

# Welcome to *PolarConnect*



## Antarctic Fish Development Under Future Ocean Conditions

With PolarTREC Teacher Denise Hardoy  
& Team Researcher Dr. Anne Todgham

**November 20<sup>th</sup>, 2019**

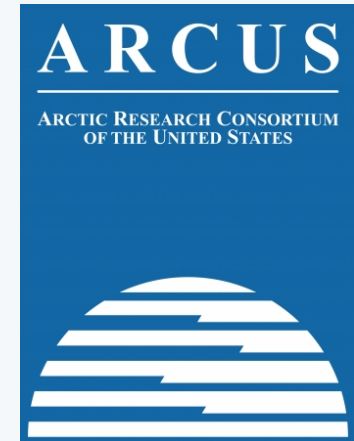
# Participant Introductions

**In the Chat box, please introduce yourself  
by typing in your:**

- ✓ Name
- ✓ School or Institution
- ✓ The number of students and adults participating with you in the same location

# What is PolarTREC?

- Since 2004, the Arctic Research Consortium of the United States (ARCUS), a non-profit organization, has been administering the PolarTREC Program.
- PolarTREC is professional development for U.S. middle and high school teachers and informal STEM educators. They are paired with researchers for 3-6 week research experiences in the polar regions.
- Over 150 educators from around the United States have joined scientists in the Arctic and Antarctica to learn about science, the polar regions, and to share what they have learned with their students and communities.



*25 Years of Connecting Arctic Research*  
[www.arcus.org](http://www.arcus.org)

# Questions

## During the Presentation:

- Type your question into the text chat box and we will insert your question when the right opportunity arises.
- Don't worry! If we haven't been able to ask your question during the presentation, we will save it for the end.
- At the end of the presentation, we often open the webinar up to family and friends who want to say "Hello" or have any last minute questions for the presenters.



# Meet our Team B-207



# Where in the World am I?



Photo Courtesy of NASA.gov



# What's so Cool About Antarctica?

- It is 1 ½ times the size of the United States
- It has the coldest temperature ever recorded on Earth(-128.6 ° F).
- It contains 70% of the world's fresh water
- If all it's ice melted, sea level would rise 200 feet
- Most of East Antarctica is covered by a one mile thick sheet of ice
- A treaty protects it from being claimed by any nation- to be used only for science
- Coldest, Windiest, Driest, Highest, Emptiest place on Earth



