CURRICULUM SUPPLEMENT

OTTERLY ORNATE WATERFOWL WEBS

A FOOD WEB & IMPACTS ACTIVITY

For use with the **Lingering Oil** section of GULF WATCH

Overview: Students will discover how interconnected harlequin ducks and northern sea otters are within the nearshore ecosystem of the Gulf of Alaska (GoA). An ecosystem that was heavily impacted by the 1989 Exxon Valdez Oil Spill. During the first of two activities students will learn how complex the nearshore food web is in the GoA. Then by participating in a lively activity, students will be able to play a role as an animal in a multi-round marine food web game. By collecting data from the results of each round students can "manage" their ecosystem and see what kind of ratios are required to maintain a healthy system.

Learning Objectives:

The student will:

- *Understand and be able to explain how **complex a marine food web is** and what factors can affect the relationships of the animals in the web.*
- ***Be introduced to the concept of resource management** by collecting data from the results of various influences upon the food web.*

Standards Addressed:

Alaska Science GLES :
https://education.alaska.gov/akstandards/standards/standards.pdf
6th: SA1.1, SA1.2, SA3.1, SE2.2
7th: SA1.1, SA1.2, SA3.1, SE1.1, SE2.2
8th: SA1.1, SA1.2, SA3.1, SE1.1, SE2.2, SE3.1

Next Generation Science Standards:
http://www.nextgenscience.org/search-performance-expectations
MS-LS1-4, 5, 6, 7
MS-LS2-1, 2, 3, 4, 5

Ocean Literacy Principles:
http://oceanliteracy.wp2.coexploration.org/ocean-literacy-framework/principles-and-concepts/
OLP #5 The ocean supports a great diversity of life and ecosystems.

Materials/Location Needed:

- *This lesson encompasses two activities; the first can be done in the classroom provided there is an area that can be cleared for all the participants to sit in chairs placed in a large circle. The second activity will need to be performed outside the classroom in an area where the students can run freely and safely. Either outside on the school grounds or inside in a room such as a gymnasium or multipurpose room.*

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- *Marine Food Web ID Tags (found on pages 7 - 14 of this lesson)*
- *Multiple, large balls of yarn (ideally 6-8 balls)*
- *Hole punch*
- *Eight quarts of popped corn*
- *Black sharpie marker (or equivalent that can mark a plastic bag without smearing!)*
- *Clear plastic sandwich bags (one per student)*
- *Masking tape (the wider the better)*
- *Colored ribbons (green, blue, & red) one for each student*
- *Timekeeping device*
- *Student worksheet found on page 6 of this lesson*
- *Clipboards and pencils*

Teaching Time: 90 minutes.

Preparation Time: 30 minutes.

Background:

Food webs in nature are nearly always complex and interconnected. However, it is often easy to track the connections in a web almost linearly as some animals have a very specific diet, foraging on a very narrow variety of sustenance. As we have seen in the **Lingering Oil** section of *Gulf Watch* researchers want to know the far reaching impacts of oil across the ecosystem. An easy way to do this is by looking at the diets of some not so picky eaters. Far from being an animal with a narrow palate the northern sea otter has one of the most varied diets in the ocean. Otters can't afford to be choosy as they have enormous caloric requirements. Adults need to eat approximately 25% of their body weight in food each day! Luckily the nearshore and shallow waters of the Gulf of Alaska provide a smorgasbord of critters the otters love to eat. Likewise the harlequin duck is an opportunistic consumer. Like otters they eat a wide variety of animals, from fish and crustaceans to larvae and insects.

By studying the bio-markers found in isotopes, researchers can trace the diet of these two target species. Much of their food lives in or eats (by filtering) sediments that were impacted by the contaminants form EVOS. As those contaminants are transferred amongst the organisms in the food web they eventually show up in the tissue samples of harlequin ducks and northern sea otters.

Directions:

1. After completing the **Lingering Oil** section of *Gulf Watch*, explain to your class that they are going to immerse themselves into the Gulf of Alaska nearshore food web. They will be discussing impacts and implications on the food webs of harlequin ducks and northern sea otters. And collecting data and making conclusions from observations made during scenario role-playing of a nearshore food web.

