



Ghost (Shrimp) Stories

Summary:

This lesson is designed to be a suite of lessons that revolve around the nature of science. The process of how scientists move from the unknown to the better known through questions, experiments, data, and observations. The activities involve exploring the need for renewable sources of energy and using the endless questions students can ask to move their learning forward using data, analysis and the characteristics of life. The activities in this lesson are centered around the development of Pacwave and the research of Dr. Sarah Henkel surrounding the mystery of Bay Shrimp off the coast of Newport, Oregon.

Background Information:

In the process of sampling the Pacwave wave energy plant off the coast of Newport, Oregon to document the ecosystem. Dr. Sarah Henkel uncovered a mystery about an organism she thought she knew well. [See the background Google Slide Presentation](#) for more information.

Materials

Teacher Resources	Student Resources
Lesson plan	Data Sheet 1: Estuary Mudflat Sampling Form
Background for Ghost Shrimp Stories	Data Sheet 2: Classroom Sampling Sampling Form
Ghost Shrimp Stories Applying the Characteristics of Life	Student Handout - Characteristics of Life
Ghost Shrimp Stories Teacher and Student Gel Electrophoresis Hands on Extension	Student Handout - Reflection
Read 1st - How to use the lesson	

Performance Expectations:

HS-LS4-1 Biological Evolution: Unity and Diversity

Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

MS-LS4-1 Biological Evolution: Unity and Diversity

Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the

assumption that natural laws operate today as in the past.

2-LS4-1 Biological Evolution: Unity and Diversity

Make observations of plants and animals to compare the diversity of life in different habitats

Specific Learning Objectives:

List the [learning objectives](#) students should demonstrate by the end of the lesson. Your learning objectives should relate to the performance expectations (PE) for the lesson, but should be focused on a smaller segment of the instructional sequence.

Shrimp sampling:

1. Accurately collect and organize data into a premade table.

Graphing activity:

1. Use student data to analyze trends and create a graph
2. Make predictions from the graph
3. Make conclusions about the student graph while supporting their ideas with evidence from the graph

Characteristics of Life

1. Students use ghost shrimp to make observations, gather evidence and apply the evidence to provide reasoning to explain how the ghost shrimp demonstrate the characteristics of life.

NGSS Dimensions:

Science & Engineering Practices:

1. Planning and carrying out investigations
2. Analyzing and interpreting data
3. Obtaining, evaluating, and communicating information

Disciplinary Core Ideas:

1. Biodiversity and humans
2. Evidence of common ancestry and diversity
3. Evidence of common ancestry and diversity

Crosscutting Concepts:

1. patterns

Ocean Literacy Principles:

1. #5 - The ocean supports a great diversity of life and ecosystems.
2. #6 - The ocean and humans are inextricably interconnected.
3. #7 - The ocean is largely unexplored.

5E Lesson Plan

ENGAGE		
<i>Teacher Does</i>	<i>Student Does</i>	<i>Concept</i>
Play the 5 minute video	Students watch the video in class.	General understanding of energy generation for humans and its possible impact on ocean organisms.

The teacher or a curriculum task accesses the learners' prior knowledge and helps them become engaged in a new concept through the use of short activities that promote curiosity and elicit prior knowledge. The activity should make connections between past and present learning experiences, expose prior conceptions, and organize students' thinking toward the learning outcomes of current activities.

Ask students: How is electricity generated?

Teacher: Show students a simple generator. Examples: Hand crank radio or [flashlight](#). Show them how the magnet moving through the copper coil moves electrons and generates an electric current.

Thing Pair Share: Have students pair up and come up with several ways they can get the magnet to move through the coil without directly using electricity.

Teacher: Introduce the idea of wave energy and how it can be used to generate electricity. ([see resource video](#) 1). Show the WeVideo about Pac Wave.

Transition: Before scientists can answer their questions about the most efficient way to develop wave technology, they have to make sure their experiment is causing as little harm as possible to the environment. Scientists need to answer the question "how is the ocean changing because of our experiment and because of climate change." They need to know what the ecosystem is like now before it is changed from Pac Wave and climate change. That is part of Dr. Sarah Henkle's job. Describe the ecosystem and keep track of how and why it is

changing.

