

Ocean Microstructure

OBJECTIVES

1. Students will learn about the microstructure of the ocean by analyzing graphs created by Dr. Mike Gregg of the University of Washington Applied Physics Laboratory during the EPIC 2001 research cruise on the Ronald H. Brown NOAA vessel.
2. Students will practice critical thinking skills by fully analyzing the data presented.
3. Students will generate a better understanding of plant and animal habitats by relating ocean profile conditions to the types of sea life that may live at different depths.

AGE

Grades 9-12

TIME ALLOWANCE

1 hour

MATERIALS

Copies of student handout

Overhead transparency of the microstructure graphs

NOTE: The data provided for these graphs were obtained using a Modular Microstructure Profiler (MMP), which measures temperature, salinity, density and dissolved oxygen of the ocean at profiles down to 300 meters in the ocean. The MMP measures additional parameters that are not included in this lesson. The MMP data in this lesson was obtained from 10N latitude, 95W longitude.

INSTRUCTION:

1. Explain to the students that they will be analyzing a graph created with data obtained from the Ronald H. Brown EPIC research cruise. Draw on the board a profile view of the ocean (basically, just a simple wave shape). Ask students what kinds of animals live in the ocean, and where they think the animals live (near the surface, near the shore, deep water, etc.). Although this lesson is not focused on sea life, this introductory step of the lesson plan will help students

Ocean Microstructure

understand how the ocean conditions (heat, waves, sunlight, etc.) are different at different depths.

NOTE: The students should recognize that certain animals and all plants need sunlight, and are therefore found close to the surface. As you go deeper in the ocean, the amount of sunlight disappears, and the animals that live there must be adapted to those living conditions.

2. Students will respond to the following prompt in their notebooks:
“I think the water near the surface is different from the deep ocean water in the following ways:” (list 5 items)

Students should reference things like: amount of sunlight, temperature, turbulence from waves, and salinity. This is an opportunity for students to use their common sense and brainstorm about a topic that may be new to them, but about which they can make reasonable hypotheses based on past knowledge.

3. Display the ocean profile graph on the overhead projector. There are three items plotted on the graph- temperature of the water, salinity of the water, and density of the water.

NOTE: The units on the y-axis are megapascals, a unit of pressure. One megapascal is equivalent to 100 meters of depth in the ocean. There are three separate x-axes. The red axis displays temperature (degrees Celcius), the green axis displays salinity (parts per thousand) and the blue axis displays density (kilograms per cubic meter).

4. Ask students to answer the following questions (also included in the Student Worksheet):
 - What temperature is the water at the surface?
 - What temperature is the water at 300 meters deep?
 - At what depth does temperature drastically decrease?
 - What is the major source of heat for the ocean?
 - What is the salinity of the water at the surface?
 - What is the salinity of the water at 300 meters deep?
 - At what depth does salinity drastically increase?
 - Why do you think ocean salinity is lowest at the ocean surface? What types of atmospheric events would alter the salinity at the surface?
 - What density is the water at the surface?
 - What density is the water at 300 meters deep?

Ocean Microstructure

- At what depth does density drastically increase?
 - Given the information presented, how is density of ocean water related to temperature and salinity?
 - How much dissolved oxygen is present at the surface?
 - How much dissolved oxygen is present at 300 meters deep?
 - At what depth does dissolved oxygen drastically decrease?
 - What is the major source of dissolved oxygen in the ocean?
 - Do you see any pockets where dissolved oxygen does not have a consistent trend with depth? Where?
 - If you were an animal that eats kelp, at what approximate depth would you live?
 - If you were a species of animal that didn't have eyes, at what approximate depth would you live?
 - If you were an animal that can tolerate low salinity conditions, at what approximate depth would you live?
5. Students will write a 2-3 paragraph data analysis based on the graphs presented. As with any data analysis, students should report trends in the data, and provide insight to try to explain those trends. They should generate new hypotheses to follow-up this research, and provide suggestions and questions that would guide further research. They can use the questions above to help guide them through their analysis, but the analysis should extend beyond those questions to present "why" they think those trends exist.

EVALUATION / ASSESSMENT

Teacher will assess students based on the attention they give this exercise, especially the data analysis that each student wrote. Did the student give serious thought to the data, or did they rush to finish the assignment without showing any independent thought?

Name: _____

Ocean Microstructure- Student Worksheet

I think the water near the surface is different from the deep ocean water in the following ways:

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1. What temperature is the water at the surface?
2. What temperature is the water at 300 meters deep?
3. At what depth does temperature drastically decrease?
4. What is the major source of heat for the ocean?
5. What is the salinity of the water at the surface?
6. What is the salinity of the water at 300 meters deep?
7. At what depth does salinity drastically increase?
8. Why do you think ocean salinity is lowest at the ocean surface? What types of atmospheric events would alter the salinity at the surface?
9. What density is the water at the surface?
10. What density is the water at 300 meters deep?

Name: _____

Ocean Microstructure- Student Worksheet

11. At what depth does density drastically increase?
12. Given the information presented, how is density of ocean water related to temperature and salinity?
13. How much dissolved oxygen is present at the surface?
14. How much dissolved oxygen is present at 300 meters deep?
15. At what depth does dissolved oxygen drastically decrease?
16. What is the major source of dissolved oxygen in the ocean?
17. Do you see any pockets where dissolved oxygen does not have a consistent trend with depth? Where?
18. If you were an animal that eats kelp, at what approximate depth would you live?
19. If you were a species of animal that didn't have eyes, at what approximate depth would you live?
20. If you were an animal that can tolerate low salinity conditions, at what approximate depth would you live?

DATA ANALYSIS

Write a 2-3 paragraph data analysis based on the graphs presented. As with any data analysis, report trends in the data, and provide insight to try to explain those trends. Generate new hypotheses to follow-up this research, and provide suggestions and questions that would guide further research. You may use the questions above to help guide your analysis, but the analysis should extend beyond those questions to present "why" you think those trends exist.



