Johanna Mendillo

Activity Title: Pollock: The fish, their story, and their future!

Subject (Focus/Topic): Marine Biology and Fisheries Research

Grade Level: 7th grade

Average Learning Time: Three-four 55-min class periods (and four night of HW assignments)

Lesson Summary (Overview/Purpose): Students will read about the life history of pollock and the Bering Sea ecosystem, research and analyze NOAA fisheries data from the Bering Sea, and prepare positions for a debate on the management and fishing quotas of the pollock fishery in comparison to the management of New England fisheries.

Overall Concept (Big Idea/Essential Question): Students will answer the following essential question: *How do humans balance competing economic and biological interests to responsibly manage a fishery resource?*

This will be the final piece in a new three-week Marine Biology/Oceanography/Coastal Studies unit I have added to my current twelve-week Biology curriculum. This unit includes the following six topics: 1) an introduction to the Boston Harbor ecosystem and the New England fishing industry, 2) a comparison to the Bering Sea ecosystem and fishery industry, 3) Federal agencies and laws related to the our marine environment, 4) ichthyology, 5) marine food webs, and 6) the chemical composition/properties of ocean water.

Specific Concepts (Key Concepts):

- How do pollock behave as a species and as part of the Bering Sea food web?
- How do NOAA scientists collect pollock data and how are decisions regarding pollock quotas made?
- Why is it important to manage our natural resources and what are the consequences behind poor fishery management decisions?
- How does the management of the pollock fishery compare with New England-based fisheries?

Focus Questions (Specific Questions):

- How and how often do pollock reproduce?
- What role do pollock play in the Bering Sea food web?
- What is hydroacoustics and how does NOAA use it to study pollock?
- How have past management decisions for pollock been made?
- How are current management decisions for pollock made?
- How will future management decisions for pollock be made?
- What are the major fisheries in New England and how have management decisions been handled there?
- What are the other major fisheries in the Bering Sea and how have management decisions been handled there?
- How are the Bering Sea and George's Bank similar to each other?
- How are the Bering Sea and George's Bank different from each other?

Objectives/Learning Goals:

- Given a series of handouts and a class powerpoint, students will be able to describe the biology and life history of the pollock species and label the parts of a pollock on a quiz with 80% accuracy.
- Given time in class and as homework to read and discuss the hydroacoustics and data analysis entries on my TAS blog, students will be able to explain the technological aspects behind NOAA's pollock data collection on a quiz with 80% accuracy.
- Given a series of handouts, diagrams, species cards, and a class powerpoint, student will be able to compare and contrast the species in the Bering Sea and George's Bank fisheries on a venn diagram with 80% accuracy.
- Given time to prepare as homework, students will be able to choose and create an "Adopt a Species" poster to describe the key life characteristics and current status of a species in the Bering Sea food web. Students will score 80% or higher

on the poster scoring rubric.

- Given a series of handouts and by watching a short video (from The Deadliest Catch), students will be able to list at least 5 key differences between past and current management decisions for different marine species in the Bering Sea

- Given a series of handouts and by watching a short video (from The Deadliest Catch), students will be able to list at least 5 themes for future management plans for different marine species in the Bering Sea

- Given time to prepare as homework, students will work together as a team, present, and earn a score of 80% or above, a position in our class debate answering this question: *"How can fisheries be responsibly managed to account for both fish and human interests?"*

Background Information: For this lesson to be taught clearly and accurately, it is important to not overwhelm students with too many handouts and too many topics at once. It is also important to focus on the main species, pollock, within the greater environment, the Bering Sea. I do not have the class time, nor is it appropriate, to teach a semester-long ichthyology course. This is simply a strong way to end our unit in Biology and to plant the seeds concerning an important environmental issue (natural resources management) as they head into their 8th grade Ecology unit next year.

To succeed with this lesson, students will have to closely read and annotate entries from my TAS blog as well as from the selected handouts I will be giving them related to pollock, fisheries management, and the Bering Sea. They will also have to develop their research skills to distinguish between websites of different literacy abilities (with differing amount of biological vocabulary and jargon) when making their "Adopt-a-Species" poster.

I foresee that some students will fall into the pitfall of assuming marine-based organisms have similar life characteristics and feeding relationships as terrestrial organisms. In addition, I foresee them overlooking the importance of the base of the marine food web, just as they tend to discount the significance of producers in terrestrial food webs.

