Activity Title: Fishing for Information

Subject: This lesson is applicable to a Biology or AP Environmental Science class.

Grade Level: High School

Average Learning Time: Two to three 45-55 minute class periods for research and data analysis, outside of class time for presentation preparation (homework), one to two periods for presentation/sharing.

Lesson Summary: After selecting and analyzing fisheries data from NOAA, students develop research questions, analyze the data and draw conclusions, which are then represented visually in the form of a poster presentation and shared with the class.

Overall Concept (Big Idea/Essential Question): How can pre-existing, large datasets help scientists to answer questions? What can we learn about an ecosystem by analyzing data?

Specific Concepts: Ecosystems, biodiversity, fisheries management, observing trends, developing testable questions, making inferences and drawing conclusions based on evidence, using mathematical or computational representations to support explanations, communicating scientific evidence.

Focus Questions:
1. What organisms are in the Gulf of Alaska food web?
2. What are the producers and consumers in this food web?
3. Does water temperature (surface and bottom), depth, stratum, location, and/or time of year affect the abundance of organisms at a location?
4. Are there greater numbers of predators or prey?
5. What changes can you observe over time?
6. Can you observe any relationships or trends in the data?
7. What does the current research say about the Gulf of Alaska?
8. How might commercial fisheries be impacted by the information you have discovered?
9. What regulations or legislation exists relevant to the species you have chosen to study?

Objectives/Learning Goals:
The student will examine large fisheries datasets and develop a research question based on the data. The student will analyze the data and create graphical or other mathematical representations of the data and develop a conclusion based on the evidence they have discovered. The student will research the species upon which they are focusing and cite any relevant regulations and/or prior research applicable to the organism(s) of focus. Finally, the student will present this information to the class as a poster presentation, which must include all thirteen of the components as described on the rubric.

Background Information: In order to be successful with this lesson, students must understand how to manipulate/analyze data and use Excel. They must be able to create graphical representations of the data and conduct statistical analyses appropriate for their age/math level.

Common Misconceptions/Preconceptions: Students may think that there has to be a conclusive answer to the scientific question they ask. However, they may not be able to make a connection or draw a conclusion from their investigation. If this is the case, encourage them to develop a
question for further investigation and to identify what kinds of information would be needed to answer this revised or new question.

**Materials:** Photocopies of database instructions for each student, poster board (optional - students could make PowerPoint or Prezi).

**Technical Requirements:** Internet access, Microsoft Excel, Microsoft PowerPoint, computers

**Teacher Preparation:** Practice using RACE Groundfish Survey website to be sure that the files will download when students are conducting their work.

**Keywords:** forage fish, groundfish, recruitment, gadids, osmerids, nektonic, neritic, zooplankton, walleye pollock, sablefish, Pacific Ocean perch, Pacific cod, Atka mackerel, yellowfin sole

**Pre-assessment Strategy/Anticipatory Set:**
As an entry task, have students read the NY Times article “Salmon Fishermen Battle Walmart on Certification” [http://www.nytimes.com/2013/10/22/business/salmon-fishermen-battle-walmart-on-certification.html?r=0](http://www.nytimes.com/2013/10/22/business/salmon-fishermen-battle-walmart-on-certification.html?r=0). Ask students to write why they think fisheries should be regulated, indicate who is responsible for the regulation, and to summarize the current battle between fishermen and Walmart. This is a good segue into a discussion about the research that is conducted that informs the regulatory process and how they can examine this research to see if they can draw any conclusions of their own.