2. **Activity 1: Weavin' Webs** Distribute the Marine Food Web ID tags and materials to your students for construction. Pass out the tags, have your students punch a hole in their card and cut a length of yarn to serve as a lanyard. Instruct them to cut the lanyard long enough that once placed around their neck they can still turn it up and read the information on the backside.
    a. Note: there are 18 ID tags the combination of which can be altered as you see fit. Obviously the lower trophic levels could easily be duplicated amongst many students as there are high numbers of these organisms in the food web (mussels and amphipods for example)
3. Have your students organize their chairs into a circle facing inward. Introduce the concept of food webs, most should be familiar with the term. Lead the discussion about what a food web is by asking them to construct a food web for their own lives. Think of all the different aspects of breakfast, lunch and dinner foods. What is involved in getting snacks into their hands? Everything from the raw materials and whole foods up thru processors, to fast food drive-ins, groceries and mini-marts, to cafeterias and pizza night. Once the idea of how complex food webs can be for top level consumers like humans has sunk in, let them know that they are about to do the same for the nearshore of the Gulf of Alaska.
4. Have students become familiar with the organisms on their ID tags, both the name of and facts about what they eat. (note: the construction of the web will be much more complex if the student's ID tags are scattered around the circle rather randomly. In other words don't let all the ducks sit next to each other!)
5. Announce that you are the sunshine making life for everything in this food web possible. Then have the students who are the primary producers identify themselves. Be sure to hold on to the loose ends of the balls of yarn and toss them to the primary producers (the phytoplankton). It's okay if you toss more than one ball to some of them as they represent a vast number of organisms in the ocean and will be connected to many other consumers in this web.
    a. Have the students explain how they are connected to the sun (thru photosynthesis they create their own food energy).
    b. Next have the primary consumers identify themselves (zooplankton who eat the phytoplankton). Ask the primary producers to hold on to the strand and toss their balls of yarn to the primary consumers, who then explain their connection to the phytoplankton.
    c. Continue this identifying and tossing of the yarn until every student is holding onto the yarn. Ask your students to identify connections from upper levels to lower by tracing the strands.
    d. Now remind the students that they are in the GoA ecosystem which was heavily impacted by EVOS. Ask them to pull on their strands if their organism was effected by the spill.

e. You can introduce any number of impacts in this way, not just oil spills. Impacts like: marine debris, climate change, storms, etc. In addition to just pulling on their string you can introduce impacts that are species specific, like an illness or over harvesting. In these cases have the affected organisms drop their strings! What happens to the web then?

6. **Activity 2: Food Web Freeze Tag** Move to a large space suitable for a game or active play (school grounds, gymnasium, etc.). Distribute the Ziploc bags, colored ribbon, a sharpie, and a 4" piece of masking tape to each student. Ask the students to draw a two horizontal lines across their Ziploc bag. The first line should be about 1½" from the bottom and the second about ½ of the way up from the bottom. Next have them open their Ziploc bags and place the piece of tape inside the opening so that ½ is sticking out and the other half is adhered to the inside of the bag.
7. Explain that they are about to participate in a GoA Food Web game of tag. Each of them will be an organism in the web trying to gather enough resources to survive. Those with the green ribbon represent zooplankton like copepods & larvae, the blue ribbon represent crustaceans like shrimp, krill, or crabs. Finally the red ribbon represent our top predators like the harlequin duck or northern sea otter.
8. The Ziploc bag is their stomach and they will be foraging for resources to fill their stomachs. Ask them to stick the remaining portion of the tape to the front of their shirt. As they are preparing their baggies take this time to spread the popcorn around the activity area. Feel free to concentrate more in some areas than others to represent abundance levels within the ecosystem. Explain that the popcorn represents phytoplankton – the primary producers in this ecosystem and the hub of our food web.
9. This activity should be divided into three or more rounds (the number of which is up to you, but the more rounds the more data your students will be able to collect!). Each round is timed at 3 to 5 minutes again depending on your circumstances. Data can be collected at the end of each round and tallied on a board or the student's worksheets. This data can be graphed or tracked as each round is played. Either you or your students can use this data to adjust the numbers of organisms in the ecosystem. More zooplankton or more predators, etc.
10. Let your students pick their own colors for the first round. Ask them to tie the ribbon around their upper arm so that it is visible to the others. You are likely to discover that many have picked the red ribbons and for the first round this is okay. As the rounds progress the students should recognize the pattern and adjust the numbers of each organism until a balance can be met to stabilize a healthy food web.
11. Define the boundaries of the game and divide the students among their 'teams' positioning each in a different area of the ecosystem. Explain that when you say "Go!" they are to begin foraging for their food – zooplankton can only eat popcorn, crustaceans can only eat zooplankton and our predators can only eat crustaceans.

