



TEACHERS AND RESEARCHERS EXPLORING AND COLLABORATING

PolarTREC Lesson Resource

What's On the Bottom?

Piper Bartlett-Browne

Northern Chukchi Integrated Study

PolarTREC Expedition Page

<https://www.polartrec.com/expeditions/northern-chukchi-integrated-study>



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Overview

This lesson plan is designed to teach students about benthic biodiversity in the Arctic by analyzing data from the Distributed Biological Observatory (DBO). Although you can't see them from the surface, the organisms found on the ocean floor are important indicators of ecosystem health and provide information about productivity. Students will explore sites throughout the Bering and Chukchi Seas using video taken aboard the Sir Wilfred Laurier research vessel, which is operated by the Canadian Coast Guard.

Objectives

1. Students will be able to map the DBO data sites using latitude and longitude.
2. Students will identify, count, and measure benthic organisms at the different DBO sites.
3. Students will understand the importance of benthic organisms in the Arctic and how biodiversity is an indicator of ecosystem health.
4. Students will be able to draw conclusions between benthic species present and the corresponding grain size of DBO sites.
5. Students will be able to draw conclusions about how biotic and abiotic factors affect the difference in biodiversity across the DBO sites.

Lesson Preparation

The Distributed Biological Observatory (DBO) is an international scientific effort in to observe changes over a latitudinal gradient in the Bering and Chukchi Seas. The sampling sites have been chosen for their high productivity, biomass, and rates of change. You can find more information [here](#). The benthic organisms at these sites are varied and can provide information about the health of the ecosystem. The benthos is dominated by sea stars, bivalves, crabs, and many other invertebrates and in many cases provide a food source for higher trophic levels. For example, bivalves provide food for walrus in the Arctic. Understanding the location and biomass of bivalves can give information about walrus foraging.

There are several factors that can affect the biodiversity and biomass of benthic organisms. These include the ambient water temperature, dissolved oxygen concentration, sediment type (grain size), and total organic carbon present in the sediment. As climate change alters these environmental factors, the biodiversity of the benthos will also change. For example, climate change has already changed the speed of ocean currents and will continue to do so. This will result in an increase

Resource Details

Region

Arctic

Completion Time

About a week

Grade

High school and Up

Permission

Download and Share

Expeditions

Northern Chukchi Integrated Study

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Link

[Distributed Biological Observatory](#)

Related Members

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Materials

Computer with internet to access to the DBO YouTube video

Printouts of the Lesson Materials included: the benthic organism ID and vocabulary worksheet, DBO sediment size data, and the

in sediment grain size, where currents have become faster, in the Bering and Chukchi Seas.

Benthic organisms have a variety of feeding strategies, which include filter feeders, deposit feeders, herbivores, and carnivores. Suspension feeders capture food from the water by filtering and include organisms such as sponges, some bivalves, and sea raspberries (a common name used for a soft coral). Deposit feeders ingest sediment and use the nutrients found here as a source of energy. Deposit feeders include some bivalves, sea cucumbers, and some gastropods. Herbivores eat plant material and include sea urchins and some fish. Carnivores eat other animals and include sea stars, anemones, crabs, and many types of fish.

Benthic organisms live on the sea floor and therefore, directly on or in the sediment. Benthic animals can be divided into those found within the sediments (infauna) or on the sediments (epifauna). Large grain sediment is deposited by stronger currents while finer grain sediment is associated with calmer currents. The size of sediment grains affects the types of organisms that are found on the bottom. An increase in particle size is predictive of an increase in suspension and deposit feeder species mainly because the larger particle size indicates that there is more food being brought past the benthic organisms with higher currents. Areas with smaller grain size have food particles settled on the bottom and these areas are best for herbivores and carnivores. Benthic sediments can be classed by the size of the predominant grains and the type is indicated on a scale from 0-5.

Phi_{≤0}(gravel and rock)

Phi₁(coarse sand)

Phi₂(medium sand)

Phi₃(fine sand)

Phi₄(very fine sand)

Phi₁₋₄ (sand total)

Phi_{≥5} (silt and clay)

Excel workbook for benthic organism count and size data collected from the video.

Topic

Tools and Methods

Ecology

Evolution and Diversity

Organisms and Their Environments

Oceanography

Climate Change

Procedure

1. For this activity, students will focus on DBO sites #1-5. Begin by splitting students into five groups and assigning them DBO 1, DBO 2, DBO3, DBO 4, and DBO 5.
2. Students will be given the Excel data spreadsheet. They will be using this to collect data from the DBO video. Each DBO site is on a different tab. Each DBO has several video locations. Have students map the locations using the latitude and longitude provide on the Excel spreadsheet so they can visual where their video was taken in Bering or Chukchi Sea.
3. Give students the benthic organism ID worksheet so that they can familiarize themselves with some of the animals they may see in their DBO video. Have them identify the species as suspension feeders, deposit feeders, herbivores, and carnivores. This will help them to analyze the data in relation to grain size later.
4. Have student groups go to the [benthic video](#). This video includes clips of DBO sites. Students should be able to find their sites at the time stamps below. Once they get to the video, they should begin watching to identify, count, and measure the organisms that they see at each site. They should record their data on the Excel spreadsheet.

