

Story of an Antarctic Research Team

By Amy Osborne

(underlined sections have visuals that are attached)

Can have students act it out!

You have been transported to the most southern continent on earth...Antarctica. As you look around it is mostly white. There are some snow covered mountains with dark rock peeking out. Then there is the sea that is covered in ice. A flat vast area of white ice where in warmer months you might see ocean.

You are joining Dr. Amy Moran and her team of researchers on an expedition across the sea ice. Dr. Moran and her team are excited to conduct research in Antarctica, especially since the ocean near McMurdo Station, Antarctica is a fairly constant temperature of -1.8°C . It is, also, somewhat isolated from the rest of the world's ocean water due to the Antarctic Circumpolar Current that keeps the water flowing in a clockwise direction around Antarctica.

You get into a red vehicle, called a Pisten Bully, with tracks, like a bulldozer or tank, that move it along the ice and thin layer of snow that covers the sea. As you bump along across the sea ice in the back of the vehicle you stare out the window at the blowing snow and red flags that mark the "road". After 45 minutes you make it to your destination... a blue and yellow one room small building with a hole in the floor known as the dive hut. You help the researchers and divers unload SCUBA tanks and bags filled with dry suits from the back of the vehicle. Dry suits will keep the divers dry when they are in the frigid water. Some of the divers even wear heated vests under their dry suits!

You take everything into the small building and try to stay out of the way as the divers put on their dry suits and all of their SCUBA gear. As they sit around the hole in the floor which leads through the sea ice to the ocean below, the divers talk about what they are collecting that day...marine ectotherms (animals that get their body temperature from their environment...also known as cold-blooded). They are specifically looking for sea spiders, nudibranchs also known as sea slugs, and any egg cases they can find.

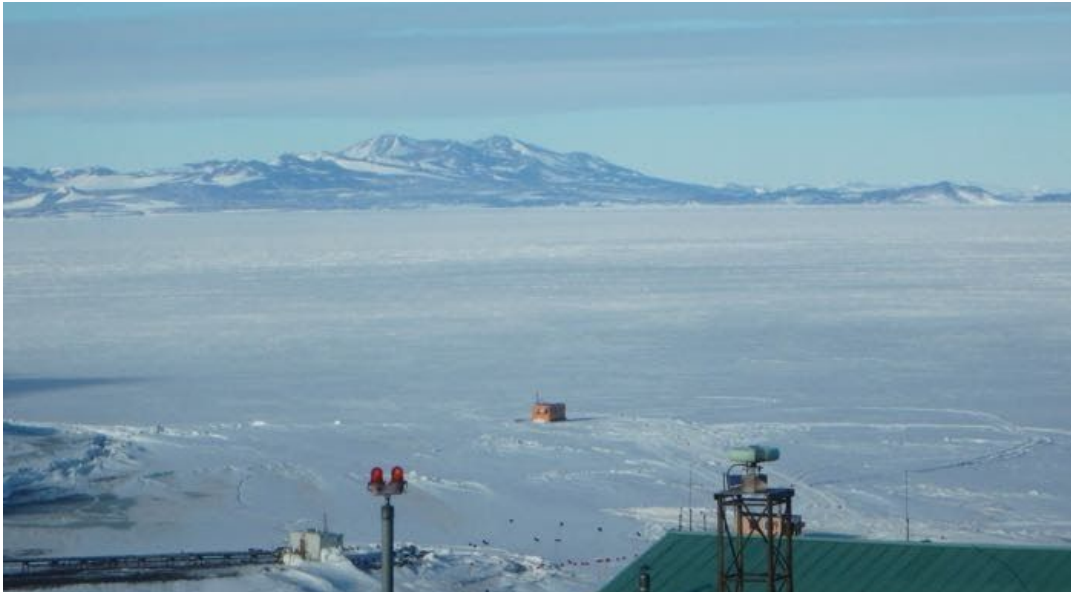
Once all of the divers have jumped through the hole to the frigid waters below you and the other dive tender keep an eye on the water in the hole for any signs of bubbles meaning a diver is coming up. You also use your scientific equipment to measure oxygen levels, salinity, and temperature of the water, and heat up lunch for everyone on the small stove that is in the dive hut. When you see bubbles rising in the dive hole you

prepare to grab the divers fins and SCUBA tanks before they climb up the ladder out of the water.