# The Arctic vs. Antarctica

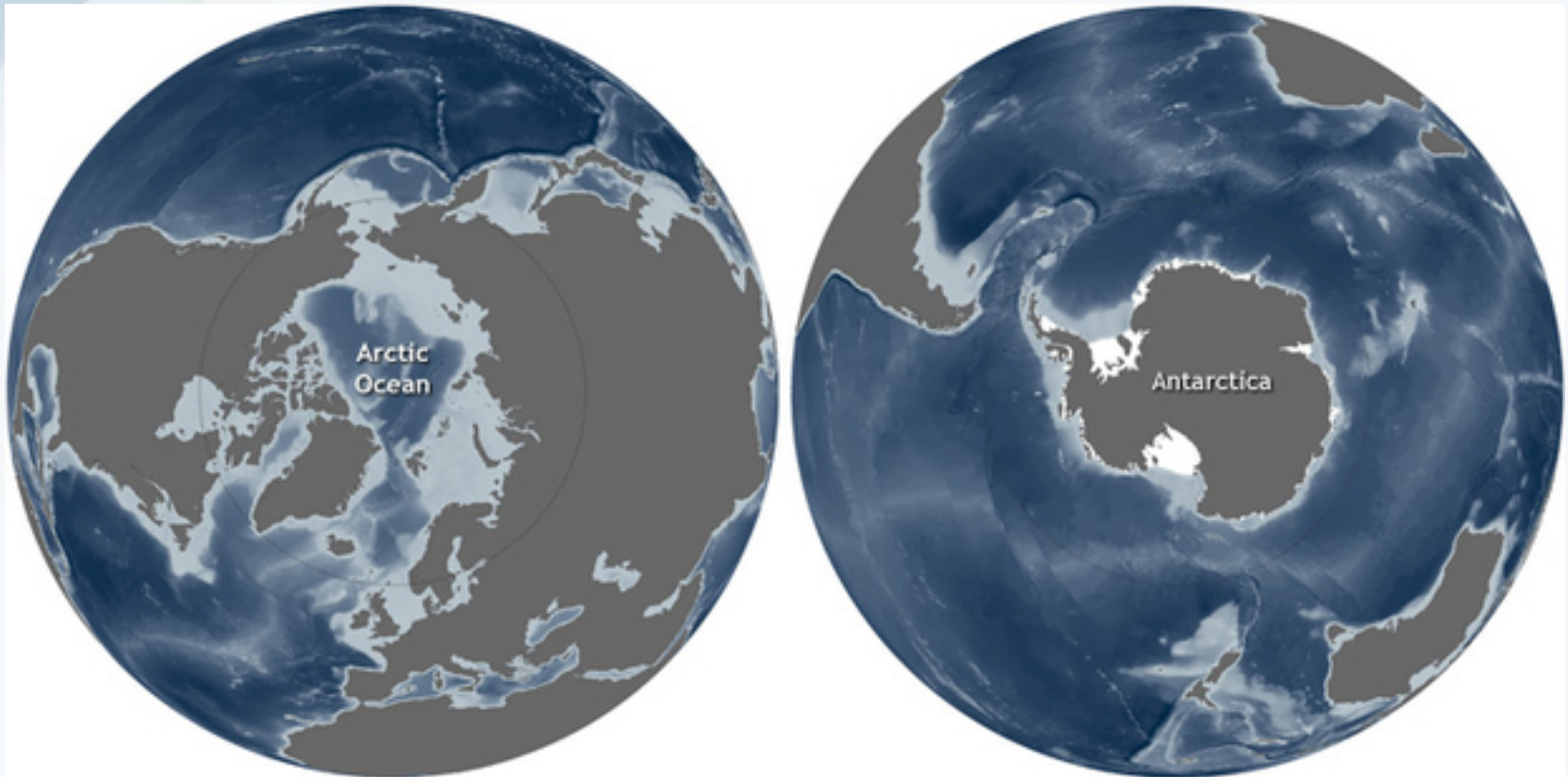


Photo courtesy of NOAA Climate.gov



# Polar Bears vs. Penguins

## Arctic

- Top of the world
- Polar bears Etc.
- Abundant wildlife
- Indigenous People-  
Inuit
- Warming temperature  
with declining sea ice
- Summer in July



## Antarctica

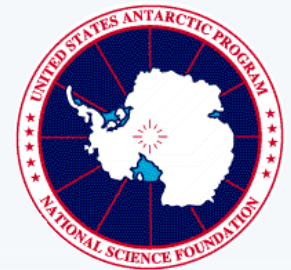
- Bottom of the world
- Penguins & Seals
- Few other terrestrial  
residents
- No indigenous people
- Variable temperature  
changes- Sea ice receding  
in west and growing in  
the east
- Summer in January



# McMurdo Station, Antarctica



- Only town that is for the sole purpose of science
- $77^{\circ}51' \text{ S } 166^{\circ}40' \text{ E}$
- Opened 1956 as Navy base
- Summer population 1,100
- Operated by the United States Antarctic Program - National Science Foundation



# Breathtaking Scenery



Royal Society Mountain Range- Part of the TransAntarctic Range



## Mount Erebus





TEACHERS AND RESEARCHERS  
EXPLORING AND COLLABORATING



# Cape Evans Ice Wall





# Amazing Food, Great People





# Getting Around

SnowMo



Mountain Bikes



MatTrax



Pick ups



Shuttle Van



Hägglund.



Piston Bully



Kress



# Staying Warm=Staying Safe

- We are required to wear our ECW-Extreme Cold Weather gear whenever we go off base.

Bibs, Bunny boots,  
and Big Red

Also need:

hat, *balacava*, neck gaiter, sunglasses, thermal base layer or two, fleece pants, fleece top, down jacket, extra thick wool socks, gloves and glove liners, goggles...extras of everything!





