5th Grade: Human Action and the Watershed

Garden of the Salish Sea Curriculum (GSSC) Modified Julie Hirsch and Lindsey Parker (GSSC), Amy Keiper, BES 5th grade

Overview of Unit Progression:

Required Classroom Lessons Before Beach Exploration	
Lesson 1. Introduction to the Salish Sea	General education classroom teacher
Lesson 2. Watersheds	
Lesson 3. Drayton Harbor Oysters and Salish Sea Challenge	
Lesson 4. Eat or Be Eaten	
Lesson 5. Clam Identification and Beach Exploration Prep	Lindsey Parker (GSSC educator) 45 minutes classroom lesson

Optional Teacher Extension Lessons	
Fall: Live Tank and Shellfish Around the World (SS)	45 minutes
Fall: Oysters in the Chesapeake "Close-Read" (SS/ELA)	Teacher determined
Types of Water Pollution	65 minutes
The Intertidal Biome Worldwide	65 minutes
Spat, What's That?	60 minutes
Cain Creek Walk	20 minutes

Blaine Harbor Exploration Rotations	
Blaine Harbor Field Exploration	Taught by GSSC leaders on at Blaine Harbor. Rotations last 30 minutes each. Event time: 1 hour plus walk Location: Blaine Harbor
Tangled in the Food Web	

Beach Exploration Rotations	
11. Microscopy	Taught by GSSC leaders on the beach. Rotations last 30 minutes each. Event time: 4-5 hrs Location: Birch Bay State Park
12. Oyster Anatomy	
13. Marine Foods and Resources	
14. Beach Exploration	
15. Clam Survey	

Required Post Lessons	
Unit Reflection Survey	5 minutes

GSSC currently drafting:

- Assessment and Action Project: Social Studies OSPI CBA "You Decide"

Integrated Environmental and Sustainability Science Standards (OSPI): Standard 1: Ecological, Social, and Economic Systems Standard 2: The Natural and Built Environment Standard 3: Sustainability and Civic Responsibility

GLAD Strategies Referenced: TPR: Total Physical Response: to learn a vocabulary word, student say a short phrase and include a motion. CCD: Cognitive Content Dictionary (GLAD strategy for learning vocabulary).
**Optional Additional Cross Curricular Connection: read chapters Joseph Gados "Explore the Salish Sea" during an outside reading time.

Student Worksheets & Notebooks:
The purpose of worksheets are defined in each lesson, teachers should read ahead and determine if they'd like to print these or complete the task in a journal. One of the goals of this modified unit is to minimize paper. Student worksheets can be printed out before each lesson and stored in individual student folders, or glued into a composition book. The cover is a picture of the Salish Sea that could be printed in color and glued as an introductory page or cover to each student notebook or folder.

Required Classroom Lessons Before "Beach Exploration"

Lesson 1: Introduction to the Salish Sea

Subject

The Salish Sea

Materials/ Teacher Preparation

- 8 light colored posters for Poster Discussion (before class, teacher should write titles on posters and hang around room. Prompts listed on Step 2 of Procedure.) Make duplicates of some prompts, the point is there shouldn't be more than four kids at a poster at a time.
- Students all need dark color markers.
- Print/cut/tape color version of the Salish Sea map and the Northwestern U.S map to the poster entitled "What Waters are Included in the Salish Sea?"
- Large laminated Salish Sea Input map- tape onto Poster A before class (GSSC will provide)
- Set up large kitchen tray with various intertidal organisms (kelp, shells; GSSC will provide)
- Printed class set of Home Connections #1
- GoogleEarth or Googlemaps ready on projector

Size/setting/duration

Entire class/Indoors/30-40 min

Background

The Salish Sea stretches from southwestern British Columbia to the northwestern portion of the U.S. state of Washington. Its major bodies of water are the Strait of Georgia, the Strait of Juan de Fuca, and Puget Sound.

The first known use of the term Salish Sea was in 1988, when marine biologist Bert Webber from Bellingham, Washington, created the name for the combined waters in the region with the intention to raise consciousness about taking care of the region's waters and ecosystems.

The Coast Salish is a group of ethnically and linguistically related Indigenous peoples of the Pacific Northwest Coast, living in British Columbia, Canada and Washington and Oregon in the U.S. The Coast Salish are a grouping of many tribes with numerous distinct

cultures and languages.The waterways of the Salish Sea were important trade routes for the Coast Salish People, and they remain a source of food and other resources for the indigenous peoples.

Overview

Target:

- I can define what the Salish Sea is and describe my connections to it.

Success Criteria

- students identify the major waterways that make up the Salish Sea, and land that make its watershed by labeling the seas and land that makes up the Salish Sea watershed, and by sharing personal connections to the sea.
- students participate in a discussion about their connections to the Salish Sea (Poster Discussion)

Procedure

Activate/Connect:

1. Explain: (1 min) This unit is called the Garden of the Salish Sea. During this unit you'll learn lessons about the Salish Sea, the Intertidal Biome, our watershed, creatures who live in the intertidal zones, some challenges the Salish Sea faces and what we as community members are doing to help. The Salish Sea is a food source for many living creatures including humans. Today's target is...
2. Have students do a "Poster Discussion." (15-20 minutes) Students walk around the room each with a marker, answering the prompts on the various posters in writing. Make sure students read other students' answers and respond to their ideas in writing. Model this behavior. Poster titles include:
    a. What waters are included in the Salish Sea? (map included);
    b. What are some plants/animals that live in the Salish Sea? (kitchen tray near poster with a bunch of shells/kelps);
    c. What do YOU or your family love about the ocean?
    d. Areas for shellfish harvest. What do you notice? What do you wonder?
    e. What does a "Salish Sea Steward" do/think/say?
    f. Why do you think the Salish Sea is important?
    g. Olympia Oyster population map. What do you notice? What do you wonder?
3. Input: (10 min) Use an atlas/Googlemaps/GoogleEarth to show students the greater context of where the Salish Sea is in comparison to the U.S (could project on whiteboard and draw a dotted line to represent the U.S/Canadian border.) The Salish Sea Watershed includes all

the rivers and streams that drain into the Salish Sea. The waters of the Strait of Georgia, Strait of Juan de Fuca, Puget Sound, and all the connected bays and inlets, and the greater Pacific Ocean. The land that borders the Salish Sea are the shorelines of U.S and Canada, including Victoria Island and 418 other islands (colored green on map).

   a. Land Acknowledgement: Let's take a moment to recognize where we are. The Coast Salish Peoples have a saying "when the tide is out, the table is set." The Coast Salish People rely on natural resources of the Salish Sea and have been stewards of this land and the traditional and customary fishing grounds for thousands of years and these resources continue to be used today.

4. Closing (5 min)
   a. Share out some responses that stood out to you from student poster discussion. Explain they'll probably have different answers and connections at the end of the unit.
   b. Have students label the major waterways and color Salish Sea Map worksheet (optional).
   c. Make your Salish Sea journals, or explain how students will keep any worksheets. One idea is to have kids cut and paste the Salish Sea Bingo Challenge on the front cover of their folder. Students will learn about this Bingo sheet in the next few lessons.
   d. Review Target.
   e. Pass out the Home Connection and encourage students to collect stories about how their family or community is connected to the Salish Sea!

Next Generation Science Standards

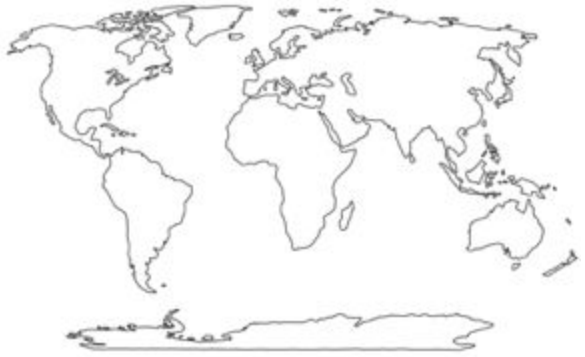
Performance Expectations		
5-ESS2-1: Earth Systems. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact		
Scientific and Engineering Practices	Disciplinary Core Ideas	Cross-cutting Concepts
Analyzing and Interpreting Data	ESS2.A: Earth Materials and Systems	Systems and System Models Science Addresses Questions About the Natural and Material World

Other Standards

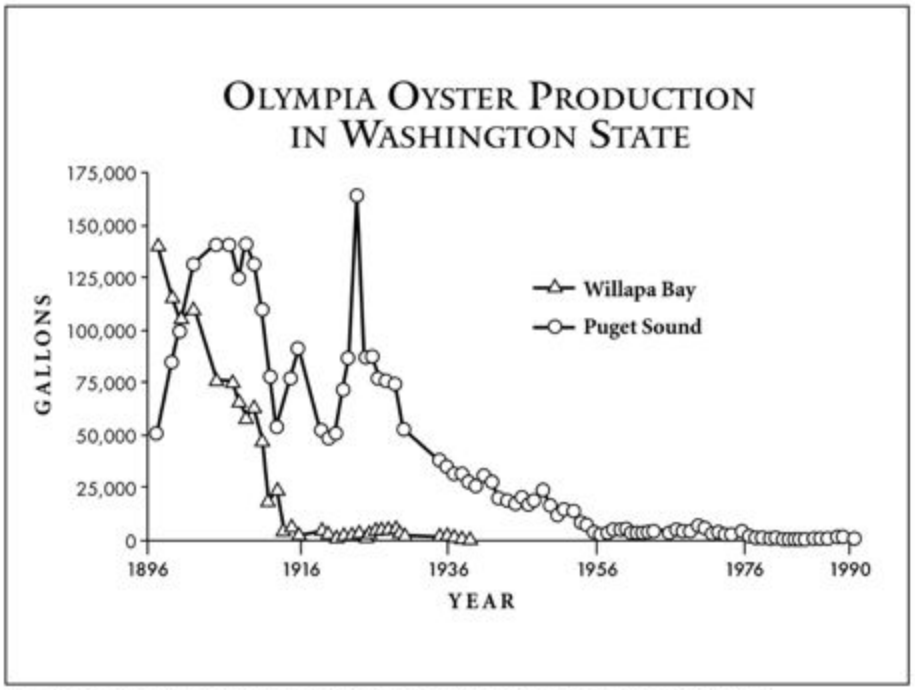
ESE3: Standard 3: Sustainability and Civic Responsibility. Students develop and apply the knowledge, perspective, vision, skills, and habits of mind necessary to make personal and collective decisions and take actions that promote sustainability.

Graphics

a.



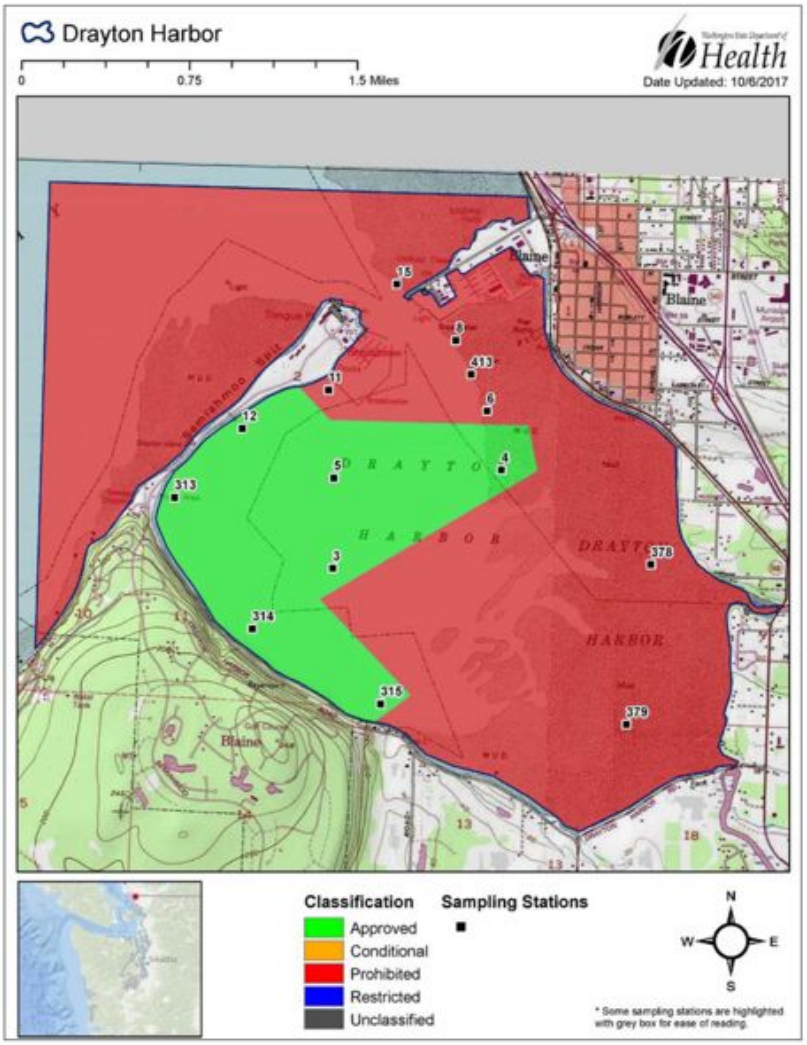
G.



Olympia oyster harvest peaked in the 1920s and, then, dropped substantially, reaching an all-time low in the 1960s, never to fully recover.

