration is truly interdisciplinary. It requires close collaboration among biologists, chemists, climatologists, computer programmers, engineers, geologists, meteorologists, meteorologists, physicists, animators and illustrators. And these interactions foster new ideas and new perspectives for inquiries.

IMAGE OF VERSION 3 OCEAN LITERACY BY OCEAN LITERACY (OCEANLITERACY.WP2.COEXPLORATION.ORG)

SCOPE & SEQUENCE

The *Sessions at a glance* provides a basic overview of the storyline connecting each of the sessions in this unit curriculum. Though any session can be implemented independently, we recommend the *Research Roadblocks* as an entry event and *Considering Careers* as an exit event to the other sessions to provide students with the most context and relevancy. If not implementing the full unit, we recommend matching one of the numbered sessions with the entry and exit events.

Every session in this Educator Guide will build toward the same primary standards noted above and follow a consistent structure and format broken into several components:

Expected time, Key terms, Objective, and **Overview**: These basic session details can be found in the colored boxes at the beginning of each session for easy reference.
Materials and recommended **Preparation**: These session notes appear at the beginning of each session and linked as appropriate in this digital version.
Research Roadblock: The research roadblock is constructed as a hook and introduction to sessions 1-3 as it uniquely and more specifically highlights both a day in the life of a field team and the realities of a harsh environment impacted by climate change.
Warm-Up: The Warm-Up will get students thinking and talking to set the stage for understanding the core content of each session. It may also serve as a formative assessment of students' prior knowledge and interests.
Guided Class Activity: The Guided Class Activity contains the core content of the session and will include real data from the field in sessions 1-3.
Think and Reflect: The Think and Reflect section is intended to support students in drawing conclusions about, processing and internalizing new learning.
Session Adaptations: Each session will also include suggestions to provide additional scaffolding or deeper exploration of related concepts.
Assessment: Each session will suggest an approach for assessing student learning.

Throughout each session, *italicized text will indicate prompt language* that educators can use to explain background information or scenarios including more technical details. **Key terms will be bolded and defined in parentheses** wherever they occur in the guide.

SESSIONS AT A GLANCE

RESEARCH ROADBLOCK	*SESSION* (*RECOMENDED ORDER*)	*TITLE*	*OBJECTIVE*	*OVERVIEW*
EXTREME ICE CHALLENGE Students consider the dynamics of sea ice movements and cracks that change due to climate change and how field researchers troubleshoot the problem.	***SESSION 1***	Fortifying Field Biologists	Students **explore** the role of marine field biologists, **analyze** the physical characteristics of seals, and **interpret** behavioral data.	Through the lens of a marine field biologist, students will use behavioral data sets (collected by Team B-030) to uncover the main research question throughout the Growing Up on Ice curriculum, "**How do Weddell seal pups develop the amazing dive capabilities the adults are known for?**" (Students can hypothesize an answer to this question in Session 2).
EXTREME WIND CHALLENGE Students consider the extreme wind speeds that are impacted by climate change and how field researchers work around the issue.	***SESSION 2***	Vetting Vet Scientists	Students **explore** the role of veterinary field scientists, **analyze** the dive capabilities of seals and humans, and **interpret** physiology data.	Through the lens of a veterinary scientist, students will use physiology data sets to form a hypothesis answering the main research question throughout the Growing Up on Ice curriculum, "**How do Weddell seal pups develop the amazing dive capabilities the adults are known for?**" (Students can test their hypothesis in Session 3).
EXTREME COLD CHALLENGE Students consider how Antarctica is the coldest place on Earth, despite climate change, and how field researchers mitigate the threat.	***SESSION 3***	Leading Lab Scientists	Students **explore** the role of clinical lab scientists, **analyze** oxygen-carrying capacity qualities in the blood of Weddell seals, and **interpret** biochemistry data.	Through the lens of a clinical lab scientist, students will use blood sample data (collected by Team B-030) to answer the main question throughout the Growing Up on Ice curriculum, "**How do Weddell seal pups develop the amazing dive capabilities the adults are known for?**"
	EXIT EVENT	Considering Careers	Students explore careers in marine science and compare their personal skills and interests.	Students will consider how their personal skills and interests could be applied to support ocean conservation by exploring career prospects, job responsibilities, and skills of various marine science careers and supporting roles.

RESEARCH ROADBLOCK

What is the Research Roadblock?

The Research Roadblock is designed as a brief series of opening activities to sessions 1-3 in which students will think critically about real scenarios from the field linking the data examined in each session to challenges presented by climate change impacts. The Research Roadblock will introduce students to the environmental challenges that a real Antarctic Research Team (Team B-030) experienced during their field research. Students will be asked to troubleshoot the field problem as if they were a member of Team B-030. They will work in groups representing different jobs to bring unique perspective and expertise to help troubleshoot each challenge.

Each challenge will introduce students to a change occurring in the Antarctic environment (shifts in seasonal ice formation, wind, and temperature patterns) due to climate change. As the world burns fossil fuels, like coal, oil, and methane gas, for energy and transportation, we are releasing carbon dioxide into the atmosphere. This excess carbon dioxide acts like a heat-trapping blanket around the world, warming the air, land, and ocean, and disrupting our climate.

These changes will have an enormous impact on our planet, especially Antarctica and our ocean. Weddell seals and other marine mammals serve as sentinels of the sea, providing clues to changes caused by climate change and other environmental shifts, and often serving as an early warning system to significant oceanographic changes that could impact human health. In the coming years, seal survival will depend on their ability to change behavior and adapt to their shifting environment.

Scientists must research how Weddell seals use their current environment in Antarctica to better understand the impact climate change could have on this important species. No matter where we live, we can all play a role in helping to address climate change. By taking action now to reduce our use of fossil fuels, and supporting critical science around the world, we can help protect people and animals from harm. Learn more about climate change and the ways you can help.

RESEARCH ROADBLOCK

Materials

- Team B-030 Portraits
- Antarctica Fact Sheet
- McMurdo Station Video
- Career Profiles

Preparation

- Team B-030 portrait, McMurdo Station Video may be projected or printed to display for the class.
- Print and prepare team portraits, fact sheet, career profiles, challenge guidelines and challenges
- Review educator resources

Warm-Up

Each Research Roadblock will follow this same set of instructions, but consider a different scenario paired with its respective session. (You may choose to begin with all of the roadblocks or match each challenge with the session you are beginning: Extreme Ice Challenge (pairs with Session 1), Extreme Wind Challenge (pairs with Session 2), Extreme Cold Challenge (pairs with Session 3).

Start by displaying the Team B-030 Portrait. Introduce Team B-030 to the class.

Prompt: Who do you think these people are? What do you think they do? What are some observations you can make about where they are? Team B-030 is a group of scientists with a passion for understanding how animals survive in the environments in which they live. They are a team of experts in seal biology (the study of living organisms), physiology (the way in which a living organism or body part functions), and veterinary care (care for the health of animals). Together, they seek to uncover the secrets of what it takes to be born in one of the harshest environments on the planet, Antarctica.

The work of Team B-030 is vital for understanding how seals and humans will adapt to climate change (As the world burns fossil fuels, like coal, oil, and methane gas, for energy and transportation, we are

Warm-Up (continued)

Prompt (continued): releasing carbon dioxide into the atmosphere. This excess carbon dioxide acts like a heat-trapping blanket around the world, warming the air, land, and ocean, and disrupting our climate).

These changes will have an enormous impact on our planet, especially Antarctica and our ocean. Weddell seals and other marine mammals serve as sentinels of the sea, providing clues to changes caused by climate change and other environmental shifts and often serving as an early warning system to significant oceanographic changes that could impact human health. In the coming years, seal survival will depend on their ability to change behavior and adapt (adjust to new conditions) to their changing environment.

Scientists must research how Weddell seals use their current environment in Antarctica in order to better understand the impact climate change could have on this important species. We'll be following the story of one Weddell seal in particular, Kit Kat.

Invite the class to watch the McMurdo Station Video to familiarize themselves with the kinds of work conducted there.

As students watch the video, they should write down what they notice about the types of equipment, facilities, and jobs that are needed to survive in Antarctica.

After the video, have the students turn to a partner and share the things they wrote down.

Next, divide your class into groups of five. Announce that they will each assume a role on Team B-030, and need to work together to navigate challenges in the field in order to safely collect critical data. Assign the recommended jobs (below) per group. It is fine if more than one student in the group has the same career field, but there should be at least three different fields represented per group.

Before reading the challenge, provide the groups a chance to prepare by discussing the unique environment detailed in the Antarctica Fact Sheet and the skills and responsibilities listed on their

Warm-Up (continued)

collective Career Profiles.

Distribute the Challenge Guidelines and challenge description for the appropriate session to each group. Read and review the challenge together as a class.

Explain that each group must listen closely to the field challenge. Not only do they need to come up with a realistic solution using the information provided in the Challenge Guidelines, but they must assign tasks to specific members on their team and coordinate their plan of action. After, ask each team to share their solution to the challenge with the rest of the class. Remind students that the goal is not to get the "right answer," but to think creatively as a team about the challenges of field work in a changing environment.

Take a few minutes to explain how Team B-030 approached the problem. Then, discuss how humans are connected to the changes happening in Antarctica and ways they can support conservation efforts. Prepare for the discussion in advance by reviewing the Educator Resources for class discussion.

RECOMMENDED JOB ASSIGNMENTS:

- **Marine Biologist**
- **Veterinary Technician**
- **Mechanical Engineer**
- **Lab Technician**
- **Field Training Officer**

CHALLENGE GUIDELINES

THINGS TO AVOID

- Frightening or injuring the Weddell seal mother and pup
- Injuring any member of your team
- Damaging your team's research equipment

THINGS TO CONSIDER

- Remember to use the unique skills and training of your team members to your advantage
- Snow can serve to insulate the ice from the air temperature, but also weighs down the ice and can hide dangerous cracks
- Exposing your skin to cold, windy weather increases your likelihood of injury caused by freezing of the skin and underlying tissues

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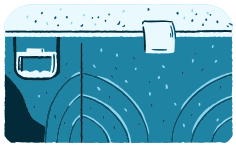
SOURCES: MAYO CLINIC (MAYOCLINIC.ORG), PHOTOS WERE TAKEN UNDER THE NMFS PERMITS 17441-00, 87 -1851, AND 21006, PHOTO OF MOTTLED PUP WITH MOM BY LINNEA PEARSON, PHOTO OF CUTE PUP BY HEATHER LIWANAG

CHALLENGE GUIDELINES

AVAILABLE EQUIPMENT

PistenBully

Large, tracked vehicle with an enclosed cab (max speed 5 mph)



Cooler

An insulated container

Heat Packs

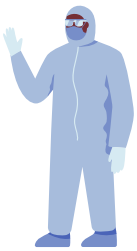
Bags containing a substance that gives off heat

Snowmobile

Small, open cab vehicle (max speed 45 mph)

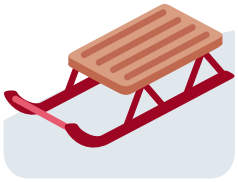
Vacutainers

Glass vacuum sealed test tubes



PPE

Personal Protective Equipment (PPE) such as snow bibs, goggles, gloves, etc.



Snow Sled

A land vehicle that can hold passengers as it slides across a surface, usually of ice or snow

Herding Boards

Protective equipment for blocking an animal's movement or view

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SOURCES: MAYO CLINIC (MAYOCLINIC.ORG)
MODIFIED PHOTO OF TOWING THE APPLE HUT BY HEATHER HARRIS
IMAGE OF VOLUNTEER WITH HERDING BOARD AT THE MARINE MAMMAL CENTER BY JULIE STEELMAN © THE MARINE MAMMAL CENTER

EXTREME ICE CHALLENGE

About 97.6 percent of Antarctica is ice that has formed over millions of years. This ice contributes 90 percent of all the world's ice and 70 percent of all the world's fresh water. Antarctica's sea ice forms, expands, and melts in the ocean. Fast ice is a specific type of ice that is attached to the coastline or shallow sea floor and does not drift with ocean currents and wind. This type of ice usually starts to grow in fall and melts away completely during the summer. In spring, Weddell seals will breed and care for their pups on the spring fast ice to avoid predators such as orcas and leopard seals. Both orcas and leopard seals have been observed in the waters around McMurdo Station in the summer, after the sea ice has broken up.

In recent years, as the world warms due to climate change, the fast ice has broken out and melted earlier. This change in the environment has provided predators access to vulnerable, young Weddell seal pups, before they can dive and forage on their own. This has also become problematic for researchers who must travel across the ice to observe and research Weddell seals in the wild. Understanding the dynamics of sea ice movements and cracks is critical when working with seals.

Today, you have arrived at your field research site with your team. Two seals have been spotted nearly one mile away from your field research site. You will have to come up with a plan to safely navigate across the fast ice with your team to observe a Weddell seal mother and her pup. **How will you safely navigate across the ice to observe the two seals? What will you do if you encounter a crack in the ice, with no way around it?**

PHOTOS WERE TAKEN UNDER THE NMFS PERMITS 17441-00, 87 -1851, AND 21006

EXTREME WIND CHALLENGE

Antarctica is the windiest place on earth. Wind speeds in Antarctica can reach up to 218 mph. (In the United States, daily wind speeds typically average between 6 and 12 miles per hour.) Weddell seals are well insulated from the cold, even in these extreme, windy conditions! Pups often rest downwind from their moms to stay warm.