# Meet *Trematomus pennellii*

Juvenile- 18 months old & about 2 inches



Photo by Anne Todgham

- Very slow growing
- Long life span
- Range- Southern Ocean
- A very abundant species in this area
- Juveniles found mostly hanging out in platelet sea ice
- Adults found on sea floor.

Adult- 8-10 inches



Photo Credit: Rob Robbins

Temperature x Food



Mussels

Temperature x Salinity



© Garold W. Snoegas

SF Bay fishes

Temperature x Food x Disease

White Sturgeon

Temperature x Hypoxia



Chinook Salmon

How good are animals at multi-tasking when faced with lots of change?

Temperature x CO<sub>2</sub>



Notothenioids  
(across ontogeny)

Temperature x Hypoxia  
x Salinity

Native Oysters



Temperature x Air

Limpets



CO<sub>2</sub> x Hypoxia



CA Rockfishes

# Our Driving Question...

We are investigating how fish budget their energy demands when they are stressed out- like from increasing ocean temperatures and from decreasing pH due to increasing levels of carbon dioxide.

We want to know if they will be able to handle ocean conditions that are predicted because of climate change.



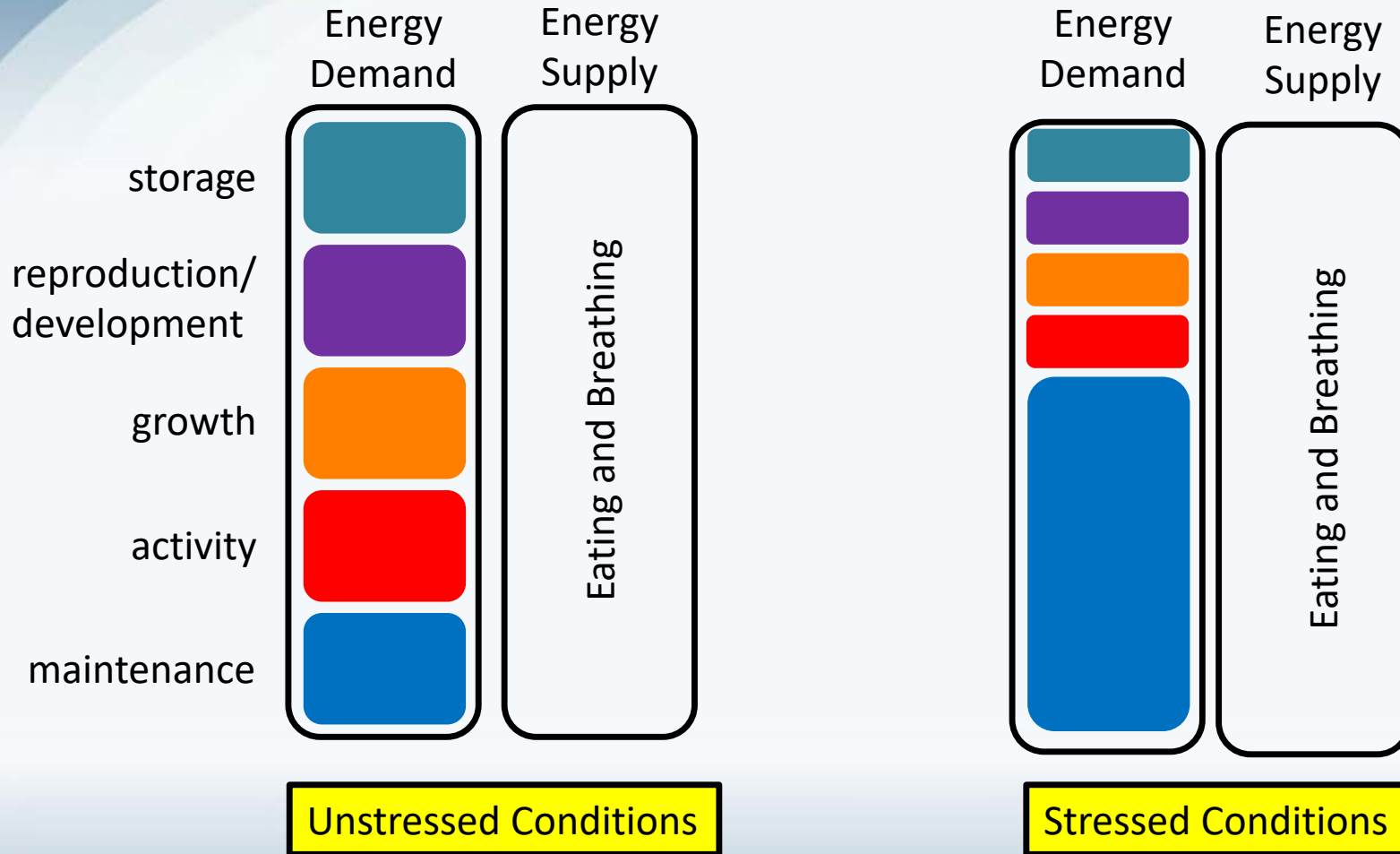
# Energy Budgets

How do organisms spend their calories?



Photo by Bridgette Ward Taken under ACA Permit number 2018-013 M#1 MMPA Permit Number 21006-01

# Balancing Energy Supply and Demand



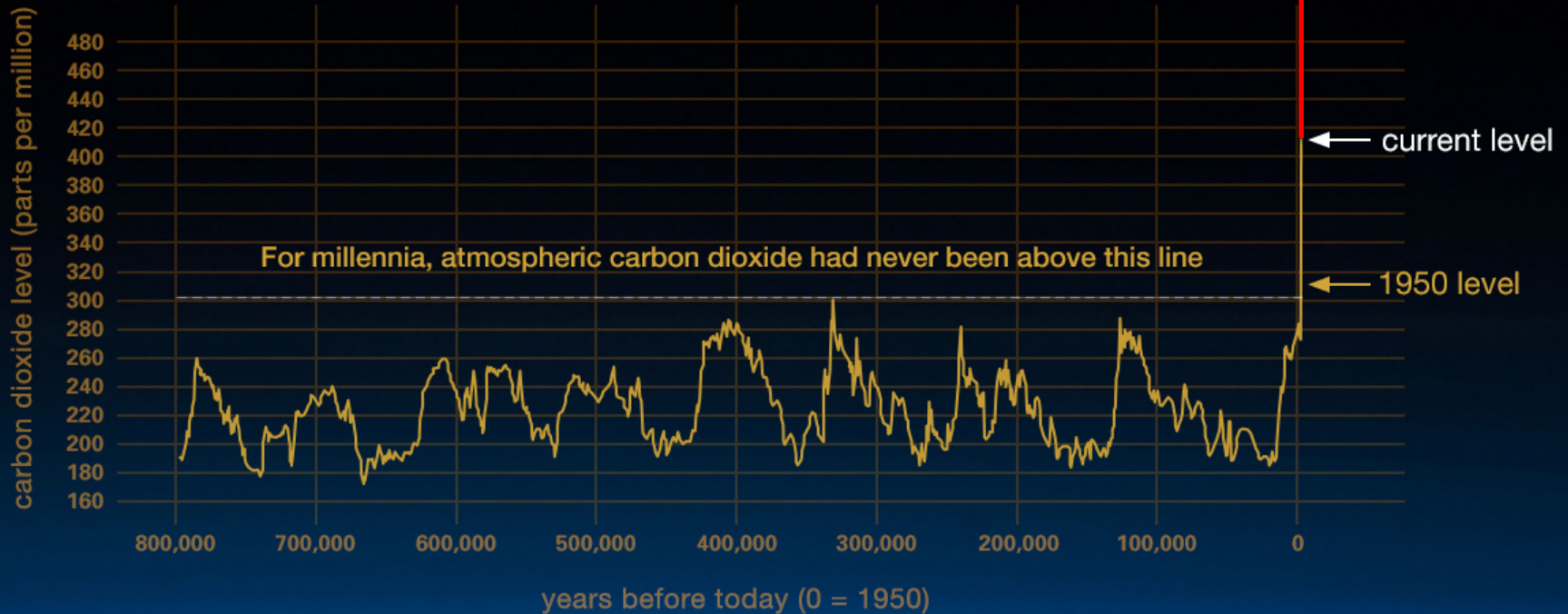
# What is the protocol based on?