Source: Baker, P. 1995. Review of ecology and fishery of the Olympia oyster, *Ostrea lurida*, with annotated bibliography.

D.



Vocabulary

- Salish Sea - the water body that stretches from southwestern British Columbia to the northwestern portion of the U.S. state of Washington. Its major bodies of water are the Strait of Georgia, the Strait of Juan de Fuca, and Puget Sound.
- Watershed - a land area that channels rainfall and snowmelt to creeks, streams, and rivers, and eventually to outflow points such as reservoirs, bays, and the ocean.

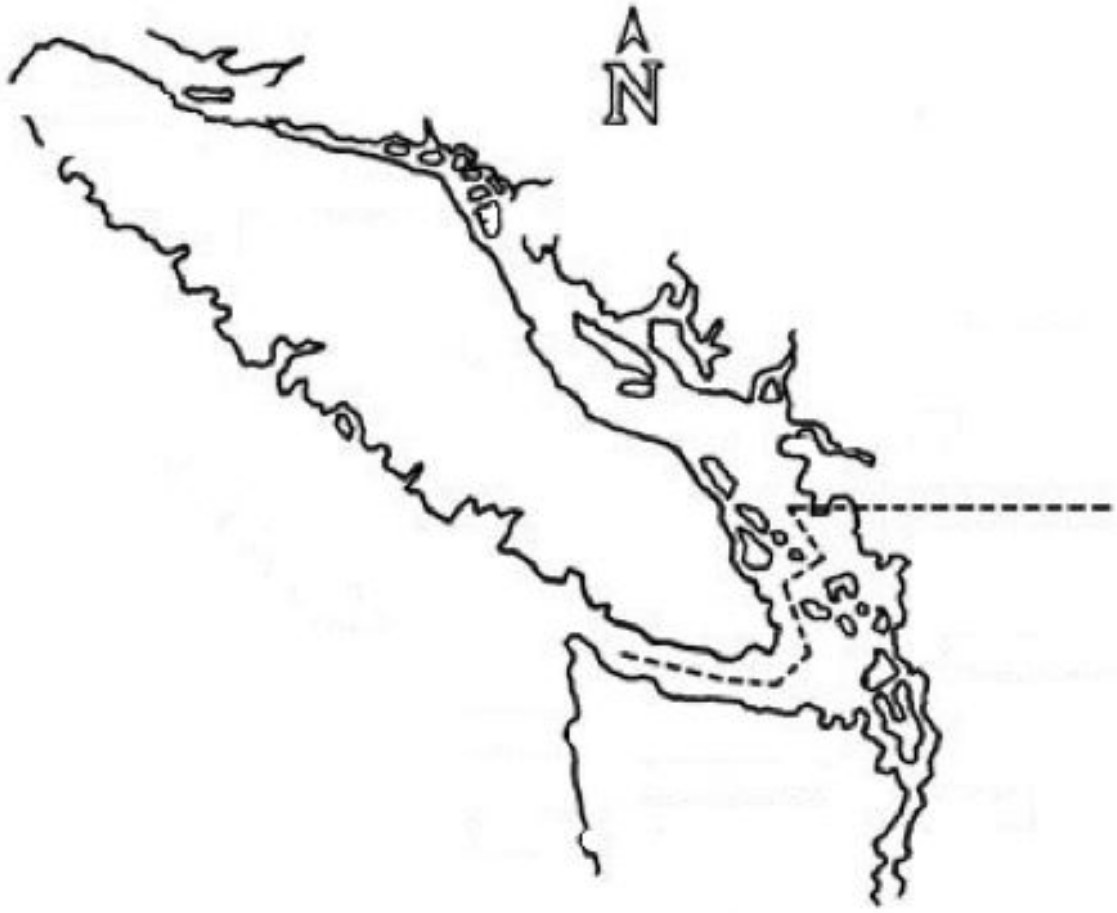
Extension

- Optional (10 min): Pass out student folders or notebooks and have students glue the Salish Sea color-prints to the outside or first page. Set up a Word Bank and Big Ideas List and update at the end of each lesson.
- Teachers could project this map below onto the whiteboard then record the names of water bodies and coastlines with Expo marker.

Worksheet

Introduction to the Salish Sea

Color the waters of the Salish Sea one color and the coastlines in another color. Label 3 water bodies and names of 3 coastlines.



Community Interviews

#1 Interviewee: Adult family or guardian member

Show this person where the Salish Sea is located.

1. Do you think the Salish Sea is important and why/why not?

Response:

_____

_____

2. How do they connect with the ocean? (Examples: fishing for fun, taking long walks, kayaking, food, etc.)

Response:

_____

_____

#2 Interviewee: Adult Non-immediate family members (grandma, neighbor, store cashier, etc.)

Show this person where the Salish Sea is located.

1. Do you think the Salish Sea is important and why/why not?

Response:

_____

_____

2. How do they connect with the ocean? (Examples: fishing for fun, taking long walks, kayaking, food, etc.)

Response:

_____

_____

Lesson 2: Watersheds

Subject
Watersheds

Materials/ Teacher Preparation

- Print a full class set of the Healthy Watershed Design Student Book page
- Optional: Print a class set of Cognitive Content Dictionaries (CCDs)
- Prepare the Watershed Model before lesson and try it out (GSSC provides lego model kit or paper mache model)
- Set the *Drayton Harbor Watershed Board* next to your Watershed Model for easy reference. Have push pins ready (provided in kit) for students to pin locations of the school, their homes, and other landmarks during the lesson.
- Write the target and success criteria on the whiteboard

Size/setting/duration
Full class/Indoor/50 minutes

Background
A watershed (also called a drainage basin or catchment) encompasses the area of land that drains to one location. Blaine Elementary School is a part of the Drayton Harbor watershed which drains from Cain Creek into Drayton Harbor. As water travels it often encounters pollutants and carries them into the ocean which can have negative impacts on the ecosystem. During heavy rain water runs off of impervious surfaces such as parking lots and roads and can carry pollution into the water whereas pervious surfaces, such as grass or gravel, let water filter through them.

Overview
Target:

- "I can describe how my local watershed works."

Success Criteria:

- Students draw a watershed, labeling the location of the school, the ocean, at least one river, and labeling at least one point source of pollution and one non-point source of pollution.

Procedure

1. Have students get their Salish Sea Notebooks/folders out
2. (5 min) Phenomena: 20 years ago there was so much poop (fecal coliform bacteria) in Drayton Harbor that the State Health Department said the community couldn't eat the oysters anymore. Show students the shellfish safety map. Zoom into Drayton Harbor. Explain that this picture was on one of the posters in the Poster Discussion. They all wondered what the colors meant and made guesses as to what the map represented. Explain that one of the maps showed that in 1999 most of Drayton Harbor was red, representing shellfish harvest was NOT allowed. Then, the second map, the one are looking at now online, shows a large area is green, or open for shellfish harvesting in 2017. *Why do you think this happened?* Turn and Talk.
3. Introduce Target: "I can describe how my local watershed works." Success Criteria: "students draw a watershed, labeling the location of the school, the ocean, at least one river, and labeling at least one point source of pollution and one non-point source of pollution.
4. Optional: (3 min) Add vocabulary to the Word Bank of Cognitive Content Dictionary (CCD) in students Salish Sea Notebooks:
    a. *fecal coliform bacteria*- tiny living things that live in poop. If eaten, often cause disease.
    b. Watershed - a system of land and waterways that drain into a central location.
5. (20 min) Watershed Model Demo
    a. Have students gather around the Watershed Model you've already set up. Connect your model with the Giant Drayton Harbor Watershed board next to you. Ask students to locate Blaine Elementary, their house and any other orienting landmarks (Edaleen Dairy, Blaine Library, California Creek, Dakota Creek, Canada, etc). As students recognize features and locations have them add a push pin to the map.
    b. Explain that 20 years ago, there was so much fecal coliform bacteria and other pollutants in the water the community was not allowed to harvest shellfish. Put food coloring on the watershed model and explain the following:
        i. Pet waste: This can be from people not picking up after their pets or farms that don't handle the waste properly. Have students add chocolate sprinkles and animal toys to the model. Mention that human waste can also have an impact if there are sewage leaks from

faulty pipes or septic systems.

ii. Chemicals: This can include herbicides on lawns, pesticides on farms and other chemical sources. Have students add chemicals (red food coloring) to the model.

iii. Vehicles: Cars can create multiple pollutants such as car oil, antifreeze and even the soap used to wash them. Have students add toy cars along with oil (worchestire sauce), antifreeze (blue food coloring), and soap (yellow food coloring).

iv. A pollutant is "any harmful substance added to the environment." This means dirt from erosion could also be a "pollutant" if it harms the ecosystem and the organisms in it, like fish.

c. Once the pollution sources are placed on the model create a "rain shower" by spraying water until the pollutants reach the ocean. Ask students to explain what happened to the pollution and how it might impact the life living in it.

d. Point out to students that all of the water ran off directly into the ocean. This is because it is an impervious surface, which means that water can not get through it. The plastic represents roads, sidewalks, driveways, any surface where you see water slide off instead of soak into. We saw in the model that all the pollutants eventually run into the ocean. Can you think of a way that this community could try to keep all the pollutants from getting into the ocean? Yes, we could choose to have less roads/impervious surfaces and more exposed green spaces."

e. Place as many sponges as possible on the model, add more food coloring, and run the simulation again. Ask for student observations about how it was different than the first time. Did the vegetation soak up or filter the pollution before it reached the ocean? This is because it is acting like a pervious surface, which means water can pass through it. Vegetation and soil act as a "sponge" for pollutants, so they don't reach the ocean as quickly.

f. Extension (if time allows):

i. There are also two different types of pollution: point and non-point pollution. Non-point pollution occurs when it rains and the storm-water runoff carries pollutants downstream. This can be pollutants like fecal coliform bacteria (poop) from broken septic systems in houses, animal waste from pets and livestock, chemical herbicides and pesticides from families and property owners

spraying their lawns or farms spraying their blueberries, or soap from the family washing their car on the lawn. When these pollutants wash into the ocean it is called "non-point source pollution." This just means that it doesn't come only from one place, like from a pipe. It comes from many places, such as animal waste from pets and livestock.

ii. "Point source pollution" is when a large amount of pollution comes from one single location. I can "point" to the single source. It could also be a broken sewage pipe breaks, or a boat where the sewage tank valve is left open instead of using the pump- out at the marina. According to the EPA, water pollution in the Salish Sea comes from multiple sources in the watershed.

g. Conclusion: What would you recommend our community members do, that includes us, so that the pollution doesn't get into the ocean? Answers include:
   i. Picking up after their pets
   ii. put a fence around livestock to keep them away from the streams
   iii. fixing up toilets right away (and maintaining septic systems based on Whatcom County maintenance requirements)
   iv. spraying non-chemical fertilizers and pesticides
   v. washing cars at a carwash not on the lawn
   vi. if you have a boat always dump at the harbor dump station

6. (15 min) Have students return to desks and pass out Healthy Watershed Design Student Book page. After reading the directions together, students can complete with a partner.

Next Generation Science Standards

Performance Expectations		
5-ESS3-1: Earth and Human Activity. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		
Scientific and Engineering Practices	Disciplinary Core Ideas	Cross-cutting Concepts
Developing and using models	ESS3.C: Human Impacts on Earth Systems	Systems and System Models Science Addresses Questions About the Natural and

		Material World

Other Standards

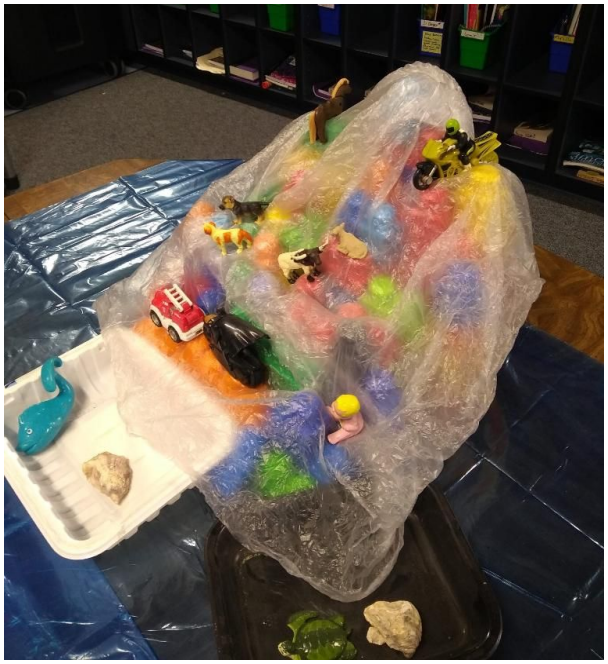
Standard 2: The Natural and Built Environment

Standard 3: Sustainability and Civic Responsibility

Graphics

Watershed map

Watershed Model Set-Up



Vocabulary

**Teacher Note: focus on students understanding of the big ideas. For example, rather than having them memorize "impervious," remind them of what effects those surfaces have.*

- fecal coliform bacteria: tiny living things that live in poop. If eaten, often cause disease
- Stormwater run-off: water that washes into a water body when it rains, carrying substances with it (for example: rain from our parking lot goes into the storm

drain outside our classroom and directly into Drayton Harbor)

- A “point source” : a direct deposit of a pollution into a waterway (example: pipe dumping waste into stream)
- A non point source: any pollutants washed into a waterbody when it rains (example: stormdrain)
- pervious surface - a surface that allows water flow through it (example: grass or gravel)
- impervious surface - a surface that does not allow water to flow through it (example: pavement or rooftops)
- Steward - someone that takes care of something

Extension

- Classes can choose to make their own paper mache models of the watershed and compare different factors that change the effects of pollution on the system. Students can work to design solutions to pollution problems in their models.