Once the divers are out of the water they begin to pull up what they have collected...sea spiders-eight legged creatures that are brown and yellowish orange, some are about the size of the lid to a peanut butter jar, some males are carrying orange colored eggs- and nudibranchs-sea slugs that are white and look like fancy snails without a shell- and some sea slug egg cases that look like spiraled white string.

The collected animals are put into a large yellow cooler filled with ocean water. You all eat some lunch and the divers change out of their dry suits. The gear, animals, and people are loaded back into the Pisten Bully and you all bump your way back to the snow covered land and the aquarium where the animals will be stored and observed.

Photos for “Story of An Antarctic Research Team”



A sea covered in ice known as sea ice near McMurdo Station, Antarctica. Photo by Amy Osborne, courtesy of ARCUS



Pisten Bully on the sea ice near McMurdo Station, Antarctica. Photo by Amy Osborne courtesy of ARCUS



Driving along a sea ice “road” in Antarctica. Photo by Amy Osborne, courtesy of ARCUS



PolarTREC educator, Amy Osborne, enters a dive hut which has been placed on the sea ice near McMurdo Station, Antarctica. Photo by Denise Hardoy courtesy of ARCUS



SCUBA tanks that divers use to help them breathe when going underwater. Photo by Amy Osborne, Courtesy of ARCUS



Dressed in dry suits, science divers and researchers Dr. Amy Moran and Aaron Toh prepare to dive through a hole in the ice into the frigid waters below. Photo by Amy Osborne courtesy of ARCUS



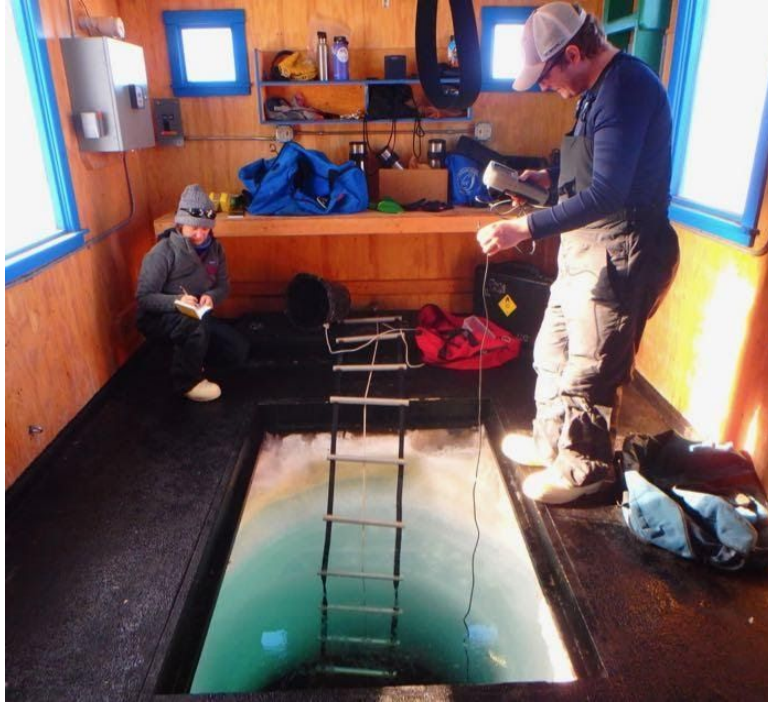
Nudibranch egg case. Photo by Amy Osborne, courtesy of ARCUS



Sea spider (*Ammonothea*) with egg cases. Photo by Amy Osborne courtesy of ARCUS Crary Lab, McMurdo Station, Antarctica (2019)



Dive tender and PhD student Graham Lobert helps diver and PhD student Aaron Toh, dressed in a dry suit, with his collecting device and flashlight. Photo by Amy Osborne, courtesy of ARCUS