- Projected carbon dioxide levels for best and worst case scenarios for the year 2100
- Projected 2100 ocean temperature is an increase of  $\sim 4^{\circ}$  C (from  $-1.9^{\circ}$  C to  $+2^{\circ}$  C).



# Carbon dioxide levels through time

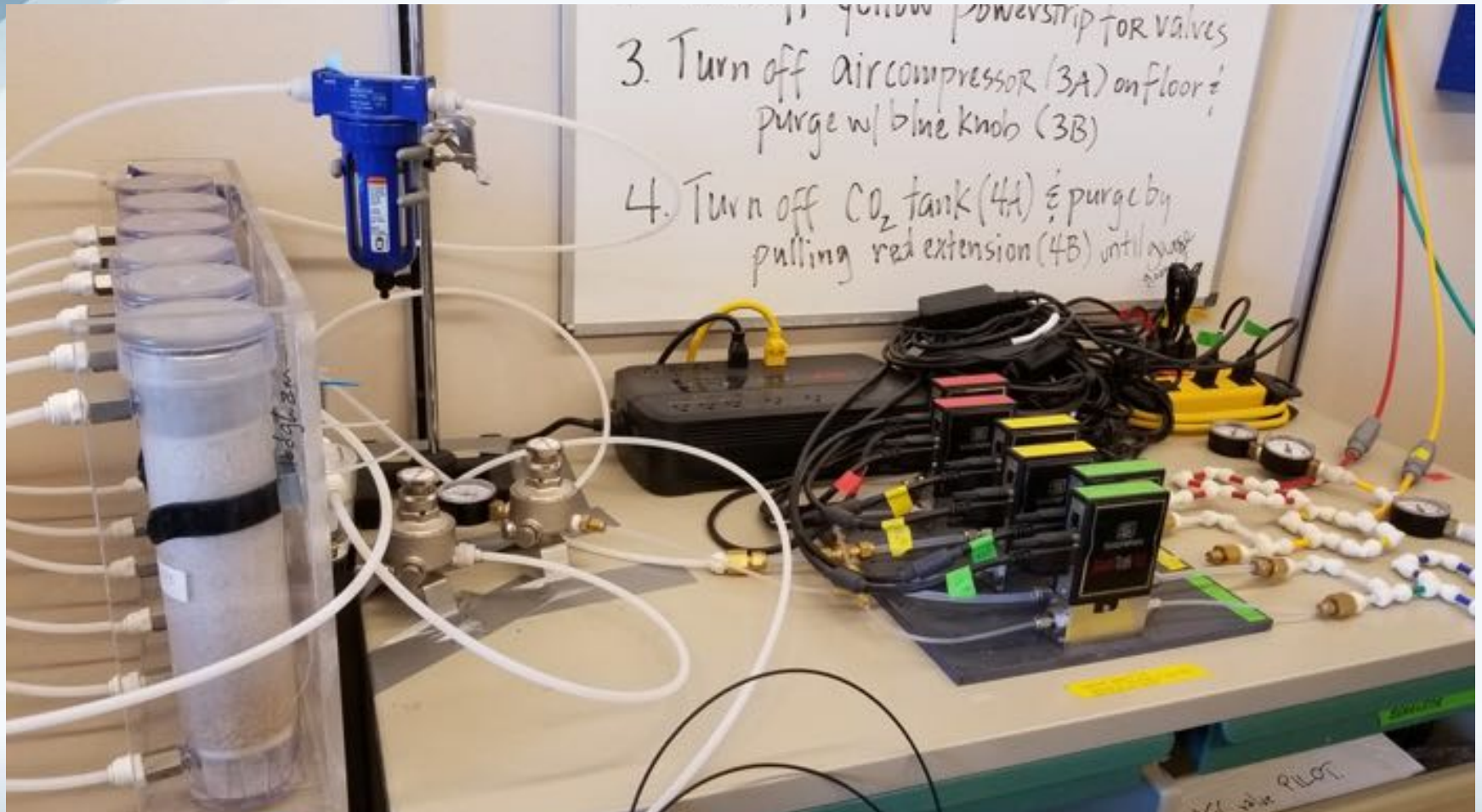
CO<sub>2</sub> levels are projected to reach ~1200 by 2100 (yes it is off the slide!)