a. The zooplankton will go around and pick up popcorn placing it in their stomach bag, while the crustaceans try and tag them. Once tagged the zooplankton must give up the contents of their baggie to their crustacean predator. At the same time the otters and ducks are trying to tag crustaceans and take their popcorn as well. Tagged students are out and must return to their start point. After tagging a crustacean each predator must return to their starting location (this represents a rest between foraging bouts) before they can return to the ecosystem and hunt for more crustaceans.
b. The round ends when one of the species is all gone or time runs out. To survive at the end of the round a student must not be tagged out and possess enough food to survive. Zooplankton must have popcorn filling their bag to the first line, crustaceans to the second line and the predators must have a full baggie.
c. Have the students record the survival rate of each of the species types. Return all popcorn to the playing area and prepare for the next round.
d. For subsequent rounds allow the students to adjust the numbers of each type of organism, playing out different scenarios until a stable food web is obtained.

12. At the end of the activity review the data with the students and lead a discussion on impacts to food webs. Some suggestions are: What would happen if there was a huge phytoplankton bloom that year? What if there were an environmental disaster such as EVOS? Could invasive species have an impact on the balance of the food web? How do the student's think these and other food webs will be effected by global climate change in the coming years?

Credits:

This activity has been adapted from the "Waterfowl Web of Life" activity found in the *Sea Ducks of Alaska Activity Guide*. 2003 Center for Alaska Coastal Studies. For the original and even more fun and interactive waterfowl activities visit: www.akcoastalstudies.org/Pdf/Sea_Duck_Curriculum.pdf

Assessment:

Students can be assessed on participation in many aspects of the activity and/or their success at completion of the worksheet.

STUDENT WORKSHEET

Name _____ Date _____ Class _____

Activity #1: Weavin' Webs

1. Record your observations, thoughts and discoveries from the activity. What organism were you? How did you fit within the web? How did some the impacts affect you and your portion of the web?

Activity #2: Food Web Freeze Tag

Record the results from each round of the game on the table below.

Round	Surviving phytoplankton	Surviving crustaceans	Surviving harlequin ducks	Surviving northern sea otters
1				
2				
3				
4				
5				
6				

Record your observations about the game. What changes were made from round to round? How did these changes impact the survival of the different organisms?

MARINE FOOD WEB ID TAGS

- If possible print the following pages duplex – if not then have students construct the fronts & backs of their own tags.
- Cut out the tag and use hole punch in circle area. Attach yarn lanyard thru hole.

Northern Sea Otter

Image USGS

Harlequin Duck

Image Alaska SeaLife Center

Orca

Image NOAA – Kim Parsons

Bald Eagle

Image USFWS

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Harlequin Duck

Habitat: Nearshore in the waves or rapids of mountain streams. Builds nest on ground near water.
Feeds on: mollusks, shellfish, octopuses, crustaceans, & echinoderms
Prey for: foxes, eagles

Northern Sea Otter

Habitat: Nearshore kelp forests and bays. Huge appetite! Eats 25% of its body weight each day.
Feeds on: mollusks, shellfish, crustaceans, echinoderms, insect larvae, small fish & fish eggs
Prey for: orcas, eagles, sharks

Bald Eagle

Habitat: Wide ranging raptor which nests in trees. Opportunistic scavenger and hunter.
Feeds on: birds, fish, octopuses, marine mammals, terrestrial mammals,
Prey for: no natural predators

Orca

Habitat: Offshore waters. Living in matriarchal groups with strong social bonds. Most diverse diet among cetaceans.
Feeds on: fish, birds, cephalopods, marine mammals
Prey for: no natural predators

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Giant Pacific Octopus

Image Alaska SeaLife Center

Sockeye (Red) Salmon

Image ADFG

Graceful Kelp Crab

Image Alaska SeaLife Center

Red Sea Urchin

Image Alaska SeaLife Center

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Sockeye (Red) Salmon

Habitat: Anadromous fish that makes epic migration from the sea to natal streams and rivers.
Feeds on: mollusks, shellfish, octopuses, crustaceans, echinoderms, copepods, amphipods
Prey for: otters, orcas, eagles, fishes

Giant Pacific Octopus

Habitat: Benthic invertebrate that spends the majority of its time hiding in a den.
Feeds on: mollusks, shellfish, octopuses, & crustaceans
Prey for: sea otters, marine mammals, eagles, fish (while in larval stage)