PolarTREC educator Amy Osborne and PhD student Graham Lobert take salinity, oxygen, and temperature measurements of the ocean. Inside a dive hut on the sea ice in Antarctica. Photo by Anne Todgham, courtesy of ARCUS



Researcher Dr. Amy Moran and Graham Lobert put sea spiders into a cooler of sea water to transport them back to the lab. Photo by Amy Osborne courtesy of ARCUS



PhD students Graham Lobert and Aaron Toh look at nudibranch eggs under a microscope and record what they are seeing. Cray Lab, McMurdo Station, Antarctica, Photo by Amy Osborne courtesy of ARCUS



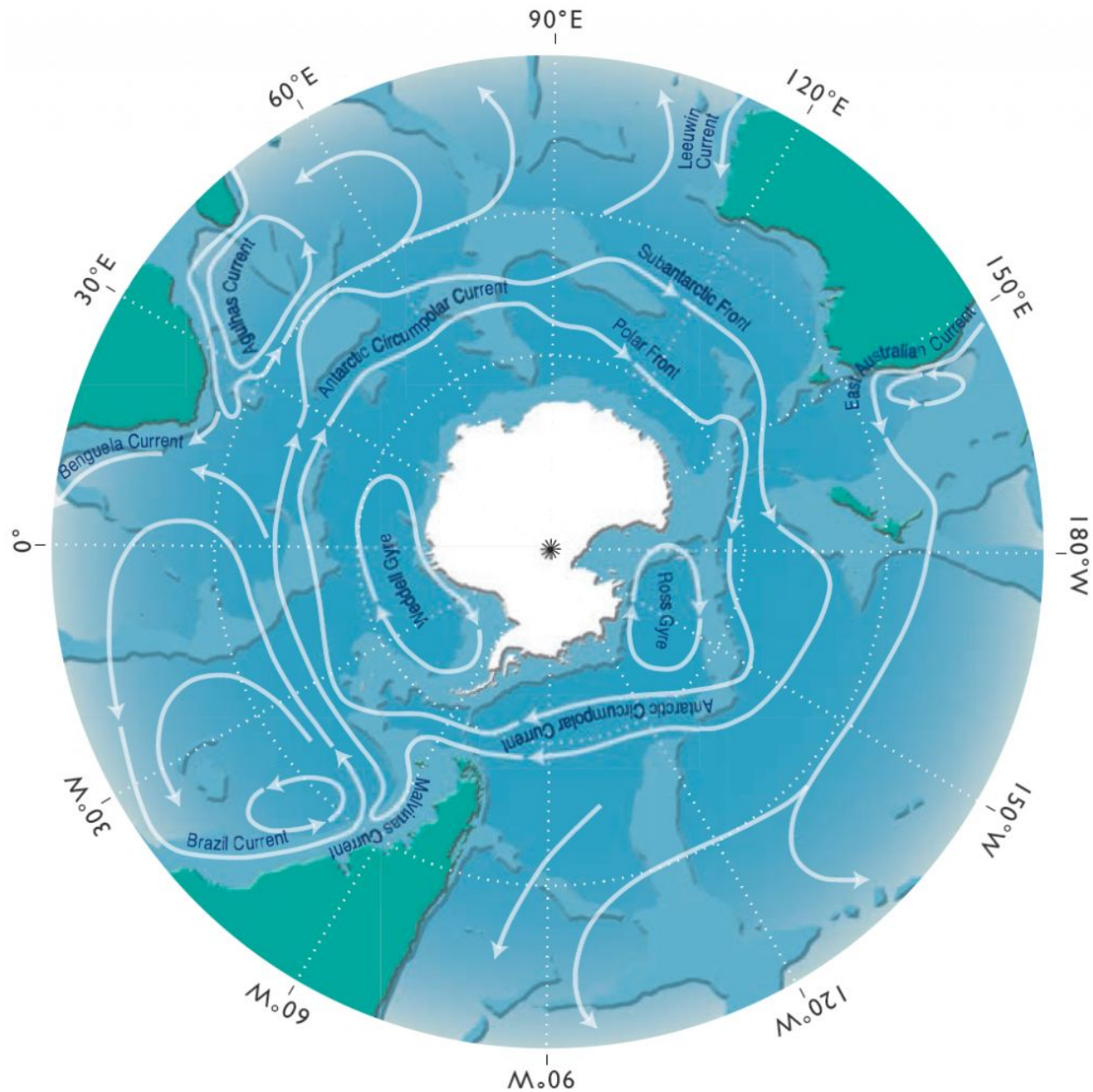
Underwater in Antarctica, researcher and diver Dr. Amy Moran searches for and collects sea spiders, nudibranchs, and their eggs. Photo by Tim Dwyer, courtesy of ARCUS



