Sample LP - Mystery of the Missing Fish

Subject (Focus/Topic): Fisheries Biology

Grade Level: 9-12

Average Learning Time: Approximately 1 hour

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LESSON PLAN DETAILS

Lesson Summary (Overview/Purpose):

Students will attempt to explain why the population of a fictitious fish is decreasing (Atlantic Red Gill) by looking at a series of different data. Students will use the data to recommend allowing fishing of the red gill or recommend denying fishing permits.

Overall Concept (Big Idea/Essential Question):

How can different factors impact fish populations in oceans?

Specific Concepts (Key Concepts):

Students demonstrate use of the scientific method.

- Students can describe how factors can influence ocean populations.
- Students can experience how scientific research does not always yield solutions.

Focus Questions (Specific Questions):

- How do you use the scientific method to solve problems?
- How can multiple factors influence the population of an ocean organism?
- How do scientists use data to make informed decisions?
- How do scientists tackle problems that may not have an answer?

Objectives/Learning Goals:

Students are to use the scientific method to solve a problem. Students will learn that there is not a solution to this mystery and will then hypothesize other possible solutions. Students will then make a conclusion to allow fishing or to continue the fishing moratorium.

Background Information:

This activity using a fictitious fish is designed to mirror the population numbers of sardines in the Pacific Ocean. In 2015, the Pacific Fishery Management Council closed fishing from Mexico to the Canadian Border after a 91% decline along the West Coast since 2007. There are several hypotheses to why this decline is occurring, but at this point scientists are unsure why these populations increase. The following are links to articles about the sardine decline:

http://www.sfgate.com/bayarea/article/Sardine-population-collapses-prompts-ban-on-6197380.php

https://www.reuters.com/article/us-oregon-fishing-sardines/u-s-bans-most-pacific-sardine-fishingafter-population-crash-idUSKCN0X82LX

Common Misconceptions/Preconceptions:

Often students believe that they will always find a solution to a scientific problem. This activity gives them a mystery that has no true solution.

Teaching Materials:

- Mystery of the Missing Fish Worksheet (attached)
- Red gill fish population graph (attached)
- Envelope of data with the fishing events and graphs of temperature, salinity, and predator printed on transparency paper (attached)
- Slides of major events in Gill Fish History (attached)

Technical Requirements:

N/A

Teacher Preparation:

Teacher should print out all necessary materials and read the articles in the background information to see how this fictitious fish mirrors the cycles of the sardine populations.

Keywords:

- Hypothesis
- Prediction
- Population
- Biomass

Pre-assessment Strategy/Anticipatory Set (Optional):

N/A

Lesson Procedure:

1. Students will look at the graph of the Red Gill biomass and determine if they see any patterns.
2. Students will list any possible explanations for the patterns in the red gill fish.
3. Discuss some of these possible explanations as a class.
4. Students will see their role in issuing fishing licenses and will make their preliminary decision.
5. Each team of students will be given an envelope with data. They will use the data to see if any of the factors could be influencing the population patterns. These can be placed on top of the graph to see if any of the patterns match.
6. For each data point, students will predict if it will have an impact on the populations prior to comparing the data. After they record their predictions, they will look at the data and see if the patterns match the fish population. They will then conclude if they feel the factor may be the cause and support their conclusion with data.
7. After analyzing the four points of data, students will see that none of the data will explain the decline of the red gill and will look for other potential variables that could influence the population.
8. Finally, students will decide if they want to maintain the moratorium on fishing red gills in the Atlantic Ocean.

Assessment and Evaluation:

The Mystery of the Missing Fish worksheet should be graded focusing on if students are supporting their conclusions with data and evidence.

Standards:

Next Generation Science Standards (NGSS) or State Science Standards Addressed

- Content Standard F: Science in Personal and Social Perspectives
- Content Standard G: History and Nature of Science

Ocean Literacy Principles Addressed

- 5: The ocean supports and great diversity of life and ecosystems o D: Ocean biology provides many unique examples of life cycles, adaptations, and important relationships among organisms (symbiosis, predator-prey dynamics, and energy transfer) that do not occur on land.
  - o F: Ocean ecosystems are defined by environmental factors and the community of organisms living there. Ocean life is not evenly distributed through time or space due to differences in abiotic factors such as oxygen, salinity, temperature, pH, light, nutrients, pressure, substrate, and circulation. A few regions of the ocean support the most abundant life on Earth, while most of the ocean does not support much life.
- 6: The ocean and humans and inextricably interconnected o D: Humans affect the ocean in a variety of ways. Laws, regulations, and resource management affect what is taken out and put into the ocean. Human development and activity lead to pollution (point source, nonpoint source, and noise pollution), changes to ocean chemistry (ocean acidification), and

physical modifications (changes to beaches, shores, and rivers). In addition, humans have removed most of the large vertebrates from the ocean.