**Lesson Procedure:** More detailed information is on the student handout following this lesson plan.

1. This project can be conducted by individual students or groups of 3, but I wouldn’t recommend larger groups.
2. If students work in groups, have them first decide which data to download based on dates and location. Once the data is downloaded, they can begin looking at what organisms and other information are represented in the data. If they cannot come up with several research questions based on the download, they should start over.
3. Once students have their research questions, they should have them checked by the instructor and get permission to move forward.
4. They can use Excel to manipulate the data and suggest that instead of deleting sections, they just make another workbook page with a refined set of data so they can always go back to the original dataset if they need to.
5. At this point they should start pulling in outside research. On the student worksheet there are some suggested readings and websites as a starting point. Students will be required to show a minimum of THREE primary sources (journal articles) and reference multiple websites (NOAA or other) regarding fisheries management.
6. Students will create poster presentations of their research. The format should be as follows:
   - Title, Introduction (including research question), Materials and Methods (could be optional - students might discuss where the data was obtained, etc.), Results (with well labeled charts/graphs - line plots, box plots, scatterplots, regression plots, bar graphs), Conclusions, and Literature Cited (MLA format)
7. Here are a couple of websites that give great advice on poster presentations. These could be modified for your classroom.
   - [http://colinpurrington.com/tips/academic/posterdesign](http://colinpurrington.com/tips/academic/posterdesign)
8. I would conduct the poster session over two class periods so that one group can present their posters, while the non-presenters visit the posters and then they can switch on the second day.

9. As a wrap up, conduct a whole class discussion about the class results and possibilities for further investigation.

**Assessment and Evaluation:** The final product, the poster presentation, will be the final assessment piece and will be graded on a rubric. Along the way, students will have checkpoints for a grade based on their initial question development and research. Students should be able to show that they can find and analyze NOAA data, they should be able to identify and explain at least one relevant regulation (US or international) that applies to the harvesting of marine food resources or helps manage marine organisms, and they should be able to share what they have learned from at least one relevant primary source (they should have read three).

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**Standards**

**Next Generation Science Standards (2013):**

**Cross Cutting Standards - Cause and Effect:**
- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

**High School: Interdependent Relationships in Ecosystems**
- HS-LS2-1 Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- HS-LS2-2 Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
- HS-LS2-6 Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

**Ocean Literacy Principles:**
- 5. The ocean supports a great diversity of life and ecosystems. (5 d,e,f)
- 6. The ocean and humans are inextricably connected. (6 b,d,e,g)
- 7. The ocean is largely unexplored (7 b,d,e,f)

**AP Environmental Science Course Outline:**
- II. The Living World A. Ecosystem Structure, B. Energy Flow, C. Ecosystem Diversity, D. Natural Ecosystem Change
- IV. Land and Water Use F. Fishing (fishing techniques, overfishing, aquaculture, relevant laws and treaties), G. Global Economics (globalization, tragedy of the commons)

**Washington State Science Standards:**
- 9-12 INQA Question - Scientists generate and evaluate questions to investigate the natural world.
- 9-12 INQB Investigate - Scientific progress requires the use of various methods appropriate for answering different kinds of research questions, a thoughtful plan for gathering data needed to answer the question, and care in collecting, analyzing, and displaying the data.
- 9-12 INQC Explain - Conclusions must be logical, based on evidence, and consistent with prior established knowledge.
• 9-12 INQD Communicate Clearly - The methods and procedures that scientists use to obtain evidence must be clearly reported to enhance opportunities for further investigation.

• 9-12 INQE Model - The essence of scientific investigation involves the development of a theory or conceptual model that can generate testable predictions.

• 9-12 INQF Communicate - Science is a human endeavor that involves logical reasoning and creativity and entails the testing, revision, and occasional discarding of theories as new evidence comes to light.

• 9-11 LS2B Living organisms have the capacity to produce very large populations. Population density is the number of individuals of a particular population living in a given amount of space.

• 9-11 LS2C Population growth is limited by the availability of matter and energy found in resources, the size of the environment, and the presence of competing and/or predatory organisms.

• 9-11 LS2D Scientists represent ecosystems in the natural world using mathematical models.

• 9-11 LS2E Interrelationships of organisms may generate ecosystems that are stable for hundreds or thousands of years. Biodiversity refers to the different kinds of organisms in specific ecosystems or on the planet as a whole.

**Common Core Connections:**

**ELA/Literacy:**

- RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

- RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

- RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

- WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

- WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

- WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

**Mathematics:**

- MP.2 Reason abstractly and quantitatively.

- MP.4 Model with mathematics.

- HSN.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

- HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

- HSN.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

- HSS-ID.A.1 Represent data with plots on the real number line.

