Regional Class Research Vessel

Oregon State University

Mystery of the Disappearing Pteropods: Dude Where's My Shell

Timeframe
60-90 minutes

Target Audience
Grades 4th- 5th

Suggested Materials
- Three tabletop stations
- Paper
- Scissors
- Graphing paper
- Pencils and colored pencils
- Sharpie marker

Contact:
SMILE Program
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Description

In this activity, the students will explore the topic of climate change by engaging in an experiment in which they will observe the estimated condition of pteropod shells collected from different time periods (past, present, and future). They will be able to collect data on the number of pteropods that have been affected by ocean acidification, as well as their different levels of shell dissolution. Students will then contrast their observations to estimate shell dissolution in the past, present, and future ocean. The students will analyze their data from their assigned experiment and determine the correlation between ocean acidification and the higher rates of shell dissolution. Students will then create an argument for or against ocean acidification effect on pteropod shells.

Learning Objectives & Outcomes

- Recognize patterns
- Data collection and data analysis
- Argument from evidence

Using This Lesson

The activity in this lesson will be done in small groups. The background information has been written so it can be used as reading material for students. Key terms are defined at the end of the lesson. Questions and charts are provided to promote discussion and critical thinking. See the resource page for links to documents that support this lesson.

Background Information/Scenario

Oregon Department of Fish and Wildlife (ODFW) biologists are concerned that pteropods, a zooplankton and one of the Ocean's best snack foods, is becoming scarcer. Salmon biologists have also taken note as pteropods make up an important component of the salmon's diet. They are also worried that a reduction in the number of pteropods may have adverse effects for many industries important to the Oregon economy. ODFW biologists have been studying the cause of this decline in pteropod populations, but they have not identified the underlying cause. They have tasked your class with

helping to determine the cause of the pteropod decline.

ODFW has set up a controlled experiment and has contacted your students for help! Your students are a team of biologists and are in charge of making a claim of what is happening to the pteropods, supporting that claim with evidence, and developing a hypothesis on what affect this may have on salmon populations in the future. ODFW has recreated water conditions at three simulated time periods (1918: Pre-Industrial, 2018: Present day, and 2118: 100 years in the future) that each contain a population of 50 pteropods.

Students must recognize and identify patterns within the population of pteropods they are studying, analyze those patterns, and then create a claim about what is happening to the pteropods population. Their teams will then be tasked with presenting that claim to 'ODFW' based on evidence that they collected. Your class will take on the role of ODFW. Students will present to their classmates, while those in the role of ODFW will listen to the presenters and ask questions.

Set Up

1. Create three table top stations. Label one station 1918, another 2018, and the last 2118. Each of these stations represents pteropods populations in a simulated experiment. 1918 has similar ocean conditions of the ocean 100 years ago, while 2118 simulates water conditions we might expect to see 100 years in the future.

2. Label each station with the time period (as followed by the *Elementary Teacher Site Data Chart* below). In addition to labeling the time period at every site, label each site with the pH factor. This can be found on the Elementary Teacher Site Data Chart below. The pH of the ocean is decreasing due to excess CO2 being dissolved in the ocean. Do not mention pH or other factors to students. The intent of the lesson is for students to recognize these patterns based on the changes in pH.

3. Cut out each individual pteropod found on the Pteropod Cutout Sheets. Use the *Elementary School Teacher Site Data Charts* to know how many pteropods types to put at each station. The elementary version of this lesson plan only includes 3 out of the 5 possible types of pteropods: No dissolution, Type 1, and Type 3. There are two other pteropod types that exist (minor dissolution and Type 2) that have been left out for ease of data collection.

Next Generation Science Standards

PERFORMANCE EXPECTATIONS:

5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

DISCIPLINARY CORE IDEAS:

ESS2.A: Earth Materials and Systems

SCIENCE AND ENGINEERING PRACTICES:

Analyzing and Interpreting Data
Developing and Using Models

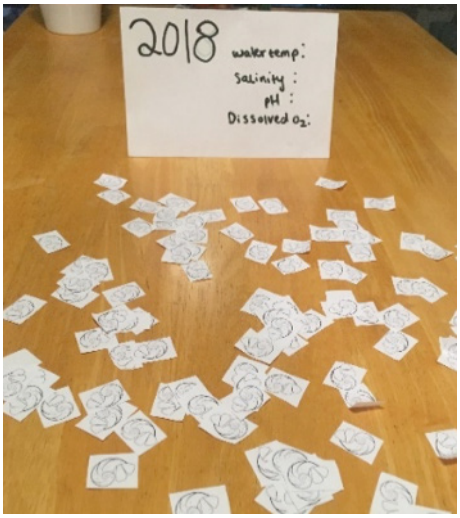
CROSSCUTTING CONCEPTS:

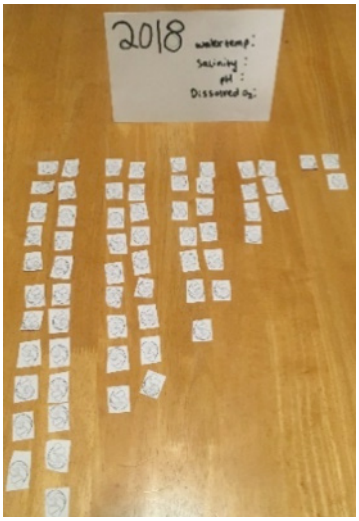
Systems and System Models

Elementary School Teacher Station Data

Sites	No Dissolution	Type I	Type III	pH
1918	48	2	0	8.25
2018	36	8	6	8.1
2118	15	11	24	7.7

Station Example





Stations should contain a mixed pile of 50 pteropod cutouts. Students will then organize the cutouts into three piles based on their dissolution type.

Elementary School Teacher Instructions

1. Show students Introductory PowerPoint and share the scenario with the class. The scenario can be found at the beginning of this lesson.
2. Separate students into groups of three. These groups will be their original 'home' groups.
3. Explain to students that their are 50 pteropods at each time period, and that they will need to separate the cutouts based on the Pteropod Shell Dissolution Chart, see below.

Pteropod Shell Dissolution Types and Descriptions

Types of Damage	Description/definition	Visual Representation
No Dissolution	No pores are visible on the surface of the shell.	
Type I Dissolution	More than 7 small pores are visible on the surface of the shell.	
Type III Dissolution	Large gaps on the surface of the shell. The shell is starting to lose its structure due to damage.	

Use this chart in addition to the pteropod cutouts to determine pteropod shell dissolution types. This chart describes three categories of dissolutions present at each station. Students will receive a dissolution chart with an area for each student to sketch the three pteropod types. You may show your students the three types of dissolution prior to the activity to get your students familiarized and comfortable.

4. Give students the *Student Handout Sheet*. The student handout sheet includes guiding questions. Answers to the guided questions can be found separately in "Teaching Guilding Question Answers." The guided questions will be answered as a class.

5. Ask each home group to send one student to the 1918 station, one student to the 2018 station, and the remaining student to the 2118 station.

6. Ask students to discuss the following question in their station groups.
    a. What are ways that you can separate cutouts at each station? Have students try to recognize to use the Dissolution Chart.

7. At each station have students divide pteropods cut outs into piles on the Dissolution Chart.
    a. Students should be dividing 50 pteropods at each site into three categories: No Dissolution, Type 1 Dissolution, and Type 3 Dissolution. Students will receive a *Dissolution Chart* and will be asked to separate pteropods by severity of damage.
    b. Students should fill out the visual representation of the dissolution chart by sketching an example of each pteropod type. Students can do this by sketching example pteropods at their stations or prior to the activity.

8. After separating the pteropod cut outs based on dissolution, ask

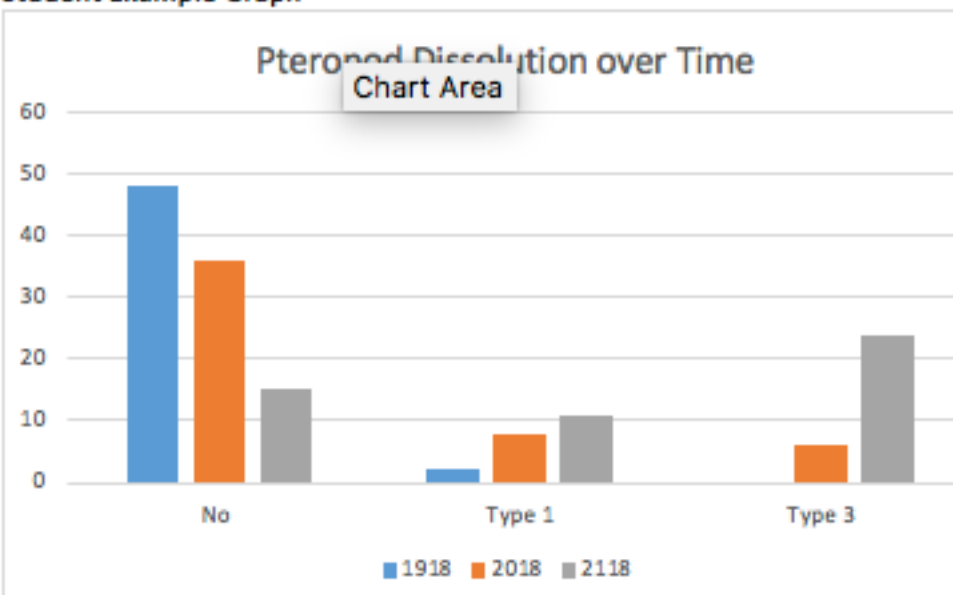
students to fill in a student data chart to record their data. The student data chart, once complete, will look exactly like the Teacher Station Data chart. See above.