Common Misconceptions/Preconceptions:

- There are an infinite number of fish in the oceans.

- We do not have good estimates for the number of fish in the ocean- just guesses.

- Yet, researchers kill too many fish in the ocean when they gather data as I did.

- Fish can reproduce very quickly and easily.

- Fish do not face any predator other than whales and sharks in the ocean.
- Fish do not compete for resources in the ocean.
- "Managing" wild species in the ocean does not really work.

Materials:

- Various NOAA-based handouts (some I will create and some are listed under the "Additional Resources" section)
- My TAS blog (and my fellow-TAS's blog, Allan Phipps)
- My TAS pictures and videos
- The Seaside Naturalist by Deborah A. Colombe
- Marine Science: Marine Biology and Oceanography by Thomas F. Greene
- The Handy Ocean Answer Book by Thomas E. Svarney and Patricia Barnes-Svarney
- Atlantic Seashore and Pacific Ocean Fishes Peterson Field Guides
- Segments from "The Deadliest Catch"
- My NOAA styrofoam cup from a CTD cast
- Data sets from my TAS cruise
- Sample journal entry from my TAS cruise
- Nautical charts of the Bering Sea and Boston Harbor/Massachusetts Bay

Technical Requirements: Computer, InFocus Projector, and access to school computer lab, access to school iPad cart, and internet access

Teacher Preparation: There are several preparations I, as the teacher, will need to make in order to teach this lesson most effectively. For example, I am going to create a "Fisheries Lab Notebook" full of background readings and formative assessments,

including fill-in-the blanks worksheets, a venn diagram, compare-and-contrast graphic organizers, and worksheets reviewing my TAS blog and video segments. I will be organizing them by topic, similar to the way I organized my TAS blog entries.

I have also collected a number of NOAA and non-NOAA publications and resources related specifically to pollock, but I need to condense and simplify much of the language so it is in a format more easily digestible to a middle school audience.

I also have some of the sample data sets and nautical charts that I brought home from my TAS experience. I will work with our 7th grade math teachers to create an activity where they graph pollock data and answer summarizing questions. I will also partner with our 7th grade geography teacher to create a short mapping activity with nautical charts, documenting the track of my ship (the *Oscar Dyson)*.

In English class, students do many assignments related to autobiographical writing and research papers; I am going to create one homework writing assignment around nautical narratives and another one around sample journal entries at sea, based on a journal entry I wrote.

I am still in search of a usable marine food web diagram that focuses specifically on the Bering Sea; I have some reasonable ones for George's Bank.

Keywords (5): sustainability, hydroacoustics, stakeholder, quota, and trawler.

Pre-assessment Strategy/Anticipatory Set: As I mentioned, this lesson will be the final piece in a new three-week Marine Biology/Oceanography/Coastal Studies unit I will be adding to my current twelve-week Biology curriculum.

This unit includes the following six topics:

1) An introduction to the Boston Harbor ecosystem and the New England fishing industry,
2) A comparison to the Bering Sea ecosystem and fishery industry,
3) Federal agencies and laws related to the our marine environment,
4) Introduction to ichthyology,
5) Introduction to marine food webs, and
6) The chemical composition/properties of ocean water

Parts #1, 3, 4, and 5 will be taught before Part #2 is introduced. Part #2, pollock and the Bering Sea, are the topics of this lesson plan.

There will be a small pre-assessment activity used to activate students' prior knowledge before the start of this Marine Biology/Oceanography/Coastal Studies unit. It will be a pre-test in the same format as the pre-tests I give each year for my other curricula

(Physics, Astronomy, Biology & Geology). It will consist of 20 multiple choice questions, and students will take the same test as a post-test. From this data, I will evaluate the piloting of both the Marine Biology/Oceanography/Coastal Studies unit and this specific piece devoted to my TAS experience.

Lesson Procedure:

Day 1: Introduction to Pollock and the Bering Sea

1. Students will do a review exercise on the New England-based fisheries they have already learned about (cod, flounder, haddock, bluefish, salmon, herring, etc.).

2. Students will receive the "Fish Lab Notebook" and read aloud about pollock as they view a powerpoint presentation and a short video segment from my TAS cruise.

3. Students will, together as a class, fill in a pollock diagram. They will learn how to identify pollock gender and age from my TAS blog, projected on the screen.