Researchers can use Apple huts (large field shelters) to move themselves and seals out of the wind to perform successful body measurements and muscle and blood sampling in less-than-ideal weather. But not all field sites have Apple huts available or nearby. Sometimes researchers have to get creative with their people and equipment to find a solution.

In order to collect this data set, your team will need to safely and briefly capture a Weddell seal pup named Kit Kat. However, her mother is also nearby. Kit Kat is a spirited pup, who earned her name because she doesn't give researchers a break! She likes to climb on her mom, and she tends to hang out close to the sea ice cracks. Your research permits require that this work is done as efficiently as possible to minimize disturbance to the animals and maintain the safety of the research team and animals at all times. **How will you safely distract the mother and capture the pup for sample collection? How do you plan to protect your team and equipment from the extreme winds during this process?**

PHOTOS WERE TAKEN UNDER THE NMFS PERMITS 17441-00, 87 -1851, AND 21006
PHOTO OF FLUFFY PUP BY EMMA WEITZNER

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EXTREME COLD CHALLENGE

Despite rising temperatures due to climate change, Antarctica is the coldest place on Earth. Winter temperatures range from −128.6°F on the high inland ice sheet to −76°F near sea level. (32°F is considered freezing.) Weddell seals are particularly equipped to handle below freezing temperatures thanks to their blubber (fat) and thick fur coats. On the other hand, the extreme cold is a difficult place for researchers to live comfortably and conduct their research. Research equipment can easily malfunction in the cold, and in weather below -4°F (which is not uncommon) syringes will instantly freeze and crack if not handled properly.

McMurdo Station serves as a logistics hub for the U.S. Antarctic Program and is the safest location to complete sample analysis indoors and out of the cold. The station not only has labs onsite, but unlike the spring fast ice that pups are on, the station is built on secure bare volcanic rock.

Today, your team must transport the Weddell seal blood and tissue samples back to the lab for analysis. But to do that, you must travel across the sea ice and protect your team against the extreme cold. **What will you use to safely warm, support, and protect samples and your team as you travel across the ice? How will you ensure that your samples will not freeze or crack from the cold or rough icy terrain?**

PHOTOS WERE TAKEN UNDER THE NMFS PERMITS 17441-00, 87 -1851, AND 21006
PHOTO OF MACARONI NURSING BY LINNEA PEARSON

EDUCATOR RESOURCE

Research Roadblock Challenge: Extreme Ice Challenge

Question presented to students in challenge: *How will you safely navigate across the ice to observe the two seals? What will you do if you encounter a crack in the ice with no way around it?*

Team B-030's solution: "We dug through the snow to examine the ice cracks more closely. We learned how to profile the cracks by accurately measuring their width and drilling down through the ice to measure the depth to the water; this allowed us to determine whether it was safe to cross over them with vehicles of various sizes." - Heather Liwanag, Ph.D. Team B-030 Principal Investigator

Guiding questions and resources for connecting with climate:
How does climate change affect Antarctica and how does Antarctica affect climate change?

- How does sea ice affect global climate?

EDUCATOR RESOURCE

Research Roadblock Challenge: Extreme Wind Challenge

Question presented to students in challenge: *How will you safely distract the mother and capture the pup for sample collection? How do you plan to protect your team and equipment from the extreme winds during this process?*

Team B-030's solution: "We used herding boards to gently separate the mom and pup. At Hutton Cliffs where there were catabatic winds (cold, strong winds caused by dense air moving downhill due to gravity), we ended up bringing the pups into the Apple (hut) for their workups. Someone stayed with mom to make sure she stayed in the area during our procedures. We also used the PistenBully (large, tracked vehicle) as a wind block on some days, because we did not have a shelter at one of our field sites (Big Razorback Island)." - Heather Liwanag, Ph.D. Team B-030 Principal Investigator

Additional Info: (click on link for more information):
The Weigh Pups Grow

Guiding questions and resources for connecting with climate:
How do winds and currents contribute to climate change?

- The current around Antarctica is speeding up because of climate change
- The reason Antarctica is melting: shifting wind patterns, driven by global warming

EDUCATOR RESOURCE

Research Roadblock Challenge: Extreme Cold Challenge

Question presented to students in challenge: *What will you use to safely warm, support and protect samples and your team across the ice? How will you ensure that your samples will not freeze or crack from the cold or rough icy terrain?*

Team B-030's solution: "To transport blood samples, we would place the vacutainers in a cooler with some heat packs. When we were ready to head back to the lab, we needed to keep the blood from freezing before getting to the lab. If we traveled in the PistenBully, we could keep the blood in the cooler because the PistenBully had an enclosed cab that protected people (and samples) from the wind. This was helpful for preventing samples from freezing, but the PistenBully can only travel at a maximum of 5 mph. That meant a long commute (1.5 to 2 hours) back to the lab. If we traveled back by snowmobile, which was much faster, the blood processing team would often put some of the bags of vacutainers into their snow bibs to keep them warm for the journey. We had to process the blood the same day, so the blood processing team would try to get back to the lab ASAP and get the samples processed before dinner." - Heather Liwanag, Ph.D. Team B-030 Principal Investigator

Guiding questions and resources for connecting with climate:

How do we take action on climate change?

- How you can help protect Antarctica
- A global challenge for ocean health

TEAM B-030

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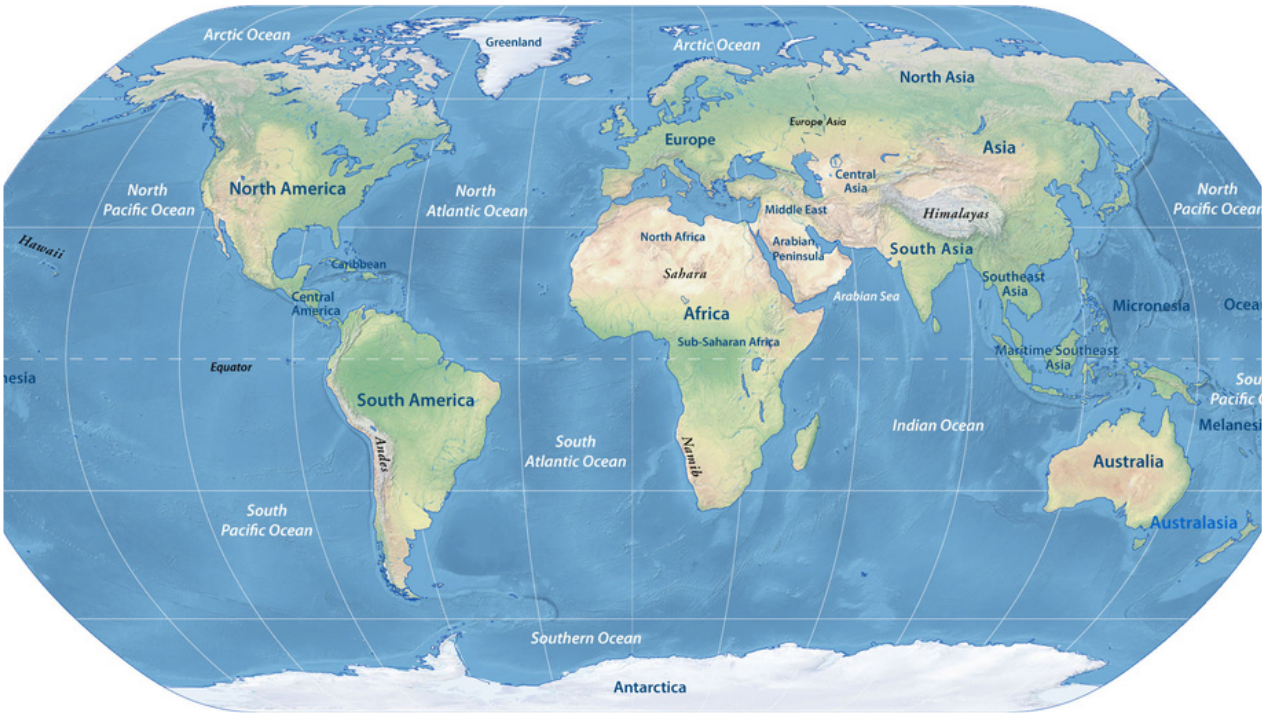
PHOTOS WERE TAKEN UNDER THE NMFS PERMITS 17441-00, 87 -1851, AND 21006
PHOTO OF MCMURDO STATION BY HEATHER LIWANAG

ANTARCTICA FACT SHEET



ENVIRONMENTAL CONDITIONS

EXTREME ICE

About 97.6 percent of Antarctica is ice that has formed over millions of years. This ice contributes 90 percent of all the world's ice and 70 percent of all the world's fresh water.

EXTREME WIND

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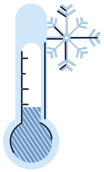
EXTREME COLD



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SOURCES: NATIONAL SCIENCE FOUNDATION (WWW.NSF.GOV), DISCOVERING ANTARCTICA (WWW.DISCOVERINGANTARCTICA.ORG.UK), AND BRITANNICA (WWW.BRITANNICA.COM), TOPOGRAPHIC MAP BY NATIONS ONLINE PROJECT (WWW.NATIONSONLINE.ORG)

FIELD BIOLOGIST

CAREER PROFILE

Description

Field biologists study living organisms such as plants and animals in their natural environments by observing the behavior of animals and the relationship they have to their environment. Their work often includes developing research studies, collecting and analyzing scientific data, and publishing research to communicate their findings.

Desired Skills

- can notice slight changes in people or the environment
- use logic and reason to draw conclusions
- can endure extended periods of time in harsh or isolated environments
- enjoy working with a small team

Work Environment

Most work takes place in the field with a team, making scientific observations and collecting samples. However, occasional trips to McMurdo Station are needed to deliver and further analyze specimens.

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PHOTOS WERE TAKEN UNDER THE NMFS PERMITS 17441-00, 87 -1851, AND 21006
PHOTO OF RETURNING RECOVERING PUP BY HEATHER LIWANAG

FIELD BIOLOGIST

CAREER PROFILE

Field biologists hold a degree in subjects such as:

- Marine biology
- Plant biology
- Animal behavior
- Ecology
- Evolutionary biology
- Neurobiology
- Molecular biology

Possible Job Titles	**Recommended Schooling/Experience**
Student Researcher	No college degree is needed, but prior experience in laboratories and performing research while earning a college degree is required
Research Assistant	Associate degree (2 years of college) acceptable, but bachelor's degree (4 years of college) is preferred
Marine Biologists	Bachelor's degree (4 years of college) acceptable, but master's degree (6+ years of college) is preferred
Principal Investigator	Bachelor's degree (4 years of college) and master's degree (6+ years of college) acceptable, but doctoral degree (3+ years of study) is preferred

VETERINARY SCIENTIST

CAREER PROFILE

Description

Veterinary scientists conduct research on animal medicine and animal health conditions. This often includes caring for animals hands-on, developing research studies, collecting and analyzing scientific data, and publishing research to communicate their findings.

Desired Skills

- experience working with animals
- can notice slight changes in animal behavior or the environment
- use logic and reason to draw conclusions
- can endure extended periods of time in harsh or isolated environments
- enjoy working with a small team

Work Environment

Most work takes place in the field with a team, making scientific observations and collecting samples. However, occasional trips to McMurdo Station are needed to deliver and further analyze specimens.

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VETERINARY SCIENTIST

CAREER PROFILE

Veterinary scientists hold a degree or certification in subjects such as:

- Biology
- Zoology
- Animal science
- Veterinary science
- Veterinary medicine
- Veterinary medicine and surgery

Possible Job Titles	Recommended Schooling/Experience
Animal Care and Service Worker	No college degree is needed but prior experience volunteering or working with animals is preferred
Veterinary Assistant	No college degree is needed but an associate degree (2 years of college) is preferred
Veterinary Technician	Associate degree (2 years of college) acceptable, but bachelor's degree (4 years of college) is preferred
Veterinarian	Bachelor's degree (4 years of college) and veterinary school (4 additional years of specialized training)

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ENGINEER

CAREER PROFILE

Description

Engineers support researchers through installing and maintaining research equipment that is needed to carry out research safely and accurately. This often includes tools that scientists will use for the collection and analysis of scientific data, such as technology, mechanical equipment, transport vehicles, housing, and more!

Desired Skills

- ability to creatively solve problems
- enjoy learning how to use modern technologies
- great attention to detail
- can work independently and with others
- willingness to follow strict safety guidelines

Work Environment

Most work takes place at McMurdo Station with a team, but there may be occasional trips out to the field to support scientists as they live and work in the field observing, collecting, and delivering specimens to McMurdo Station.

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ENGINEER

CAREER PROFILE

Engineers hold a degree or certification in subjects such as:

- Biomedical engineering
- Chemical engineering
- Computer engineering
- Electrical engineering
- Health and safety engineering
- Industrial engineering
- Mechanical engineering

Possible Job Titles	**Recommended Schooling/Experience**
Mechanic	Trade school or associate degree (2 years of college) is required
Engineer	Associate degree (2 years of college) is required, but bachelor's degree (4 years of college) is preferred
Engineering Coordinator	Bachelor's degree (4 years of college) is acceptable, but master's degree (6+ years of college) is preferred
Engineering Supervisor	Bachelor's degree (4 years of college) is acceptable, but master's degree (6+ years of college) is preferred

CLINICAL LAB SCIENTIST

CAREER PROFILE

Description

Following strict health and safety procedures, clinical lab scientists collect samples and perform tests using technical equipment to analyze hazardous chemicals, body fluids and tissue, biological waste, and other substances.

