

NOAA Teacher at Sea Program

Lesson Plan #1

Unit Plan: Sustainable Harvesting of Chinook Salmon; A Fisheries Management Decision

Activity Title: Investigation of Arctic Ecosystems

Subject (Focus/Topic): Life science: marine ecology /fisheries

Grade Level: 9th – 12th Grade

Average Learning Time: 2 hours

Lesson Summary (Overview/Purpose): Students will participate in an *Expert Jigsaw* to gather background knowledge about topics and methods that are addressed when making decisions regarding fisheries management.

1. Basic Geographical and Climatological Information about Bering Sea
2. Life History of an Alaskan Chinook Salmon
3. Fishing Industry of Walleye Pollock
4. Commercial Fishing Methods Employed in the Bering Sea and their Environmental Impact
5. Human Impact on Kenai River System in Alaska

Overall Concept (Big Idea/Essential Question): This activity is designed to acquaint students with the Alaskan ecosystem and introduce them to basic vocabulary used in fisheries research that is associated with the life stages of fish and the methods used to catch them. These four seemingly unrelated topics will each play an essential role in ultimately understanding the impact of fisheries management decisions in

Specific Concepts (Key Concepts)

- The Bering Sea is a unique ecological environment that supports a very large food web.
- Climate change has/will impact the chemical and biological structure of the Bering Sea.
- Chinook Salmon have unique life histories that are inextricably linked to humans.
- Fishery management must take into consideration various aspects such as stake-holders, environmental stresses and technological limitations.

Focus Questions (Specific Questions for each Expert Group)

Basic Geographical and Climatological Information about Bering Sea

- 1) Why is the Bering Sea a sea and not an ocean or gulf?
- 2) What is the general topography of the Bering Sea?
- 3) When and to what extent is sea ice in the Bering Sea?
- 4) Give an example or two of how the biology of the Bering Sea has changed over the past decades.
- 5) Give an example or two of evidence of climate change in the Bering Sea over the past decades.
- 6) Give four (4) examples of how climate change will impact fisheries in the Bering Sea.

Life History of an Alaskan Chinook Salmon

- 1) How is the Chinook Salmon different than the other varieties of salmon?
- 2) Is the Alaskan Chinook Salmon listed as either Endangered or Threatened under the Endangered Species Act?
- 3) Where do Chinook Salmon live? (Be specific in terms of their age)
- 4) What is their typical lifespan?
- 5) Why are salmon anadromous fish?
- 6) How do Chinook Salmon reproduce?
- 7) Why can the Chinook Salmon be considered a keystone species?

Fishing Industry of Walleye Pollock

- 1) What ecological roles do Walleye polluck play in the Bering Sea?
- 2) What is the history of the walleye polluck population?
- 3) What is the status of polluck stocks in US waters?
- 4) What products are made from Alaskan polluck?
- 5) What role do stellar sea lions play in terms of managing polluck fisheries?
- 6) Where is the habitat of the Alaskan polluck?
- 7) Give examples and distinguish predators and prey of the Alaskan polluck.

Commercial Fishing Methods Employed in the Bering Sea and their Environmental Impact

- 1) What is the difference between trawling, purse seining and gill netting?
- 2) What environmental impact does trawling have on the environment?
- 3) What environmental impact does purse seining have on the environment?
- 4) What environmental impact does gill netting have on the environment?
- 5) What is meant by bycatch?
- 6) What is subsistence fishing and how does it differ from commercial fishing?
- 7) What harvest sharing agreement is laid out in the Yukon Salmon Agreement?

Human Impact on Kenai River System in Alaska

- 1) Where are the spawning and nursery habitats in the Kenai River Basin located?
- 2) What time of year will the salmon be in the refuge waters?
- 3) Explain how urban and residential development may impact the aquatic habitat of the Kenai river basin.
- 4) What “water rights” do fish have in Alaska?
- 5) What impact does hydropower have on salmon populations?
- 6) Explain how timber harvesting can impact the aquatic habitat of the Kenai river basin.
- 7) Explain how mining can impact the aquatic habitat of the Kenai river basin.