4. Students will fill out a graphic organizer, contrasting pollock with cod, using their earlier handout on cod from our New England fisheries day.

5. Students will label a diagram of the Bering Sea as they view a powerpoint presentation from my TAS cruise.

6. Students will read aloud a sample journal entry at sea, based on a journal entry I wrote. There will be a short class discussion about living on a ship and a powerpoint presentation with pictures from my living quarters.

7. For HW, students will A) write a sample journal entry of what it would be like for them to live and work on a research ship) return to my blog (they read it earlier in the year) and answer a series of HW questions in preparation for Day 2.

Day 2: Bering Sea Food Webs

1. Students will watch 2-3 short video segments from "The Deadliest Catch" to introduce them to the Bering Sea food web.

2. Students will label a Bering Sea food web in their "Fish Lab Notebook".
3. Students will have a class discussion and fill out a venn diagram comparing the Bering Sea food web to the George's Bank food web handout from our earlier New England fisheries class.

4. Students will be assigned to one of four groups for the class debate: NOAA, NMFS, the fishing industry, and citizens and families from the local fishing industry

5. Students will review the format and scoring rubric for the upcoming class debate,

focusing on this topic: *"How can fisheries be responsibly managed to account for both fish and human interests?"*

6. For HW, students will conduct their research, using both readings in their "Fish Lab Notebook" and internet-based sources. This debate will occur on Day 4.

Day 3: NOAA's Pollock Data Collection Techniques (and Preparation for Debate Day)

1. Students will review yesterday videos and complete a venn diagram comparing and contrasting the management of the George's Bank and Bering Sea fisheries.

2. Students will view a powerpoint presentation on how NOAA collects and anlyzes Pollock data in the Bering Sea using hydroacoustics.

3. In small groups, they will read and answer questions related to pollock data in their "Fish Lab Notebooks".

4. In small groups, they will graph a sample pollock data set from my TAS cruise.

5. In a culminating class discussion, students will share their graphs and report on trends and patterns in pollock population sizes over the last several years.

6. Students will gather in their assigned group and share the research they collected for HW.

7. Students will type and submit, as a group, the opening statement they will read aloud in the debate.

8. Students will review the format and timing for the debate.

9. Students will review the format and scoring rubric for the "Adopt a Species" poster research project. For homework, students will begin their "Adopt a Species" poster project. This project will be assigned as HW for the next 3-4 nights.

Day 4: Fisheries Management Debate

1. Students will review the topic of the class debate: *"How can fisheries be responsibly managed to account for both fish and human interests?"* Students will also review the rules and terms of the class debate format and the scoring rubric they will be assessed on.

2. Students will gather in their position group to finalize speaking order, supplementary materials, and other final details.

3. Students in the 1st group, NOAA, will present their opening statement.

4. Students in the 2nd group, the fishing industry, will present their opening statement.

5. Students in the 3rd group, the National Marine Fisheries Service, will present their opening statement.

6. Students in the 4th group, citizens and families from the local fishing industry, will present their opening statement.

7. Rebuttal period: each of the four groups will have a chance to caucus, review their notes, and select two points for rebuttal.

8. Response to rebuttal period: each of the four groups will have a chance to caucus and respond to the rebuttals they heard.

9. Open response period: each of the four groups will have the opportunity to introduce additional information or respond with additional rebuttals.

10. Closing statement: each of the four groups will have a representative deliver their closing arguments.

11. Students will vote, anonymously, on which group they think provided the most persuasive argument for their team.

12. Students will vote, anonymously, on which group's recommendations they would accept if they were a voting member of the Northwest Fisheries Management Council.

13. Students will review directions for HW reflection essay about the debate.

Assessment and Evaluation:

- There will be a summative quiz on the biology and life history of the pollock species (including labeling the parts of a pollock).

- There will be a summative quiz on the hydroacoustics and data analysis entries on my TAS blog

- There will be a "Fisheries Lab Notebook" graded; it contains several formative assessments that students will either complete alone or in small groups in class, such as fill-in-the blanks worksheets, venn diagrams, compare-and-contrast graphic organizers, and worksheets reviewing my TAS blog and video segments.

- There will be a scoring rubric attached to the "Adopt a Species" poster research project, where students will describe the key life characteristics and the current status (healthy, near threatened, vulnerable, endangered, critically endangered, or extinct) behind a species in the Bering Sea food web.