Worksheet

Healthy Watersheds Design

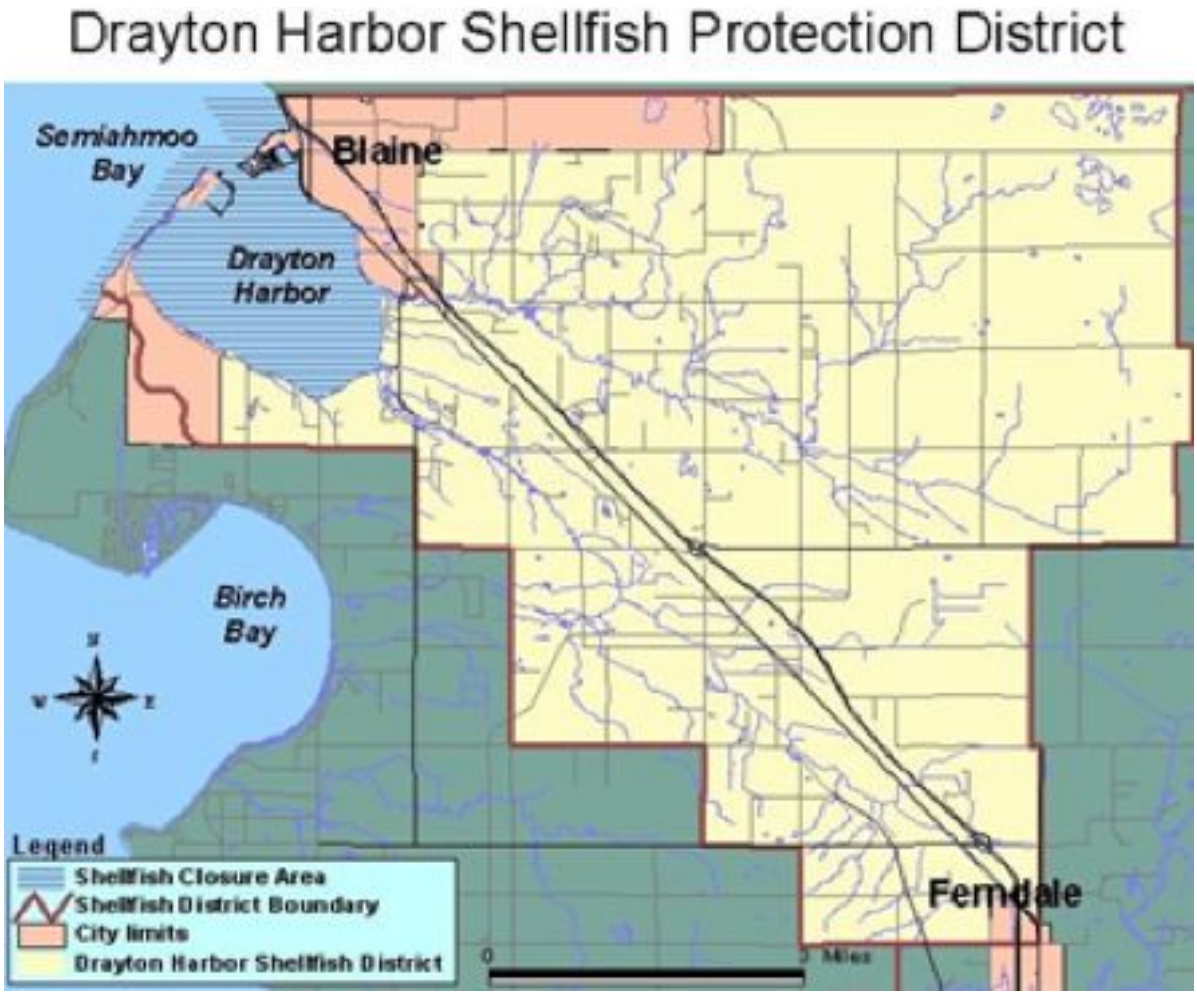
What are three sources of pollution you saw in the watershed model? Label them as non-point sources (NP) or point sources. (P)

1. _____

2. _____

3._____

Label/outline as many landmarks as you can on the Drayton Harbor Watershed map in your favorite colors. Include your house, the school, and 2 streams.



Healthy Watersheds Design

Name two things you can do to decrease the amount of pollutants that reach our intertidal zones

1._____

2._____

Design your own watershed below (use the outline of Drayton Harbor Map if you'd like). Then, draw some farms and houses near streams. Finally, add each item listed below strategically on your map. Be prepared to explain your thinking to the group. Label everything!

Include: farms, houses, storm drain, a bunch of cows (dairy farm), trees, fields of grass, at least two streams, sidewalks and roads, a plastic bag, a stone pathway, a kid with a dog, fences.
Extra: solar panels, gardens, an organic farm, a bicycle. How might each of these help reduce ocean water pollution?

Lesson 3: Drayton Harbor Oysters and Salish Sea Challenge

Subject
Student Action

Materials/Teacher Preparation
- Print half a class set of "Drayton Harbor Oysters Video" sheet
- Set up youtube projection video
- Print class set of Salish Sea Stewards Challenge Bingo sheets in color, if possible
- *Community Sources for Clean Water* Poster hanging for reference (GSSC provides)

Size/setting/duration
Full Class/Classroom/40 minutes

Background
Shellfish harvest areas in Drayton Harbor started getting downgraded in 1995 due to nonpoint source pollution. Since then, community actions have helped reopen a large portion of the harvestable areas. Our actions in the watershed make a huge difference to the health of the watershed, and the harvestability of the shellfish that are in the bay.

Overview
Students will:
- Choose actions they can take to help improve water quality.

Procedure
1. Briefly review the *Community Sources for Clean Water* Poster, and have a student hang somewhere in the room.
2. Optional: Pass out Cognitive Content Dictionaries and have them write "steward". Display your copy for everyone to see; students write a prediction and then the teacher guides them to a correct sketch of the word meaning and gives the final definition. Model how to use it correctly in a sentence and ask for volunteers to do the same. Model how kids should add a "check" in the "oral sentence" box with however many times the class used it correctly.
3. Introduce the Salish Sea Stewards Challenge. Pass out the Salish Sea Stewards Challenge Bingo sheet and have students store in folders. *This whole unit is about*

human action and the watershed. We have the knowledge that pollutants are getting into our watershed and we also have a responsibility to take care of what is ours. Read through the Bingo Sheet directions with kids. Explain that the idea is to be mindful about when they are doing something that helps keep the watershed clean. For example, if they help parents garden, they are helping to upkeep greenery/a pervious surface, so they can cross off the "tree" image on the bingo sheet. Take a few minutes to talk through what kids could do to cross off boxes.

4. Add vocabulary to to word bank or CCD:
    a. Steward - a person who takes care of something
    b. Shellfish industry - all the businesses related to turning raw shellfish into goods. Examples include jobs related to food service or oyster farming; related to gardening, crushed shellfish shells mixed into soil for fertilizer; jobs related to tourism in the area, lively sea life is world famous and oysters filter the water, which benefits all organisms.
    c. Ecosystem services - benefits from healthy ecosystems. (Teacher note: services include how plants produce O2, shellfish filter water, oyster shells provide a base for other organisms to grow off of, roots prevent erosion.)
5. (5 min) Pass out *Poop in Drayton Harbor Video Question* half-sheets to keep in notebooks. Preview the video questions. Explain that Blaine Harbor is part of the bigger Drayton Harbor that touches Semiahmoo.
6. (3 min) Play News Story About Drayton Harbor Community Shellfish Farm.
7. (5 min) Review answers to the Question Sheet with students.
8. Shellfish are filter-feeders. That means that they eat microscopic things like plankton from the water, and clean it in the process. Adult oysters can filter up to 50 gallons of water in a day. If we want to be able to harvest oysters and other shellfish we need to be careful about what gets into the water. Pollutants like fecal coliform bacteria, which is in poop that can come from animals or faulty septic systems, can make us very sick.
9. Explain that we should never collect shellfish without checking the Washington Department of Health's biotoxin hotline (1-800-562-5632) for paralytic shellfish poisoning and pollutant closures or look at the shellfish safety map.
10. (5 min) Reflection: Salish Sea Steward Challenge Bingo. Lead students to take out their bingo sheet and reflect on anything they've done recently. *What can I do to keep my watershed clean?* Remind them to X off any they've done since the last lesson, (they can cross off multiple.) When they've gotten four in a row they should let the teacher know, they can share if they choose to, and they can sign the Salish Sea Stewards Classroom poster, hanging on the wall. "Let's be stewards

today, tomorrow, and every day that we live here!" or other reward you have in mind. The idea of the Bingo game is that you will create a habit of connecting actions during the week with how it affects the watershed. You could limit students to placing three "Xs" per day that you review the game. Have a few students explain the connection between the action and the water quality. (Students often refer back to the Watershed model here).

Next Generation Science Standards

Performance Expectations		
5-ESS3-1: Earth and Human Activity. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		
Scientific and Engineering Practices	Disciplinary Core Ideas	Cross-cutting Concepts
Developing and using models	ESS3.C: Human Impacts on Earth Systems	Systems and System Models Science Addresses Questions About the Natural and Material World

Other Standards

Standard 2: The Natural and Built Environment
Standard 3: Sustainability and Civic Responsibility

Graphics

None

Vocabulary

**Teacher Note: focus on students understanding of the big ideas. For example, rather than having them memorize "impervious," remind them of what effects those surfaces have.*

- fecal coliform bacteria: tiny living things that live in poop. If eaten, often cause disease
- shellfish industry: all the businesses that convert raw shellfish into goods for consumers
- Stormwater run-off: water that washes into a water body when it rains, carrying substances with it (for example: rain from our parking lot goes into the storm drain outside our classroom and directly into Drayton Harbor)

- Steward - someone that takes care of something
- Ecosystem services - the important benefits that come from healthy functioning ecosystems such as cleaning the water or production of oxygen.

Extension

- If you have time you can watch these other videos about Blaine's oysters:
    - Growing Oysters at the Drayton Harbor Oyster Farm Video
    - Drayton Harbor Oyster Video

Worksheet

Salish Sea Stewards Challenge Bingo

Let's try to create a habit by adopting certain routines in our daily lives because we care about protecting our oceans. Every few days we'll re-visit this sheet and X off the actions you/your family have done during this unit... Whoever gets a bingo by the end of the unit gets a Salish Sea Sticker!

I want to protect my Salish Sea because… (Use words or pictures)

Drayton Harbor Oysters Video Student Question Sheet

What are some of the pollution sources that caused the shellfish closures?

Think back to the watershed model. Why do you think shellfish harvest closes when it rains?

Drayton Harbor Oysters Video Student Question Sheet

What are some of the pollution sources that caused the shellfish closures?

Think back to the watershed model. Why do you think shellfish harvest closes when it rains?

Drayton Harbor Oysters Video Answer Sheet

What are some of the pollution sources that caused the shellfish closures?
Leaking sewer systems and pollution from storm drains.

Think back to the watershed model. Why do you think shellfish harvest closes when it rains?

Water picks up pollutants as it goes through the watershed.

Lesson 4: Eat or Be Eaten

(Food Web game adapted from Mystery Science)

Subject
Intertidal zones and food webs

Materials/Teacher Preparation

- Eat or Be Eaten Cards (one set of cards per 2-4 students)
- Eat or Be Eaten Instructions (can be put on overhead projector)
- Score Cards (one per student)

Size/setting/duration
Entire class/Indoors/30 min

Background
The intertidal zone has a complex food chain which creates many interdependent relationships.

The Eat or Be Eaten activity was adapted from Mystery Science Web of Life Lesson 1. For more information, watch this video.

Overview
Target:

- I can describe the flow of energy through a local intertidal food chain
- I can describe organisms that live in the four intertidal zones (spray, high tide, middle tide, low tide) of our local Salish Sea.

Success Criteria:

- Students create an intertidal food chain and accurately describe the trophic level of each organism within the chain. Students explain how energy moves through the chain.

Procedure

1. Eat or Be Eaten Card Activity (30 min)
    a. Goal of the Game: Make as many cards as you can into food chains AND make

those food chains as long as you can.

b. How to play
    i. Shuffle the deck and pile the cards in the center, face down.
    ii. On the first round, players take turns picking a card from the pile & reading the card aloud.
    iii. On each subsequent turn, a player has a choice. They can choose a card from the pile or steal a card from another player.
    iv. Important Note: Once a card is linked in a food chain, it can't be stolen. Putting cards in a food chain protects them.
    v. The game continues until all the cards are used or you run out of class time.
    vi. At the end of the game, each player tallies their score using their Eat or Be Eaten scorecard.
c. Rules for Scoring
    i. You get 1 point for every card in a food chain.
    ii. Food chains of four or more cards get 2 bonus points.
d. Note: We encourage players to reason from the descriptions on the cards. For example, the cricket eats dead leaves and the oak tree produces leaves. Though the oak tree card doesn't say that there are dead leaves under the oak tree, a player may contend that there are leaves under the tree to provide food for the cricket and make a food chain.