Objectives/Learning Goals

- Students will be able to locate the Bering Sea and provide information about its’ geology.
- Students will be able to identify how climate changes have and may impact the physical and biological makeup of the Bering Sea.
- Students will be able to explain the life history of the Chinook salmon and elaborate on its’ important ecological role in the Bering Sea.

- Students will be able to explain the life history of the Walleye polluck and elaborate on the fishing industry that it supports.
- Students will become familiar with common fishing practices in the Bering Sea and be able to elaborate on how each can potentially harm the marine environment.
- Students will describe the differences between subsistence and commercial fishing.
- Students will elaborate on how humans can potentially impact a river aquatic environment.

Background Information

The Bering Sea is an extremely biologically productive region that is home to many variety of marine life. This productivity supports very profitable fisheries. A fishery is defined as a place where a population of fish or invertebrate is hunted and collected. This population is then referred to as stock. Fishers in the fishery vary from large commercial businesses to subsistence and recreational fishers. The fish landing, (the part of the fish that is put ashore) is what is used to manage the fishery and to keep track of specie populations. Fish recruitment is the number of new juvenile fish that reach either the size or the age that is required for them to be part of the stock. A fishery is considered sustainable when it maintains a stock by supporting recruitment and a strong ecological base while preventing overfishing. Because of the number of stake-holders involved in a specific fishery and complicated ecological and environmental pressures, government services often play a role to set guidelines and/or rules on how a specific fishery will be managed.

Web Resources

1. Basic Geographical and Climatological Information about Bering Sea

What is the difference between a Sea and an Ocean?

<http://oceanservice.noaa.gov/facts/oceanorsea.html>

Why is the Bering Sea Important?

http://www.beringclimate.noaa.gov/essays_alexander.html

Bering Climate

http://www.beringclimate.noaa.gov/bering_status_overview.html

Marine Ecosystem; Bering Sea

<http://www.arctic.noaa.gov/detect/marine-bering.shtml>

Human Related Effects of Climate-Related Changes in Alaska Commercial Fisheries

www.besis.uaf.edu/besis-oct98-report/Fisheries.pdf

2. Life History of an Alaskan Chinook Salmon

Meet the Different Salmon Species

http://www.salmonnation.com/fish/meet_species.html

Salmon Life History

http://www.nap.edu/openbook.php?record_id=11080&page=23

Anadromous Fish as Keystone Species in Vertebrate Communities

<http://nativefishsociety.org/wp-content/uploads/Willison-salmon-as-keystone-species-CB.pdf>

NOAA Teacher at Sea Log #2 from BASIS Survey 2010
<http://oscardyson2010.blogspot.com/2010/08/noaa-log-2.html>

3. Fishing Industry of Walleye Pollock
Walleye Pollock Research
<http://www.afsc.noaa.gov/species/pollock.php>
Walleye Pollock Fact sheet
http://www.afsc.noaa.gov/Education/factsheets/10_Wpoll_FS.pdf
Fish Watch: Alaska Pollock
http://www.nmfs.noaa.gov/fishwatch/species/walleye_pollock.htm

4. Fishing Methods Employed in the Bering Sea and their Environmental Impact
Types of Fishing Methods and Environmental Impacts
http://www.montereybayaquarium.org/cr/cr_seafoodwatch/sfw_gear.aspx
Subsistence Management Information
<http://www.subsistmgtinfo.org/basics.htm>
Yukon Subsistence Fisheries
<http://alaska.fws.gov/fisheries/fieldoffice/fairbanks/subsistence.htm>
Yukon River Salmon Agreement
<http://yukonriverpanel.com/salmon/about/yukon-river-salmon-agreement/>
Yukon River Panel
<http://yukonriverpanel.com/salmon/>

5. Human Impact on Kenai River System in Alaska
Kenai National Wildlife Refuge
<http://kenai.fws.gov/Wildlife/fish/fish.htm>
Kenai River
<http://dnr.alaska.gov/parks/units/kenrvmap.htm>
Kenai Habitat Assessment 2010
www.fishsciences.net/.../Kenai_Habitat_Report_Review_2010.pdf
USGS Real-time Water Data for Alaska
<http://waterdata.usgs.gov/ak/nwis/rt>

Common Misconceptions/Preconceptions

- All fish are caught by the same method
- Subsistence fisheries are not regulated
- Fish are classified as either saltwater or freshwater fish
- Human impact on terrestrial land will not influence ocean ecosystems

Materials

Handout with Five Expert Topics titled in boxes for Pre-Assessment
Poster paper if student groups will be coordinating information on a poster.