Desired Skills

- enjoy working hands-on when solving puzzles and problems
- great attention to detail
- capable of working on several projects at once
- can work independently and with others
- willingness to follow strict safety guidelines

Work Environment

Most work takes place in a laboratory at McMurdo Station with a team, but there may be occasional trips out to the field to collect or deliver specimens or to take measurements.

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CLINICAL LAB SCIENTIST

CAREER PROFILE

Clinical lab scientists hold a degree in subjects such as:

- Biology
- Biomedical science
- Biotechnology
- Chemistry
- Environmental science
- Forensic science
- Pharmacology
- Physics

Possible Job Titles	**Recommended Schooling/Experience**
Assistant Lab Technician	No college degree is needed but an associate degree (2 years of college) is preferred
Lab Technician	Bachelor's degree (4 years of college) is acceptable
Lead Lab Technician	Bachelor's degree (4 years of college) is acceptable
Laboratory Manager	Bachelor's degree (4 years of college) is acceptable, but master's degree (6+ years of college) is preferred

STATION SUPPORT

CAREER PROFILE

Description

There is an extensive support network of support behind all research that occurs in Antarctica from the food teams eat to the equipment they use to the safety training and policies they participate in.

Desired Skills

- ability to creatively solve problems
- great attention to detail
- can work independently and with others
- can endure extended periods of time in harsh or isolated environments
- willingness to uphold strict safety guidelines and take responsibility for the safety of others

Work Environment

Most work takes place at McMurdo Station with a team, but there may be occasional trips out to the field to support scientists as they live and work in the field observing, collecting, and delivering specimens to McMurdo Station.

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STATION SUPPORT

CAREER PROFILE

Individuals who support scientific research hold a degree or certification in subjects such as:

- Outdoor education
- Adult education
- Wilderness first aid
- Incident command structure
- Leadership

Possible Job Titles	Recommended Schooling/Experience
Station Leader	No college degree is needed but an associate degree (2 years of college) or bachelor's degree (4 years of college) is preferred
Station Supply Officer	No college degree is needed but an associate degree (2 years of college) or specialized training is preferred
Watercraft Operator	No college degree is needed but an associate degree (2 years of college) or specialized training is preferred
Field Training Officer	No college degree is needed but a bachelor's degree (4 years of college) is preferred and wilderness first aid certifications are required

FORTIFYING FIELD BIOLOGISTS

Expected time: 1hr 30 min

Key terms: Scientific method, observations, adapt, adaptations, scientific observation, field biologist, Time-Depth Recorder (TDR), prior research

Objective

Students will **explore** the role of marine field biologists, **analyze** the physical characteristics of seals, and **interpret** behavioral data.

Overview

Through the lens of a marine field biologist, students will use behavioral data sets (collected by Team B-030) to uncover the main research question throughout the Growing Up on Ice curriculum, "**How do Weddell seal pups develop the amazing dive capabilities the adults are known for?"** (Students can hypothesize an answer to this question in Session 2).

Materials

- Scientific Method Infographic
- Antarctica Fact Sheet
- Pacific Harbor Seal Fact Sheet
- Weddell Seal Fact Sheet
- Career Profiles
- Tag! You're IT PolarTREC Journal
- Research Roadblock - Extreme Ice Challenge and Challenge Guidelines
- Time-Depth Comparison
- Weddell Seal Pup Data Sheet - Table 1
- Recap of Research Video (only if the class is NOT participating in Session 2 and Session 3)

Preparation

- Review the the Tag! You're IT PolarTREC Journal prior to class instruction.
- Fact Sheets, Time-Depth Comparison, Career Profiles, and Weddell Seal Pup Data Sheet may be projected or printed to display for the class.

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RESEARCH ROADBLOCK:

Marine field biologists can observe Weddell seal behavior in the wild to uncover their adaptations and form questions. But first, they must get to the seals in their natural environment. Follow the directions of the Extreme Ice Challenge to discover how Team B-030 safely travels across the fast ice to observe Weddell seals in the field.

Warm-Up

Display or distribute the Scientific Method Infographic to each student or small group. Describe the process using the infographic as your guide.

*Prompt: **Observations** (using your senses or measurement to gather information) help scientists form questions, which influences how they investigate and perform their research.*

This process includes making observations, defining a question to investigate, making a prediction to answer that question, preparing for research, gathering data, and analyzing data to draw conclusions. Today, we will take the role of lead marine field biologists observing the dive behavior of Weddell seal pups in Antarctica and begin asking our own questions about them.

Distribute the Antarctica Fact Sheet and Pacific Harbor Seal Fact Sheet to each student or small group. Ask students to read the facts and imagine how a more common species found throughout the world, like a harbor seal, would **adapt** (adjust to new conditions) to survive Antarctica. Provide a few minutes for students to list or draw their **adaptations** (a physical or behavioral trait that helps an organism survive in its environment). Encourage students to reference the harbor seal image found on their fact sheet and add labels to sketches.

Prompt: Scientists on Team B-030 rely on comparisons like this, too, from their experience on other research projects or with organizations like The Marine Mammal Center, who have years of experience caring for local marine mammal species.

Once a few students or groups have shared some of their adaptations, distribute the Weddell Seal Fact Sheet to the class. Highlight some of the physical similarities and differences compared to the harbor seal.

Warm-Up (continued)

Use this as an opportunity to help students develop scientific observation (observation that is objective and free from bias) skills. Display the Field Biologist Career Profile and describe the role using the profile as your guide.

Guided Class Activity

Inform students that they will now take the role of marine field biologists observing the dive behavior of Weddell seal pups in Antarctica. Share that they have already tracked dive behavior using a **Time-Depth Recorder (TDR)**, which records behavioral data, such as the depth of each dive using a pressure sensor. Prior to class instruction, educators can review the Tag! You're IT PolarTREC Journal to learn more.

Part 1:
Explain that it is not only important to make observations, but to study and consider any **prior research** (research that has already been conducted by other scientists). Display or distribute the Time-Depth Comparison with the class or divided groups. Ask students to compare the average time-depth data of adult Weddell seals, Pacific harbor seals, and humans. Have them write notes or discuss in their groups what they notice about the two graphs. Meet back as a class to discuss their findings. If the students have not already brought up that the dive duration and depth of Weddell seals are much longer than harbor seals and humans, prompt them to do so.

Part 2:
Distribute a copy of the Weddell Seal Pup Data Sheet to each marine field biologist or small group. Explain that they are responsible for reviewing the TDR Data (Table 1) for Kit Kat, which was collected every 4 seconds from deployment (when Kit Kat was 1 week old) to retrieval (when Kit Kat was 7 weeks old). The table represents the average TDR data during week 1, 3, 5, and 7. (Table 2 is not used during this activity and is intended for Sessions 2 & 3 only.)

Guided Class Activity *(continued)*

Ask students to write notes or discuss in their groups what they notice about the TDR data of Kit Kat collected over a 7 week span. Reconvene as a class to discuss their findings. If the students have not already brought up that the dive durations of Kit Kat appear to increase with age, prompt them to do so.

Think and Reflect

Remind students that every scientific research project begins with a scientific question. Ask students what questions they have related to the TDR data after making observations as field biologists. Provide students with time to write their questions in a notebook. Then, have a few students share their questions with the rest of the class.

Transition by asking students why they think being able to dive for longer periods of time might be a beneficial adaptation for Weddell seals. Have students look back at the Antarctica Fact Sheet and Weddell Seal Fact Sheet to help them make the connection between the Weddell seals and their environment. Provide students with time to write their answers in a notebook.

Explain that Team B-030 is studying the Weddell seal pups to understand how they are learning to swim and dive. *Prompt: Weddell seals are unusual because they learn how to swim from their moms. Most true seals must learn how to swim and dive entirely on their own, with no help from mom. Team B-030's research is the first study to measure the earliest swimming and diving attempts by Weddell seals, from the time they first got into the water at 1 or 2 weeks old. Their research question is: "**How do Weddell seal pups develop the amazing diving capabilities the adults are known for?**"*

If your class is participating in Sessions 2-3, explain that over the next few sessions, the class will also try to answer the same research question by interpreting the data Team B-030 collected from Kit Kat during their research. Have the students copy Team B-030's research question down in a notebook and refer to it in later sessions.

If your class is NOT participating in Session 2-3, play the Recap of Research Video to help them summarize Team B-030's findings.

Session Adaptations

Easy adaptation: If charts and graphs are new skills for your students, consider spending additional time reviewing how to read these resources before breaking into groups or conducting the guided class activity all together to provide added support for reading across rows or columns or understanding units of measurement, for example.

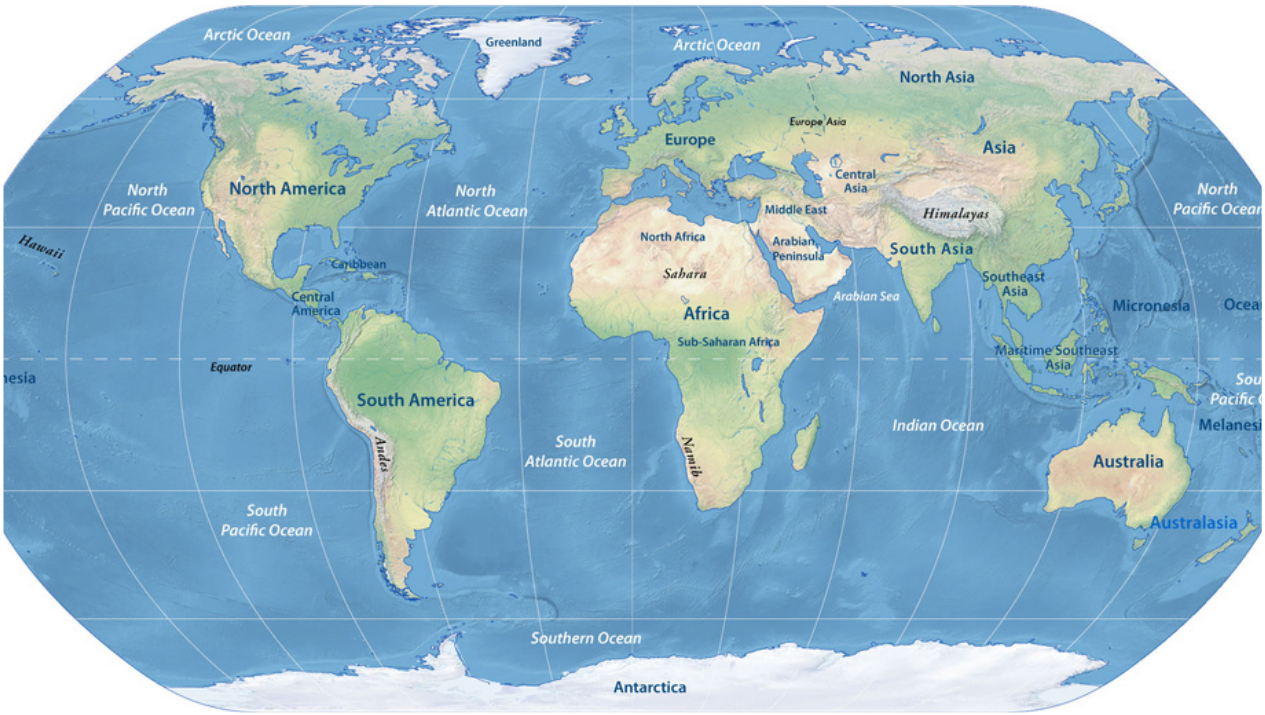
Deep dive: Create correlation graphs (by hand or using Microsoft Excel) with various factors found on the Weddell Seal Pup Data Sheet (example: dive duration vs. dive depth). Are there other creative ways students would communicate or share data?

Assessment

At the conclusion of this session, students should be able to:

- Describe the role of a marine field biologist
- Compare a few physical adaptations of seals
- Form questions based on scientific observations

ANTARCTICA FACT SHEET



ENVIRONMENTAL CONDITIONS

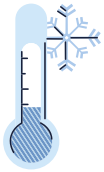
EXTREME ICE

About 97.6 percent of Antarctica is ice that has formed over millions of years. This ice contributes 90 percent of all the world's ice and 70 percent of all the world's fresh water.

EXTREME WIND

Antarctica is the windiest place on earth. Wind speeds in Antarctica can reach up to 218 mph. *(In the U.S., daily wind speeds typically average between 6 and 12 miles per hour.)*

EXTREME COLD



Antarctica is the coldest place on earth. Winter temperatures range from −128.6°F on the high inland ice sheet to −76°F near sea level *(32°F is considered freezing)*.

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SOURCES: NATIONAL SCIENCE FOUNDATION (WWW.NSF.GOV), DISCOVERING ANTARCTICA (WWW.DISCOVERINGANTARCTICA.ORG.UK), AND BRITANNICA (WWW.BRITANNICA.COM), TOPOGRAPHIC MAP BY NATIONS ONLINE PROJECT (WWW.NATIONSONLINE.ORG)

FIELD BIOLOGIST

CAREER PROFILE

Description

Field biologists study living organisms such as plants and animals in their natural environments by observing the behavior of animals and the relationship they have to their environment. Their work often includes developing research studies, collecting and analyzing scientific data, and publishing research to communicate their findings.

Desired Skills

- can notice slight changes in people or the environment
- use logic and reason to draw conclusions
- can endure extended periods of time in harsh or isolated environments
- enjoy working with a small team

Work Environment

Most work takes place in the field with a team, making scientific observations and collecting samples. However, occasional trips to McMurdo Station are needed to deliver and further analyze specimens.