EXPLORE		
<i>Teacher Does</i>	<i>Student Does</i>	<i>Concept</i>
One of three scenarios is possible: actual sampling on a mudflat, looking at a classroom aquarium with crayfish or a similar crustacean or the model of ghost shrimp sampling	Collects data on one of the three activities. Reads and completes Data Sheet Option 2	Students can make observations and collect data to analyze.

Option 1: If you live by mudflats with Ghost shrimp, take your students out there and show them their habitat. If you have the equipment, remove one of the shrimp and show the students the identifying characteristics of the shrimp. Male vs. Female. Males have one claw that is noticeably larger than their other claw. Females have two claws that are the same size. Eggs might be visible on the ventral side of the female at the bottom of the abdomen. Show them the carapace and how to measure it. Allow them to collect the shrimp and fill out Data Sheet 1

Option 2: If you do not have the ability to take your students to mudflats, or access to Ghost Shrimp. If possible use the closest relative that the students would recognize from their community. In the midwest, we were thinking crayfish would be a good replacement for Ghost shrimp. Use the crayfish as a model for the parts of the Ghost Shrimp.

Option 3 Students observe crayfish or another similar crustacean in a classroom aquarium.

Then, read [Data Sheet Option 2](#) for instructions on how to build a model of a mudflat to simulate sampling shrimp.

EXPLAIN		
<i>Teacher Does</i>	<i>Student Does</i>	<i>Concept</i>
Teacher provides background context on the ghost shrimp and the process of science.	Students generate and voice questions about the observations that they have made with ghost shrimp or another model organism.	The process of science is messy. Often collecting evidence for one question can lead to more unanswered questions.

ELABORATE		
<i>Teacher Does</i>	<i>Student Does</i>	<i>Concept</i>
Teacher may use all three activities or pick and choose.	Students generate their own data in the 3 different activities available: Ghost (shrimp) Stories Shrimp sampling mudflats in the classroom, Ghost (shrimp) Stories Intro to Graphing Activity and Google Sheet, Ghost (shrimp) Stories applying the Characteristics of Life in all 3 of these activities students are exploring the nature of science by collecting their own data to analyze in the elaborate section.	Shrimp Sampling: students understand the complexities of collecting data in the field Shrimp Intro to Graphing Activity: students understand and construct graphs to tell a story and understand use them to predict what comes next in the story. Shrimp and the Characteristics of Life: students apply the characteristics of life using ghost shrimp as a model.

EVALUATE		
<i>Teacher Does</i>	<i>Student Does</i>	<i>Concept</i>

Mudflats in the Classroom: The teacher modifies syringes and creates imitation collection bins if mud flats are not available. Intro to Graphing Activity: The teacher gives each student a sticky note and prepares labels for the pie stations. The teacher also uses the template for easily generating graphs of student data. Characteristics of Life: The teacher leads a lecture style presentation with 11 stops embedded for student reflection on their handout. The teacher also sets up gel electrophoresis hands on extension.	In the 3 different activities : Ghost (shrimp) Stories Shrimp sampling mudflats in the classroom, Ghost (shrimp) Stories Intro to Graphing Activity and Google Sheet, Ghost (shrimp) Stories applying the Characteristics of Life, each describe ways teachers can evaluate student thinking and learning.	Mudflats in the Classroom: Students get hands-on experience extracting shrimp (whether live or imitation) and evaluate the data that is collected. Intro to Graphing Activity: Students get to generate class data that is then used for creating their first graphs. They then apply what they did to analyze data they did not collect. Characteristics of Life: Students apply knowledge of the characteristics of life to the example of ghost shrimp
--	--	--

Differentiation / Modifications

This lesson was developed to have multiple, short, stand alone activities. The Ghost (Shrimp) Stories applying the characteristics of life could be done as a whole class on a projected board or could be printed out.

Enrichment:

Again, the lesson is multi-faceted so that it could be completed in one class period or over multiple days.

Helpful Resources:

- [Data Sheet 1](#)
- [How Wave Energy Works](#)
- [Discovery of a large offshore population of the northeast Pacific burrowing shrimp Neotrypaea sp. \(Decapoda: Axiidea\) – ScienceDirect](#)
- [All Science. No Fiction.](#) - Video about PacWave, Dr. Henkel's work and climate change.
- [Purchasing crayfish/crawdads](#) from Carolina Biological