Next Generation Science Standards

Performance Expectations		
5-LS2-1: Develop a model to describe the movement of matter among plants, animals, and decomposers, and the environment 5-ESS2-1: Earth Systems. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact		
Scientific and Engineering Practices	Disciplinary Core Ideas	Cross-cutting Concepts
Developing and using models	LS2.A Interdependent Relationships in Ecosystems ESS2.A Earth Materials and Systems	A system can be described in terms of its components System and System Models

Other Standards

ESE2: The Natural and Built Environment. Students engage in inquiry and systems thinking and use information gained through learning experiences in, about, and for the environment to understand the structure, components, and processes of natural and human-built environments.

Graphics

Eat or Be Eaten Cards

Vocabulary

- food chain - a hierarchical series of organisms each dependent on the next as a source of food.
- Nutrients - a substance that provides nourishment essential for growth and the maintenance of life.
- Photosynthesis - the process of using sunlight to synthesize foods from carbon dioxide and water.

Extension

- Eat or Be Eaten Advanced Play: Making Food Webs Players may realize that some of their food chains could be connected to form a network of interlocking chains — that is, a food web. If your group realizes this and if you have time, ask them to see how many chains they can connect in a food web.

Lesson 5: Clam Identification

Subject

Clam Identification

Objectives

The students will:

- Recognize patterns in order to identify clam species.

Materials

- Clam ID kits (one per table group)
    - Each kit contains 3 of each species (Horse Clam, Eastern Softshell, Cockle, Manila, Native Littleneck, Butter Clam, Macoma)
- Calipers (at least one per table group)
- Clam ID guides (one per student)
- Clam ID powerpoint (and projector)

Size/setting/duration

Full class in table groups/indoors/45 minutes

Background

This lesson is a key way to introduce the students to clam identification before their clam survey at Birch Bay State Park.

Procedure

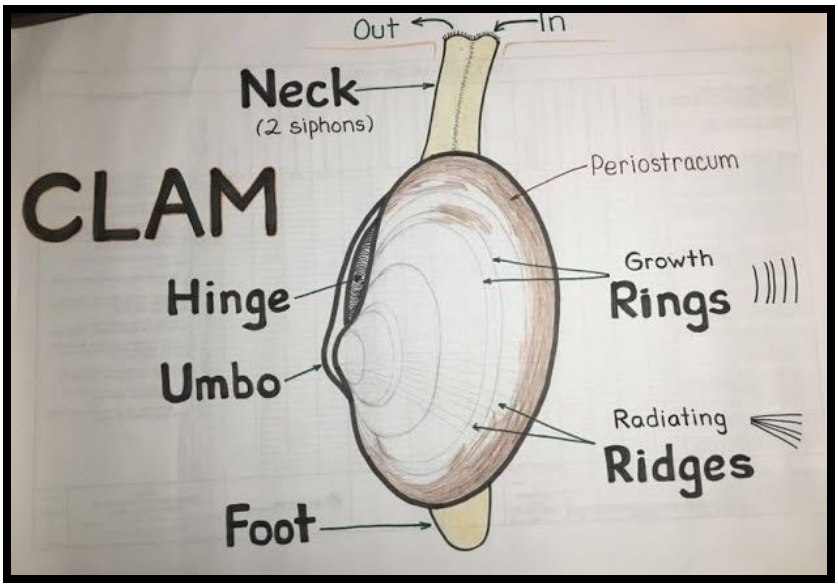
- Initial shell sort (10 minutes)
    - In groups of about 5 have students observe the sets of shells. Begin by having the groups work together to sort the shells by ones they think are similar.
    - Walk around with the groups and ask students what they are sorting the shells by and suggest some of the other ideas for how to organize the shells.
- Ask students how they sorted the shells (5 minutes)
- Once the whole class has organized the shells display this powerpoint on the screen and discuss the anatomy of shells. With each shell pattern, ask students to hold up one shell that has this characteristic.
- Shell Sort 2

    - After discussing the different shell characteristics, give students a chance to reorganize the shells using these patterns and use this time to point out to individual groups if there are any of the characteristics that they may be missing in their sorting.
- Shell ID
    - Once the class feels confident in their shell pattern recognition have each student choose one shell to observe and identify and handout the Shell ID worksheet.
    - Using the shellfish ID cards have students try to identify their shells, diagram them and label the dimensions of the shells.
    - Explain to students that these shells that they have been working with are the exoskeletons of the shellfish that are essential for them to continue living. What would happen if they didn't have their skeleton?
- Shellfish are sensitive indicator populations which are affected by multiple stressors and they need a balanced system to thrive. There are many things that can upset the balance such as:
    - Overharvesting is when we collect something faster than it can grow so the population decreases. This has happened with our native oysters, the olympia oyster.
    - Ocean acidification affects shellfish ability to make and grow their shells. Today we measured shell thickness. Shellfish with thick strong shells are less likely to be damaged or eaten. When the ocean chemistry is out of balance it can leave the shellfish vulnerable.
    - Fecal coliform

Next Generation Science Standards

Performance Expectations		
Scientific and Engineering Practices	Disciplinary Core Ideas	Cross-cutting Concepts
Constructing explanations and designing solutions Developing and using models Engaging in argument from evidence	LS1.A: Structure and Function LS1.D: Information Processing ET S1.B: Developing possible solutions	Patterns Structure and Function Influence of Engineering, Technology, and Science on Society and the Natural World System and System Models

Graphics & Worksheet



Clam Identification Key

Adapted from King County Beach Assessment program

Anatomy Terms

- Umbo
- Hinge
- Siphon
- Periostracum

Things to Note:

Shape:
Round vs Oval/Elliptical vs Triangular
Patterns:
Concentric Rings vs Radiating Ridges
Color

Can you see a leathery hinge connecting the shells? (Beside the Umbo, the leathery hinge is visible outside of the live clam or closed clam shell.)
If no, go on to "A"
If yes, skip to "B"

A. No leathery hinge visible:

(hinge is hidden inside)

1. Outlines of both shells are mirror images of each other, flaps are present on the tips of siphons. It is a **Horse Clam**.

[two horse clam species: "Horseneck" (*Tresus nuttalii)* or "Fat Gaper" (*Tresus capax*). They are often *misnamed* "geoduck" when large, but these are *not* geoducks!]

2. Shells are not mirror images, one shell overlaps onto the other at the top; no flaps are present on the tips of siphons. The shell has elliptical shape. It is an **Eastern Softshell** Clam.

Both Eastern softshell and horse clams often have a brown-black papery skin (periostracum), on outer (newer) edge of shell, wearing off over time. When small, the shells may seem thin and fragile, when large (as large as an adult's hand!) the shells can get thick and robust.

B. Yes, leathery hinge visible on outside of shell **(next page)**
(clam key continued, page 2)
B. Yes, leathery hinge visible on outside of shell

1. Shell is half circular, half like triangle, pointed on one end. Often has brown or black skin-like periostracum, which may flake off older parts of shell.
    a. Has a more blunt point. Reddish-brown periostracum may cover whole shell or where flaking off, shell may look purplish-white. It is a **varnish clam** (or "purple varnish clam", "savory clam")

    b. Triangular edge often more pointed, sometimes tip is curved up. Grayish Periostracum may be worn off or with just a little around edge… It is a **Macoma** (includes many species: "bent-nose", "pointed"/"polluted", sand, and Baltic macomas)

2. Shell is **mostly circular or oval, rather thick and strong**. Rings or ribs are easily seen on the shells. No periostracum

    a. Shell has **heavy ribs**, shell is heart-shaped when viewed from on end. It is a **Cockle**. (aka. "heart-cockle")

    b. **Rings and ribs** are equally visible. Shells may have patterns of color

(1) Shell is elongated, oddly oval. there is a smooth, flattish groove where shells meet near the umbo (non-hinged side of umbo). It is a **Manila clam**.
(also called "Japanese littleneck")

(2) Shell is rounded, there is no pit near the umbo – more of a ridge that continues all the way to umbo.
It is a **native littleneck clam**

3. thick oval shell, rounded on both ends, has faint rings. Plain chalky white or stained gray from mud. Live clams have a noticeably strong leathery hinge. It is a **butter clam**.

Classroom Clam Shell Sort

Sort out the shells given to your group. Divide them up by common characteristics. In the space below, for each clam, record the attributes, and write a brief description with a diagram of the clam. Be sure to label any identifying features.

Description:	Drawing of Shell
Color: _____ Shape: _____ Markings:_____ Length:_____ Width:_____ Type of Clam: _____	
Color: _____ Shape: _____ Markings:_____ Length:_____ Width:_____ Type of Clam: _____	

Optional Teacher Extension Lessons

Fall Extension 1: Shellfish Around the World

Subject
Social Studies

Materials/ Teacher Preparation

- large physical map set up with shellfish samples correctly placed around the world
- Shellfish Time and Place (Social Studies Support) Student Worksheet
- Live Tank
- Phytoplankton to feed oysters
- 2 or more oysters
- Predictions Paper (2) on clipboard next to Live Tank. Print and glue the following prompt on the paper. Make a prediction on the tank. How do you predict East coast colonies and native groups used oysters? What do you think oysters need to survive? Do oysters provide a service to the ecosystem in any way?
- Make copies of the five Colonial Regions Expert Groups (not provided here, A.Keiper has)
- write Work Time Tasks on the board
- Make 15 copies of Student Worksheet. Students will complete this in partnership

Size/setting/duration
45 minutes
NOTE: In the end, the Map Station took kids about 15 min (group of 3-4) and the Live Tank Prediction Station took about 5 min, then the map to the side of the tank was Free Exploration

Background
Shellfish live on coastlines all around the world, where they provide many ecosystem

services. Both the Coast Salish People and the British colonists used shellfish as a food source. Shellfish are filter feeders, and continuously clean the water that they live in.

Overview

Placement: November
Supports: the Colonization and Devastation portions of Unit 1 social studies

Big Ideas:

- the British colonists discovered a coastline much like our west coast and used shellfish as a resource
- Shellfish live on coastlines all around the world

Social Studies Conclusions:

- Coastlines are rich in biological diversity-- this is part of New England's geography where colonists lived
- What do shellfish need to survive on all these coastlines? What does this tell us about New England's geography? (Shellfish need well balanced water chemistry (pH) to survive and they also clean the water. The highly diverse shellfish fisheries tells us the ecosystem was healthy! Native communities were good stewards of the environment because they didn't overharvest and didn't have add too much carbon dioxide into the environment.

Target:

- I can describe the physical geography of the east coast where colonists were settled and where native people lived.

Focus Questions:

- What did the land look like where various colonists settled?
- What resources were available to help them survive and thrive?
- How did shellfish play an important role for colonists?

Success criteria:

- Students read a text and sketch important details about the east coast's geographic features.
- Students conclude that shellfish helped to provide a healthy ecosystem that colonists used to survive and thrive.

Procedure

1. Introduction at their desks (15 min):
    a. Connect to Yesterday: ...We've been learning about New England's geography and you're currently researching why different English colonists groups moved here. You've done some Picture File Card sorts (GLAD unit) and have ideas about what the land looked like.
    b. Target: Read target/success criteria.
    c. CCD: geography: physical characteristics of a place. resources: things that provide something useful
    d. Students move to 13 Colonies Input Map
2. Predict: T/T, based on what you know about the east coast region and the resources produced by colonists here, what do you predict the geography was like in these three regions?
3. Connect: New England predictions "Some of you talked about how the New England colonies were famous for its seafood. This group said the physical geography must be a lot like here on the west coast because we also have the ocean. What types of plants, animals, or physical characteristics of the land do you notice around here near the ocean? (coastal plain, shellfish, dolphins, whales, fish, rocks, pebble beaches, sand).
    a. Middle Colony predictions:
    b. Southern Colony predictions:
4. Set Partner Work Time Tasks (move to meeting place):
    a. Read a text about your assigned colony's region, highlight important information, and sketch a picture under each paragraph (teacher MODELS).
    b. When finished, they work on cartoon poster OR explore the Shellfish Stations. (Stations open all week)
    c. Shellfish Stations includes the Shellfish Map, samples, and Live Tank
        i. Shellfish Map (15 min groups of 3-4): kids should follow the prompts on the activity sheet.
        ii. touch these plants and things from the coastal ecosystem, these help you imagine you're on the coast of New England. The plants/animals there will be slightly different, but related to these plants and animals.
        iii. Week Long Oyster Live Tank.

1. What: Oyster tank placed in back of room with two oysters demonstrating how quickly it clears the water. Set up as around when kids read the Chesapeake Bay Close Read and learn the reason the bay was such an asset to colonists was partially because of shellfish adequately supporting the environment through filter feeding and they were a food source.
2. Something to remember: Many shellfish are filter feeders. They take out microscopic organisms (plankton) from the water to eat and leave the water cleaner than before...how might animals that clean the water be helpful? (Don't give away at this time)

5. 30 min (10:55-11:25) Individual/Partner Work Time

Day 2 (10 min)
Whole Group Conclusion Big Ideas:

- According to your text, what resources were available to colonists? (ocean for trade, shipping things to England and food, local rivers for travel routes and trade and fish; forests supplied timber; good soil; How did colonists use those resources (did they farm, did they build things?)
- What did you learn from the Shellfish Map? (shellfish live around the world on coastlines. The shells look similar/different all over the world. We have oysters here and on the east coast).
- Which British colonies do you think had access to resources from the sea? What kind of resources are provided by the sea? (food: fish/oysters/clams; ships could come and go, delivering food/trade; trade with other native nations).
- You saw the shellfish eating back there, they are filtering the tank. In a few days, or you may have noticed already, the tank water will be very clean. Here are some ideas from a few ideas about how the oyster tank affects the environment...