Data from the Vostok Ice Core

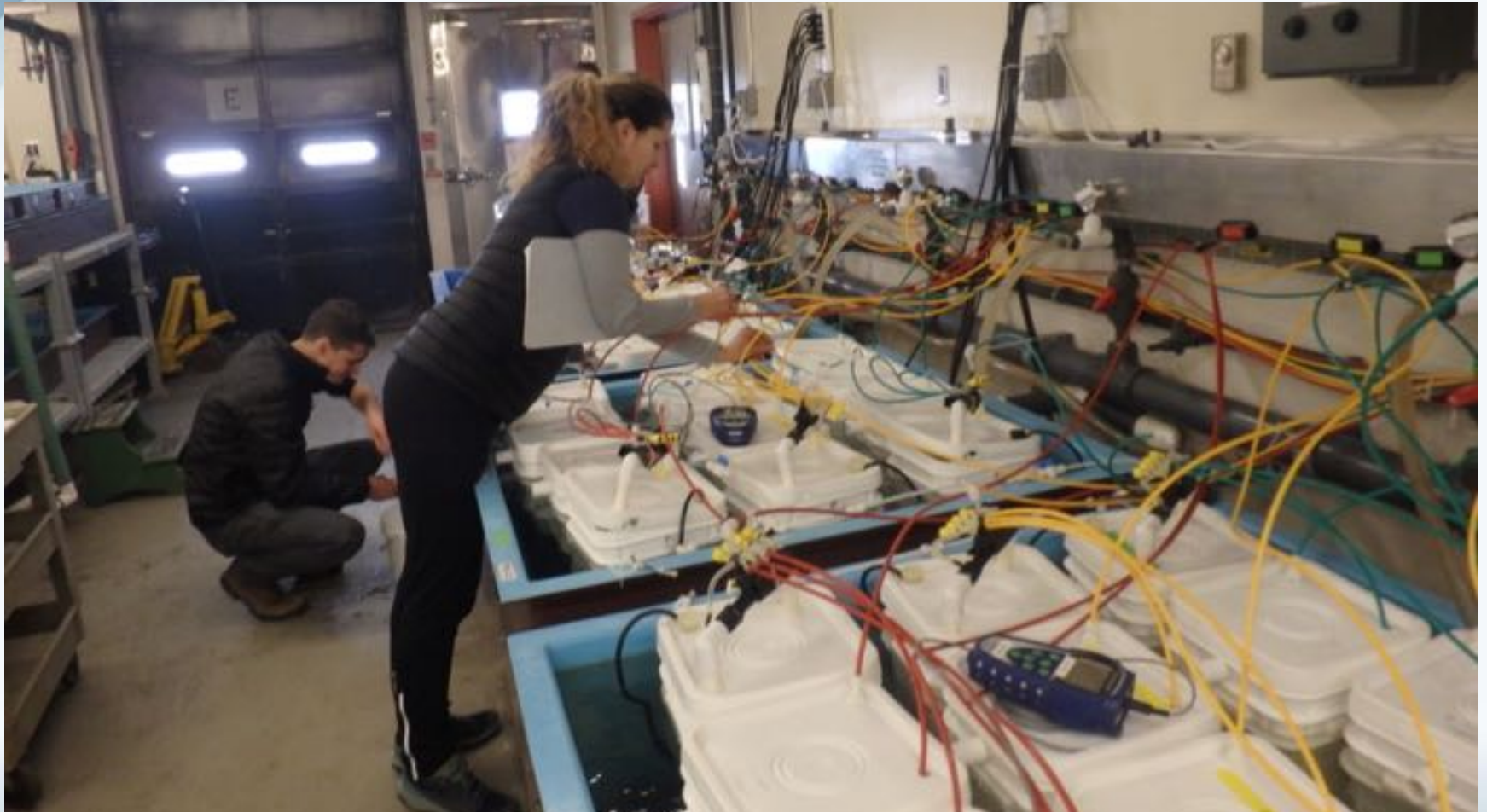
Petit, J. R. *et al.* (1999) Climate and atmospheric history of the past 420,000 years from the Vostok ice core, Antarctica. *Nature* **399**, 429-436.