The Marine Mammal Center®

FIELD BIOLOGIST

CAREER PROFILE

Field biologists hold a degree in subjects such as:

- Marine biology
- Plant biology
- Animal behavior
- Ecology
- Evolutionary biology
- Neurobiology
- Molecular biology

Possible Job Titles	**Recommended Schooling/Experience**
Student Researcher	No college degree is needed, but prior experience in laboratories and performing research while earning a college degree is required
Research Assistant	Associate degree (2 years of college) acceptable, but bachelor's degree (4 years of college) is preferred
Marine Biologists	Bachelor's degree (4 years of college) acceptable, but master's degree (6+ years of college) is preferred
Principal Investigator	Bachelor's degree (4 years of college) and master's degree (6+ years of college) acceptable, but doctoral degree (3+ years of study) is preferred

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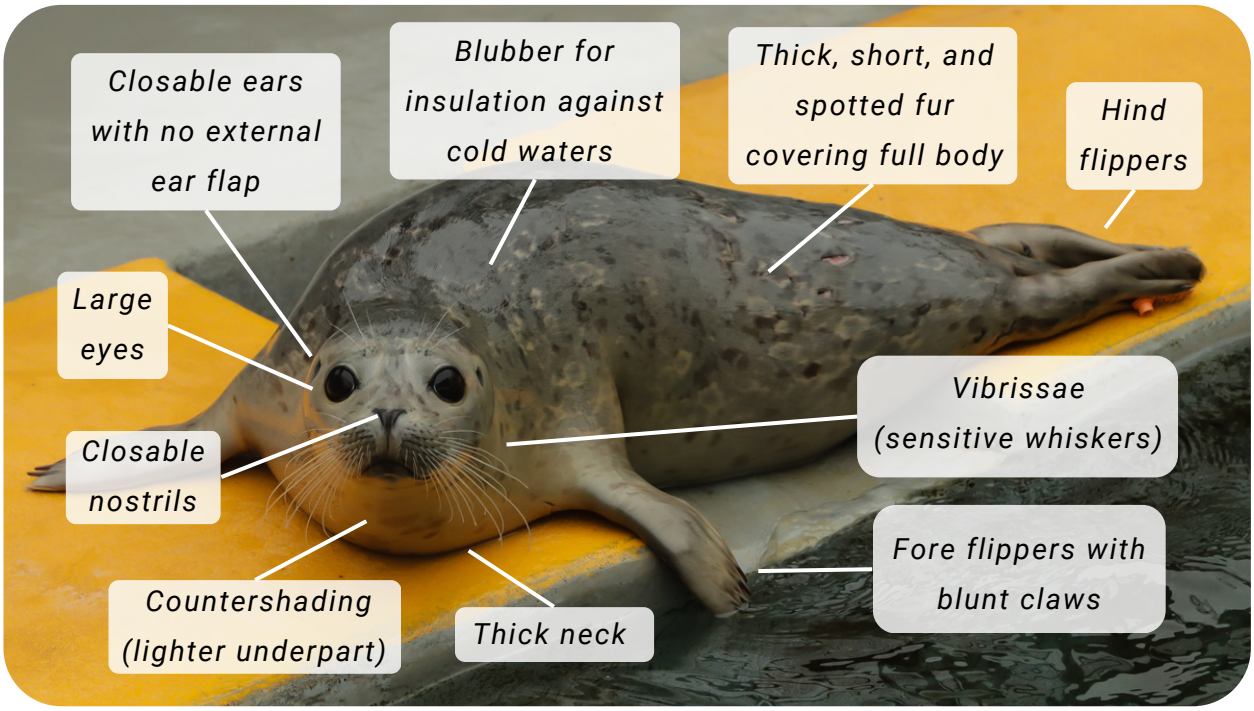
PACIFIC HARBOR SEAL FACT SHEET



HABITAT & BEHAVIOR

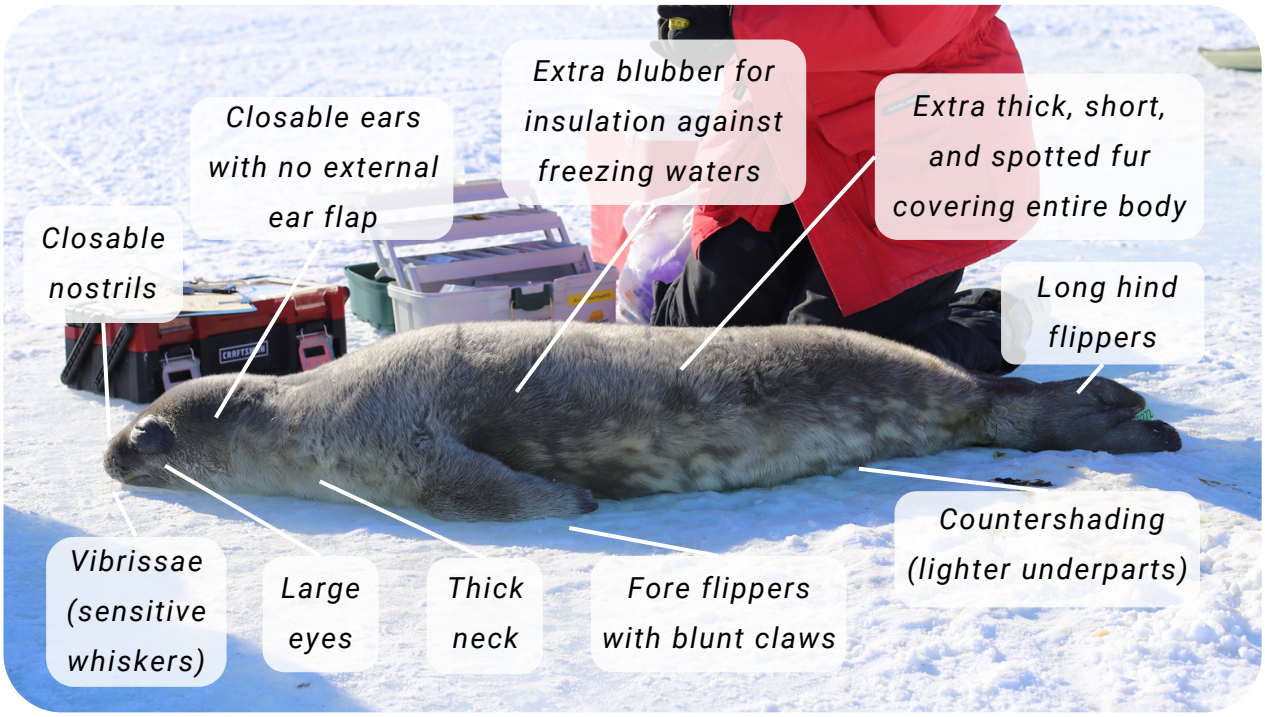
Pacific harbor seals are found north of the equator in both the Atlantic and Pacific oceans. In the Pacific, they can be found in areas ranging from Alaska to Baja California, Mexico.

Harbor seals live in coastal habitats. They use rocks, beaches, and floating ice to haul out when they are not traveling and/or foraging at sea. Harbor seals haul out on land to rest, regulate temperature, interact, give birth, nurse pups, and avoid predators.

The Marine Mammal Center.

SOURCES: NOAA'S NATIONAL MARINE FISHERIES SERVICE (WWW.NMFS.NOAA.GOV) AND THE MARINE MAMMAL CENTER (WWW.MARINEMAMMALCENTER.ORG), IMAGES OF PACIFIC HARBOR SEAL AT THE MARINE MAMMAL CENTER BY BILL HUNNEWELL © THE MARINE MAMMAL CENTER, IMAGE OF WORLD MAP BY NOAA FISHERIES (WWW.FISHERIES.NOAA.GOV)

WEDDELL SEAL FACT SHEET



HABITAT & BEHAVIOR

Weddell seals live all around Antarctica and stay mostly near the “fast ice” – the ice that is attached to the land. They are safer there than on the “pack ice” – the ice that flows near the water. Their main predator, the killer whale is less able to hold its breath for long enough periods to reach the fast ice.

Weddell seals haul out on the fast ice to rest, regulate temperature, interact, give birth, nurse pups, and avoid predators.

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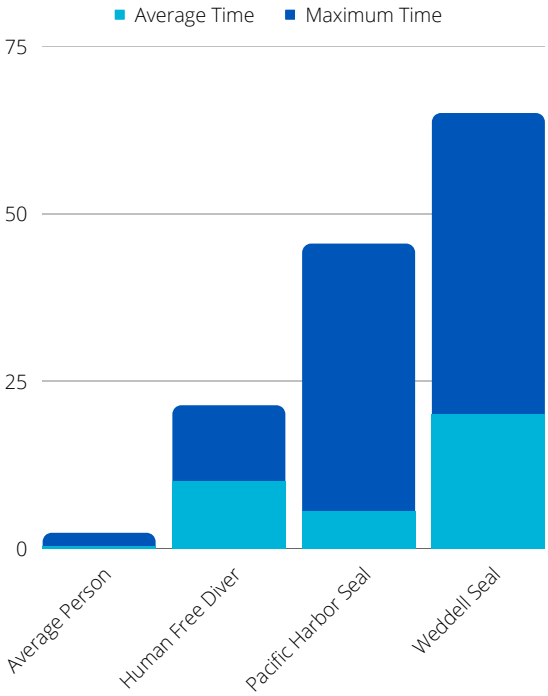
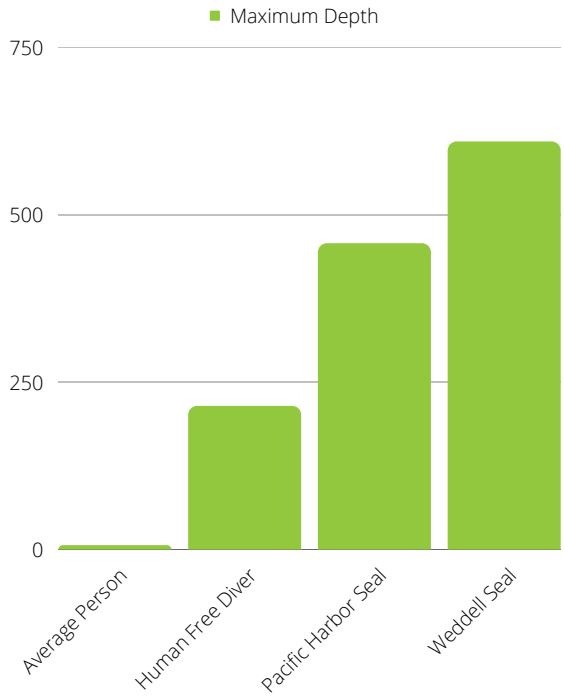
SOURCE: GROWING UP ON ICE (ICYSEALS.COM)
PHOTOS WERE TAKEN UNDER THE NMFS PERMITS 17441-00, 87 -1851, AND 21006, PHOTO OF LITTLE BLUE BY SOPHIE WHORISKEY

TIME-DEPTH COMPARISON

DURATION (time in minutes)



DEPTH (meters)



The Marine Mammal Center.

SOURCES: NATIONAL GEOGRAPHIC (NATIONALGEOGRAPHIC.COM), KO'OX ADVENTURES (KOOKSADVENTURES.COM), THE MARINE MAMMAL CENTER (MARINEMAMMALCENTER.ORG), PHOTOS WERE TAKEN UNDER THE NMFS PERMITS 17441-00, 87 -1851, AND 21006, PHOTO OF NEONATE WITH TAGS BY LINNEA PEARSON

WEDDELL SEAL PUP DATA SHEET

KIT KAT

Animal ID: LW1903
Sex: Female

TABLE 1

Age (weeks)	Weight (kg)	Total Time in Water (minutes)	Maximum Dive Depth (meters)	Maximum Dive Duration (minutes)	Mean Dive Depth (meters)	Mean Dive Duration (minutes)
1	40.5	3	0	0	0	0
3	66	1127.5	16.629	4	9.321	2.4
5	82.5	1831	20.708	5	9.588	2.4
7	85	553	7.961	10.5	7.961	10.5

TABLE 2

Age (weeks)	Chamber	Count 1	Count 2	Count 3	Count 4	Count 5	Sum of Counts	Average RBC (x10,000)
1	1							
	2							
3	1	60	60	67	68	69	324	327
	2	61	71	69	66	63	330	
5	1	76	66	68	65	70		
	2	60	70	56	69	79		
7	1	71	70	68	70	66		
	2	58	58	69	58	70		

The Marine Mammal Center.

SOURCE: GROWING UP ON ICE (ICYSEALS.COM)
PHOTOS WERE TAKEN UNDER THE NMFS PERMITS 17441-00, 87 -1851, AND 21006

VETTING VET SCIENTISTS

Expected time: 1hr 30 min

Key terms: marine mammal, physiology, mammalian dive reflex, stored oxygen distribution, oxygen-carrying capacity, myoglobin, hemoglobin, hematocrit, blood volume, hypothesis, chemical sedation, biopsy, blood samples

Objective:

Students will **explore** the role of veterinary field scientists, **analyze** the dive capabilities of seals and humans, and **interpret** physiology data.

Overview

Through the lens of a veterinary scientist, students will use physiology data sets to form a hypothesis answering the main research question throughout the Growing Up on Ice curriculum, "**How do Weddell seal pups develop the amazing dive capabilities the adults are known for?**" (Students can test their hypothesis in Session 3).