9. While students are working at each station, ask the first two guided questions to the class. Students will take this knowledge and apply it later to their home groups to help them create their claims. As a class, using data from all three sites (1918, 2018, and 2118), have students graph their pteropods numbers based on the dissolution type. See *Example Student Graph*.

10. Ask the following questions to the class after students have created graphs and had time to discuss some of their findings:

a. What did our bar graph look like?
b. What trends did you notice?
c. Why do you think these trends are happening?

Student Example Graph



11. Answer the remaining guided questions as a class.

12. Give the students the *Student Handout Articles* (2) to read. You may read them to the class, or do popcorn style reading with your students. If you have access to the Internet the students can also do Internet searches to find additional information.

13. In their home groups, ask students to construct a claim based on the evidence they collected and that of the readings using the *Claim and Evidence Chart*. You may create one Claim and Evidence as a class or have students create their own.

14. In their home groups, have students present their evidence and claim to 'ODFW'! You, or your class as a whole will take on the role of ODFW. Students will present to their classmates, while the rest of the class in the role of ODFW will listen to the presenters and ask questions.

What is happening to the pteropods in the ocean, and based on the evidence, why is it happening?

Using their claim and evidence have students make a hypothesis on how what is happening to pteropods will affect future salmon populations, industry in Oregon, and the Oregon economy.

This project is supported by the Regional Class Research Vessel Program in the College of Earth, Ocean, and Atmospheric Sciences at Oregon State University.

Resources

https://www.pmel.noaa.gov/co2/story/What+is+Ocean+Acidification%3F

https://ww2.kqed.org/quest/2014/02/25/pteropods-very-small-and-very-important/

http://rspb.royalsocietypublishing.org/content/281/1785/20140123

http://www.noaanews.noaa.gov/stories2014/20140430_oceanacidification.html

https://apps.seattletimes.com/reports/sea-change/2014/apr/30/pteropod-shells-dissolving/

Elementary School Student Page

One of the Ocean's best snack foods is becoming scarcer due to environmental changes and salmon population. Scientists are concerned! Oregon Department of Fish and Wildlife is worried that a loss of pteropods may have adverse effects for many industries in Oregon. However, they are unsure of the cause of the declines in pteropod populations and what it means for future Salmon populations.

ODFW has set up a controlled experiment and has contacted you for help! You are a team of oceanographers and are in charge of determining what is happening to the pteropods, why it is happening, and if it will be detrimental to the future Salmon industry. ODFW has recreated water conditions at three simulated sites (the past 1918, the present 2018, and 100 years in the future) that each contain a population of pteropods.

Student Materials

- Desk space
- Graphing paper
- Pencils and colored pencils
- Paper

Instructions

1. Send one person from your group to the 1918 station, one person to the 2018 station, and one person to the 2118 station. Pteropods will be categorized into three types: no dissolution, type 1 dissolution, and type 3 dissolution.

2. Look at your pteropod dissolution chart. The type chart includes an area for you to sketch the different pteropod types. To determine these, look at your pteropod samples and describe any patterns you recognize.