Technical Requirements

- Access to the Internet for student research on topics

- Wiki available for student collaboration (Wikispaces.com)
- OR Student access to Google Docs
- Google Ocean: <http://earth.google.com/ocean/>

Teacher Preparation

Select one means below for student groups to collaborate:

- Develop Private Class Wikispace and ask students to join. Each Expert Group should have its' own unique page on the Wikispace to edit.
- Create Google Document for each Expert Group.
- Poster paper is available for each Expert Group to coordinate Expert Information

Class should be divided into five *Expert Student Groups* for this investigation.

Class *Fisheries Management Teams* should be created for the Structured Controversy (Last Lesson) Each team should have atleast one member from each expert group. These teams will take the Pre-assessment as a team building exercise.

Keywords: anadromous, bycatch, fry, gill-netting, harvest, hydropower, keystone specie, landing, purse seining, recruitment, sedimentation, spawn (spawning), stock , topography, trawling, turbidity

Pre-assessment Strategy/Anticipatory Set (Optional)

Place students in their *Fisheries Management Teams* and sharing the five research topics that is the focus of today's Expert Group Investigation. As an initial team building strategy, introduce the following terms one at a time and ask the team to work together to decide which expert group will come across or use that term. Have them write this information down to revisit at a latter time. This is simply a chance for student to start working together and be introduced to new vocabulary.

Lesson Procedure

Student research

1. Allow individual students in the *Fisheries Management Teams* to choose the topic for which they wish to become an expert.
2. Members who have chosen the same expertise topic meet in expert groups to discuss, research and present their topic.
3. Student expert teams must first discuss how they will answer the Focus Questions associated with the given topic. This information is shared with the teacher.
4. Student teams put together a page on the Wiki that is dedicated to answering the focus question of the team. (Alternative: teams put together a Google doc or presentation)
5. A due date for all research and presentation materials is assigned, because student experts must return to their original *Fisheries Management Teams* to present their knowledge.

(The time required for research and development of Wiki page will depend on the level of your student and the amount of class time devoted to the project as opposed to individual work at home. A suggested time frame is two 45 minute class periods for the research and 1-2 45 minute class periods for the expert presentations.)

6. In their *Fisheries Management Teams*, ask students to return to their original

vocabulary lists and correctly place each in the appropriate topic. Ensure that each group member understands the meaning of the word cited. Any vocabulary that the group is unsure of or did not use, must be defined.

Assessment and Evaluation

For the purpose of this lesson, evaluate students based on both their individual work as well as their ability to work as part of an expert team. The content of the wiki should adequately answer all of the focus questions. Credit should be given to the team based on their ability to work together and put together a neatly designed page. You may consider rewarding students for making their Wiki page interactive with Internet sources.

Students may also assess how well they worked within the group. A peer evaluation at the end of the activity could be used to assess how well students participated within the group.

Standards

National Science Education Standard(s) Addressed:

- NSES A: Unifying Concepts and Processes
Sub-categories 1, 2, 3 and 5
- NSES B: Science as Inquiry
Sub-category 1 and 2
- NSES D: Life Science
Sub-categories 4, 5 and 6
- NSES F: Science and Technology
Sub-categories 1 and 2
- NSES G: Personal and Social Perspectives
Sub-categories 1, 2, 3, 4, 5 and 6
- NSES H: History and Nature of Science
Sub-categories 1, 2 and 3

Ocean Literacy Principles Addressed:

- Principle 1: The Earth has one big ocean with many features.
Fundamental Concepts: g and h
- Principle 2: The ocean and life in the ocean shape the features of the Earth
Fundamental Concepts: c
- Principle 5: The ocean supports a great diversity of life and ecosystems.
Fundamental Concepts: a, c, d, e, f, and i
- Principle 6: The ocean and humans are inextricably interconnected
Fundamental Concepts: b, c, d, e, and g
- Principle 7: The ocean is largely unexplored.
Fundamental Concept: a, b, c, d, e, and f

Author: Natalie Macke

Creation date: December 10, 2011