Adult nudibranch (*Tritonia challengeria*) Photo by Amy Osborne, Courtesy of ARCUS



Adult sea spider (*Ammonothea*) Photo courtesy of ARCUS by Amy Osborne, Crary Lab, McMurdo Station, Antarctica (2019)



“The major ocean currents south of 20°S are shown by the arrows. The largest current in the world, the Antarctic Circumpolar Current, circles from west to east around Antarctica. This current creates a fairly isolated marine ecosystem in the ocean around Antarctica. As a result, warm subtropical waters are kept away from the continent and the ocean temperature in the Southern Ocean is fairly constant. Around McMurdo Station the ocean temperature stays constant at around -1.8°C” (Diagram courtesy of Academic Press / de Vos Design) (Photo: Academic Press / de Vos Design)

Name:	HERMIT CRAB INQUIRY DATA COLLECTION SHEET						Date:
Trial	Temperature- WARM container	Time for hermit crab to emerge in WARM container	Temperature- neutral	Time for hermit crab to emerge in neutral container	Temperature -COLD side	Time for hermit crabe to emerge in COLD container	Notes
1							
2							
3							
4							
5							
6							
Average Temp/Average time for hermit crab to emerge							

SCIENTIFIC INVESTIGATION- ANTARCTICA STYLE



Note to teachers:

- Print these two sided
- These can be used to introduce science investigations using research conducted in Antarctica in Fall 2019 and 2021 as an example!
- They can also be used to help students develop their own investigations.

OBSERVATION

In Antarctica the ocean is a frigid -1.8°C (29°F) and often has ice on top of it called sea ice. There is a variety of wondrous life underwater.



It is cold and windy on the sea ice in Antarctica.



Sea Spider, sea stars on the Antarctic ocean floor.(Photo by Tim Dwyer)

What are you observing about the topic you are researching?

Prior Knowledge

Antarctic ocean researcher Dr. Amy Moran knows that sea spiders and nudibranchs live in the cold waters of Antarctica.



Nudibranch



Dr. Moran



Sea Spider

She knows these animals are cold-blooded (ectotherms), meaning their bodies cannot control their temperature.

Dr. Moran also knows that these animals have survived in constant cold temperatures for millions of years. They are sensitive to small changes in water temperature.

Dr. Moran knows that, due to global climate change, the temperature of the ocean water is getting warmer.

What do you know or think you know about the topic you are researching?

Asking Questions

Dr. Moran wondered:

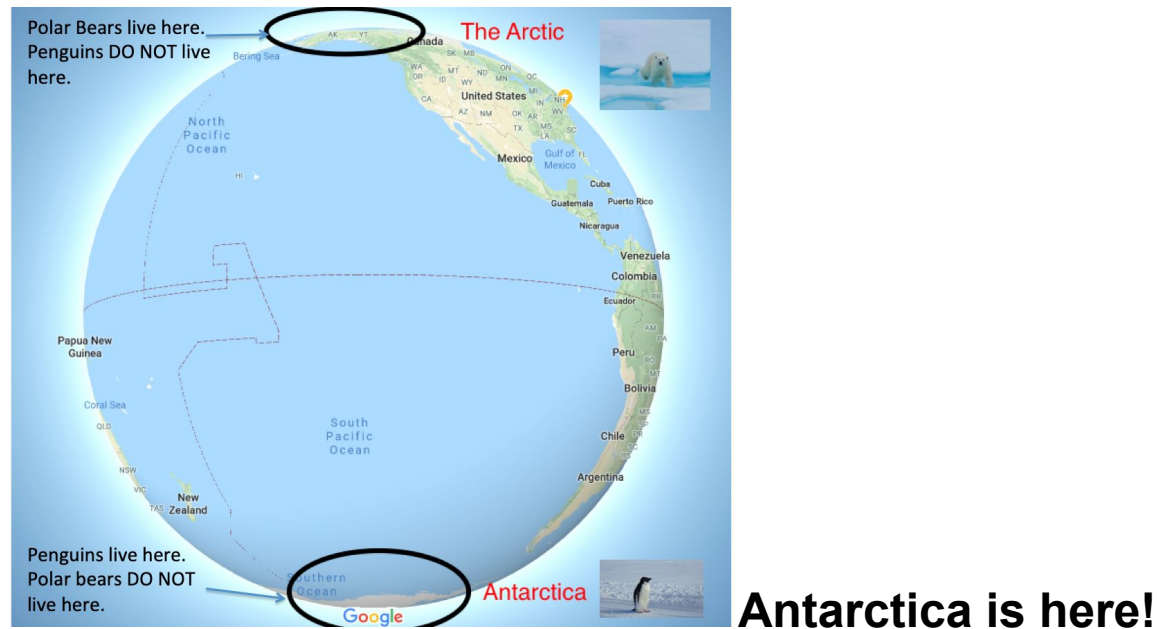
Will changing ocean temperatures affect the growth and development of marine ectotherms?



What questions do you have about the topic you want to research?

Choosing a Question

Dr. Moran received a grant from the National Science Foundation to spend two summer seasons in Antarctica running tests to find the answers to her question.



Look at the questions you asked and choose one to investigate.

To choose your question, ask yourself...

- **Is it testable-can it be answered by experimenting?**
- **Is it specific?**
- **Do you have the time to test it?**
- **Do you have the resources to test it?**

HYPOTHESIS

Dr. Moran and her team have worked with sea spiders before and know, from other researchers, that marine invertebrate growth can be affected by warming ocean temperatures.

They hypothesize that the growth of the animals they are studying will speed up under warmer water conditions. They also hypothesize that this sped up growth will affect the way the animals develop.



Nudibranch Eggs (Photo by A. Toh)



Faster and different



Adult Nudibranch

Now that you have chosen your question to investigate, use what you know and have observed to write your hypothesis.

PLANNING THE INVESTIGATION

The steps the Antarctica research team took to do their research:

1. Collect sea spiders, nudibranchs, and their eggs from the ocean around Antarctica



Sea Spider with eggs

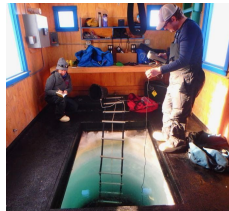


Dr. Moran diving in Antarctica
(Photo by Tim Dwyer)



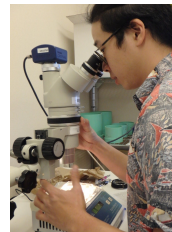
Nudibranch egg case

2. Measure and record the temperature of the water and amount of oxygen in the water.



PolarTREC educator Amy Osborne and PhD researcher Graham Lobert measure and record oxygen, salinity, and temperature of the water under the sea ice in Antarctica.
(Photo by Anne Todgham)

3. Observe eggs and larvae exposed to different temperatures and record observations.



Aaron Toh observes eggs
under a microscope

4. Analyze the data.



PhD researcher Aaron Toh
compiles and analyzes the data so far.

What steps will you take to conduct your investigation?

All photos by Amy Osborne, unless otherwise noted, (PolarTREC 2019) courtesy of ARCUS.