- There will be a scoring rubric attached to the class debate answering this question: *"How can fisheries be responsibly managed to account for both fish and human interests?"* Students will be evaluated on the quality of the research (pre-debate), their presentation and rebuttal during the debate, and on a reflective essay (post-debate)

Standards:

National Science Education Standard(s) Addressed:

1. Systems, Order and Organization
3. Change, Constancy, and Measurement
4. Evolution and Equilibrium
5. Form and Function
20. Reproduction and Heredity
22. Populations and Ecosystems
23. Diversity and Adaptations of Organisms
35. Transfer of Energy
51. Populations, Resources and Environments
52. Natural Hazards
53. Risks and Benefits
54. Science and Technology in Society
69. Understanding About Scientific Inquiry K-12

Ocean Literacy Principles Addressed:

Ocean Literacy Principle #5: The ocean supports a great diversity of life and ecosystems.

Fundamental Concepts addressed: d & e

d) Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (such as symbiosis, predator-prey dynamics and energy transfer) that do not occur on land.

Linked to the following National Science Education Standards:

3. Change, Constancy, and Measurement
4. Evolution and Equilibrium
5. Form and Function
18. Organisms and Environments

20. Reproduction and Heredity
22. Populations and Ecosystems
23. Diversity and Adaptations of Organisms
35. Transfer of Energy
69. Understanding About Scientific Inquiry K-12

e) The ocean is three-dimensional, offering vast living space and diverse habitats from the surface through the water column to the seafloor. Most of the living space on Earth is in the ocean.

Linked to the following National Science Education Standards:

3. Change, Constancy, and Measurement
4. Evolution and Equilibrium
5. Form and Function
18. Organisms and Environments
22. Populations and Ecosystems
69. Understanding About Scientific Inquiry K-12

Ocean Literacy Principle #6: The ocean and humans are inextricably interconnected.

Fundamental Concepts addressed: b, e, & g

b) From the ocean we get foods, medicines, and mineral and energy resources. In addition, it provides jobs, supports our nation's economy, serves as a highway for transportation of goods and people, and plays a role in national security.

Linked to the following National Science Education Standards:

1. Systems, Order and Organization
3. Change, Constancy, and Measurement
22. Populations and Ecosystems
51. Populations, Resources and Environments
54. Science and Technology in Society

e) 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 leads to pollution (such as point source, non-point source, and noise pollution) and physical modifications (such as changes to beaches, shores and rivers). In addition, humans have removed most of the large vertebrates from the ocean.

Linked to the following National Science Education Standards:

1. Systems, Order and Organization
3. Change, Constancy, and Measurement
22. Populations and Ecosystems
51. Populations, Resources and Environments
52. Natural Hazards
53. Risks and Benefits
54. Science and Technology in Society
69. Understanding About Scientific Inquiry K-12

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.

Linked to the following National Science Education Standards:

1. Systems, Order and Organization
3. Change, Constancy, and Measurement
53. Risks and Benefits
54. Science and Technology in Society
69. Understanding About Scientific Inquiry K-12

State Science Standard(s) Addressed:

Life Science: Biology (Gr. 6-8; Massachusetts)

10. Give examples of ways in which genetic variation and environmental factors are causes of evolution and the diversity of organisms.

13. Give examples of ways in which organisms interact and have different functions within an ecosystem that enable the ecosystem to survive.

14. Explain the roles and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web.

17. Identify ways in which ecosystems have changed throughout geologic time in response to physical conditions, interactions among organisms, and the actions of humans. Describe how changes may be catastrophes such as volcanic eruptions or ice storms.

Additional Resources:

http://teacheratsea.wordpress.com/category/johanna-mendillo/

http://www.fishwatch.gov/seafood_profiles/species/pollock/group_pages/

http://www.nmfs.noaa.gov/stories/2012/10/10_17_12teacher_at_sea_pollock.html

http://www.afsc.noaa.gov/education/Activities/seafood_intro.html

http://www.climatewatch.noaa.gov/article/2012/climate-fish-sticks

http://www.afsc.noaa.gov/

Author: Johanna Mendillo, John D. O'Bryant School of Mathematics and Science, 55 Malcolm X. Blvd., Boston, MA 02120; johanna.mendillo@gmail.com

Creation date: 10/22/12