- o E: Changes in ocean temperature and pH due to human activities can affect the survival of some organisms and impact biological diversity (coral bleaching due to increased temperature and inhibition of shell formation due to ocean acidification).
- o G: Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all.

Other National or State Science Standard(s) Addressed:

- **PA.3.2.10A**: Apply knowledge and understanding about the nature of scientific and technological knowledge.
- **PA.3.2.10C:** Apply the elements of scientific inquiry to solve problems.
- **PA.3.5.10D:** Assess the value of water as a resource
- **PA.4.1.10A:** Examine the effects of limiting factors on population dynamics.
- **PA.4.1.10D:** Research practices that impact biodiversity in specific ecosystems.
- **PA.4.5.10A:** Explain how public policy encourages or discourages the sustainable use of natural

Additional Resources:

N/A

MYSTERY OF THE MISSING FISH WORKSHEET

Name: _____ Date: _____ Period: _____

What is the pattern?

Look at the graph showing the population of the Atlantic Red Gill since fisherman began recording data in 1765. What patterns do you see in the graph?

List some possible explanations to these patterns you see in the fish.

Make an informed decision

Currently, the government is not issuing commercial fishing licenses. Your team is charged with issuing a recommendation to maintain the moratorium or to begin issuing commercial fishing licenses. You should make your decisions based on the data. Looking at the fish data, what are your first thoughts? Should we continue to block licenses or allow fisherman to begin commercially fishing for the Atlantic Red Gill? What data is there that supports your data?

Possible Explanations:

Temperature: This graph shows how much the temperature is above or below the average temperature.

Prediction:

| What patterns do you see in the data compared to the red gill data?	Could this be the reason for the pattern in the red gill? Why?

Salinity: This graph shows the salinity (the measure of the "saltiness") of the ocean.

Prediction:

What patterns do you see in the data compared to the red gill data?	Could this be the reason for the pattern in the red gill? Why?

Ocean Predator: This graph shows the biomass of the Atlantic Sharpfin, the key predator of the Red Gill.

Prediction:

What patterns do you see in the data compared to the red gill data?	Could this be the reason for the pattern in the red gill? Why?

Fishing Industry: Listed were key dates in the fishing of the red gill.

Prediction:

What patterns do you see in the data compared to the red gill data?	Could this be the reason for the pattern in the red gill? Why?

Using the data in class, what explanation can you provide for the pattern seen in the red gill fish population? Support your answer with evidence and data.

What would be other variables that could influence the population?

