THE MISSING SEA OTTERS *(MODIFIED FOR ADEED)*

INSTRUCTIONS

Overview:

In this 4-5 day investigation, students begin by reading a mystery story about sea otters in the Aleutian Islands, and examining an accompanying population graph. They identify information that they will need to help them solve the missing sea otter mystery, and explore ecological relationships in the sea otter environment using Web sites, video clips, and readings. Information is shared with the class and/or summarized on clue cards, and students then create murals showing the sea otter/kelp bed ecosystem.

*(**Note:** This is the first investigation from the science unit "The Case of the Missing Sea Otter." Online investigation can be found at http://seagrant.uaf.edu/marine-ed/curriculum/grade-4/investigation-1.html.)*

Essential Question:

In what ways are organisms in aquatic environments connected to each other?

Enduring Understandings:

- Organisms in aquatic habitats interact with and depend on one another in various ways.
- An ecosystem is a community of living things with its physical environment, functioning as a unit.
- Science is a way to help us study the many connections in our world.

Targeted Alaska Content Standards:

Science

[4] SC2.2 The student demonstrates an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms by describing the basic characteristics and requirements of living things.

[4] SC3.1 The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy by identifying examples of living and non-living things and the relationship between them (e.g., living things need water, herbivores need plants).

[4] SC3.2 The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy by identifying a simple food chain and diagramming how energy flows through it and describing the effects of removing one link.

[5] SC3.1 The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy by diagramming how matter and energy are transferred within and between living and nonliving things.

Materials:

- Science notebooks
- Student handouts and items for group display
- Butcher paper, art materials
- Internet access
- LCD or overhead projector
- Tagboard and felt-tip pens (if clue cards are used)
- Art materials for making murals, if time permits
- VISUAL AID: Map of Aleutians
- Sea Otter Story Part 1 (http://aswc.seagrant.uaf.edu/grade-4/investigation-1/sea-otter-story-part-1.html)
- Reading 1 (http://seagrant.uaf.edu/marine-ed/curriculum/grade-4/investigation-1/producers-in-the-ecos.../32.html?task=view)
- Reading 2 (http://seagrant.uaf.edu/marine-ed/curriculum/component/content/50.html?task=view)

- Reading 3 (http://seagrant.uaf.edu/marine-ed/curriculum/grade-4/investigation-1/marine-invertebrates/fish.html?task=view)
- Reading 4 (http://seagrant.uaf.edu/marine-ed/curriculum/grade-4/investigation-1/marine-mammals.html?task=view)
- Food Chain Cards (http://seagrant.uaf.edu/marine-ed/curriculum/images/stories/grade4/foodchain_cards.pdf)
- Sea Otter Data Graphs (http://seagrant.uaf.edu/marine-ed/curriculum/grade-4/investigation-1/sea-otter-biology/history/31.html?task=view#graphs)
- Large Diagram of Beach (http://seagrant.uaf.edu/marine-ed/curriculum/images/stories/grade4/intertidal.pdf)
- Food Chain Diagram (http://seagrant.uaf.edu/marine-ed/curriculum/images/stories/grade4/foodchain.pdf)

Teacher Background Information:

The story begins with biologist James Estes being surprised by the results of his sea otter survey of an area in the Aleutian Islands that he has been studying for 15 years. The numbers of otters he sees are far less than in previous surveys. What has happened to the missing otters is a mystery.

Dr. Estes was surprised by the obvious decline in numbers because he had previously studied the sea otters when populations were expanding. Sea otters disappeared from much of their range from the Aleutians to California as a result of the fur trade during the late 18th and the 19th centuries. Several small remnant populations remained, however, in the Aleutians. These populations reproduced rapidly and eventually recolonized all of the available habitat around the islands.