MATERIALS and TOOLS (1)

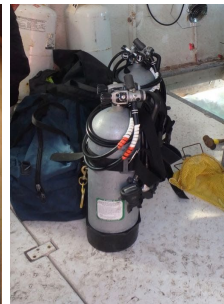
To conduct her experiments Dr. Moran needed to collect animals from the ocean and then study them in the lab.

She needed more researchers to help her do her experiments and more divers to help her collect the animals she needed.

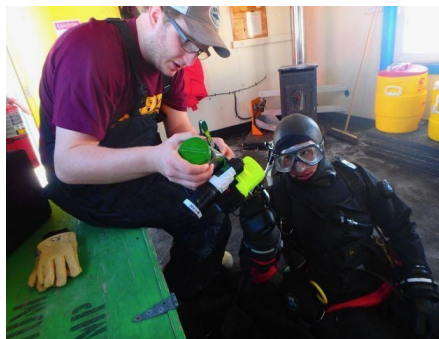
Science divers prepare to dive through a hole into the icy ocean below.



To collect under water the dive team needed: a Pisten Bully to help travel on the sea ice, a collecting container with a flashlight, SCUBA gear, a hole in the ice with a dive hut over it to stay warm.



The team needed people to make sure the divers stayed safe (aka dive tenders) and collect more data.



PolarTREC educator Amy Osborne (Photo by Anne Todgham) and PhD student Graham Lobert dive tended and collected data while the divers were in the water.

What human resources and tools will you need to conduct your research?

All photos by Amy Osborne, unless otherwise noted, (PolarTREC 2019) courtesy of ARCUS.

MATERIALS and TOOLS (2)

Once the research team brought the animals back to the lab they needed tools to make observations and identify animals.



ID charts for nudibranch and sea spider growth



Welled trays to look at eggs under a microscope



Nudibranch egg case under a microscope

To learn how animals grow at different temperatures, they needed a way to keep the eggs they were studying at specific temperatures.



PhD student Graham Lobert observes embryos in a thermal block. A tool designed by the research team that creates a temperature gradient in water.



PhD student Aaron Toh looks in an incubator set at a very cold temperature

Are there any additional tools you will need to conduct your research?

EXPERIMENTING
and
RECORDING
RESULTS and
OBSERVATIONS

Dr. Moran and her team looked at and recorded the way the embryos and larvae of sea spiders and sea slugs changed over time under different water temperatures.



PhD students and researchers Aaron Toh and Graham Lobert observe and record the growth of sea spiders and nudibranchs under different water temperatures.

How will you record your data?

Begin experimenting!

ANALYZING DATA

Dr. Moran along with her research team of Aaron Toh and Graham Lobert used a computer to help them compile their data and look at in a way that they could better understand the data they gathered.



Aaron Toh uses a computer to compile and analyze data.

Look at the data you collected.

How can you present the information in a way that you can easily understand it, like using a graph?

What do you notice about the data you collected?

CONCLUSION

What are they finding out?

The research team is learning that as ocean temperatures increase the sea spiders and nudibranchs develop more quickly.



Faster

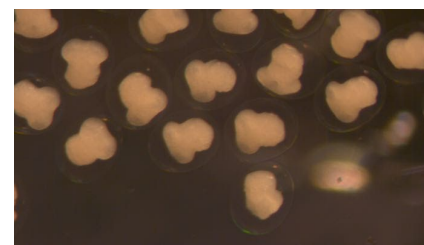


Faster

Ocean Temperature



Sea Spider Eggs (Photo by A Toh)



Veliger stage of Nudibranch (Photo by A Toh)

Larvae of these invertebrates are really sensitive to warmer temperatures! They develop a lot faster when the water is a little warmer than usual.

What can you conclude from the data you gathered?

MORE EXPERIMENTING AND MORE QUESTIONS

Now What?

The Antarctic research team is running some long-term experiments throughout 2019-2022.

They will be in Antarctica for two seasons doing their research.



They will take some of their specimens back to Hawaii and run more tests in the lab there.

What questions do you still have about your investigation?

How might you change parts of it and re-run your experiments?