Red Sea Urchin

Habitat: Nearshore waters to depths of 300'. Preferring rocky shores and kelp forests.
Feeds on: grasses, algae, kelps, occasional scavenging on detritus
Prey for: otters, fish, octopuses, ducks

Graceful Kelp Crab

Habitat: Nearshore grasses and kelps.
Feeds on: algae (kelps & etc.), crustaceans, & shellfish
Prey for: ducks, otters, salmon, octopus, eagles, smaller fish when in larval stage

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Threespine Stickleback

Image Alaska SeaLife Center

Copepod

Image NOAA

Algae – Diatoms

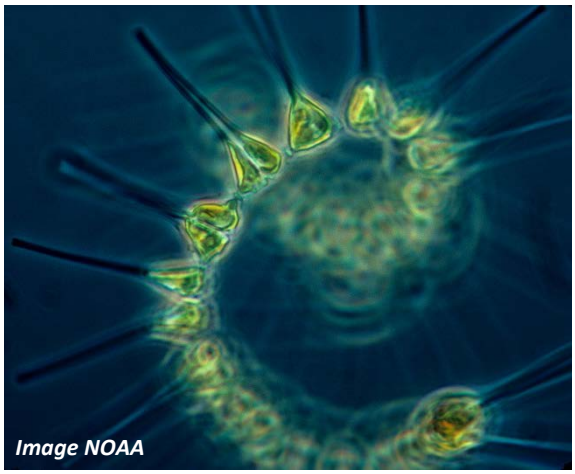
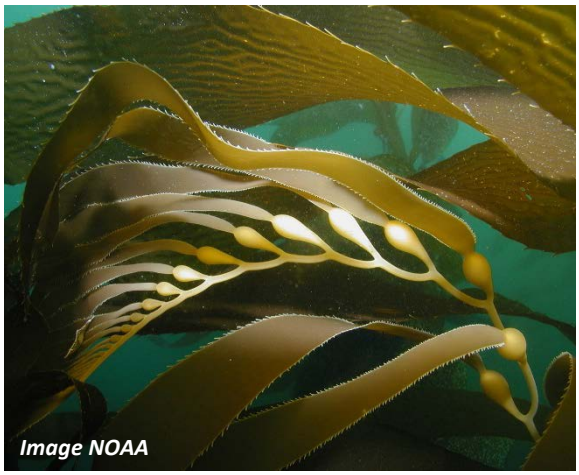


Image NOAA

Algae – Giant Kelp



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Copepod

Habitat: nearly every habitat where water is present. Can be benthic or planktonic.
Feeds on: detritus, algae (phytoplankton), smaller zooplankton
Prey for: fishes, baleen whales, ducks, & amphipods

Threespine Stickleback

Habitat: Anadromous fish often in found in huge shoals. Small with most only measuring 2" long.
Feeds on: copepods, amphipods, mollusk larvae
Prey for: salmon, marine mammals, ducks, other fishes & eagles

Algae – Giant Kelp

Habitat: Nearshore mostly rocky bottoms which provide substrate for their holdfasts.
Feeds on: Primary producer photosynthesizing from Sun's energy.
Prey for: fishes, crabs, echinoderms

Algae – Diatoms

Habitat: Nearly every habitat where water is present. Living in the upper photic levels of the water column.
Feeds on: Primary producer photosynthesizing from Sun's energy.
Prey for: copepods, amphipods

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Blue Mussels

Image NOAA

Razor Clam

Image NOAA

Amphipod

Image NOAA

Red Fox

Image ADFG – Lisa Higgblom

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Razor Clam

Habitat: Mollusk found buried in mudflats and sandy beaches.
Feeds on: Is a filter feeder straining out detritus, algae, and larvae from the water.
Prey for: ducks, otters, octopuses, foxes, shorebirds, echinoderms

Blue Mussels

Habitat: Mollusk found attached to rocks along shorelines.
Feeds on: Is a filter feeder straining out detritus, algae, and larvae from the water.
Prey for: ducks, otters, octopuses, foxes, shorebirds, echinoderms

Red Fox

Habitat: Resides in dens across a wide range of ecosystems. Opportunistic hunter and scavenger.
Feeds on: rodents, hares, eggs, insects, carrion, shellfish
Prey for: wolves, lynx, coyotes, & eagles (when kits)

Amphipod

Habitat: mostly planktonic crustacean until settling out on the bottom as it matures.
Feeds on: copepods, larval invertebrates and detritus
Prey for: fishes, ducks, and baleen whales