# Carbon Dioxide System





# Setting up the tanks





# Diving for Juveniles



Photos Courtesy Steve Rupp and John Heine

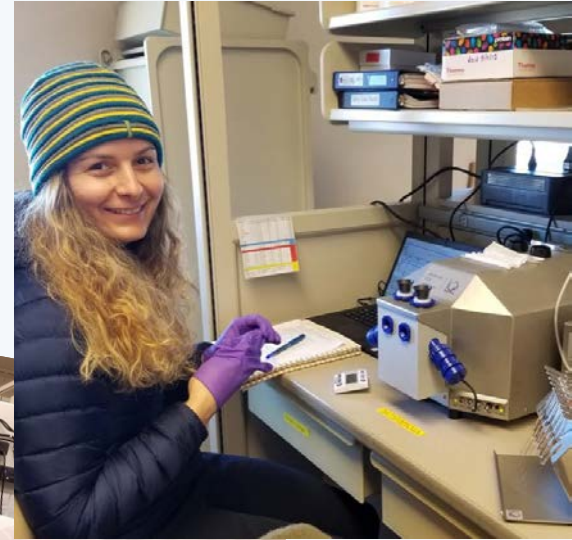
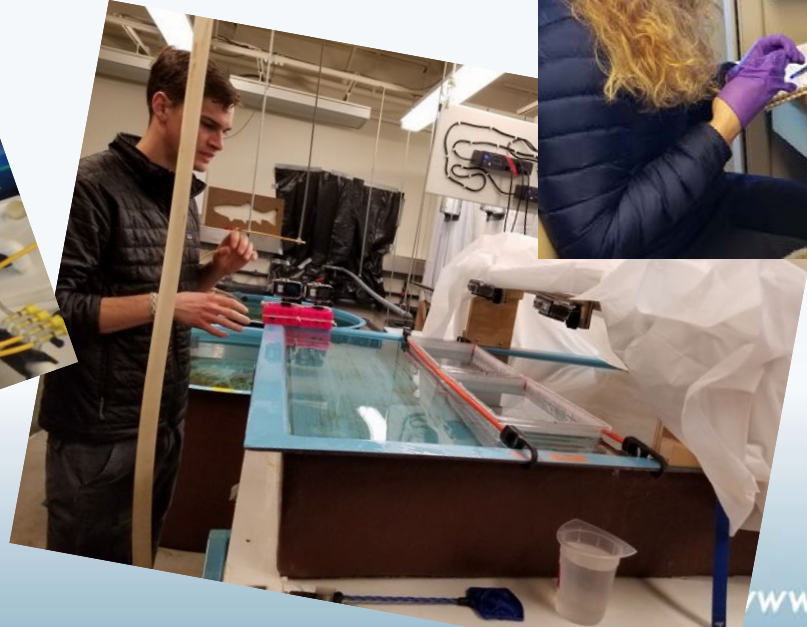
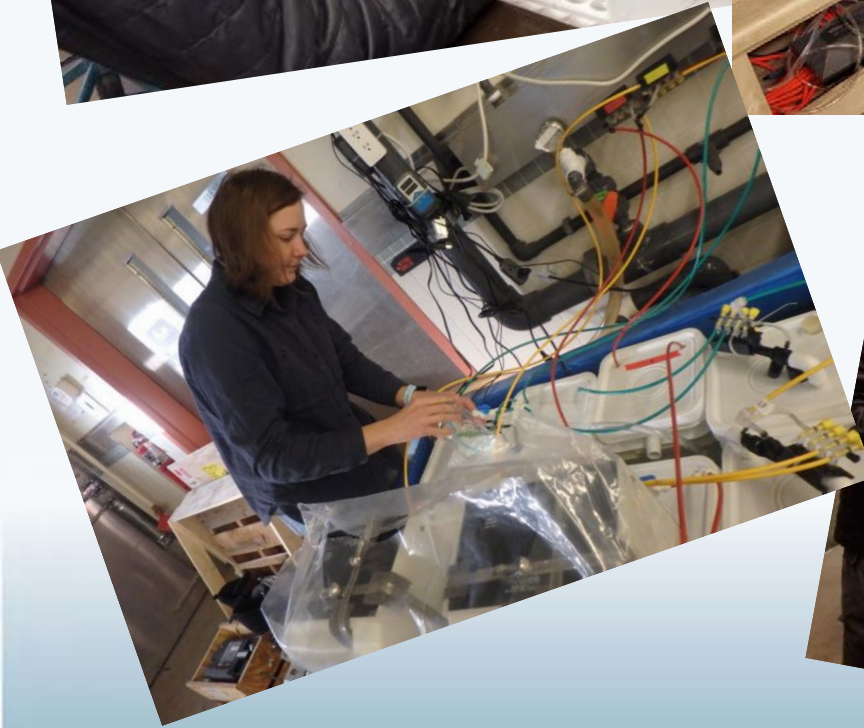
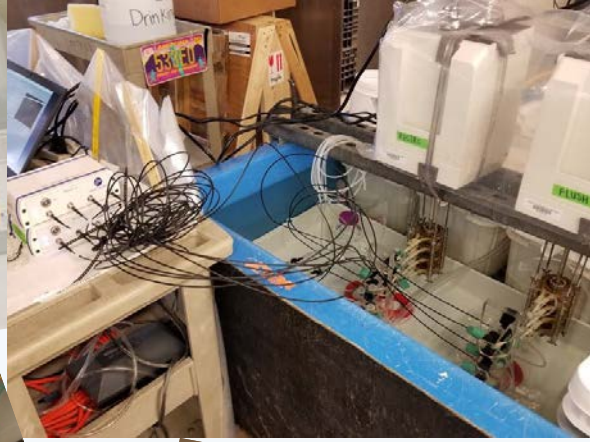