DBO1

Slip 1 – 0:11

Slip 2 – 1:48

Slip 3 – 2:40

Slip 5 – 3:20

Slip 4 – 4:28

DBO2

UTBS5 – 6:27

UTBS2 – 7:19

UTBS2A – 8:28

UTBS1 – 9:47

UTBS4 – 11:08

DBO3

UTN1 – 11:51

UTN2 – 12:40

UTN3 – 13:30

UTN6 – 13:54

SEC8 – 14:37

SEC7 – 15:54

SEC6 – 16:39

SEC5 – 17:51

SEC4 – 18:47

SEC3 – 19:46

SEC2 – 20:38

DBO4

DBO4.4n – 22:10

DBO4.3n – 22:46

DBO4.2n – 23:13

DBO4.1n – 23:40

DBO5

BarC10 – 24:41

BarC9 – 25:10

BarC8 – 25:41

BarC7 – 26:20

BarC6 – 27:00

BarC5 – 27:38

BarC4 – 28:35

BarC3 – 29:17

BarC2 – 29:58

BarC1 – 30:32

5. Once students have collected their DBO data from the video, have them create a hypothesis about what the grain size may be at their DBO site based on the types of organisms that they found in their video.
6. Have students calculate the percentage of different types of feeders (deposit, filter, carnivore, herbivore) there are at each of their DBO site locations.
7. Give students the Sediment Parameter data. They should focus on the grain size. For each DBO site, the grain size is broken down into the percent of size present at each site. The column “SufSedModalSz” indicates that grain size (0-5) that is dominant at the site.
8. Students will graph the dominant grain size for each site versus the percent of species for each of the four feeding types.
9. Students draw conclusions about the relationship between the feeding strategies of benthic organisms and grain size at the DBO site.
10. Students should read the article <https://www.washingtonpost.com/climate-environment/2020/02/05/worlds-oc...>

- Ask students to predict what may happen to their DBO site with the increase of ocean currents due to climate change.
- What will happen to the grain size of your DBO?
- What will happen to the benthic community of your DBO site?

Extension

The distribution of benthic organisms can also be affected by water temperature, dissolved oxygen concentration, and total organic carbon present in the sediment. Using the Sediment Parameter Data, students can look for relationships between these environmental factors and the biomass and biodiversity of the organisms they observed at their DBO site.

Resources

<https://www.pmel.noaa.gov/dbo/>

<https://data.eol.ucar.edu/dataset/dsproj?DBO>

Assessment

Students will be assessed by the data that they collect and graph for their DBO. They will submit:

- Data Excel Sheet
- Graphs comparing biodiversity with environmental parameters
- Explanations about how climate change will affect the distribution of benthic organisms at their site using data to support their argument.

Author/Credits

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Epifauna Benthic Organisms of the Northern Bering and Chukchi Seas

Vocabulary

1. **Epifauna:** animals living on the surface of the seabed or a riverbed or attached to submerged objects or aquatic animals or plants.
2. **Benthic:** The **benthic** zone is one of the ecological regions of a body of water. It comprises the bottom—such as the ocean floor or the bottom of a lake—the sediment surface, and some sub-surface layers. Organisms living in this zone—that is, on or in the bottom of the body of water—are called benthos.

ECHINODERMS

Ophiura sp. – Common name: Brittle star



Photo Credit: The Marine Life Information Network

Leptasterias sp. – Common Name: Six-Rayed Star



Photo Credit: marinespecies.org

Leptychaster anomalus – Common Name: Pentagonal Sand Star



Photo Credit: jaxshells.org

Gorgonocephalus sp. – Common Name: Basket Star



Photo Credit: deepseacru.org

Evasterias sp. – Common Names Include: Mottled Star, Giant Star, and Western Star. (You do NOT need to distinguish between them.)



Photo Credit: jaxshells.org

Other Echinoderms you may see:

- *Strongylocentrotus droebachiensis* – The Green Sea Urchin
- *Echinarachnius parma* – The Sand Dollar

CNIDARIAN

Gersemia rubiformis – Common Name: Sea Raspberry



Photo Credit: arcodiv.org

Other Cnidarians that you might see

- **Anemones** (*Urticina crassicornis* or *Stomphia sp.* but you DO NOT need to distinguish between them)

BIVALVES

Serripes sp. and similar species – Common Name: Clams



Photo Credit: arcodive.org

GASTROPODS

Buccinids – Common Name: Snails



Photo Credit: berkeley.edu

ARTHROPODS

Chionoecetes opilio- Common Name: Alaska Snow Crab



Photo Credit: NOAA

**If you don't recognize the crab in the video, it could be one of the following:

- Toad Crab (*Hyas coarctatus*)
- Helmet crab (*Telmessus cheiragonus*)
- Red king crab (*Paralithodes camtschaticus*)
- Blue king crab (*P. platypus*)

FISH

For any fish that you observe, use the NOAA website on fish and sharks of Alaska to identify the species.

<https://www.fisheries.noaa.gov/fish-sharks>

****REMEMBER:** You need to use the drop-down menu on this website to indicate that you want the Alaska Region and then filter the results. Otherwise, you will be going through A LOT of fish!