Do you recommend issuing commercial fish licenses? Explain your decision and support with data. What could potentially change your mind in the future?
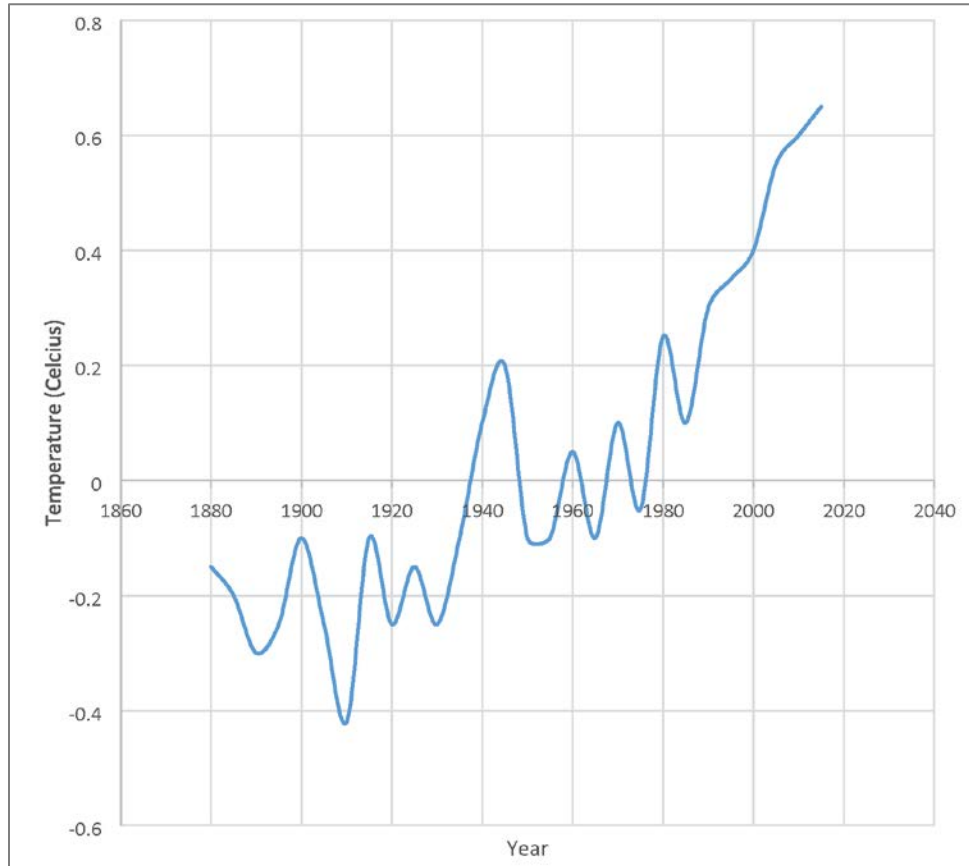
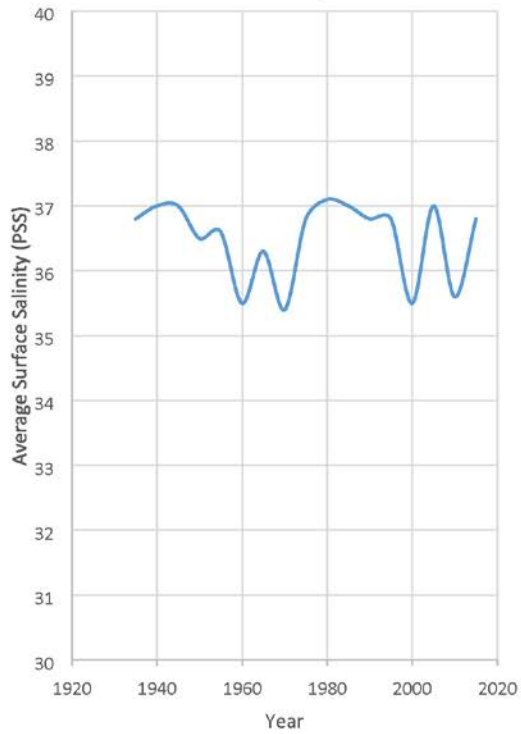# RED GILL FISH POPULATION GRAPH

