Bringing Polar Research to Your Classroom

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Funded by the National Science Foundation, the **objective of Polar-ICE** is to engage students in understanding how Polar Regions influence our lives while improving their understanding of how scientists work and understand a changing climate system.

**Polar-ICE project site:**
http://polar-ice.org/
Today we will:

• Hear from a polar scientist
• Introduce the Polar Literacy Principles
• Introduce resources available for use in classrooms
• Introduce educator PD opportunities
Dr. Philipp Boersch-Supan
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I'm Philipp & I combine field observations w/ maths & stats to better understand open ocean animals like seabirds
#ActualLivingScientist
Why study seabirds?

Large, long-lived animals
Efficient fliers/divers, many travel very large distances

**Sentinels of ocean environment**
Many populations declining, many species threatened or endangered
  - Fisheries bycatch
  - Invasive predators
  - Extreme weather events
  - Climate variation

We know much about drivers of seabird population dynamics in the past demography, but what about the future?
How do animal physiology and the environment interact to shape individual growth, reproduction, and survival?

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Quantifying how bioenergetics and foraging determine population dynamics in threatened Antarctic albatrosses

Project lead: Leah Johnson (VirginiaTech), Sadie Ryan (U Florida)
Prediction is very difficult, especially about the future

(ascribed to Niels Bohr)

I use models to explore animal-environment interactions, but models need to be grounded by confronting them with data.
Collecting biological data requires interacting with seabirds. This is easier at their colonies, harder at sea.
Carefully designed technology can:
- increase measurement accuracy
- increase temporal coverage
- reduce disturbance
- reduce stress
- Animal-borne sensors can record behavioural data outside the colony
  - GPS, other location technology: track movements
  - Accelerometers: locomotion types, effort
  - Seawater immersion sensors: flight-rest cycles, foraging attempts
  - Radio telemetry: nest/colony attendance
Polar predators as sensor platforms

- Animal-borne sensors can also record environmental data
- Elephant seals wearing Conductivity-Temperature-Depth sensors have helped us understand the Southern Ocean since 1998
- Radar-sensing GPS tags on albatrosses help identify seabird-fisheries interactions and can locate illegal fishing operations

The penguin weighbridge

with PN Trathan, HJ Peat
British Antarctic Survey

Bird Island, South Georgia
Macaroni penguins
- one of the most abundant seabirds: 6 million breeding pairs
- single largest seabird consumer of prey biomass

Goals of the study:
Quantify food consumption during the breeding season
Better understand chick-provisioning strategies

Project combined
- biology
- physics
- engineering
- data science
Penguin hops onto bridge. Threshold value is exceeded and system moves to Mode 2.
Simple Newtonian physics: \( F = m \cdot a \)  
\[ \Rightarrow \] integrate force over time to get penguin mass  
\[ \Rightarrow \] Difference between outbound and inbound mass = meal mass

Challenges: 
accurate mass requires high-frequency sampling 
50,000-80,000 crossings per season = 40 – 60 million data points per season

Solution: 
use machine learning algorithms and high-performance computing to automate analysis
What have we learned so far?

- Timing of foraging is highly synchronous between years
- Parents tailor meal size to chick demand
- Discovery of a colony-based foraging period after the breeding season,
  - previously unrecognized b/c it coincided with end of summer field season and staff drawdown
Questions?

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Polar Literacy Standards
Polar Research Technologies
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Classroom Activities

• Ocean Robots and Data: What? How? Why?

• Investigating Why Penguins Forage There: Piloting Gliders
Ocean Robots and Data: What? How? Why?

Gliders enable scientists to collect information about ocean conditions (temperature, salinity, chlorophyll, etc) throughout the water column.

During this lesson, students will make observations about how a glider operates. Building upon these observations, students will brainstorm why and how scientists use ocean robots, such as gliders, to collect data as well as become oriented to glider data to look for variations of ocean conditions.
Investigating Why Penguins Forage There: Piloting Gliders

Balancing multiple data sets from locations where penguins are foraging and where ocean temperature convergence zones are located contribute to the decision as to where to send the glider.

Through a hands-on data synthesis activity, students will simulate the work of the Science Research Team as they integrate information and decide where to dispatch the Glider and other equipment to study Antarctic waters.
Questions? Thank you!!!

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