- HSS-IC.A.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

- HSS-IC.B.6 Evaluate reports based on data.
Fishing for Information: Analyzing NOAA Fisheries Data

Introduction:

Excerpt below is from: http://www.afsc.noaa.gov/RACE/groundfish/

“The Groundfish Assessment Program is responsible for planning, executing, analyzing, and reporting results from surveys to establish time series estimates for the distribution and abundance of Alaska groundfish resources in the Gulf of Alaska, Bering Sea, and Aleutian Islands. The program also investigates biological processes and interactions with the environment to estimate growth, mortality, and recruitment to improve the precision and accuracy of forecasting stock dynamics. Impacts of bottom trawls on the seafloor and the description of bottom type are also being studied in the Bering Sea and Aleutian Islands.”

In this lesson, you will have the opportunity to put yourself in the shoes (er...rubber boots) of a NOAA fisheries scientist and analyze data that has been compiled as the result of several fisheries research cruises. The datasets range from 1982 to the present and data can be obtained for the Aleutian Islands, Bering Sea Slope, Eastern Bering Sea Shelf, Northern Bering Sea Shelf, and the Gulf of Alaska. During this project, you will develop your own research questions and conduct an analysis of the data. You will then present your research and conclusions to the class during a poster presentation. Your analysis will be accompanied by a review of relevant primary sources and fisheries regulations.
Step One - Retrieving Data:


2. At the bottom, make sure “Pollock, cods, grenadiers (Gadiformes) is selected and select “Walleye Pollock” as shown below. Don’t change the catch dropdown menu. Your selections should appear as in the image below.

3. At the top of the screen, select “Download Data”

4. Choose the location (Aleutian Islands, Bering Sea Slope, Eastern Bering Sea Shelf, Northern Bering Sea Shelf, or Gulf of Alaska) and the range of years that you want to research. For this example, I have selected “Gulf of Alaska” years 2007-2013.

5. When you click on the years, the data will be download and will appear as a zip file in the lower right hand corner of your screen. Click to open the downloaded file. An Excel spreadsheet will be generated. Save this file to a USB drive so you don’t have to be on a computer with an internet connection to do this work once you have the file.

6. Most of the columns are self explanatory, with the exception of “WTCPUE,” which represents kilograms per hectare and “NUMCPUE,” which represents number per hectare. You can hide column K as we will not use it in our analysis.
7. Notes on Station and Haul
   - **Station**: a location on a map where the sample was taken. You can go back to the
     http://www.afsc.noaa.gov/RACE/groundfish/survey_data/default.htm website
     and find the station where the organisms were collected on the map.

   - **Haul**: the number of that particular haul. For example, all organisms labeled haul
     87 were collected in the same net/trawl.

**Step Two - Making Discoveries:**

1. The information you have downloaded includes:
   - Latitude and longitude (you could use this later to make a map of your sites)
   - Station ID
   - Stratum
   - Year/Date/Time
   - Kilogram/hectare
   - Number/hectare
   - Scientific and Common Names
   - Bottom Depth
   - Bottom Temperature
   - Vessel # and Cruise #
   - Haul #

2. You have already made some choices based on location and year(s). Now look over
   the data you have retrieved and brainstorm questions. Write the questions in your lab
   notebook.

3. Consider the following focus questions to help guide you:
   a) What organisms are in the Gulf of Alaska food web?
   b) What are the producers and consumers in this food web?
   c) Does water temperature (surface and bottom), depth, stratum, location, and/or time of year affect the
      abundance of organisms at a location?
   d) Are there greater numbers of predators or prey?
   e) What changes can you observe over time?
   f) Can you observe any relationships or trends in the data?
   g) What does the current research say about the Gulf of Alaska?
   h) How might commercial fisheries be impacted by the information you have discovered?
   i) What regulations or legislation exists relevant to the species you have chosen to study?
4. Discuss what makes a good research question. As a team, go through each of your questions and determine which question is most “researchable” (i.e. not too broad, can be examined using the available data, etc.).

5. Once everyone has agreed on the best research question, ask the teacher for approval before continuing.

6. Use Microsoft Excel to analyze the data. Instead of deleting sections, I recommend that you make another workbook page with a refined set of data so you can always go back to the original dataset without having to download it again.