Materials

- Scientific Method Infographic
- Time-Depth Comparison
- Weddell Seal Pup Data Sheet
- W.H.A.L.E.S. Acronym
- Free Diver Video
- Mammalian Dive Reflex Video
- Comparison of Stored Oxygen Distribution
- Hypothesis Options
- Career Profiles
- Research Roadblock - Extreme Wind Challenge and Challenge Guidelines
- Recap of Research Video (only if the class is NOT participating in Session 3)

Preparation

- Scientific Method Infographic, Time-Depth Comparison, Weddell Seal Pup Data Sheet, Stored Oxygen Distribution data, Hypothesis Options, Career Profiles, and Blood Sample Images may be projected or printed to display for the class.
- Write the W.H.A.L.E.S. acronym on a whiteboard.

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RESEARCH ROADBLOCK:

Veterinary scientists are trained to safely collect body measurements and muscle and blood samples from Weddell seals that can be used to help investigate the oxygen in each animals body. But first, they must secure the Weddell seals for sample collection. Follow the directions of the Extreme Wind Challenge to discover how Team B-030 safely captures Weddell seals in order to advance our understanding of this species and their environment.

Warm-Up

Display or distribute the Scientific Method Infographic, Time-Depth Comparison and Weddell Seal Pup Data Sheet. Refer to them as you introduce for the first time or recap what was established in Session 1.

*Prompt: Scientists have found through **observations** (using your senses or measurement to gather information) that adult Weddell seals can dive at great depths and for extended times. Looking at the data collected by Team B-030, the dive durations of Kit Kat appear to increase with age.*

Direct the student's attention to the W.H.A.L.E.S. acronym (below).

*Prompt: Humans and Weddell seals are the same in many ways, such as our need to breathe oxygen and our ability to voluntarily hold our breath. Weddell seals are **marine mammals,** and they have six specific characteristics they share with other marine mammals (refer to the acronym W.H.A.L.E.). Five out of the six characteristics are also shared by humans. Can you tell me which ones they share? (Answer: Unlike land mammals (humans), marine mammals live all or part of their life in the ocean.)*

*Because they are both mammals, scientists can observe both humans and other marine mammals to explain or form a **hypothesis** (educated guess that can be proven or disproven) about aspects of one another.*

W.H.A.L.E.S.

- ***W**arm-blooded*
- ***H**aving hair or fur*
- ***A**ir breather (breathes air through lungs)*
- ***L**ive young (bears live young)*
- ***E**ats milk (nurses their young with milk produced by mammary glands)*
- ***S**ea (lives all or part of their life in the ocean)*

Warm-Up (continued)

Display the Veterinary Scientist Career Profile and describe the role using the profile as your guide.

Guided Class Activity

Inform the students that they will now take the role of veterinary scientists responsible for deciding what their team will study about Weddell seal pups to answer the research question: "**How do Weddell seal pups develop the amazing dive capabilities the adults are known for?**" By studying the **physiology** (the way in which a living organism or body part functions) of humans and other marine mammal species who spend a lot of their time underwater, they will form a hypothesis to try and answer Team B-030's research question.

Part 1:
Play the Free Diver Video and after, the Mammalian Dive Reflex Video for the students. As they watch the video, ask them to write down things that the free diver must do to survive extreme underwater conditions. After the video, ask students to define the mammalian dive reflex. (Answer: The **mammalian dive reflex** is a series of physiological changes that take place in the body in response to a mammal holding its breath.)

Ask them if they think Weddell seals would have a similar series of physiological changes. (Answer: Yes, they are mammals.) Considering what they know now about free-divers, ask them what they think Team B-030 should investigate about the physiology of Kit Kat that would help them understand her diving capabilities. If the students have not already done so, remind them of the physiology of the diver that helps to transport oxygen throughout their body: the lungs, muscles, and blood.

Part 2:
Display the **Comparison of Stored Oxygen Distribution** (where oxygen is stored throughout the body) graphic with the class. Have students write definitions of the upcoming terms in a journal or notebook.

Prompt: Here are two graphs that compare how much oxygen is stored throughout the lungs, muscles, and blood of humans and northern elephant seals.

Guided Class Activity (continued)

Prompt: Northern elephant seals are known to be incredible divers that live off the coast of California and are another species that Team B-030 has a wealth of expertise working with. Because northern elephant seals are marine mammals, we can compare their physiology to that of humans to start making guesses about the Weddell seal's physiology. What do you notice right away that is different between these two graphs?

If students have not already brought up that the seals' lungs hold the least amount of oxygen, prompt them to do so.

Prompt: Free divers train their lungs to hold more oxygen with a single breath than average people. Still, the lungs store a small amount of the free diver's oxygen during a dive. The muscles store some of the free diver's oxygen during a dive through ***myoglobin*** *(a protein that supplies oxygen to the cells in muscles). Most of the oxygen that the free diver is using comes from their blood, transported through* ***oxygen-carrying capacity qualities*** *in their red blood cells including: the amount of* ***hemoglobin*** *(a protein within red blood cells that stores oxygen in the blood),* ***hematocrit*** *(the percentage by volume of red cells in the blood), and* ***blood volume*** *(amount of all blood in the body).*

Part 3:
Share the Hypothesis Options with the class. Explain that a good hypothesis is testable (can be supported or disproven by evidence). Decide as a class or in groups which hypothesis can be supported or disproven using the muscle and blood samples they plan to collect (revisit the Comparison of Stored Oxygen Distribution, Time-Depth Comparison, and Weddell Seal Pup Data Sheet). (Answer: All hypothesis options are testable. Have the class choose whichever one they are most interested in.)

HYPOTHESIS OPTIONS:

- *Over the span of 7 weeks during the time Kit Kat is nursing, she develops **more myoglobin** (supplying more oxygen to the cells in the muscles that allow them to hold more oxygen as she dives).*
- *Over the span of 7 weeks during the time Kit Kat is nursing, she develops **more hemoglobin** within red blood cells (storing more oxygen in the blood as she dives).*
- *Over the span of 7 weeks during the time Kit Kat is nursing, she develops **more red blood cells** (storing more oxygen in the blood as she dives).*
- *Over the span of 7 weeks during the time Kit Kat is nursing, she develops a **greater blood volume** (storing more oxygen in the blood as she dives).*

Think and Reflect

Remind the students of Team B-030's research question by writing it on a whiteboard, **"How do Weddell seal pups develop the amazing dive capabilities the adults are known for?"** Ask the class if they can remember why they want to collect and study the muscle and blood samples of Weddell seals. (Answer: The samples will be used to answer the question and support or disprove the class hypothesis.) Explain that once veterinary scientists have a testable hypothesis, they can collect samples from Kit Kat in the field.

Prompt: In order to collect the muscle and blood samples, veterinary scientists will first sedate the pup using the mass of the animal to determine the level of sedation needed. ***Chemical sedation*** *is medicine administered to the seal to reduce irritability or agitation. Once the animal is under sedation, a single* ***biopsy*** *(a procedure to remove a piece of tissue or a sample of cells) of the muscle will be completed. While the pup is still sedated, veterinary scientists will then take* ***blood samples*** *using a syringe to extract some of the pup's blood. Though this procedure is invasive, it is completed as quickly and carefully as possible without lasting harm to the animal. It is done only by trained and experienced professionals who have applied for limited permits allowing them to interact with the animals for the purpose of learning more about them and their environment.*

Have the students refer to the Comparison of Stored Oxygen Distribution. Ask students which sample they think will have the most oxygen once the muscle and blood samples are tested and why. Have students consider how large the northern elephant seal is compared to the human free diver and ask them if they think body measurements of Kit Kat influence or change the amount of hemoglobin in the muscles and oxygen-carrying capacity qualities in the blood. Explain that blood cells can be bigger in bigger animals. However, blood volume can also increase during exercise and be affected by many other factors. This is why it is important to conduct research before making assumptions. Allow students the opportunity to change or modify their hypothesis after the class discussion.

If your class is participating in Session 3, explain that blood samples will later (in Session 3) be analyzed to discover how much oxygen Kit Kat has stored throughout her body and if it changes in the span of 7 weeks during the time Kit Kat is nursing.

If your class is NOT participating in Session 3, play the Recap of Research Video to help them summarize Team B-030's findings.

Session Adaptations

Easy adaptation: Examine and discuss additional comparisons between human and Weddell seal oxygen-carrying capacity qualities using the Weddell Seal Blood PolarTREK Journal entry.

Deep dive: Incredible diving abilities aren't the only thing elephant seals and Weddell seals have in common; they are also both being impacted by climate change. Explore more with this Animals of the Antarctic activity from The Marine Mammal Center.

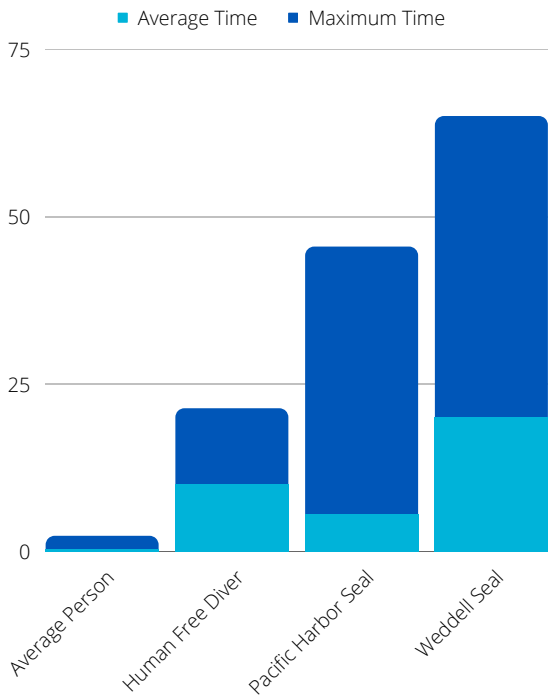
Assessment

At the conclusion of this session, students should be able to:

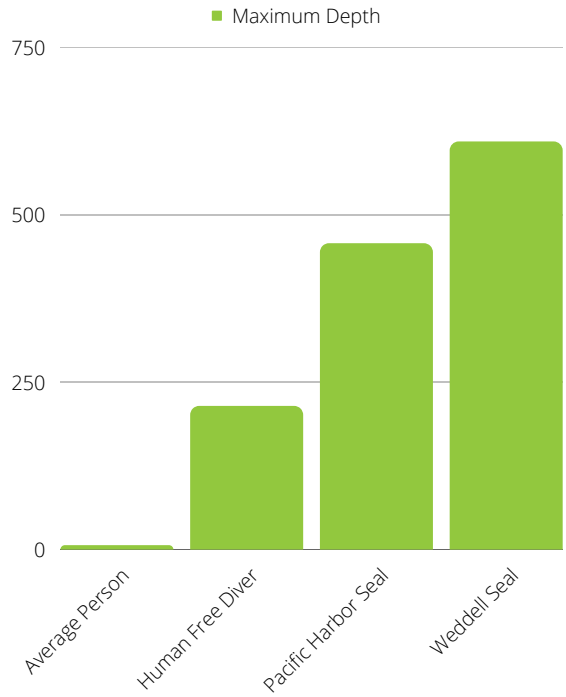
- Describe the role of a veterinary scientist
- Compare the dive capabilities of humans and seals
- Form hypotheses based on evidence

TIME-DEPTH COMPARISON

DURATION (time in minutes)



DEPTH (meters)



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SOURCES: NATIONAL GEOGRAPHIC (NATIONALGEOGRAPHIC.COM), KO'OX ADVENTURES (KOOKSADVENTURES.COM), THE MARINE MAMMAL CENTER (MARINEMAMMALCENTER.ORG), PHOTOS WERE TAKEN UNDER THE NMFS PERMITS 17441-00, 87 -1851, AND 21006, PHOTO OF NEONATE WITH TAGS BY LINNEA PEARSON

WEDDELL SEAL PUP DATA SHEET

Animal ID: LW1903
Sex: Female

TABLE 1

Age (weeks)	Weight (kg)	Total Time in Water (minutes)	Maximum Dive Depth (meters)	Maximum Dive Duration (minutes)	Mean Dive Depth (meters)	Mean Dive Duration (minutes)
1	40.5	3	0	0	0	0
3	66	1127.5	16.629	4	9.321	2.4
5	82.5	1831	20.708	5	9.588	2.4
7	85	553	7.961	10.5	7.961	10.5

TABLE 2

Age (weeks)	Chamber	Count 1	Count 2	Count 3	Count 4	Count 5	Sum of Counts	Average RBC (x10,000)
1	1							
	2							
3	1	60	60	67	68	69	324	327
	2	61	71	69	66	63	330	
5	1	76	66	68	65	70		
	2	60	70	56	69	79		
7	1	71	70	68	70	66		
	2	58	58	69	58	70		

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SOURCE: GROWING UP ON ICE (ICYSEALS.COM)
PHOTOS WERE TAKEN UNDER THE NMFS PERMITS 17441-00, 87 -1851, AND 21006

VETERINARY SCIENTIST

CAREER PROFILE

Description

Veterinary scientists conduct research on animal medicine and animal health conditions. This often includes caring for animals hands-on, developing research studies, collecting and analyzing scientific data, and publishing research to communicate their findings.

Desired Skills

- experience working with animals
- can notice slight changes in animal behavior or the environment
- use logic and reason to draw conclusions
- can endure extended periods of time in harsh or isolated environments
- enjoy working with a small team

Work Environment

Most work takes place in the field with a team, making scientific observations and collecting samples. However, occasional trips to McMurdo Station are needed to deliver and further analyze specimens.