Repeat the Big Idea:

- Shellfish help make the coastal ecosystem very rich and healthy. They can be eaten, sold for money/supplies, used for jewelry/trading, and help keep the water clean so other organisms can thrive. For example, when the water is clean, plants and animals at the bottom of the waterway can get sunlight, and grow, providing even more food and oxygen for other plants and animals.

After Lesson Reflection/Notes:
*NOTE: In the end, the Map Station took kids about 15 min (group of 3-4) and the Live Tank Prediction Station took about 5 min, then the map to the side of the tank was Free Exploration

Next Generation Science Standards

Performance Expectations		
5-ESS3-1: Earth and Human Activity. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		
Scientific and Engineering Practices	Disciplinary Core Ideas	Cross-cutting Concepts
Obtaining, evaluating, and communicating information	ESS3.C Human Impacts on Earth Systems	Science Addresses Questions about the Natural and Material World

Other Standards
Standard 1: Ecological, Social, and Economic Systems Standard 2: The Natural and Built Environment Standard 3: Sustainability and Civic Responsibility

Graphics

Vocabulary

- Geography - the study of the physical features of the earth and its atmosphere
- Resources - a source or supply from which a benefit is produced
- Shellfish - an aquatic shelled mollusk or crustacean

Extension

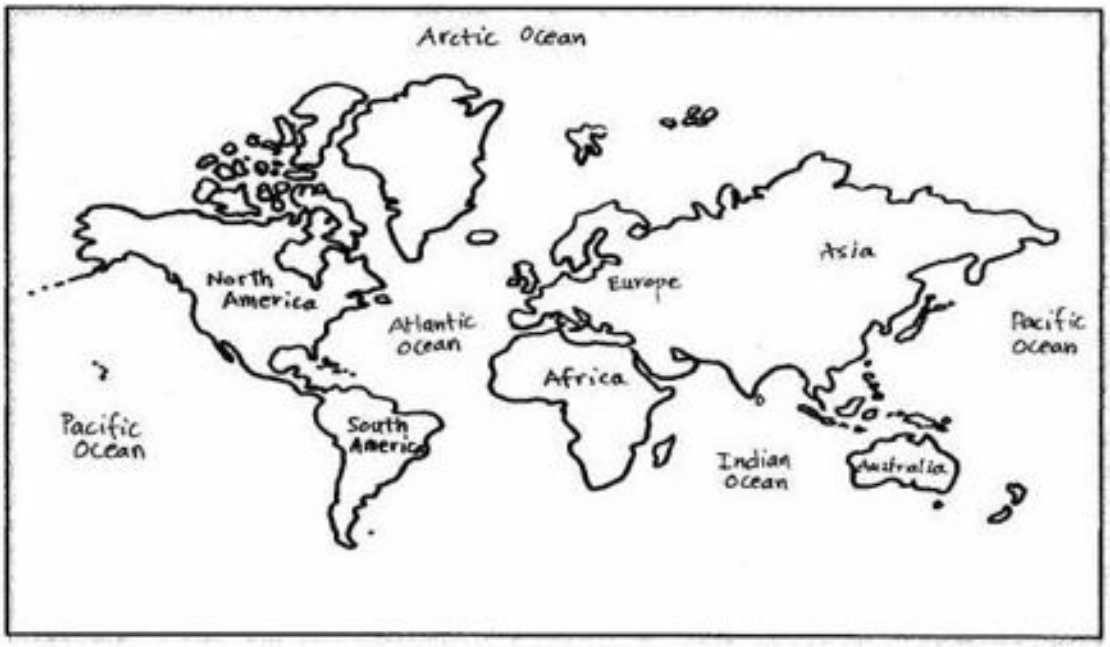
None

Worksheet

Shellfish around the World

Shellfish are mollusks that appeared on earth more than 500 million years ago according to the fossil record. Marine shellfish have lived along coastlines worldwide, providing food and resources to native peoples since before anyone can remember.

1) Trace the coastline of two continents where shellfish are found and record the continent names a)_____b)_____



2) Study the large map. What are two things that you notice about where the shellfish are located?

_____

_____

3) What questions do you have?

_____

_____

4) Name the oyster commonly found in the Chesapeake Bay, on the east coast of North America

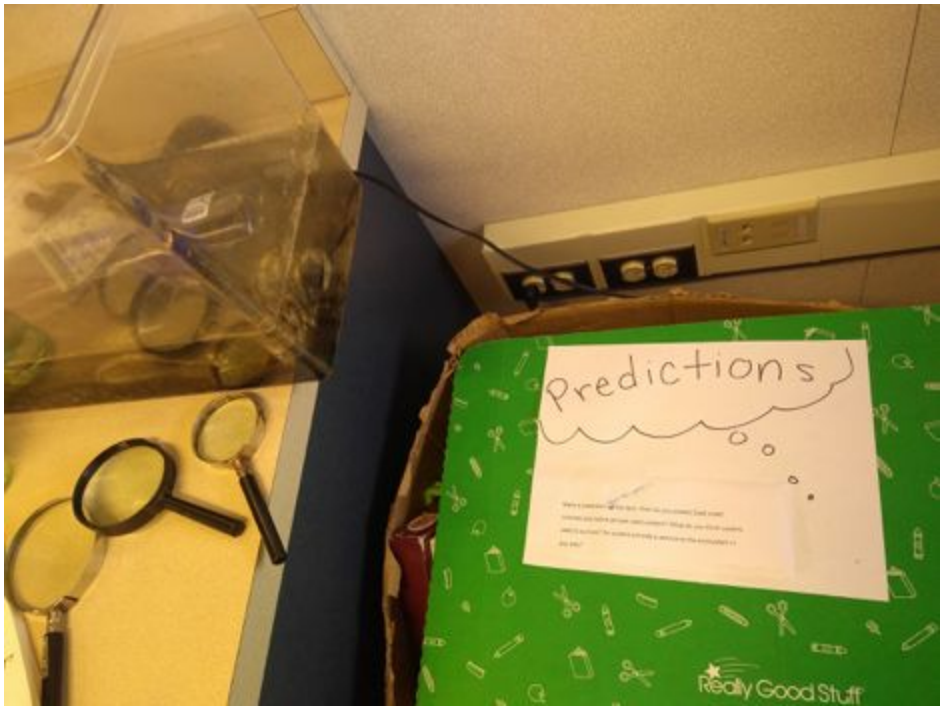
_____

5) Pick a shell on the map to learn more about. Look at the card for this shell and record something interesting about it. Where is it found?

_____

_____

Photos



Fall Extension 2: Oyster in Chesapeake Close Read

Targets: *History 4.2.2 Analyzes how people from various cultural groups have shaped the history of the United States. Reading: Close Reading routine for higher reading comprehension ESE 5.1: Students develop knowledge of the interconnections and interdependency of ecological, social, and economic systems. They demonstrate understanding of how the health of these systems determines the sustainability of natural and human communities at local, regional, national, and global levels.*

OSPI History suggested example: " Examines how native peoples helped the colonists establish survival skills in their new environment."
Big Ideas:
History- native groups used the shellfish beds of the Chesapeake. This wildlife was a major cause of the settlement of North America. New England colonies relied on the sea as well as land for food.

ESE- The Chesapeake tribes lived and harvested in small enough numbers that it didn't negatively impact shellfish populations. They also didn't overharvest trees, resulting in pristine environment for shellfish=exceptional water quality=abounding other wildlife.

Reading: this is a high level text because of vocabulary/sentence structure/topic. Good readers can read closely multiple times to understand it best. Reading closely involves reading multiple times and answering levels of questions to get at underlying ideas. (placement: a practice, after kids have done Close Reading a few times)

Note to Teacher: I could do this lesson inside a reading period or history period.

Materials: Reserve Chrome Cart or build your library (Goal 13 chromes, currently have 4)

Launch: See a map of the Chesapeake bay and have a student color/label the Bay of Virginia of the Wall Map. Ask a student to point out the paragraphs as numbers.

Routine: Read 1: read aloud, kids follow along with Chromebooks. Instruct kids on how to annotate on googledocs, or in notebooks (highlighting/bolding on comp, starring in journal, adding a message on comp, etc). Allow pause time every few paragraphs for kids to annotate.

Close Read Questions

Level 1: What the text says

1. Which Bay is this text talking about? Where is it?
2. Why is this species of oyster named the "Crassostrea **virginica?"**
3. What are at least three reasons oysters thrived in the Chesapeake Bay?
4. Were oysters important to the native peoples of the region? Support your answer with multiple pieces of text evidence.
5. What are the names of the native people who depended on the oysters in this Bay?

Level 2: Craft and Structure "how does the text work?"

1. What does the word **abundant** mean in paragraph 2? The word **pristine** in paragraph 4?
2. Did the colonists overharvest oysters? Use evidence to support your thinking.
3. Draw and label a timeline showing what happened to oyster population over time. Include at least three dates.

Level 3: Interpret: What did the text mean?

1. "The story of the Chesapeake oysters is a classic example of a recurring tendency in human history: use it until it is gone;" what do you think this line means? Have do you see this happening in our world today?
2. What actions caused the biggest change in the number of oysters? Use text evidence to support your thinking.
3. Contrast how native peoples and colonists used oysters. Was one way better? Why or why not?

Level 4: Application

1. What are consequences for humans and the environment from having less oysters in our local Birch Bay?
2. How do you feel about the big change in oyster abundance? Why do you feel that way?
3. Has the same story of overharvesting happened on the Pacific coast (Blaine)? Do a google search and watch a video to find out. (Tip: if you're stuck, type "pacific northwest oyster problem")

Types of Water Pollution

Subject

Pollution and stewardship

Materials/ Teacher Preparation

- Chrome Book Cart or half a class set of chromes
- Each student needs their own Salish Sea Stewards Bingo printed page easily accessible for each lesson. Teachers may decide to have students glue these into science notebooks, fold poster paper to make a cheap folder to hold worksheets, or collect/return them to students for each lesson.
- Cognitive Content Dictionary: teacher could print 1 copy to share with class, or each student could have their own copy.

Size/setting/duration

65 min (2 instructional days)

Background

Big Idea: Kids will come away from this lesson with an understanding that our community actions impact the health of the Salish Sea. We can take responsibility for a healthy environment by choosing to change our habits. Kids learn that one common sources of water pollution in the Salish Sea is carbon dioxide (CO_2). They discuss how they can reduce pollution and are introduced to the Salish Sea Stewards Challenge (Bingo game).

Overview

Target:

- I can identify a few pollutants of the Salish Sea
- I can explain specific actions we can take to be good stewards of my watershed

Success Criteria:

- Students explain types of water pollution common to the Salish Sea by watching videos/reading articles on Climate Kids website and participating in class discussion.
- Students review and discuss the Salish Sea Bingo game

Procedure

1. Vocabulary:
    a. Watershed: an area of land where the rivers all drain to one place
    b. Stewardship: taking care of something
2. If you haven't launched the Bingo game, do so now. You don't need to play the entire game; visit this bingo board for a few minutes once or twice a week until a few students have won, or you've had a chance to discuss all the connections between the watershed and each action picture. This whole unit is about human action and the watershed. We have the knowledge that pollutants are getting into our watershed and we also have a responsibility to take care of our environment. Read through the Bingo Sheet directions with kids.
3. Have kids share a computer for reading comprehension support. *Now that we know what the Salish Sea is and why we love it, you're going to learn about some of the challenges it's facing with water pollution. It looks like some of you think water pollution is____and that it comes from _____. (from student posters).*
    a. TPR Action: "water pollution:" things that make water unhealthy for critters or people
    b. CCD: greenhouse gases: "gases that warm Earth's atmosphere" absorb: "to
    c. take in"
4. Explain that water pollutants can be anything that makes the water unsafe for critters or people such as chemicals, trash, poop, or too much of anything, such as soil, nutrients, carbon dioxide or temperature extremes. Explain whether the pollutant that you chose is from air, water or soil. What pathway did the pollutant take to get into the water?
    a. https://www.youtube.com/watch?v=0m42Lppkd9w
5. Inquiry (30 min): Explain that students will learn about a few types water pollutants by watching videos/reading articles and getting prepared to share this research during Closing Discussion. Teachers may choose to have kids take notes on the Types of Water Pollution Student Worksheet.
    a. Management: Assign the videos listed in the Student Worksheet. Text readability varies by article, teachers may want to assign reading partners as a support.
    b. Have students navigate to https://climatekids.nasa.gov/ocean/ (Google: "climate kids nasa ocean") and remind to use earbuds/headphones and navigate responsibly. Tell students they should have notes prepared for at least 2 videos or activities by the end of the work time.

