Lesson 2: Station Activities

Materials

- Plastic cups
- Food coloring
- Source of hot and cold water
- Water of different salinities
- Pie pans
- Confetti
- Straws
- Honey
- Peanut butter
- Vegetable Oil
- Marble or raisins

Overview

There are abiotic factors that help establish unique regions in Palmer Deep that allow for the formation of biological hotspots. In this lesson, students will explore these abiotic factors in the ocean and begin to connect these to living organisms, including:

- *Definition of density--effect of salinity and temperature on density with explanation*
- *Definition of eddies, fronts, convergent zones (perhaps a picture or two that they can show the students)*
- *Definition of Reynold's number (table that Matt showed of the different numbers for different organisms) Explanation of how Reynold's number affects the organisms that will move into the Palmer Deep Canyon.*

Motivating Question: How can temperature, salinity, currents and water viscosity affect where living organisms are found in the ocean?

Take Home Message

Students will be able to understand how abiotic factors such as temperature, salinity, currents, and water viscosity (Reynold's number) contribute to the creation of a biological hotspot at the Palmer Deep Canyon.

Engage: Introduce students to the four questions that will guide each station. This will have them start predicting what may happen when they visit that station.	5 minutes
Explore: Small groups of students (3-4) will travel around the room to four different stations. The students will form a prediction, execute a procedure, and record their observations.	25 minutes
Make Sense: The class will come back together and discuss the questions associated with each station. This will require that the students interpret their results and form connections between the different abiotic factors.	15 minutes
Total:	**45 minutes**

Audience

Middle and high-school students.

Preparation

The teacher will need to set up each station, so that it can be reset for each group in the class.

- Station #1:
    - Dye enough tap water green (using food coloring) to have 100 mL for each group
    - Create a 10% salt solution (to have 100 mL for each group) and dye it yellow (using food coloring)
    - Pour 100 mL of freshwater into beakers/plastic cups to have one for each group
    - Pour 100 mL of saltwater into beakers/plastic cups to have one for each group
    - Set up an empty clear container (Tupperware or fish tank possibly) at the lab table for students to pour each cup into to observe what happens when the liquids are combined
- Station #2:
    - Dye ice water blue (using food coloring) to have 100 mL for each group
        - Divide into enough cups for each group
    - Dye water red and heat using an electric kettle or a hotplate (enough for each group to have 100 mL)
        - Set out a graduated cylinder so each group can measure out 100 mL of hot water when they arrive at the station
    - Set up an empty clear container (Tupperware or fish tank possibly) at the lab table for students to pour each cup into to observe what happens when the liquids are combined
- Station #3:
    - Fill a pie pan partially with water
    - Have paper confetti (use hole punches) and straws. A handful of confetti will be put into the water where students will blow into the straw across the top of the water to see how wind drives currents and eddies, creating fronts
        - Optional: adding a piece of clay to simulate an island
- Station #4:
    - Fill plastic cups a quarter of the way with water, oil, honey, or peanut butter
        - Each group will need all four cups
    - Set out a handful of marbles (four for each group)
    - Place the marble into each cup and record how fast it falls to the bottom

Engage (5 minutes)

- Students will become engaged at each individual station where they are asked to make predictions about how *temperature*, *salinity*, *wind*, and liquid *viscosity* affect the ocean before they complete the station, making observations at each station.

Explore (25 minutes)

- Small groups of students (3-4) will travel around the room to four different stations. The students will form a prediction, execute a procedure, and record their observations. More

details can be found on the student hand-out.
- Teachers can set up 2 replicates of each station, if space allows, to keep groups small.

Make Sense (15 minutes)

- The class will come back together and discuss the questions associated with each station. This will require that the students interpret their results and form connections between the different abiotic factors. The station questions can be completed together and then the summary questions can be assigned as homework. This could serve as either homework or a lab grade.

NGSS Standards

Disciplinary Core Ideas

HS-PS1-5 Matter and its Interactions
Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. Performance Expectation Grade: High School (9-12)

HS-PS3-2 Energy
Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects). Performance Expectation Grade: High School (9-12)

Cross Cutting Concepts
Cause and effect
Systems and system models
Energy and matter
Stability and change

Science and Engineering Practices
Developing and using models
Planning and carrying out investigations

Polar Literacy Principles Addressed
Principle #3: Polar Regions play a central role in regulating Earth's weather and climate.

Ocean Literacy Principles Addressed
Ocean Literacy Principle #1: The Earth has one big ocean with many features.

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