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VETERINARY SCIENTIST

CAREER PROFILE

Veterinary scientists hold a degree or certification in subjects such as:

- Biology
- Zoology
- Animal science
- Veterinary science
- Veterinary medicine
- Veterinary medicine and surgery

Possible Job Titles	**Recommended Schooling/Experience**
Animal Care and Service Worker	No college degree is needed but prior experience volunteering or working with animals is preferred
Veterinary Assistant	No college degree is needed but an associate degree (2 years of college) is preferred
Veterinary Technician	Associate degree (2 years of college) acceptable, but bachelor's degree (4 years of college) is preferred
Veterinarian	Bachelor's degree (4 years of college) and veterinary school (4 additional years of specialized training)

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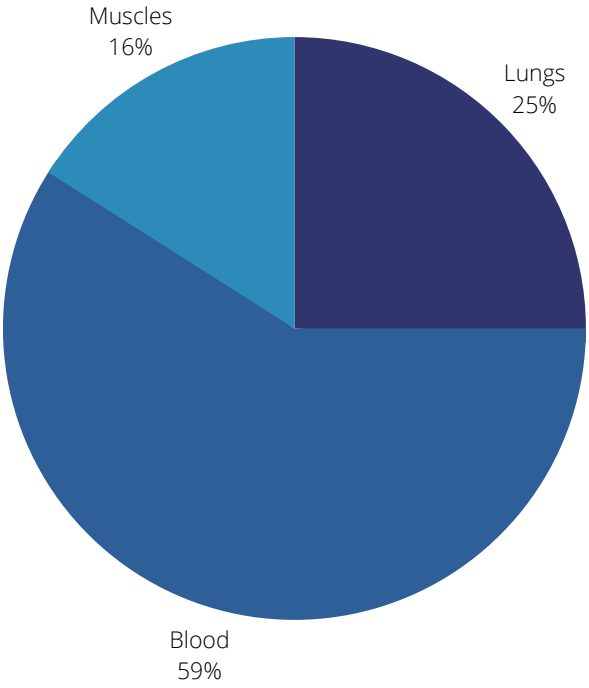
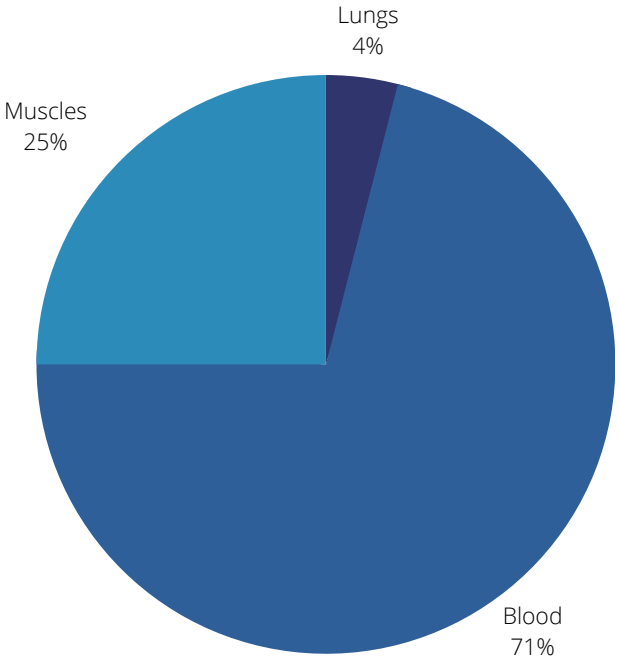
COMPARISON OF STORED OXYGEN DISTRIBUTION

HUMANS



NORTHERN ELEPHANT SEAL



SIZE COMPARISON

A fully grown northern elephant seal male can reach lengths of over 13 feet and can weigh nearly 4,400 pounds!

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SOURCES: © 2013 EARTHGUIDE AT SCRIPPS INSTITUTION OF OCEANOGRAPHY, UCSD (EARTHGUIDE.UCSD.EDU), NOAA FISHERIES (FISHERIES.NOAA.GOV), NORTHERN ELEPHANT SEAL IMAGE BY NOAA FISHERIES (FISHERIES.NOAA.GOV)

SESSION 3

LEADING LAB SCIENTISTS

Expected time: 1hr 30 min

Key terms: centrifuge, analysis, platelets, plasma, red blood cell (RBC), biopsy, myoglobin, oxygen-carrying capacity, hemoglobin, hematocrit, blood volume, hemocytometer

Objective

Students will **explore** the role of clinical lab scientists, **analyze** oxygen-carrying capacity qualities in the blood of Weddell seals, and **interpret** biochemistry data.

Overview

Through the lens of a clinical lab scientist, students will use blood sample data (collected by Team B-030) to answer the main question throughout the Growing Up on Ice curriculum, **"How do Weddell seal pups develop the amazing dive capabilities the adults are known for?"**

Materials

- RBC Count Protocol Video (Educator resource only)
- Scientific Method Infographic
- Weddell Seal Pup Data Sheet
- Background Research
- Centrifuge Demo Video
- Career Profiles
- Research Roadblock - Extreme Cold Challenge and Challenge Guidelines
- Class set of magnifying glasses (optional)
- Hemocytometer Side 1 & Side 2
- Educator Solutions
- Recap of Research Video

Preparation

- Educators should plan to review the RBC Protocol Video prior to class instruction.
- Centrifuge Video may be projected, or live demo should be set up to display for the class.
- Print RBC Count Protocol, Hemocytometer sides, and Weddell Seal Pup Data Sheet for every student or small group.
- Project Recap of Research Video at the end of class session.

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RESEARCH ROADBLOCK:

Before blood samples are separated and analyzed by the clinical lab scientists, they must be kept warm, supported, and protected as they are transported from the field back to the lab at McMurdo Station. Follow the directions of the Extreme Cold Challenge to discover how Team B-030 safely transports samples back to McMurdo Station.

Warm-Up

Display or distribute the Scientific Method Infographic to each student or group. Refer to it as you introduce for the first time or recap what was established in Session 1 & Session 2 (refer to Background Research below).

Explain how researchers will perform tests on the lab samples.

Prompt: Once blood samples are transported back to the lab from the field, at McMurdo Station, clinical lab scientists must spin the Weddell seal pup's blood down using a ***centrifuge*** *(equipment later explained in video below) and divide samples for immediate* ***analysis*** *(detailed examination) or later analysis. The muscle samples are stored in different containers for different analyses as well. Today, you will take the role of lead clinical lab scientists, responsible for testing and analyzing samples to help Team B-030 form a conclusion about the dive capabilities of Weddell seals. These samples will test how much oxygen Kit Kat has stored throughout her body and indicate changes in the span of 7 weeks during the time she is nursing.*

Play the Centrifuge Demo Video or complete a live demo in front of the class. As students watch the video or live demo, ask them to write down their observations. Have a few students share what they observed. Then, explain to the class why separating the blood is significant. *Prompt: The centrifuge spins the blood to separate red blood cells from the* ***platelets*** *(tiny blood cells that help your body to form clots and prevent bleeding) and* ***plasma*** *(liquid portion of blood that is mostly water). Why do you think it is important to separate these?*

Warm-Up (continued)

*(Answer: We want to focus on **red blood cells (RBC)**, which transport oxygen throughout the body.) The muscle samples taken from the **biopsy** (a procedure to remove a piece of tissue or a sample of cells) will be sent to a lab in California, and a summary of the muscle results will be mailed back to us at a later date. There, other lab specialists will be able to test a protein known as **myoglobin** (protein that supplies oxygen to the cells in muscles).*

Display the Clinical Lab Scientist Career Profile and describe the role using the profile as your guide.

Guided Class Activity

Inform the students that they will now all take the role of lead clinical lab scientists, responsible for analyzing the blood samples.

*Prompt: Much of the oxygen used during a dive comes from the blood, transported through **oxygen-carrying capacity qualities** in red blood cells including: the amount of **hemoglobin** (a protein within red blood cells that stores oxygen in the blood), **hematocrit** (the percentage by volume of red cells in the blood), and **blood volume** (amount of all blood in the body).*

BACKGROUND RESEARCH

- ***Observations and prior research:*** *Adult Weddell seals can dive at great depths and times. The dive durations of Kit Kat appear to increase with age (refer to time-depth data recorded on Weddell Seal Pup Data Sheet).*
- ***Research question:*** *How do Weddell seal pups develop the amazing diving capabilities the adults are known for?*
- ***Hypothesis:*** *(select one of the Hypothesis Options from Session 2)*
- ***Kit Kat's Test Samples:***
  - *muscle samples*
  - *blood samples*

As lab scientists you will perform the red blood cell (RBC) counts for Kit Kat to analyze the oxygen-carrying capacity qualities in the blood of Weddell seals.

Educators should plan to review the RBC Protocol Video prior to class instruction.

Part 1:
Distribute a copy of the Weddell Seal Pup Data Sheet, RBC Count Protocol, Hemocytometer Chamber 1 and Hemocytometer Chamber 2 to each student or divide your class into four groups.

Guided Class Activity (continued)

Explain to the class that a **hemocytometer** is a specimen slide that is analyzed under a microscope to determine the number of cells in a liquid sample, such as Kit Kat's blood.

Together, the class will complete the RBC counts for Kit Kat for Week 1 by filling in the blank boxes on their Weddell Seal Pup Data Sheet. Walk the students through the RBC Count Protocol and complete Chamber 1 square 1 together. Please note: part of the math has been completed for the students - the dilution (1:20) has already been incorporated. It is also optional to provide magnifying glasses to support students through the activity. Some of the cells in the images are hard to tell apart. For example: in Chamber 1, box 2, there is a grouping of two separate cells, but they overlap and look like one cell.

Ask the students why they think it is important to count the cells accurately. What might happen if their cell count is wrong? What could they use to help their counts be more accurate?

Part 2:
Invite students to use their notebooks for calculations and recording their answers. Complete the remaining counts (square 2-5) as a class or divide amongst four groups.

Repeat process for Chamber 2. Meet together as a class to review, correct, and calculate the RBC sum and the Average RBC for all weeks (week 3 is provided). Have the students fill in the missing RBC data on their Weddell Seal Pup Data Sheet (refer to Educator Solutions).

Have students discuss what they notice about the completed RBC counts of Kit Kat collected over a 7 week span. Meet as a class to discuss their findings. If they have not already brought up that the time and depths of dives and the RBC counts of the Weddell seals appear to increase with age (except for week 7), prompt them to do so.

Think and Reflect

Remind the students of Team B-030's research question by writing it on a whiteboard, "**How do Weddell seal pups develop the amazing dive capabilities the adults are known for?**" Have students write their own conclusions based on the results from the lab analysis in a notebook. Ask them if their hypothesis was supported by the evidence or disproven. Have a few students share their answers.

Prompt: Why does the time and depth of dives mostly appear to increase along with RBC? (Answer: More red blood cells = more oxygen, more oxygen = longer and deeper dives.) We discovered that the time and depths of dives and the RBC counts mostly increase with our pup's age (except for week 7). What do you think happened during week 7 that made the RBC count lower? (Answer: Errors collecting blood data or other factors outside of the ones being tested may have skewed the results.) Ask students what they think they should do to achieve more accurate results? (Answer: Team B-030 studied multiple pups each year for multiple years to increase the sample size and compare across other environmental variables. More research should be conducted on other factors that could contribute to the TDR data of Weddell seals.)

Have more questions than answers? That's great! You're thinking as a scientist. While we only explored one of the hypotheses from Session 2, Team B-030 is continuing to analyze more data and ask new questions all the time too. Play the Recap of Research Video to help them summarize their findings.

Explain that the research doesn't stop here! It's important that researchers continue learning about the ocean through questions and observations. Ask students to write down any new questions they have and the research they would want to conduct next on Weddell seals.

Session Adaptations

Easy adaptation: Discuss what equipment you may or may not have available in your own lab. Connect this conversation with the Research Roadblock and Career Profiles to reinforce the importance of collaboration as highlighted by these samples being processed in multiple different labs that specialize in different functions.

Deep dive: Have students create a scatter plot (by hand or using Microsoft Excel) to display relationships between average RBC vs average time-depth data. Are there other creative ways students can think of to communicate or share data?

Assessment

At the conclusion of this session, students should be able to:

- Describe the role of a clinical lab scientist
- Compare multiple data points
- Draw conclusions based on evidence

CLINICAL LAB SCIENTIST

CAREER PROFILE

Description

Following strict health and safety procedures, clinical lab scientists collect samples and perform tests using technical equipment to analyze hazardous chemicals, body fluids and tissue, biological waste, and other substances.

Desired Skills

- enjoy working hands-on when solving puzzles and problems
- great attention to detail
- capable of working on several projects at once
- can work independently and with others
- willingness to follow strict safety guidelines

Work Environment

Most work takes place in a laboratory at McMurdo Station with a team, but there may be occasional trips out to the field to collect or deliver specimens or to take measurements.