6. Closing Discussion (15 min): Put away chromes and gather in the meeting area with the talk ball in front of a poster/whiteboard entitled *Types of Water Pollution in our Salish Sea* and sentence frame: "According to the____(type of resource)_____(title), one type of water pollution is _____." Have students lead the discussion while teacher charts answers. Press students to define their terms or answer each others' questions.
    a. Teacher Big Idea: When the ocean absorbs CO2 from the air it changes the chemistry of the ocean, which harms shellfish and other marine critters that need to make shells, like crabs. 5. Salish Sea Challenge Reflection (5 min): Pass out the Salish Sea Stewards Bingo, allow kids to respond to first prompt, then discuss the "I can reduce carbon emissions" section only, helping kids understand how the action reduced carbon emissions. You'll unpack the others in later lessons. Students could store these worksheets in a folded over poster paper (makeshift folder)

Next Generation Science Standards

Performance Expectations		
5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		
Scientific and Engineering Practices	Disciplinary Core Ideas	Cross-cutting Concepts
Obtaining, evaluating, and communicating information	ESS3.C Human Impacts on Earth Systems	Science Addresses Questions About the Natural and Material World

Other Standards

ESE3: Standard 3: Sustainability and Civic Responsibility. Students develop and apply the knowledge, perspective, vision, skills, and habits of mind necessary to make personal and collective decisions and take actions that promote sustainability.

Graphics

None

Vocabulary

- water pollution
- toxins
- greenhouse gases
- carbon dioxide (CO2)
- run-off
- Ocean acidification

Extension

For another activity related to the carbon cycle, look at the [EPA's Carbon Cycle Activity]

Worksheet

Types of Water Pollution

Directions: Navigate to https://climatekids.nasa.gov/ocean/. Use the search bar to find more resources and prepare to present your information about types of water pollution. Record the title and type of each resource. Annotate your thinking.

Video/Activity/ Article Title	**Big Idea about Water Pollution**
	Resources: *all about how air pollution *Slideshow: LOCAL WATER QUALITY PROBLEMS
Meet the Greenhouse Gases, Cards *(Activity)*	(find this activity by typing "water pollution" in the Climate Kids search bar)
"What is Ocean Acidification?" (Article)	(location: type "water pollution" in the Climate Kids search bar)
Climate Bingo! (Activity)	**(**location: click on green "Plants and Animals" tab, scroll down, click "Play Bingo!")

Climate Bingo! (Activity)	**Stewardship: What Can We Do?**
	Discuss the many ideas from climate bingo.

Student Dictionary:

Carbon dioxide (CO2): an invisible gas that comes from burning fossil fuels (cars burn a type of fossil fuel)

Fossil fuels: Fuels made by burning coal. For example, fuels used to power an airplane, bus, or car are usually fossil fuels.

Atmosphere: the whole mass of air that surrounds the Earth

Types of Water Pollution Answer Key

Directions: Navigate to https://climatekids.nasa.gov/ocean/. Use the search bar to find more resources and prepare to present your information about types of water pollution. Record the title and type of each resource. Annotate your thinking.

Video/Activity/ Article Title	**Big Idea about Water Pollution**
	Resources: *all about how air pollution (sources of carbon dioxide) *Slideshow: LOCAL WATER QUALITY PROBLEMS (fecal coliform, poop)
Meet the Greenhouse Gases, Cards *(Activity)*	(find this activity by typing "water pollution" in the Climate Kids search bar) **Some greenhouse gases are CO2, ozone, methane, and nitrous oxide*
"What is Ocean Acidification?" (Article)	(location: type "water pollution" in the Climate Kids search bar) **oceans absorb CO2 (a greenhouse gas) from the air which creates carbonic acid and increases acidity*
Climate Bingo! (Activity)	**(**location: click on green "Plants and Animals" tab, scroll down, click "Play Bingo!") *Greenhouse gas pollution: Sources: *cars and buses add greenhouse gases to atmosphere *electricity can still be made by burning fossil fuels *when we use paper products we're encouraging more trees to be cut down. Less trees mean more greenhouse gases in the ocean *cars that use diesel fuel rather than unleaded get better gas mileage, which means less greenhouse gases are released into the air.

Climate Bingo! (Activity)	**Stewardship: What Can We Do?**
	Discuss the many ideas from climate bingo.

Student Dictionary:

Carbon dioxide (CO2): an invisible gas that comes from burning fossil fuels (cars burn a type of fossil fuel)

Fossil fuels: Fuels made by burning coal. For example, fuels used to power an airplane, bus, or car are usually fossil fuels.

Atmosphere: the whole mass of air that surrounds the Earth

Cognitive Content Dictionary

WORD	PREDICTION	SKETCH	FINAL DEFINITION	ORAL SENTENCE (checks)

The Intertidal Biome Worldwide

Subject

Intertidal biomes

Materials/ Teacher Preparation

- Locate Intertidal Ecosystem Picture File Cards (PFCs). Located in plastic ziplock labeled as PFCs
- copy a class set of the Cognitive Content Dictionary (CCDs)
- Hang a blank poster for the concluding discussion; entitle it "Characteristics of the Intertidal Biome"
- Write the following sentence frames on sentence strips. Place #1 up only:
    - *#1 "the intertidal biome____because____"*
    - *#2 "___is an abiotic/biotic factor because____"*

Size/setting/duration

Entire Class/Indoor/Part I: 35 minutes, Part 2: 30 minutes

Background

The intertidal zone is a difficult place to live since organisms have to survive being both underwater and exposed during low tides. Many organisms have adaptations to live in specific parts of the intertidal zone. Intertidal zones around the world are called the intertidal biome and have shared characteristics.

Overview

Target:

- I can describe the characteristics of the intertidal biome worldwide.

Success Criteria:

- students sort pictures to draw conclusions about the intertidal biome
- students identify abiotic and biotic factors within the biome

Procedure

1. Activate/Connect (2 min): *Yesterday we... today we will (refer to target/success*

criteria)

2. (2 min) Biomes of the World Video*:*
    a. Teacher Note: Pause the video at 3:00. “Kids, you’ve learned that biomes are large areas where the plants, animals, temperature, and climate are similar. We saw the marine biome, and were just introduced to a biome inside the marine biome...the coral reef biome. Let’s jump to multiple points here in the video with the sound off...do you recognize any of the other biomes on earth?” (allow kids to see snapshots of the rest of the biomes in the video) b.
    b. Answers: freshwater biome, land biomes, tundra, grasslands, rainforest, tropical rainforest, deserts, etc. “As you can see there are a lot of different biomes depending on what large area you are talking about.”
3. (5 min) Today we’re studying the intertidal biome. The intertidal biome of the Salish Sea mostly has the same sorts of plants, animals, temperatures, and climate. It’ll look similar if you’re in Blaine, Bellingham, Seattle, the Olympic peninsula, Victoria Island, etc. But the intertidal biome doesn’t look the same in every part of the world. Now you'll draw conclusions about the characteristics of the intertidal biome worldwide. What is it?
4. PFC Sort (10-15 min)
    a. Put a bunch of PFCs in front of every small group of students: 3-4 kids to about 12ish PFCs.
    b. Explain that kids are going to draw conclusions about what the intertidal biome looks like around the world.
    c. They should sort the pictures in different ways, using the sentence frames listed on the board. (For example, they might choose to sort the cards by types of animals or plants, or by things that probably live in the same area, or...anything.)
    d. Model the sentence frame: *maybe you’ll say to your partner, “I think intertidal biomes have some animals that live partially on the land because there are pictures of a crocodile and a lizard.”*
    e. As students draw conclusions, have them jot them down somewhere so they’ll be prepared to share at the end.
    f. Walk around the room guiding students to draw conclusions. As you listen, record student names who drew the following conclusions about the intertidal biome worldwide.
        i. the intertidal biome has different types of plants
        ii. the intertidal biome is located along different shorelines around the world

iii. the intertidal biome has some animals/plants that live on the shore, shallow water, and deep water
iv. the intertidal biome includes living and nonliving things
v. Some intertidal biomes have hot climates, like the mangrove forests, and some intertidal biomes are more temperate, like the Salish Sea intertidal biome vi. intertidal biomes all are related to ocean water.
vi. the intertidal biome support different food chains, depending where in the world it is located viii. intertidal biomes are important nurseries for young animals to grow

5. Conclusion (10 min): Teacher wraps up the session by including big ideas on a class poster. "The intertidal biome_____".
6. CCD routine:
    a. Word: Intertidal biome. (allow kids to make predictions on their own, but wait to record the sketch).
    b. Final definition: "the environment that is covered with water during high tide and exposed to air during low tide."

Part II (25-30 min)

1. Post Sentence Frame #2 on the whiteboard: **#2 "___is an abiotic/biotic factor because____"*
2. Have kids get out their Cognitive Content Dictionaries (CCDs)
3. Vocabulary (8 min)
    a. TPR: "biotic: living"; "abiotic: non living" (include student created motions)
    b. CCD routine: "abiotic factor" "biotic factor" (Word, prediction, sketch, and final meaning).
        i. biotic factor: a living that influences that environment.
            1. Sketch: types plant life and animal life present
        ii. Abiotic factor: a nonliving thing that influences the environment
            1. Sketch: wave force, water temperature, or amount of sunlight
            2. Explain that these are three abiotic factors of an environment but there are many more.
4. PFC Sort #2 (10 min)
    a. Next, explain that students should sort their cards again, this time by abiotic and biotic factors, justifying their choices using the sentence frame.

5. Share (5-10 min):
    a. Rephrase students observations to highlight examples and nonexamples of abiotic/biotic factors. Begin to bring in trophic level (food chain) language.
    b. Biotic factors in intertidal biomes include a orca as a consumer (eats other organisms), seagrasses as producers (uses energy from the sun to make its own "food"), and plankton as either consumers or producers (zooplankton are plankton consisting of small animals and the immature stages of larger animals. Phytoplankton consisting of microscopic plants.)
    c. Abiotic factors of intertidal zones include the water temperature, amount of sunlight, soil composition, and dominate geographical features like the size and type of rocks.
    d. Review that an the intertidal biome is "the environment that is covered with water during high tide and exposed to air during low tide."
6. Input Poster: 15 min
    a. Have students take a few Eat or Be Eaten Cards or PFC's near them and gather on the carpet in front of the large Intertidal Input Poster. Explain that if students see a connection between the information presented on the poster and their picture, they should quietly hold it up. If the teacher gives them a thumbs up they can grab a piece of tape and add it to the poster.
    b. Teacher outlines the poster in marker as they introduce the various facts about the intertidal zones.

Key Ideas to add to Poster

- the part of the shore between high tide and low tide is called the intertidal ecosystem. Inter means between, and tidal refers to the water coming and going
- This marine ecosystem is found all over the world, and it looks different in each setting
- It is rich in nutrients and oxygen and is home to many plants and animals (organisms)
- The closest intertidal ecosystem to us is down at Drayton Harbor or Birch Bay!
- The intertidal zone is an active place. Many organisms have adapted by anchoring themselves to rocks in this high energy environment with a holdfast or by a type of "glue" it makes.
- At high tide, organisms in the 1. spray zone get wet, but not covered with water.
- Organisms in the 2. high tide zone are wet during high tide, but somehow have

to hold their own when the water leaves. Everything gets dried out.

- Same thing goes for the 3. middle tide zone, but they get access to the water a bit longer than their neighbors above. When the tide is in, it's dinner time, oysters open their shells a bit and filter the water, keeping the food and releasing the rest of the water.
- When the tide goes out, shellfish close their shells to help them stay wet while the tide is out and animals that can move will follow the water (salmonids, sculpins, seals).
- Organisms in the low tide zone get the most access to water and scrumptious food. They still can't wait for the next tide though, since it will bring fresh nutrients for them and their neighbors in zones above.
- Plants that waved in the water now lay flat on sand or rocks (eelgrass).
- Algae take nutrients from the water and plants get nutrients through their roots from soil (or whatever substrate they are growing from). Both algae and plants use photosynthesis to make their own food from sunlight.
- This is sure a tough place to live! Organisms here have to survive changing moisture levels, being underwater during high tide and dry during low tide. They have to be ok with the changing temperatures, according to tides. They have to be able to get oxygen while underwater, and also have a strategy to get oxygen when there's no water! They must survive the wave action pushing and pulling them around.
- Shellfish like oysters have adapted like this: build Oyster Adaptation Table together as a class.

