Lesson 1: Modeling Polar Data

Materials

- Computers with internet access (1 per pair of students)
- Method of sharing links for models with student computers

Overview

Models are a useful tool in scientific research, as they allow scientists to make predictions about places they cannot collect data, or data is sparse, due to location. In this lesson, students will examine computer model data to make observations about biological hotspots, as well as determine the value that models add to science.

Motivating Question: **How can models be used to enhance our knowledge about unique ecological systems, such as the biological hotspots in the Palmer Deep region?**

Take Home Message

- Students will recognize the value of using models in science for providing information that would otherwise be difficult to obtain. Models can allow scientists to go forward or backward in time, study places that are physically inaccessible due to their location or study events that occur on too large/small a scale, or by adding or removing variables gain a better understanding of a system.
- Students will make observations based on models of varying abiotic factors to determine what is unique about the Palmer Deep region.
    - They will use these observations to see if they can visually identify any unique or special regions that stand out (these will then be defined as biological hotspots).

Engage: Introduction to SWARM and Antarctica • Familiarize students with Antarctica (show map, discuss features/conditions/organisms in this ecosystem, assert the importance of studying this region and its impact on the globe) • Could also show videos (Introduction to Project SWARM Video)	15 minutes
Explore: Observations about Palmer Deep Using Digital Models • Introduce students to the concept of modeling (use provided Google Slides if desired) • Break students up into groups and assign each group 1-2 of the models as specified in the slides • Allow students time to observe the models and make observations about what they see. These can be added to the blank slides provided in the slideshow. • Bring students back together as a class to discuss observations made for each variable	15 minutes

Make Sense: Value that Models Add to Science ● As a class, ask students the “key discussion questions” that are provided in the notes of slides, or any others you wish to add ○ Be sure to highlight key areas of Palmer Deep that are unique in all of the models, as well as introduce the term “biological hotspots” as provided in the slides ● Show “Tools of Science” video on Modeling (https://www.youtube.com/watch?v=RK9m4OmFAbY) ● Ask students to Think, Pair, Share to discuss how models can add value to scientific research/what they provide that experiments cannot	10 minutes
Total:	**40 minutes**

Audience

- Middle and high school students

Preparation

- Teachers should familiarize themselves with the Western Antarctic Peninsula region of Palmer Station and specifically the Palmer deep, including location and what is unique about this region and biological hotspots. Go through the provided slides/videos/images to do this
- Teachers should play all of the models before the students and be comfortable with identifying what the models show, as well as where the hotspots are in this model
    - Go through the provided slides, paying close attention to the teacher questions at the bottom of each slide
- Teachers should read the discussion questions and add others if they feel it is necessary
- Teachers should prepare student computers to be able to share the links to models. Links are found in PowerPoint and should be assigned to student groups by teachers.

Engage (15 minutes)

- Introduction to Antarctica and SWARM (through photos, maps, videos). See fly over video and exploring Palmer LTER worksheet.

Explore (15 minutes)

- Introduce students to the concept of modeling by showing several examples, discussing what can be learned from each and which examples provide more information
- Students will make observations while observing the provided models and share out with the class

Make Sense (10 minutes)

- Ask the provided discussion questions to help students make connections between the models, define biological hotspots
- Watch the "Tools of Science" video (https://www.youtube.com/watch?v=RK9m4OmFAbY) to show students examples of models

NGSS Standards Addressed

Disciplinary Core Ideas

MS-PS3-1 Energy
Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. Performance Expectation Grade: Middle School (6-8)

MS-PS4-2 Waves and their Applications in Technologies for Information Transfer
Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. Performance Expectation Grade: Middle School (6-8)

HS-ETS1-4 Engineering Design
Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. Performance Expectation Grade: High School (9-12)

Science and Engineering Practices

Asking questions and defining problems
Developing and using models
Analyzing and interpreting data

Cross-cutting Concepts

Scale, proportion, and quantity
Cause and effect
Systems and system models
Stability and change

Polar Literacy Principles Addressed

Principle #4: The Polar Regions have productive food webs.
Principle #7: New technologies, sensors and tools — as well as new applications of existing technologies — are expanding scientists' abilities to study the land, ice, ocean, atmosphere and living creatures of the Polar Regions.

Ocean Literacy Principles Addressed

Ocean Literacy Principle #1: The Earth has one big ocean with many features.
Ocean Literacy Principle #7: The ocean is largely unexplored.

Climate Literacy Principles Addressed

Climate Literacy Principle #5: Our understanding of the climate system is improved through observations, theoretical studies, and modeling.