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CLINICAL LAB SCIENTIST

CAREER PROFILE

Clinical lab scientists hold a degree in subjects such as:

- Biology
- Biomedical science
- Biotechnology
- Chemistry
- Environmental science
- Forensic science
- Pharmacology
- Physics

Possible Job Titles	Recommended Schooling/Experience
Assistant Lab Technician	No college degree is needed but an associate degree (2 years of college) is preferred
Lab Technician	Bachelor's degree (4 years of college) is acceptable
Lead Lab Technician	Bachelor's degree (4 years of college) is acceptable
Laboratory Manager	Bachelor's degree (4 years of college) is acceptable, but master's degree (6+ years of college) is preferred

WEDDELL SEAL PUP DATA SHEET

Animal ID: LW1903
Sex: Female

TABLE 1

Age (weeks)	Weight (kg)	Total Time in Water (minutes)	Maximum Dive Depth (meters)	Maximum Dive Duration (minutes)	Mean Dive Depth (meters)	Mean Dive Duration (minutes)
1	40.5	3	0	0	0	0
3	66	1127.5	16.629	4	9.321	2.4
5	82.5	1831	20.708	5	9.588	2.4
7	85	553	7.961	10.5	7.961	10.5

TABLE 2

Age (weeks)	Chamber	Count 1	Count 2	Count 3	Count 4	Count 5	Sum of Counts	Average RBC (x10,000)
1	1							
	2							
3	1	60	60	67	68	69	324	327
	2	61	71	69	66	63	330	
5	1	76	66	68	65	70		
	2	60	70	56	69	79		
7	1	71	70	68	70	66		
	2	58	58	69	58	70		

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SOURCE: GROWING UP ON ICE (ICYSEALS.COM)
PHOTOS WERE TAKEN UNDER THE NMFS PERMITS 17441-00, 87 -1851, AND 21006

EDUCATOR SOLUTIONS

TABLE 2

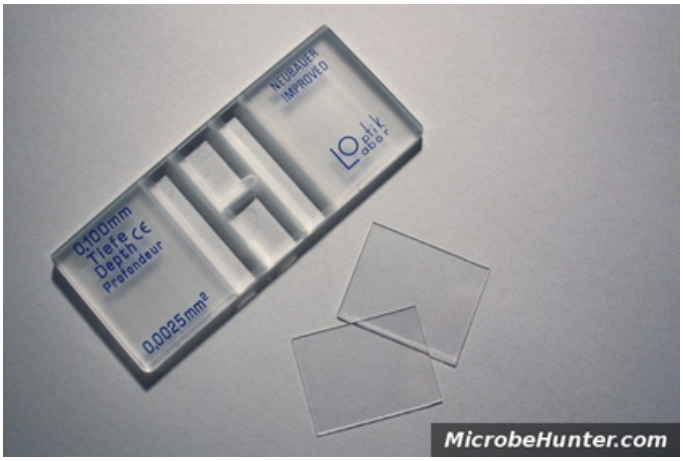
Age (weeks)	Chamber	Count 1	Count 2	Count 3	Count 4	Count 5	Sum of Counts	Average RBC (x10,000)
1	1	51	68	63	68	57	307	311
	2	57	67	59	70	62	315	
3	1	60	60	67	68	69	324	327
	2	61	71	69	66	63	330	
5	1	76	66	68	65	70	345	339.5
	2	60	70	56	69	79	334	
7	1	71	70	68	70	66	345	329
	2	58	58	69	58	70	313	

RBC COUNT PROTOCOL

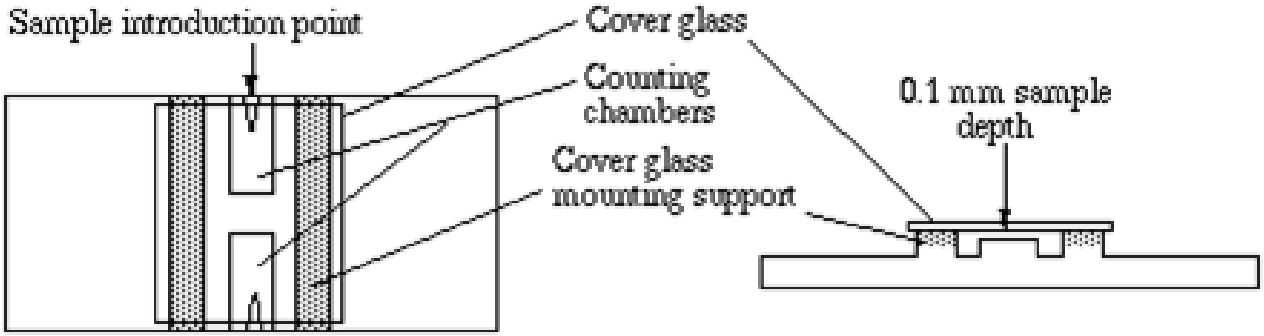
DIRECTIONS

Follow the protocol on the next page to count Kit Kat's red blood cells (RBC) for Week 1. Use both sides of the hemocytometer (Chamber 1 and Chamber 2) during your blood sample analysis. Record all calculations on your Weddell Seal Pup Data Sheet.

WHAT IS A HEMOCYTOMETER?



A hemocytometer (or counting chamber) is a specimen slide that is analyzed under a microscope to determine the number of cells in a liquid sample, such as blood.



REFERENCES:
- BROWN, B.A., HEMATOLOGY: PRINCIPLES AND PROCEDURES. 6TH ED., PHILADELPHIA: LEA AND FEBIGER, 1993.
- RBC DETERMINATION FOR MANUAL METHODS, UNOPETTE MICRO-COLLECTION SYSTEM, PRODUCT CIRCULARS 5804 AND 5853, BECTON-DICKINSON, RUTHERFORD, NJ 07070.

PHOTO OF HEMOCYTOMETER BY MICROBEHUNTER MICROSCOPY (MICROBEHUNTER.COM)

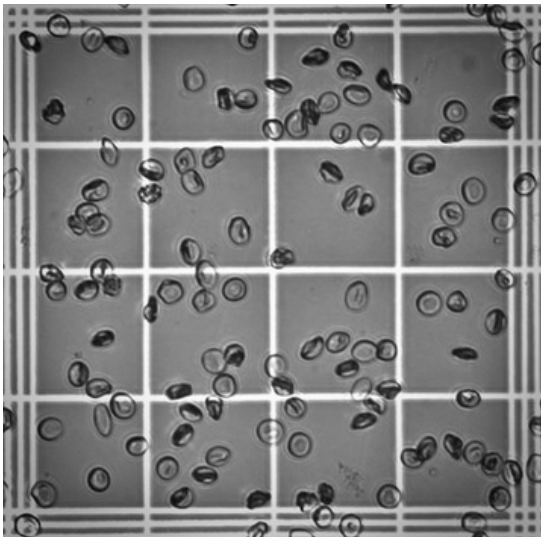
RBC COUNT PROTOCOL

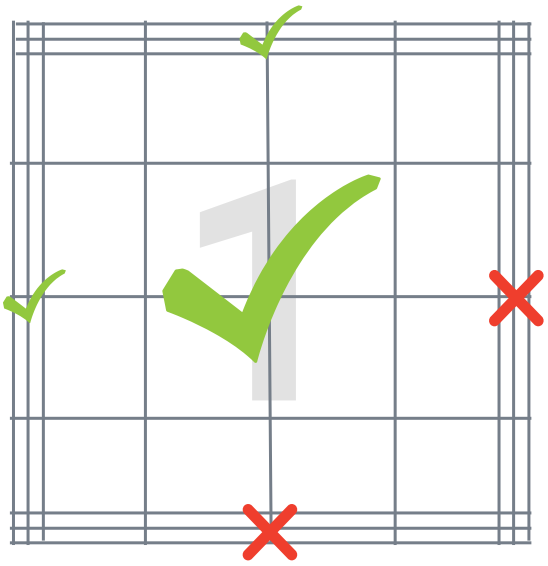
Protocol (steps)

1. Count and record the number of red blood cells in each of the 5 numbered squares for Chamber 1. **DO NOT** count unnumbered boxes.
2. Combine the counts for all 5 squares for Chamber 1 and record the total sum.
3. Repeat steps 1-2 for Chamber 2.
4. Combine the total sums of Chamber 1 and Chamber 2, divide by 2 and record the Average RBC.
5. Multiply the Average RBC x 10,000 to get Kit Kat's final RBC count for Week 1.
6. Calculate and fill in the rest of the missing data on the Weddell Seal Pup Data Sheet.

COUNTING GUIDE

Count the cells that lie on the top and left-hand lines of each square but **DO NOT** count any touching the 3 bottom or 3 right-hand lines.

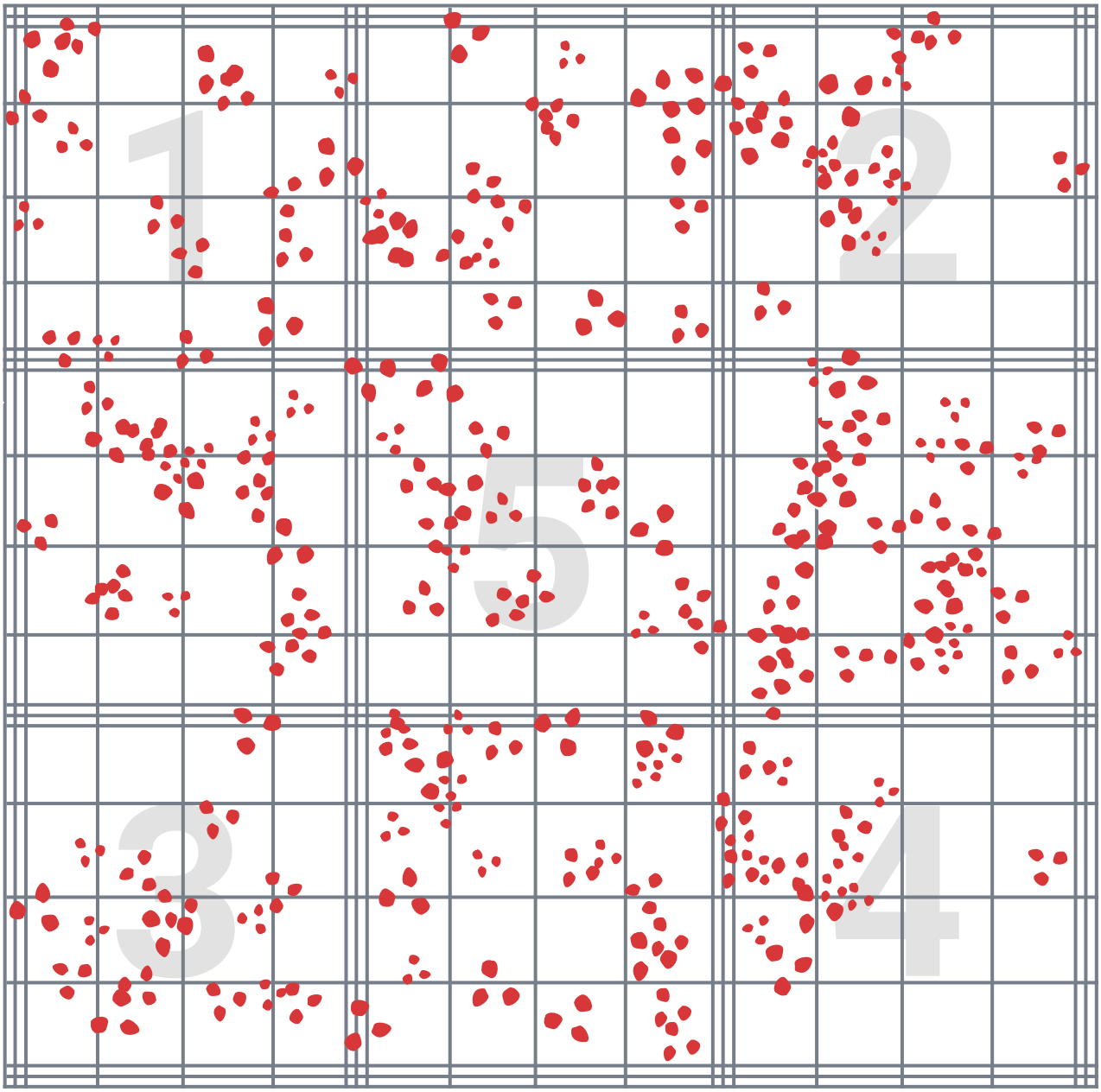




REFERENCES:
- BROWN, B.A., HEMATOLOGY: PRINCIPLES AND PROCEDURES. 6TH ED., PHILADELPHIA: LEA AND FEBIGER, 1993.
- RBC DETERMINATION FOR MANUAL METHODS, UNOPETTE MICRO-COLLECTION SYSTEM, PRODUCT CIRCULARS 5804 AND 5853, BECTON-DICKINSON, RUTHERFORD, NJ 07070.

