Activity Title: Hake Dissection

Subject: Species adapt to their environment

Grade Level: Eighth grade

Average Learning time: Two hours

Lesson Summery: In small groups, students will dissect hake and look for adaptations to their environment.

Overall Concept: How does a hake survive in the ocean?

Specific Concepts:
1. Hake can be classified with other fish based on common anatomical structures.
2. Species adapt to their environment.

Focus Questions:
1. In what ways is your hake's body well adapted for swimming?
2. In what ways is your hake a well-adapted predator?
3. In what other ways is your hake adapted to its niche?
4. From an evolutionary standpoint, is a hake more similar to a shark or a turtle? Give evidence.
5. A hake's otolith helps with orientation. Many fish that live in lakes and streams, such as trouts, do not have a otoliths. Explain why an otolith is a more important adaptation for a hake than a trout.
6. From our data, is there a correlation between a hake's length, age, and sex? Explain.
7. What else would you like to learn about hake, issues affecting hake, or other factors in a hake's environment?

Objectives/Learning Goals:
1. Given a sketch of a hake and a word bank, students will be able to label gills, fins, and major organs with 80% accuracy.
2. Given a description of another fish's niche, students will be able to explain specific adaptations with 80% accuracy.
3. Given 10 pictures and descriptions of marine life, including fish, students will be able to classify them as being like or unlike hake with 80% accuracy.

Background Information:

This activity is designed to conclude a unit on evolution. Students should have a good understanding of biological classification and adaptations.

Pacific hake, a mid-level predator, supports the biggest fishery off of the West coast of the US and Canada. In 2008, the total coastal stock was estimated between

1.0 and 2.5 milion metric tons. Every other year, the National Ocean and Atmospheric Administration (NOAA) from the US and Fisheries and Oceans Canada collaborate in a project to estimate the hake population. The survey relies primarily on acoustics instruments but verifies and augments the acoustics data with mid-water and bottom trawls. Hake brought aboard the ship during the trawls are used for additional information, including length, sex, stomach content, and age. To determine the age, scientists remove the otolith, or ear bone, and preserve it for later study. Much like rings on a tree, the otolith shows annual growth spurts. For hake, the otolith is useful for navigation.

The survey is used to set fishery limits, but also provides important information about the health of the ocean. During the 2009 survey, Humboldt squid were found much further north than they had been seen previously. The squid were preying heavily on the hake. Other research aboard the vessel, including ocean currents and zooplankton, augments the hake biomass survey.

Common Misconceptions/Preconceptions:

Students may conceive of adaptations occurring within one generation rather than over the course of many generations. For example, they think that a hungry hake will grow sharper teeth in order to be a better predator, or change its color if it is concerned about being seen. It is important to emphasize that evolution happens not to one organism but over many generations.

Materials: (for each group of 3-4 students)

- Hake
- Dissecting knife
- Fine-pointed tweezers
- Tray for holding hake
- Tray for holding samples
- Ruler
- "Hake Dissection" handout (attached)
- "Hake Dissection Pre-qualification Quiz" (attached)
- Dissecting microscope
- For alternate assignment: Computers and "Virtual Salmon Dissection" handout (attached)

Technical Requirements: Internet access for alternate assignment

Teacher Preparation: The teacher needs to thaw all frozen hake and have a plan for disposal of the dissected hake.

Keywords: Niche, homologous structure, adaptation, anatomical characteristic, classify

Pre-assessment Strategy/Anticipatory Set (Optional):

Given a picture of a hake, ask students:

1. Do you think this fish lives in streams, ponds, lakes, or the ocean? Why?
2. What do you think this fish eats? Why?
3. Evolutionarily speaking, do you think this fish is more similar to a great white shark or a turtle? Why?

In preparation for the dissection, students must study for, and pass with 80% accuracy, the "Hake Dissection Pre-Qualification Quiz." This quiz does not need to be scored, and students may be given a second chance to pass it before the dissection.

Also in preparation for the dissection, students must submit a proposal for the dissection. In order to be accepted, the proposal must address the following concerns:

1. How will the dissection help you learn the course content?
2. Name at least one ethical issue about doing a dissection in class. Justify your decision to do the dissection in spite of ethical concerns.

Any student opting out of the dissection, or whose proposal is rejected, will the do the alternate assignment.

Lesson Procedure:

Warm up (in notebook):

1. Today we'll look at the stomach content of eight hake, all caught in one trawl. What information might we learn from the stomach content? Feel free to speculate and be creative.
2. Do you think we'll find a correlation between length and age? Will it be different for males and females? Explain.

Dissection:

1. Distribute "Pacific Hake Dissection" handout.
2. Distribute hake and dissection equipment, except for knives.
3. Students complete questions 1-3.
4. Demonstrate how to cut open a hake's stomach and find its gonads, stomach, and liver.
5. Distribute knives.
6. Students complete questions 4-7.
7. Demonstrate how to remove and examine the otoliths.
8. Students complete question 8.
9. Collect knives.
10. Students clean up.

Conclusion:

1. Students write their data for age, length, and sex on class data table.
2. Students complete conclusion questions.
3. Discuss questions.

Alternate assignment:
Students who do not wish to participate in the dissection will complete a virtual dissection of a salmon and use a reading to complete conclusion questions that address the same standards but applied to salmon. Students completing the alternate activity can provide an opportunity to compare the anatomy of two species of fish. Depending on the number of students doing the alternate activity, teahcers may wish to have students share their conclusions with each other.

A virtual salmon dissection can be found at
http://library.thinkquest.org/05aug/00548/DissectionGame.html.
and construct the graph along with the rest of the class.

Readings on the adaptations of salmon can be found at
http://www.coastrange.org/salmon&survivalpg2.html and
http://bioweb.uwlax.edu/bio203/s2009/obry_jere/Adaptations.htm

Assessment and Evaluation: Learning will be measured by students' responses to the conclusion questions.

Standards:

National Science Education Standards Addressed:
E.C.3 Organisms and Environments
M.C.4 Populations and Ecosystems
E.C.1 Characteristics of Organisms
E.C.2 Life Cycle of Organisms
M.C.5 Diversity and Adaptations of Organisms

•Ocean Literacy Principles Addressed:

5. The ocean supports a great diversity of life and ecosystems.

Oregon State Science Standards Addressed:
8.1L.1 Explain how genetics and anatomical characteristics are used to classify organisms and infer evolutionary relationships.
8.2L.1 Explain how species change through the process of natural selection. Describe evidence for evolution.

Other National or State Standards Addressed (Optional): N/A

Additional Resources:
Fisheries and Oceans Canada http://www.dfo-mpo.gc.ca/science/publications/article/2009/02-03-09-eng.htm
NOAA article on hake:

http://www.nwfsc.noaa.gov/research/divisions/fram/acoustics.cfm
My blog while researching hake:
http://teacheratsea.wordpress.com/category/noaa-teacher-at-sea-2/caitlin-thompson/

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