Biomass of the Atlantic Red Gill
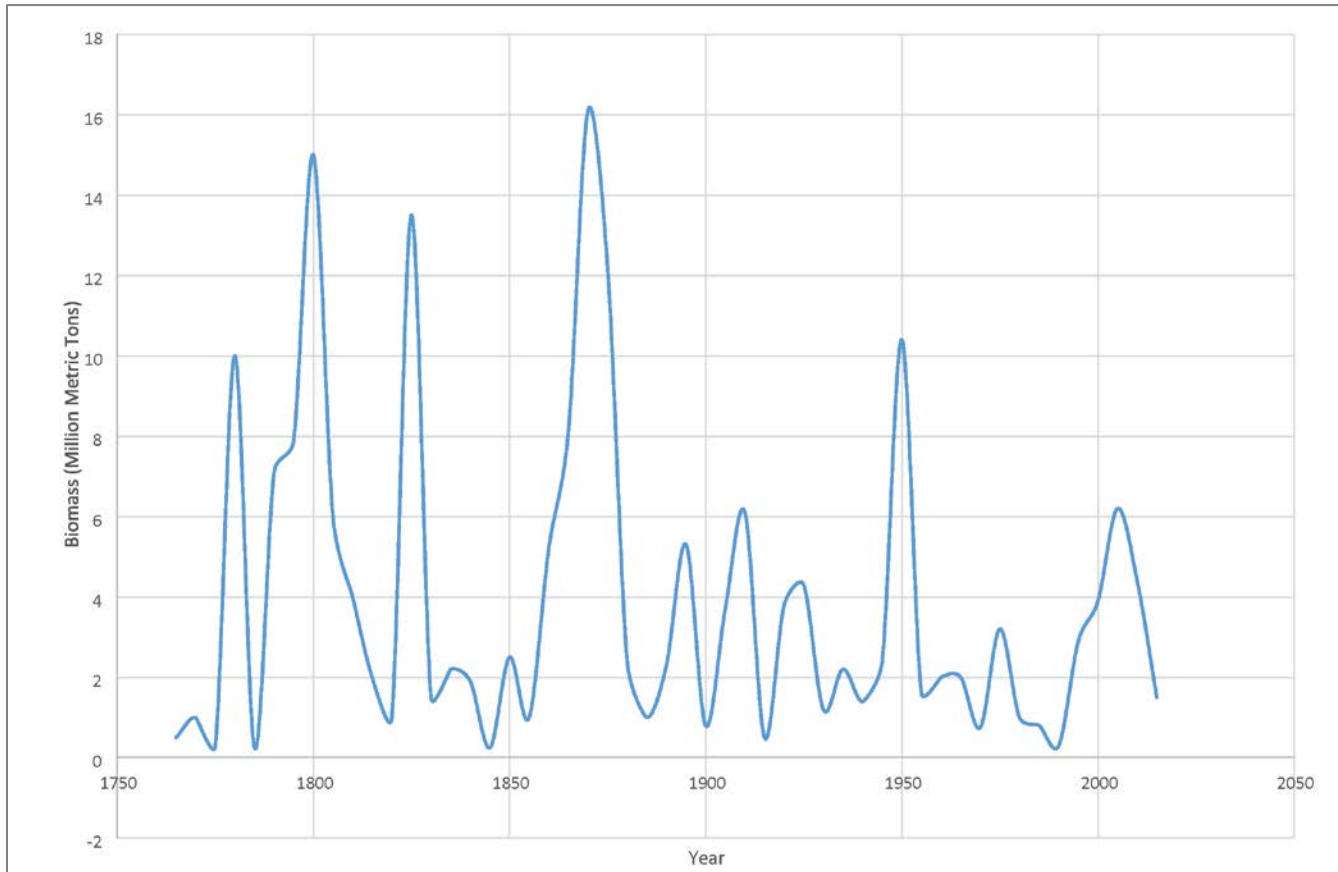
ENVELOPE DATA: BIOMASS, TEMPERATURE, SALINITY, AND PREDATOR CHARTS

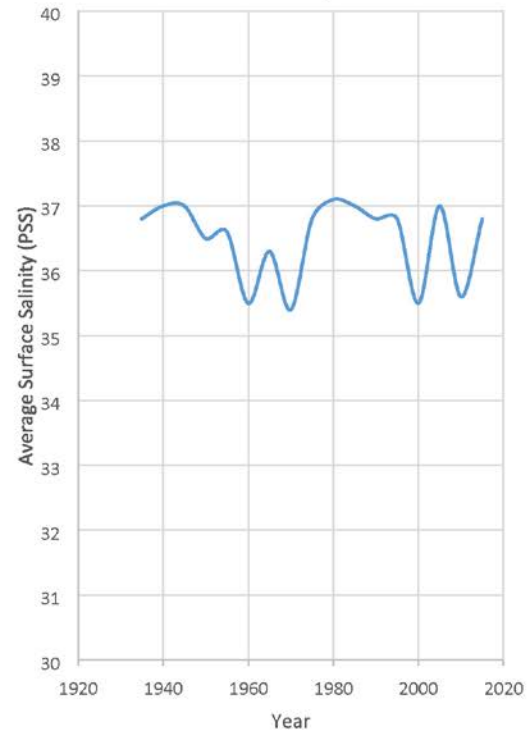**Annual Temperature Difference in the Atlantic Ocean**