HEMOCYTOMETER IMAGE BY POLARTREC)

HEMOCYTOMETER CHAMBER 1



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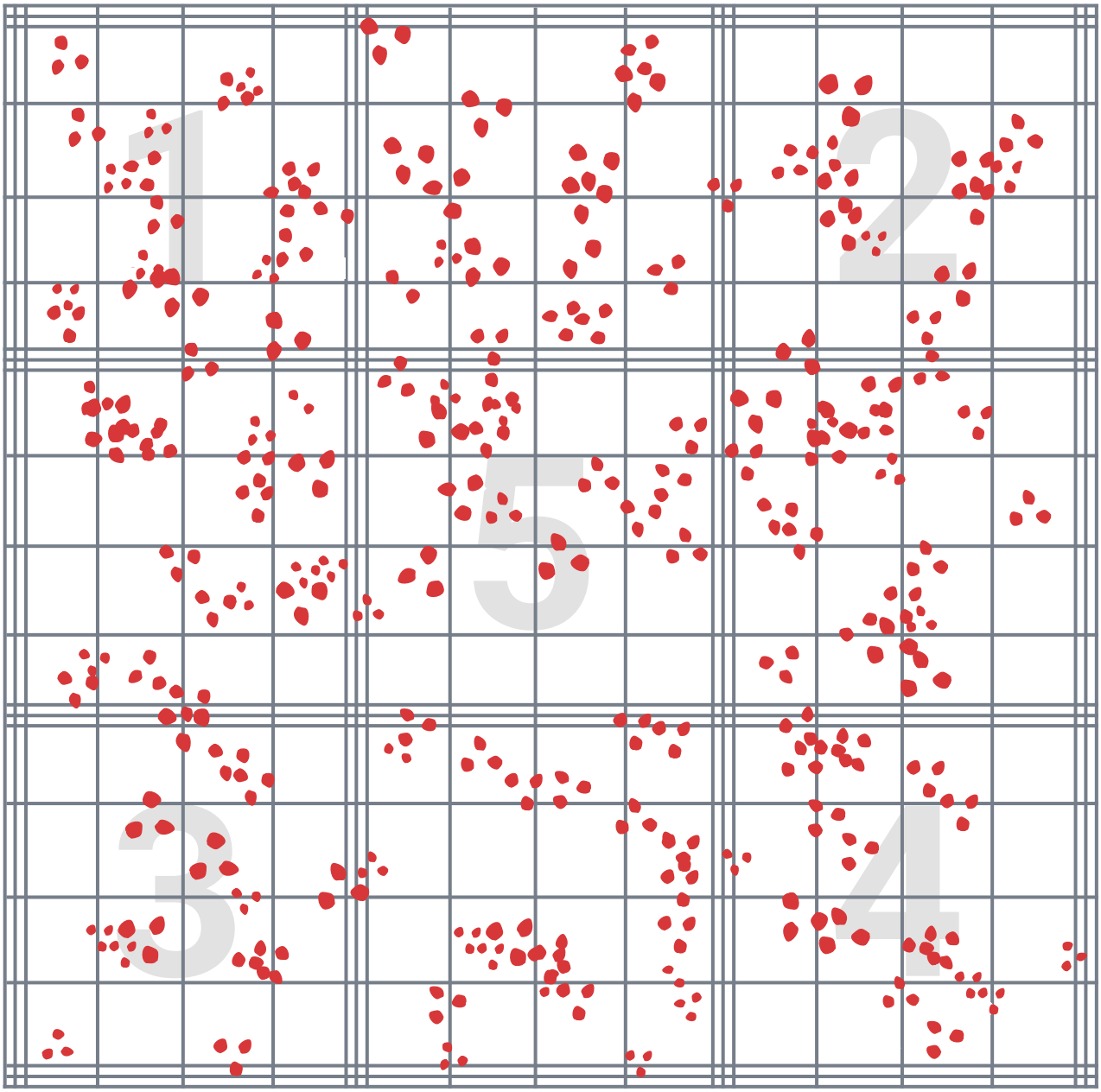
HEMOCYTOMETER CHAMBER 2



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CONSIDERING CAREERS

Expected time: 1hr 30 min

Key terms: National Science Foundation (NSF), job fair

Objective

Students will consider careers in marine science and compare their personal skills and interests.

Overview

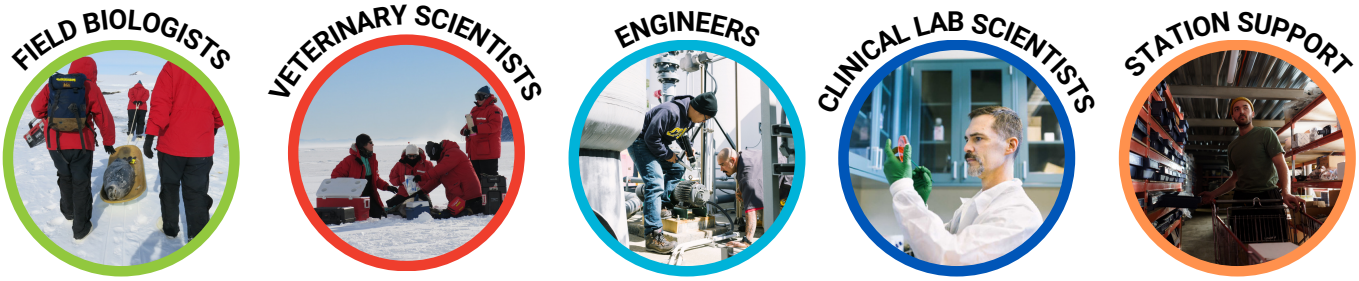
Students will consider how their personal skills and interests could be applied to support ocean conservation by exploring career prospects, job responsibilities, and skills of various marine science careers and supporting roles.

Materials

- McMurdo Station Video
- Reflection Questions
- Example Prompt
- Career Profiles

Preparation

- Team B-030 photo, McMurdo Station Video may be projected or printed to display for the class.
- Write some of the Reflection Questions and the Example Prompt on a whiteboard.
- Print and set up multiple Career Profiles throughout classroom for student viewing.



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Warm-Up

Guide students to reflect on their experience as a marine field biologist, veterinary scientist, or clinical lab scientist in the previous session(s). First, ask students to identify the skills they used during the session(s). Have them consider what they felt was easy or difficult about the work. Remind the students that it is okay if they do not enjoy all the work that they experienced. Encourage them to consider what they enjoyed the most and ask them to weigh the pros and cons of the role(s) by writing it in a notebook. Invite them to think about what skills and interests they have that they did not get a chance to apply. Ask them how they would use their unique skills and interests to support marine science and ocean conservation.

Revisit the McMurdo Station Video to refresh on the many kinds of jobs and work there. As students watch the video, they should revisit their previous notes about the types of equipment, facilities, and jobs that they noticed are needed to survive in Antarctica. After the video, have the students turn to a partner and share something new that they learned or observed in the video differently following the additional sessions they've now participated in.

Remind the students that no matter the role, each person at McMurdo Station contributes their own skills, interests, and personality that supports the research that takes place there. In this session, we'll be reflecting on the unique skills and interests that we all contribute and how that could translate to a role like those on or supporting Team B-030.

Share a handful of Reflection Questions. Invite students to write their thoughts in a journal or notebook.

REFLECTION QUESTIONS:

- *How would your friends or family describe you in three words?*
- *Which class projects or accomplishments in your life have you enjoyed doing the most and why?*
- *What have been your most and least favorite classes to date and why?*
- *What has been your favorite internship/job? Extracurricular activity? Hobby?*
- *Do you enjoy group projects or prefer to work independently and why?*
- *Do you like to ask questions?*
- *Do you consider yourself a problem-solver and why?*
- *Do you consider yourself creative and why?*
- *Do you like to work with your hands and why?*
- *What motivates you to do your absolute best and why?*
- *Do you like to be outside or prefer the indoors? Explain.*

Guided Class Activity

Explain to the students that today they are prospective job seekers at a job fair hosted by the **National Science Foundation** (NSF), one of the leading funders of scientific research in the United States.

A **job fair** is a great opportunity to learn about different opportunities and sometimes even apply or interview for a position. A prospective employer will want to learn about your skills, qualifications, and interests, but it is equally important for you to learn about the role and work environment to explore if it aligns with your interests.

There are various Career Profiles set up around the class with information about current jobs for hire that either conduct or support the Weddell seal research of Team B-030. Each profile has a summary of the responsibilities, prior experience, and skills needed to apply for roles listed. As students explore the profiles, have them take notes on two to three roles that they would like to "apply" for based on their personal skills or interest in obtaining the experience needed and skills desired for the field.

To "apply" for the job, students will describe why they feel they are a good fit for the job(s) they chose. Strong applications will support their selection with evidence of how their personal skills could be used to complement the role or an explanation of why they are interested in working towards the experience and skills needed. Share the example prompt below with the class by writing it on a whiteboard.

EXAMPLE PROMPT:

I believe I would make a great _____ (job title) because I have _____ (prior experience) and _____ (these skills). My experience and skills will help me succeed because _____ (how my prior experience and skills can apply to the responsibilities of role). I am also interested in _____ (something that I want to learn how to do or learn more about the job) because _____ (why I am interested in learning more).

Think and Reflect

To “interview” for the position, have students pair share the roles they chose and why. Then, have each student share what they learned about each other with the full class to expose students to careers that they may not have considered.

Remind students that each person at McMurdo Station contributes their own skills, interests, and personality that supports the research that takes place there. The same is true for all types of conservation work across the globe, whether it happens in Antarctica or right in their own communities! No matter where a student lives, they can play a role in helping to address problems affecting our ocean, like climate change. Whether it be through a future career choice, or by taking action now to reduce use of fossil fuels, and supporting critical science around the world, everyone can help protect people and animals from harm. Encourage students to continue thinking about what they are most interested in that relates to this work and how they could apply their own unique skills to ocean conservation no matter what career path they pursue. Especially when it comes to global issues like climate change and ocean conservation, it will take everyone's participation to make a difference.

Session Adaptations

Easy adaptation: Simply adjust the depth of exploration by guiding students to select a broad field of study or identify a specific job title from the career profiles.

Deep dive: This session explores careers more closely related to the current research question. Discover even more about the full array of careers available in Antarctica and learn more about them. The Australian Antarctic program also has great information about the salaries and training requirements for various specific roles.

Assessment

At the conclusion of this session, students should be able to:

- Identify and explain their interest in marine science and ocean conservation careers

Continue your learning

For additional learning or for related content designed for older or younger audiences, we invite you to check out our other online learning resources.

LEARN MORE

WE WANT TO HEAR FROM YOU!

The Marine Mammal Center's mission is to advance global ocean conservation through rescue and rehabilitation, scientific research, and education. We can't do it alone and invite you to be part of our community! There are many ways for you and your students to get involved from volunteering to fundraising to following us on social media or signing up for our newsletter. We especially love hearing from educators on how we can best support you at learn@tmmc.org and invite you to share any feedback or student work as you implement these sessions.

The Marine Mammal Center®

REFERENCE LIST

LINKED URL's
In order of appearance

https://www.nextgenscience.org
www.marine-ed.org/ocean-literacy/overview
https://www.marinemammalcenter.org/science-conservation/conservation/climate-change
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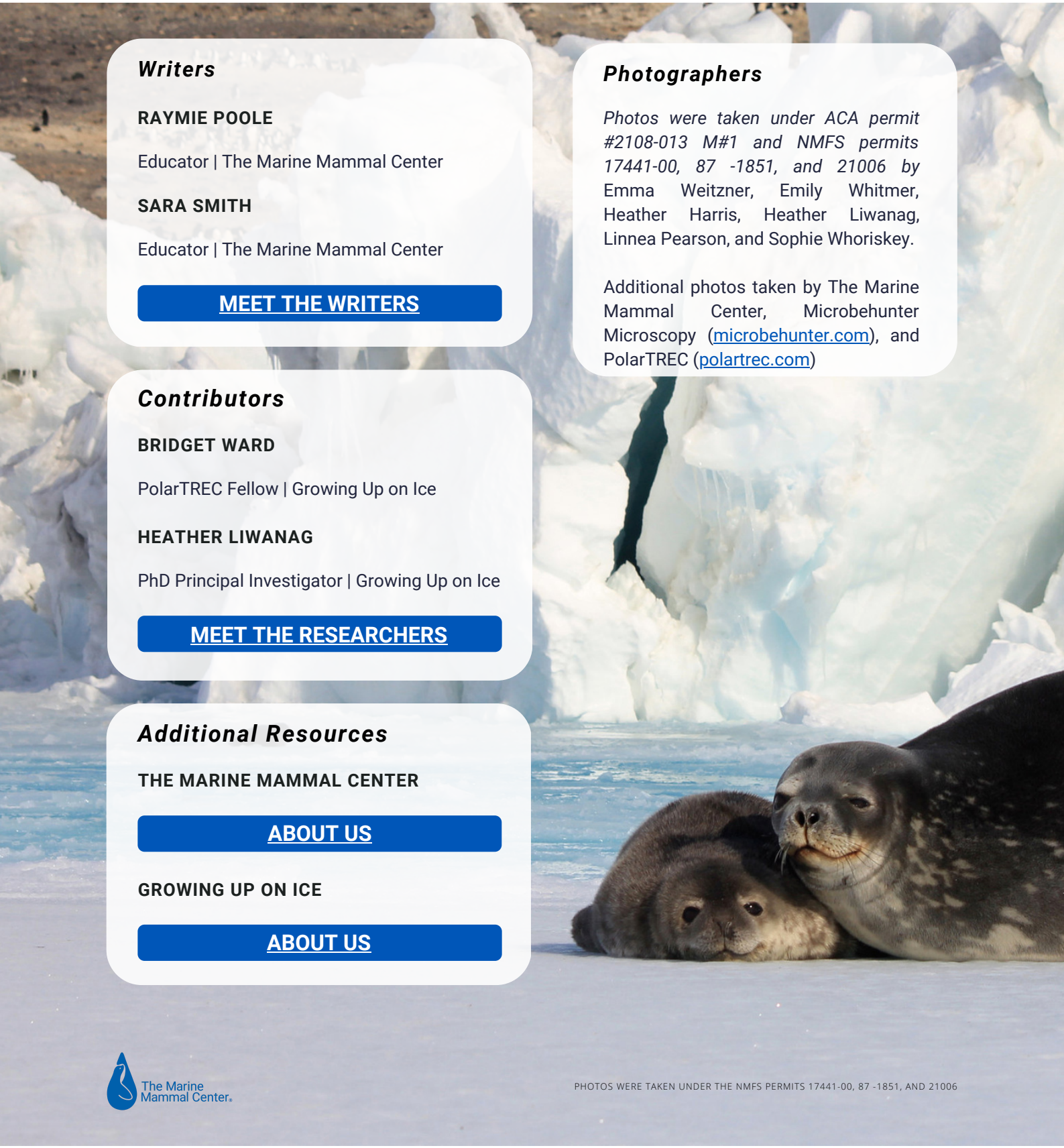

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