Investigation 1: The Missing Sea Otter

In 1992, Jim Estes finds low numbers of otters at Amchitka, where he has studied the otters and kelp forest ecosystem for 15 years. The otter population had been high all through the 1970s and 1980s. His report of the data to the U.S. Fish and Wildlife Service leads to more surveys in 1992 and 2000 of the entire Aleutian Islands

Prior Student Knowledge:

1. Experience with reading graphs
2. Basic knowledge of tides

Activity Preparation:

1. 60 minutes to read, view web sites, copy and prepare materials Prior Student Knowledge
2. Useful vocabulary words for this lesson are: Algae, Baleen, Blubber, Consumer, Copepod, Decompose, Ecosystem, Food Chain, Holdfast, Intertidal , Invertebrates, Kelp, Microbe, Organism, Pelt, Phytoplankton, Predator, Producer, Recolonize, Scavenger, Subtidal, Tally, Transient, Underfur, Urchin, Zooplankton
3. Read the background information and the lesson materials.
4. Investigate Web sites to choose images and video clips.
5. Copy student handouts.
6. Cut apart Food Chain Cards: http://seagrant.uaf.edu/marine-ed/curriculum/images/stories/grade4/foodchain_cards.pdf.
7. Make and post a large diagram (3D): http://seagrant.uaf.edu/marine-ed/curriculum/images/stories/grade4/intertidal.pdf of a beach showing intertidal and subtidal zones.
8. Make overhead transparencies and/or prepare for showing digital images.
9. Teacher's Background: http://seagrant.uaf.edu/marine-ed/curriculum/component/content/53.html?task=view and Resources: http://seagrant.uaf.edu/marine-ed/curriculum/component/content/54.html?task=view

Tips from Teachers:

Ask students to draw sea otters using oil pastels!

Curricular Connections:

1. Social Studies
2. Alaska History
3. Fur Trade

Lesson Credit:

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Activity 1:

Focus Question: What is an ecosystem? How are things in an ecosystem connected?

Procedure:

Engagement (30 minutes):

1. Locate Aleutians on a map: http://seagrant.uaf.edu/marine-ed/curriculum/grade-4/investigation-1/map-of-aleutians.html?task=view, and/or take a look at the study area using Google Earth.
2. With the whole class, read the Sea Otter Story Part 1: http://seagrant.uaf.edu/marine-ed/curriculum/grade-4/investigation-1/sea-otter-story-part-1.html?task=view about sea otters in the Aleutian Islands while displaying the sea otter data graphs.
3. Discuss with the students:
   - What do the graphs tell you?
   - As a scientist, what questions do the data prompt?
   - What do you think happened to the otters?

Exploration (2-3 class periods of 30-45 minutes):

4. Post a large diagram showing a cross-section of a beach: http://seagrant.uaf.edu/marine-ed/curriculum/images/stories/grade4/intertidal.pdf with intertidal and subtidal zones depicted. Explain what those terms mean. You can draw or write in the plants and animals in the appropriate zones as they are mentioned and discussed during this investigation. Ask students to write a definition of "ecosystem" in their science notebooks. Since they may not have an understanding of the term, the definitions may be quite brief or incorrect. They will continue to develop their understanding throughout the unit.
5. With the whole class together, share and discuss the definition of "ecosystem."
6. An ecosystem is made up of plants, animals (including humans), microbes, and physical environmental features (e.g. rocks, currents, precipitation) that depend on each other in some way. Interactions between plants, animals, and physical features make an ecosystem an interconnected unit. (See Teacher Background: http://seagrant.uaf.edu/marine-ed/curriculum/grade-4/teacher-background.html?task=view)
7. Show internet video clips of sea otters and kelp beds from some of these sites and/or have students investigate some of the sites to see visual images.
   - Photos of Sea Otters from Otternet: http://www.otternet.com/galleries/seaotter/
   - Kelp Forest Photographs by Phillip Colla: http://www.oceanlight.com/html/kelp.html
   - Monterey Bay Kelp Forest Virtual Dive: http://www.nationalgeographic.com/monterey/ax/primary_fs.html
   - Monterey Bay Aquarium Sea Otter Live Cam and "Surrogate Sea Otter Moms" Video: http://www.mbayaq.org/efc/efc_otter/otter_cam.asp
   - US Fish and Wildlife Service Sea Otter Photos: http://alaska.fws.gov/media/seaotter2004/photos.htm
   - US Fish and Wildlife Service Sea Otter Video Clip 1: http://alaska.fws.gov/media/seaotter2004/Otter%201.avi
   - US Fish and Wildlife Service Sea Otter Video Clip 2: http://alaska.fws.gov/media/seaotter2004/Otter%203.avi
   - Waves of Change Sea Otter Video: http://oceanlink.island.net/seaotterstewardship/index.html
   - Jean-Michel Cousteau: Ocean Adventures Kelp Forest Video: http://video.google.com/videosearch?client=safari&rls=en-us&q=sea%20otters%20kelp%20forests&oe=UTF-8&um=1&ie=UTF-8&sa=N&hl=en&tab=wv
8. Do a "KWL": http://seagrant.uaf.edu/marine-ed/curriculum/images/stories/grade5/kwl.pdf (K-W-L explanation: http://seagrant.uaf.edu/marine-ed/curriculum/images/stories/grade5/kwl_chart.pdf) activity with students:

9. After looking at the visual images, ask the students what they know about sea otters and their ecosystem. This information will be added to the "K" section of the chart. Students can create their own version of the chart in their science notebooks, and fill in the sections as you go.

10 As a whole group, brainstorm what would have to be understood in an otter's ecosystem in order to understand the otter population decline: (food needs, need for shelter, adaptations to their environment, what dangers are in their environment—predators, pollution, how they are used by people). This information will be added to the "W" section of the chart - What do they want to learn, or what do they think they will need to learn to understand the otter's ecosystem.

11 Assign readings to small groups of 4-6 students as research to discover the ecological relationships that will help solve the eco-mystery. Ask students to take notes and make illustrations in their science notebooks as they read.
- Reading 1: Sea Otter Biology and History in the Aleutian Islands: http://seagrant.uaf.edu/marine-ed/curriculum/grade-4/investigation-1/sea-otter-biology/history.html?task=view
- Reading 2: The Producers in the Ecosystem: http://seagrant.uaf.edu/marine-ed/curriculum/grade-4/investigation-1/producers-in-the-ecos....html?task=view
- Reading 3: Consumers: Marine Invertebrates and Fish in the Kelp Forest: http://seagrant.uaf.edu/marine-ed/curriculum/grade-4/investigation-1/marine-invertebrates/fish.html?task=view
- Reading 4: Consumers: Marine Mammals: http://seagrant.uaf.edu/marine-ed/curriculum/grade-4/investigation-1/marine-mammals.html?task=view

Explanation (30 minutes):

12. Students groups report their research to the class as pieces of the mystery to be solved.
OR

13. Students summarize their research on clue cards with illustrations on one side and facts on the other side.

Extension (Application): (45 minutes - 1 hour)

14. Discuss the sea otter's food web using a food chain diagram: http://seagrant.uaf.edu/marine-ed/curriculum/images/stories/grade4/foodchain.pdf and cards: http://seagrant.uaf.edu/marine-ed/curriculum/images/stories/grade4/foodchain_cards.pdf. As a class, have students create a mural of the otter/kelp/urchin ecosystem, showing the relationships between organisms. Have students use the cards to create their mural, or if time allows, have them create representations of the organisms themselves using a variety of art and craft materials. Be sure to include humans as part of the ecosystem. Discuss the mural as you work on it.

15. Ask students to reflect in their science journals:
- What questions do you have?
- Is there an idea you don't understand?
- What do you know now that you didn't know before?

Evaluation:

16. Formal Evaluation will be done at the end of the unit..

Map of Aleutian Islands and Bering Sea