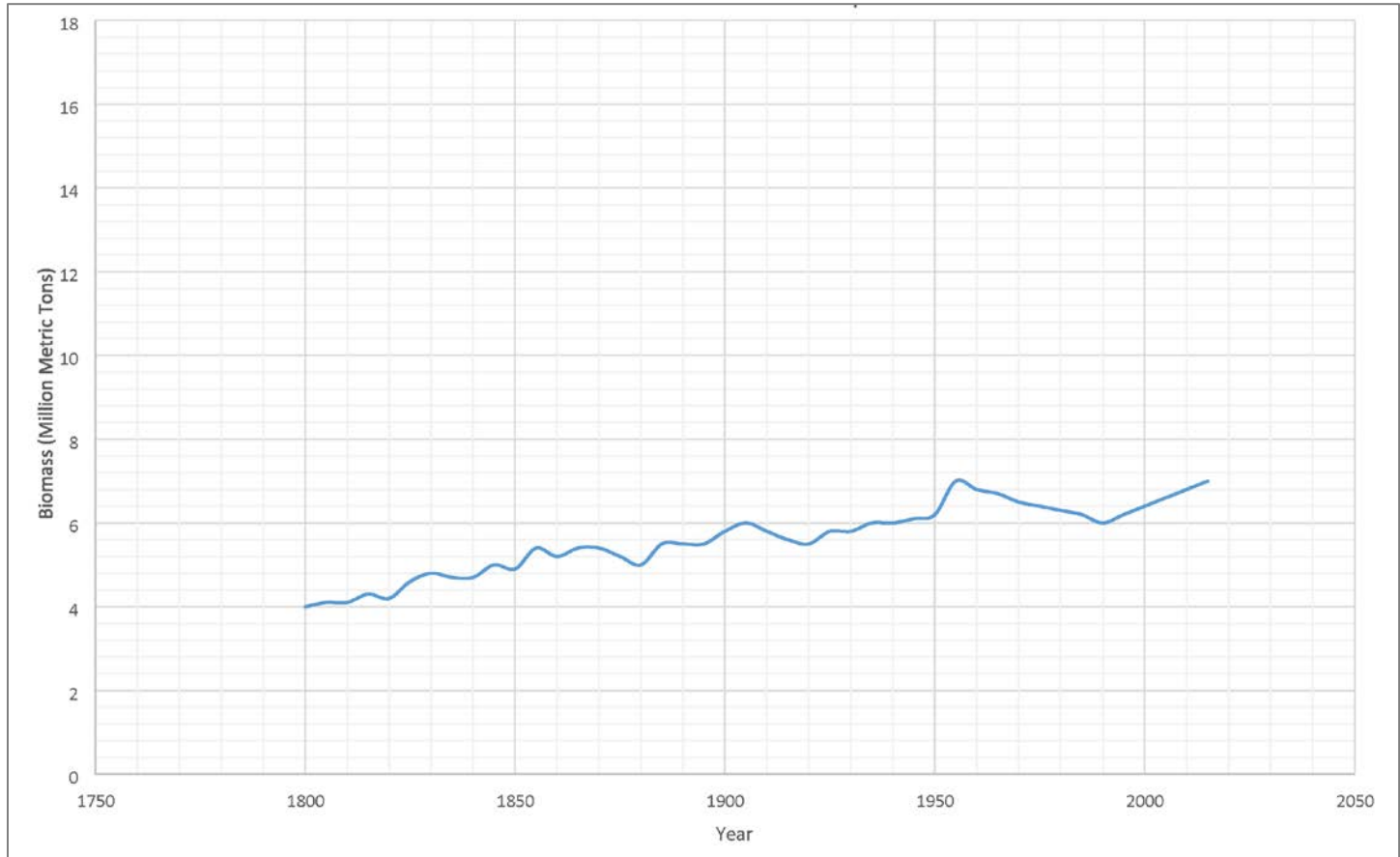Print on transparency paper

Atlantic Ocean Salinity Over Time

Atlantic Ocean Salinity Over Time

Print on transparency paper

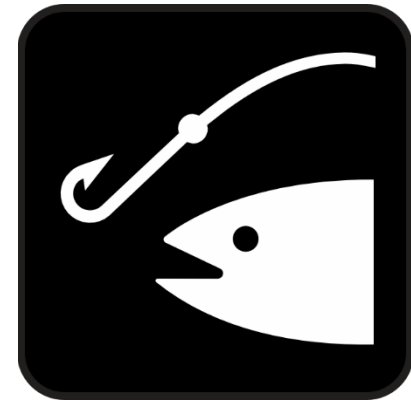## Biomass of the Atlantic Sharpfin

Print on transparency paper

SLIDES

This section contains 2 slides to be displayed during the Lesson

Major Events in the Red Gill Fishing Industry

Major Events in the Red Gill fishing industry

- Commercial fishing was open until 1910.

- In 1910, the federal government began regulating the number of the licenses.

- From 1960-1970, there was no commercial fishing of the red gill.

- In 1970, they began issuing licenses again. That lasted until 2010 when they stopped all commercial fishing of the red gill.

- There was an improvement to the fishing technique in 1870 and another step forward in 1925. These technologies made fishing for red gills easier and cheaper.