(Put up the Oyster Challenges strips, kids should discuss the adaptation strips with the class as they put them up)

Next Generation Science Standards

Performance Expectations		
5-LS2-1: Develop a model to describe the movement of matter among plants, animals, and decomposers, and the environment 5-ESS2-1: Earth Systems. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact		
Scientific and Engineering Practices	Disciplinary Core Ideas	Cross-cutting Concepts
Developing and using models	LS2.A Interdependent Relationships in	A system can be described in terms of its

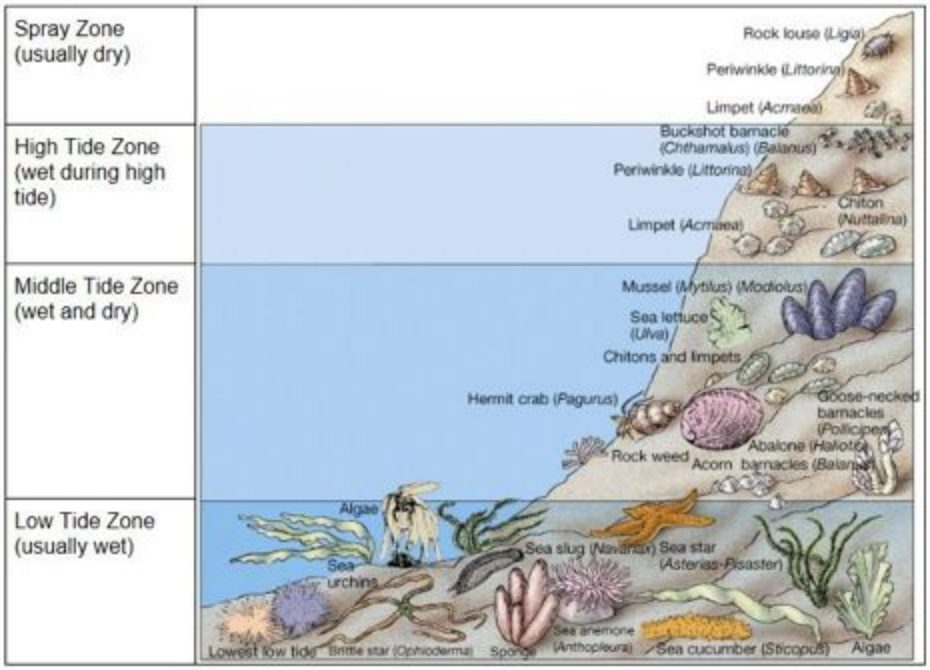
	Ecosystems ESS2.A Earth Materials and Systems	components System and System Models

Other Standards

ESE2: The Natural and Built Environment. Students engage in inquiry and systems thinking and use information gained through learning experiences in, about, and for the environment to understand the structure, components, and processes of natural and human-built environments.

Graphics

[Link to Intertidal Ecosystem Cards]



Challenges	Oyster Adaptations
must survive changing oxygen levels, both when underwater and exposed	ability to pump oxygenated water through gills and close to protect against drying out
must be able to find food both without water and with water. Or, just wait.	”clam up,” close shell tightly to keep in moisture and food. Wait until the next tide

must be able to withstand the changing temperatures	build a dense shell with many layers, like a blanket to stay cold
must be able to withstand the wave action	produces a special glue that holds them to the rock. Dentists/scientists copied this glue.

Vocabulary

- the intertidal biome worldwide - the community of organisms that live between the low and high tide lines
- abiotic factor - non-living chemical or physical factor in the environment
- biotic factor - the living parts of an ecosystem
- Phytoplankton - microscopic marine algae
- Zooplankton - microscopic marine animals and larvae

Extension

- 2 min Extension: Show the first 2 minutes of this video by Neil DeGrasse Tyson. It helps students understand that tides aren't actually moving in and out, the earth is turning into a bulge of water created by the pull of the moon.
- Intertidal Zones Box
    - Students use a shoebox without the lid to create their own intertidal ecosystem. Project requirements:
        - labeled zones
        - at least 3 biotic and 3 abiotic factors placed at their correct intertidal zone. Each factor should be numbered.
        - Sides of Box: Biotic Factors Key and an Abiotic Factors Key (**) = required

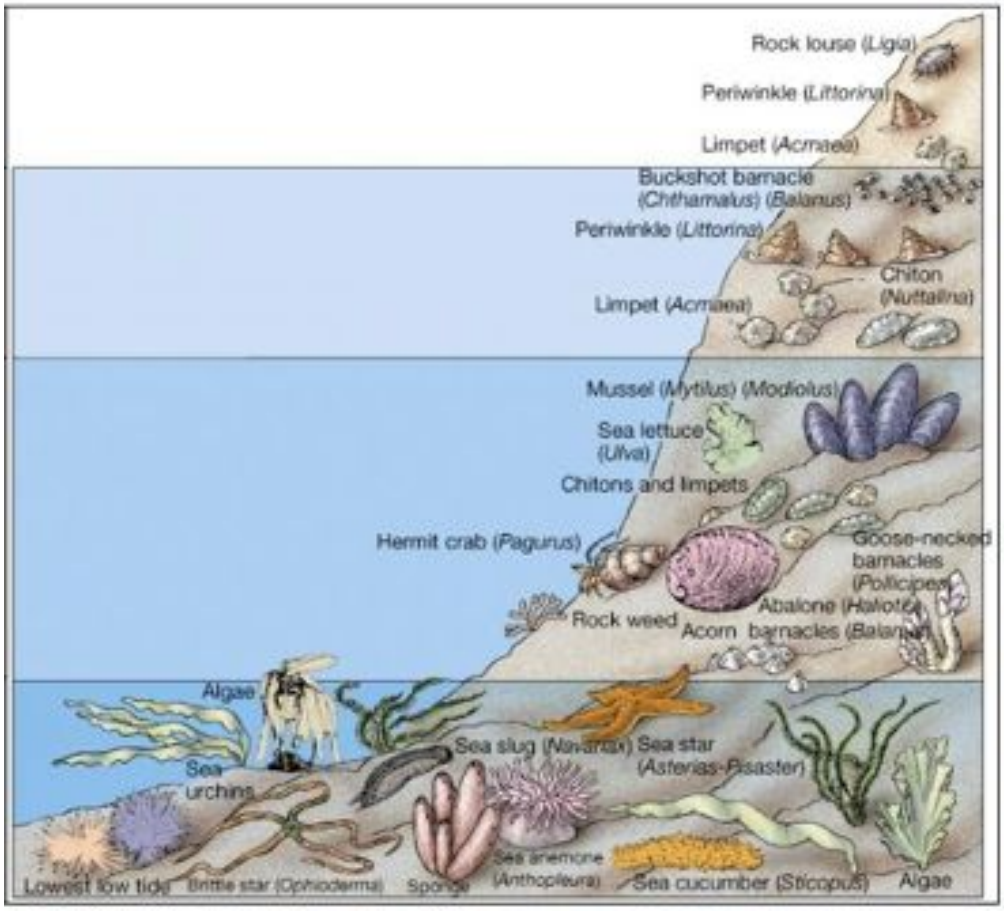
Biotic Factors	
1.	Oysters**
2.	Otter
3.	Eelgrass

Abiotic Factors	
1.	Rocky shore
2.	Tides**
3.	Sun

Worksheet

Exit Ticket:

1. Draw a picture of an intertidal ecosystem. Draw and label 2 biotic and 2 abiotic factors. Please include a caption describing what an intertidal ecosystem is.



2. What are the four zones of an intertidal ecosystem? Where does an oyster live and how does it survive (name a challenge and adaptation the oyster uses)?

_____

_____

_____

_____

_____

_____

Spat, What's That?

Subject
Oyster Life Cycle

Objective
Students will:

- Obtain and combine information about multiple intertidal life cycles and seasonal growth patterns
- Use a model to understand natural and human caused pressures that impact life cycle stages

Materials

- Printed life cycle graphics
- Sized shells
- Hand lens
- Birdseeed
- "Spat Spots" (can be paper, rubber discs, or oyster shells)
- H+ T-shirts or stickers
- Salish Sea Challenge

Size/setting/duration
Entire class/ Outdoor/ 1 hour

Activity	Time
Part 1: Life Cycle Overview	20 minutes
Part 2: Oyster Growth Rings	15 minutes
Part 3: Spat Tag	15 minutes
Part 4: Wrap Up	10 minutes

Background
Student prior knowledge: NGSS 3rd grade standards (Heredity: inheritance and variation of traits)

Teacher Background: Oysters are bivalve molluscs that live in marine or brackish waters and filter

phytoplankton out of the water. Adult oysters can filter up to 50 gallons of water per day. Oysters are capable of spawning within their first year of life. Larger oysters produce more gametes than smaller oysters. Some oysters (Eastern oyster) can change their sex based on environmental pressures and over time can create both sperm and eggs, but since they are only one sex at a given time they can't self- fertilize. Other oysters (Olympia oysters) can produce both eggs and sperm at the same time, making self-fertilization possible. Environmental cues such as temperature and salinity trigger the spawning process (commonly 68 degrees Fahrenheit, depending on the species). Oysters are broadcast-spawners, releasing their eggs and sperm into the water column where they encounter each other in the water, begin the fertilization process, and drift away from the spawning grounds by the current. It is estimated that females produce between 2 and 115 million eggs each year. Once the larvae are approximately two weeks old and in the pediveliger stage (larva with a foot), they begin to settle from the water column to search for a hard substrate to attach to using their foot. Once they have successfully located a suitable location, usually an oyster shell, they begin to attach to the shell by secreting a glue. Once attached, the larvae metamorphose their internal anatomy to become spat and begin putting all of their energy into shell growth by sequestering calcium carbonate from the water column. At one year oysters become a juvenile, capable of reproducing, and at three years they are considered adult. Oysters have been observed to live up to 20 years in captivity. Oysters reefs provide ecosystem services by filter the water column, provide habitat, and reproducing.

Procedure

Part 1: Life Cycle Overview

- Begin this lesson by asking students for examples of life cycles they know about. Most students were taught about frog or butterfly life cycles in 3rd grade.
- Show students examples of shells with barnacles or spat. Ask students for observations. Ask students for ideas of why the barnacles or spat attach to the shells. What might cause difficulty for the organisms during attachment?
- Have students rotate through stations about multiple different life cycles and fill in the worksheet for each one. Stations cover clam, oyster, and barnacle life cycle. Stations should be set up with an image of the life cycle and at least one physical example of that organism. (Graphics provided, physical examples of each can be collected locally)
- As a whole class, have students discuss how these life cycles are the same and how they differ. One key similarity is that all of the life cycles include planktonic larval stages where they float through the water column. One key difference is once both oysters and barnacles settle from the water column they attach to rocks or shells, whereas clams settle to become juvenile clams that bury themselves.

Part 2: Oyster Growth Rings

- As oysters settle down and attach to a solid surface to grow (such as rocks or old shells) they accumulate and create an oyster reef. Oyster reefs create important habitat for forage fish, invertebrates, and other shellfish. They also provide a safe nursery for commercially valuable species. Oyster reefs also provide important barriers to storms and tides, preventing erosion and protecting productive estuary waters.
- Depending on the species, oysters are capable of spawning within their first year of life. Larger oysters produce more gametes than smaller oysters. Similar to trees, shellfish have annual seasons of rapid shell growth. This process creates rings which can be counted to estimate the age of the shellfish, just like growth rings are used to estimate the age of trees.
- Inside the shell of the oyster, the animal is covered in flesh the called the mantle which builds the shell. Shell growth rate depends on water temperature, season, available nutrients, and dissolved minerals. In warm weather, when food is abundant, growth is faster than in cold weather with a less algae to eat. The shell growth is visible as concentric growth lines on the exterior of the shell. The growth lines tend to be narrower in winter and wider in summer indicating season of growth.
- The appearance of the growth lines is different for two halves of the shell. In oysters, where there is normally a flat and a cupped shell, it is easier to determine age based on the flat side since it is smoother, making the lines clearly visible instead of the cupped half which has growth shoots that give it a “frilled” appearance.
- Have each student observe multiple oyster shells and make hypotheses about the ages of the shells. Each group should get one shell that has the age estimate written on it as an example to compare to.
- As a class compare results of the ages of the shells to see who had the oldest shell. (Samples range from seed to 5 years). Were the oldest shells always the largest?

Part 3: Spat Tag

- The goal of this game is to better understand the pressures that an oyster might face during its life cycle each round of the game you will be modelling a different pressure. In this game, part of the class will be acting as oyster spat whose goal is to attach, become spat, and survive to reproduce. The other part of the class will act as some of the pressures that oyster larvae face during their life cycle that make it difficult for oysters to become spat and reproduce.
- Round 1: Predation
    - Students divide approximately into half. Team 1 is oyster larvae. Team 2 is

predators. Arrange students so that the oyster larvae team is in a line on one end, the predator team is in another line in the middle of the field and the 'spat spots" are in a line on the opposite end of the field. Larvae attempt to reach the 'spat spots' before being tagged. If tagged, they must freeze. If they reach a spat spot, they may throw rice to 'reproduce'. Each larva must have his/her own spat spot.

- Round 2: Ocean Acidification
    - Divide students in thirds and give the third group t shirts to signify that they are H+. H+ makes the ocean acidic, which makes it harder for oyster larvae build their shells. Repeat game.
- Round 3: Habitat Loss
    - Repeat the game again, but remove some of the 'Spat Spots". This represents what happens when there is less suitable habitat for larvae to attach and grow into adult oysters.

Part 4: Wrap Up

- Ask students what some of the things they learned about intertidal life cycles today. What were some of the pressures that the different organisms faced? What are some of the pressures that humans can impact?
- Ocean acidification, a chemical imbalance due to air and water pollution, can impact shell formation. By choosing to change our habits, like riding a bike or walking instead of driving we can help reduce the effects of ocean acidification.
- Hand out the Salish Sea Challenge
- This is a list of ideas for ways that you can have a positive impact on the health of your watershed and decrease the amount of CO2 you are releasing. Take these home and make a commitment with your families to be stewards of the Salish Sea and practice watershed healthy habits.