3. At your station, separate your pteropod samples into three groups based on the pteropod type chart.

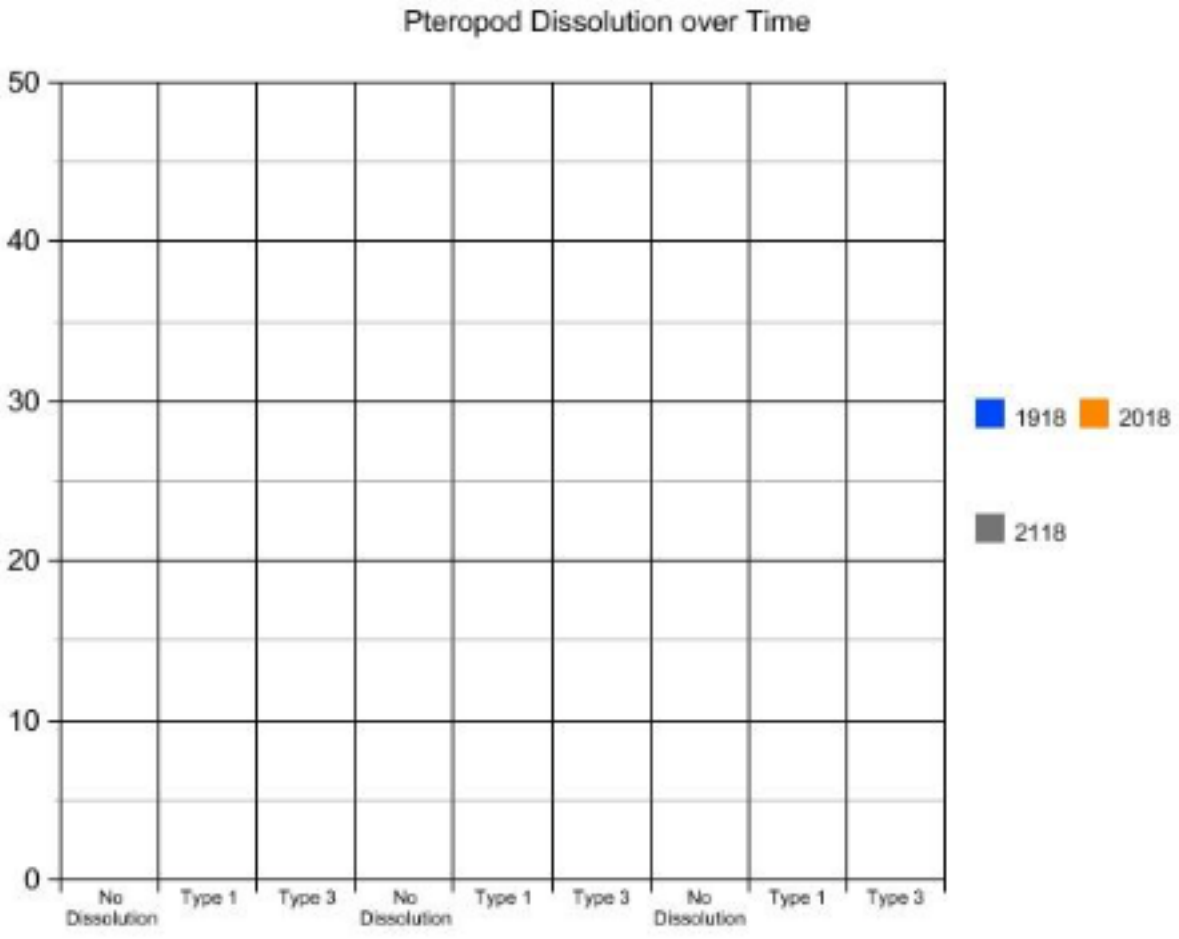
Pteropod Type Chart

Types of Damage	Description/definition	Visual Representation	Pteropod Sketch
No Dissolution	No pores are visible on the surface of the shell.		
Type I Dissolution	More than 7 small pores are visible on the surface of the shell.		
Type III Dissolution	Large gaps on the surface of the shell. The shell is starting to lose its structure due to damage.		

4. Fill in the student data chart to collect the data at your station in the space provided below.

Sites	No Dissolution	Type I	Type III	pH
1918				8.25
018				8.1
2118				7.7

5. With your class, create a graph that compares each pteropod type at each station (1918, 2018, and 2118) in the space below or on a separate sheet of graphing paper.



6. As a class, read the two articles:
Pteropods: The Beer Nuts of the Sea
Ocean Acidification: A Risky Shell Game

7. With your class, construct a claim based on evidence using the *Claim and Evidence Chart*. A description of how to use a Claim and Evidence Chart to create a scientific explanation can be found below.

Example

Description	Example
Claim: The answer or conclusion to the scientific question	*The Yankees are the best team in Major League Baseball.*
Evidence: Scientific Data that supports the claim	*The Yankees have won the World Series more than any other team in history.*
Reasoning: Explains why the evidence supports the claim, providing a logical connection between the evidence and claim	*The World Series is a championship to determine who is the best team in the major leagues. Because the Yankees have won this championship more times than any other team, they are the best team in Major League Baseball.*

Claim and Evidence Chart

CLAIM (The environmental impact on the pteropod shells is occurring because...)	**EVIDENCE** (List data that backs up your evidence and supports your claim)	**REASONING** (This evidence supports my claim because...)

Complete the Claim and Evidence Chart in your home group to construct a claim that will later be presented to ODFW.

8. With your home group, present your evidence and claim to ODFW! What is happening to the pteropods in the ocean, and based on your evidence, why is it happening?

Using your claim and evidence make a hypothesis on how what is happening to pteropods will affect future salmon populations, industry in Oregon, and the Oregon economy.

Guided Questions

Answer as a class

1. How did you decide to organize your pteropods? What do the spots on the pteropod shells represent?

2. Do you expect the data at the other two time periods to look similar to the data you collected at your station?

Explain your answer.

3. What time period had the greatest amount of severely affected pteropods? What trends do you see? What do you think shell dissolutions might look like at 2150?

4. Why do you think the rates of shell dissolution may vary at different time periods?

5. What would you conclude to be the main cause of pteropod dissolution?