7. Once you have refined your dataset, start pulling in outside research. There are some suggested readings and websites following this set of instructions to be used as a starting point. You will be required to show a minimum of THREE primary sources (journal articles) and reference a minimum of THREE websites (NOAA or other) regarding fisheries management on your poster.

8. If you find that your research question doesn’t allow you to develop an adequate analysis or if in light of new information you would like to change your question, you may revise your question with teacher approval.

9. Your group will create a poster presentation to summarize your research. The format should be as follows:
   - Title
   - Introduction
   - Materials and Methods (discuss where the data was obtained and how you analyzed it, consider creating a map of the stations where you used data, etc.)
   - Results (with well labeled charts/graphs - line plots, box plots, scatterplots, regression plots, bar graphs)
   - Conclusions and suggestions for further investigation
   - Literature Cited (MLA format)

10. Your group will be evaluated on the projects checkpoints and final poster presentation.

11. As a wrap up, we will conduct a group discussion about the class results and possibilities for further investigation.

**Background reading:**

Salmon Fishermen Battle Walmart on Certification
http://www.nytimes.com/2013/10/22/business/salmon-fishermen-battle-walmart-on-certification.html?_r=0

General Fisheries Information: A Good Catch
http://www.education.noaa.gov/Marine_Life/A_Good_Catch_NMFS.pdf

Alaska Fisheries Science Center Education Website:
http://www.afsc.noaa.gov/Education/oceanlife/fish/oceanlifefish.htm
NOAA Fisheries
http://www.nmfs.noaa.gov/
http://www.nmfs.noaa.gov/regulations.htm

NOAA Alaska Fish Background Information
• Atka Mackerel http://www.afsc.noaa.gov/Education/factsheets/10_AtkaM_fs.pdf
• Sablefish http://www.afsc.noaa.gov/Education/factsheets/10_Sablefish_fs.pdf
• Walleye Pollock http://www.afsc.noaa.gov/Education/factsheets/10_Wp_poll_FS.pdf
• Pacific Cod http://www.afsc.noaa.gov/Education/factsheets/10_Pcod_fs.pdf
• Pacific Ocean Perch http://www.afsc.noaa.gov/Education/factsheets/10_POP_fs.pdf
• Yellowfin Sole http://www.afsc.noaa.gov/Education/factsheets/10_Yellowfin_fs.pdf

Inter-research Science Center

The North Pacific Research Board Website
http://publication.nprb.org/list.jsf

Possible Readings from NPRB (you are not limited to these):

• Logerwell, Elizabeth A., Duffy-Anderson, Janet, Wilson, Matthew, and McKelvey, Denise 2010. The influence of pelagic habitat selection and interspecific competition on productivity of juvenile walleye pollock (Theragra chalcogramma) and capelin (Mallotus villosus) in the Gulf of Alaska. Fisheries Oceanography 19: 262-278.

Other NOAA Fisheries Data Online
Ecosystems and Fisheries-Oceanography Coordinated Investigations Links to Data and Metadata http://www.ecofoci.noaa.gov/efoci_data.shtml
Fishing for Information Rubric and Tracking Sheet

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<td><strong>POSTER COMPONENTS</strong></td>
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<td>The <strong>title</strong> is specific, original, and scientific.</td>
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<td>The <strong>methods</strong> section explains how you analyzed the data.</td>
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<td>The <strong>methods</strong> section includes a <strong>map</strong> of the location from which the data was obtained.</td>
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<td>The <strong>results</strong> section includes well labeled charts, tables, and graphs as appropriate. Consider using line plots, box plots, scatterplots, regression plots, bar graphs to display your data.</td>
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<td>The <strong>conclusion</strong> is based on evidence and mathematical or computational representations are used to support explanations.</td>
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<td>Poster includes a <strong>literature cited</strong> section. A minimum of <strong>three</strong> journal articles are cited and minimum of <strong>three</strong> websites are cited in MLA format.</td>
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<td><strong>POSTER QUALITY</strong></td>
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<td>Poster layout is easy to follow (good flow) and images, graphs, and tables help the viewer understand the presentation.</td>
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<td>The poster construction is neat and the text is large enough for the viewer to read.</td>
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**TOTAL POINTS**

Teacher notes:

* Highlight the boxes in the completed column in yellow if you have completed the step.