# Handle with Care





# Collecting Data





# Back at UC Davis...

- The tissue samples will be analyzed
- Lots of behavior videos to analyze.
- We will write up our findings to publish in scientific papers.
- Applying for future grants



# What we expect to learn

- Prediction: Antarctic fish species will have a difficult time coping with multiple challenges.
- Hypothesis: It all comes down to balancing energy supply and demand.
- Antarctic fish can cope with one stressor at a time but when there are two together they will have a hard time providing energy to important life functions.



# Why It Matters

- Knowledge informs decision making
- Apply to other species
- Impact of human actions





# Why I am here....

- Increase awareness about polar science
- Bring authentic science to classrooms
- Foster a stewardship mindset



Follow my journal at:

<https://www.polartrac.com/expeditions/antarctic-fish-development-under-future-ocean-conditions>

# Thank You!

Dr. Anne Todgham and the whole B-207 team- UC Davis

Polar TREC- Janet Warburton & Judy Fahnestock

USAP- Elaine Hood

National Science Foundation and ARCUS

San Antonio Family and Community

My Family

# Join PolarTREC!

[www.polartrac.com/about/join](http://www.polartrac.com/about/join)

Everyone can participate in different ways:

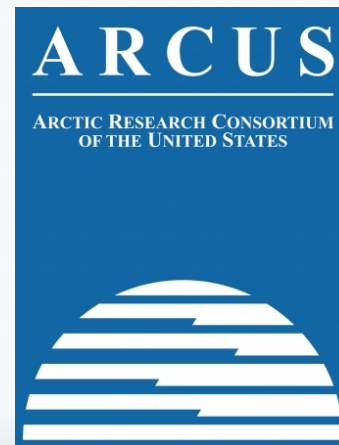
- **Follow Expeditions**
- **Participate in PolarConnect Events**
- **Join the Polar Education Email List**
- **Check out the great resources**
- **Become a PolarTREC Teacher or Researcher**
- **Become a member of ARCUS**



# Thank You!

*An archive of the event will be available shortly.*

<http://www.polartrec.com/polar-connect/archive>



*25 Years of Connecting Arctic Research*  
[www.arcus.org](http://www.arcus.org)