Extension

Have students play the other life cycle games included in the GSSC Games Kit which include:

- Oyster Life Cycle Game: This is a board game meant for four players. Players move through the board game and learn about the struggles oysters face as they grow into adults.
- Clam Life Cycle Game: Students try to assemble the clam life cycle cards in the correct order. This game can be done alone or in groups of up to 4 students. There are two sets included in this kit, so two groups could do this at once and try to see which group can assemble the clam life cycle correctly the fastest.

- Anemone Life Activity: Students learn about the two different ways sea anemones can reproduce through constructing the anemone life cycle stages with play dough. This activity can be done alone or in groups of up to 4-6 students. For more details on the games please see the Games Kit Guide and the 5th Grade Games Worksheets.

Have students organize a way to be advocates for their environment. Ideas include:

- Write letters to legislators.
- Hold a stakeholder forum.
- Reach out to or learn about their local shellfish protection district.

Next Generation Science Standards

Performance Expectations		
5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		
Scientific and Engineering Practices	Disciplinary Core Ideas	Cross-cutting Concepts
Developing and Using Models Obtaining, Evaluating, and Communicating Information	ESS2.A: Earth Materials and Systems ESS3.C: Human Impacts on Earth Systems	Systems and System Models Science Addresses Questions About the Natural and Material World

Worksheet

Life Cycle Worksheet

Oyster Life Cycle What is a baby oyster called when it has just attached to a substrate (rock or shells)?

_____

Clam Life Cycle Does the clam attach to anything?

_____

What does this tell you about where it lives (habitat and substrate)?

_____

Barnacle Life Cycle Is a barnacle a mollusk?

_____

Do barnacles attach? What might be a benefit of attaching?

_____

_____

_____

Summary

What is something that these life cycles had in common?

_____

What is something that was different?

_____

_____

Life Cycle Answer Key

Oyster Life Cycle

What is a baby oyster called when it has just attached to a substrate (rock or shells)?

Spat

Clam Life Cycle

Does the clam attach to anything?

No, it has a foot to dig.

What does this tell you about where it lives (habitat and substrate)?

The substrate is different where clams live compared to oysters. Oysters need hard substrate to attach to, but clams need soft substrate like mud or sand to bury themselves underground for protection.

Barnacle Life Cycle

Is a barnacle a mollusk?

No, since it has appendages it is an arthropod related to a lobsters, crabs, and insects.

Do barnacles attach? What might be a benefit of attaching?

Yes, it helps them survive the strong wave action of the intertidal zone.

Summary

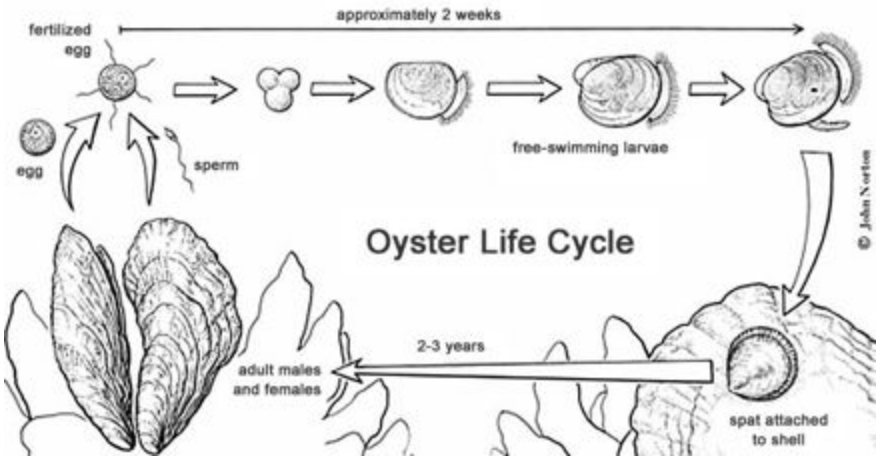
What is something that these life cycles had in common?

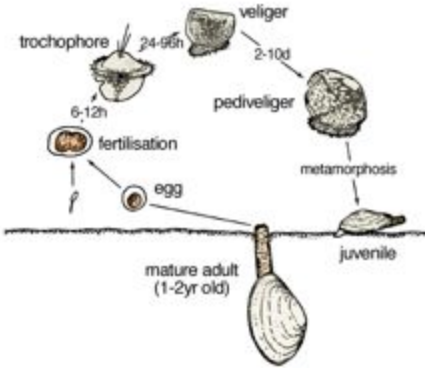
- *All species have a planktonic stage where they float in the water column*
- *All species have a settlement stage*
- *All species metamorphose*

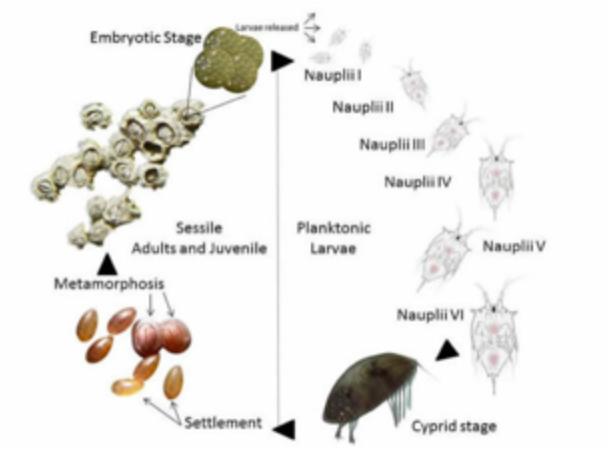
What is something that was different?

- *Clams develop a foot*
- *Barnacles are not mollusks, they are arthropods.*
- *Clams do not attach, but barnacles and oysters do.*

Graphics

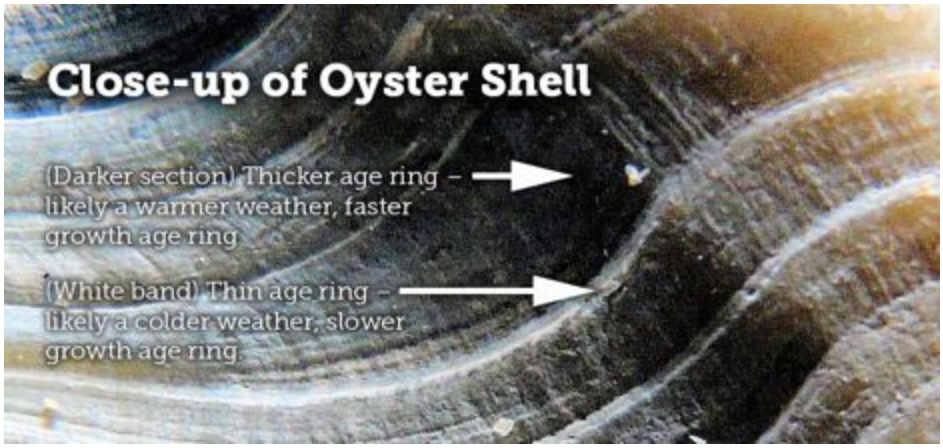


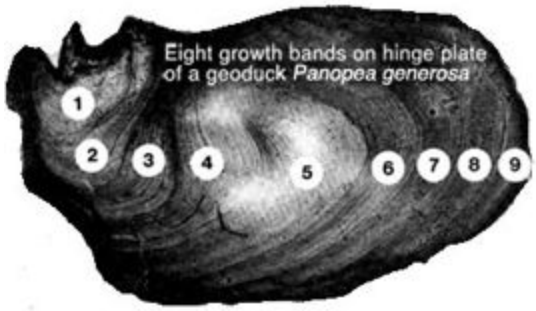




Barnacle Life Cycle

Barnacles are not shellfish, they are arthropods which makes them related to lobsters, crabs, and insects! However, during attachment they compete for the same habitat (lower intertidal rocks and shells) as oysters.





Possible other graphics:

http://www.barnegatshellfish.org/clam_lifecycle_01.htm
http://www.nio.org/userfiles/image/images/naupliarcycle.jpg
https://en.wikipedia.org/wiki/Barnacle

Cain Creek Walk

Subject
Exploring the watershed

Materials/Teacher Preparation
- Prepare students for an outdoor field trip

Size/setting/duration
Full Class/Outdoor/20 minutes

Background
Blaine Elementary school is in the Cain Creek watershed. Students will follow the path of the water from their school, down Cain Creek, and out to Blaine Harbor as a way to observe the factors that influence the health of the ecosystem.

Overview
Students will:
- Observe the path of water in the Cain Creek drainage during the walk to Blaine Harbor

Procedure
- Walk down the ramp to the Mitchell Avenue apron.
- Stop at the new Cain Creek interpretive signs and read aloud about the watershed and its history.
    - Notice the pet waste station.
    - Notice the native plants that have been planted along the bank of Cain Creek.
    - Notice the bioswale that will be planted with natives in the fall.
    - Notice whether you see yard waste along the creek bank.
- Continue to Blaine Harbor keeping count of storm drains along the way.
- Notice where the creek goes beneath the pavement.
- Notice the pet waste stations (there is one behind the library and one along the path as it reaches Peace Portal.
- Ask students to diagram Cain Creek as observed along the walk.
    - Observe pervious and impervious surfaces
    - Storm drains

    - Pollution sources
    - Pet waste stations.
    - Wildlife
    - Other
- Use the garbage bag provided to pick up litter along the walk.

Graphics
Map is in development

Vocabulary
None

Extension
None

Worksheet
None

Blaine Harbor Exploration Rotations

Blaine Harbor Field Exploration

Subject
Species identification

Materials/Teacher Preparation

- Clipboards
- Field notes pages (two copies printed front and back)
- Hand lenses
- Fish net
- Clear plastic cups (or other vessel to hold organisms)
- Life jackets
- Field identification guides (links provided in graphics)

Size/setting/duration
Half of class/Blaine Harbor dock/30
minutes

Background
After classroom lessons about the intertidal zone, students will be excited to get real life experience with some of these critters! The docks at Blaine Harbor are often home to anemones, sea stars, barnacles, mussels, and fish. Before this lesson, prepare students to be dressed for the outdoors.

Overview
Students will:

- Draw a diagram of an organism and identify the species based on physical features
- Relate an organism to other species in the food chain

Procedure

- Each student is given a lifejacket and clipboard with two field study pages (printed front and back) prior to walking onto the dock. Explain that each student must complete at least three of these four pages. Once on the dock, students may gently collect organisms with fishnets and put them in plastic cups for diagramming. Ensure that all students lay on their stomachs when looking in the water to prevent

falling in. Students should look at the species guides to identify their organism.

Next Generation Science Standards

Performance Expectations		
5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.		
Scientific and Engineering Practices	Disciplinary Core Ideas	Cross-cutting Concepts
Obtaining, Evaluating, and Communicating Information	ESS3.C: Human Impacts on Earth Systems LS2.A Interdependent Relationships in Ecosystems LS2.B Cycles of Matter and Energy Transfer in Ecosystems	Scale, proportion, and quantity

Other Standards

Common Core Standard RI.5.7: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
Standard 1: Ecological, Social, and Economic
Systems Standard 2: The Natural and Built
Environment

Graphics

To download free field guides visit: NOAA Intertidal Zones Animals Field Guide or LiMPETS Field Guide

Vocabulary

- Species

Extension

- Students can pick one of the organisms that they identified to do a research project and presentation on. Students can present information on:
    - What does your organism eat?
    - What are two things that eat your organism?
    - What habitat does your organism live in?

Worksheet

Field Notes

Choose an organism that you found and observe it up close, draw and label it too!

Researcher: _____ Time: _____ Date: _____

Location (be specific):

_____

_____

Common Name: _____

Scientific Name: _____

Observations: (size in cm, color, other unique features):

_____

_____

_____

_____

_____

What might this organism eat?

_____

What might eat this organism?

_____

What is one question you have about this organism?

_____

Field Sketch

Tangled in the Food Web

Subject

The interdependence of the Intertidal Food Web

Materials/Teacher Preparation

- Plankton tow and sample
- Dropper
- Microscope with camera and computer
- Slides and slide covers
- Printed and laminated organism cards (included in graphics)
- Ball of yarn or string

Size/setting/duration

Half of class/indoors/30 minutes

Background

The intertidal and marine environment has a complex food chain which creates interdependent relationships. Impacts on one species can have widespread effects on the rest of the ecosystem.

Overview

Students will:

- Use a model to understand the interdependent relationships in the natural world and how energy transfers through the food chain.

Procedure

- Show the class a sample of water from a plankton tow in a clear cup. Ask students what they think might be in it. Show students the plankton tow, explaining how the very fine mesh catches organisms that are often too small to see with our eyes.
- Use the dropper to take a small sample from the plankton tow and prepare a slide for the microscope. Using the microscope with a camera and computer, show students the microscopic organisms within the seawater.
    - Either in the sample or using laminated photographs, show students examples of phytoplankton. Explain that these are some more examples of microscopic organisms that are often found in seawater. Phytoplankton are green because, just like plants, they create their own food from sunlight.

Phytoplankton are also on the bottom of the food chain like plants. Students can use the worksheet to draw phytoplankton.

- Gather the students into a circle and give each student an organism card. Hand the string to the student holding the phytoplankton card and ask them what they might be eaten by and repeat with the next student until the string is connected to all students. Run students through the following scenarios to see the impacts on the food web, shuffle the organism cards, and repeat.
  - Ocean Acidification: Remind students about the life cycle lesson and how ocean acidification makes it hard for oysters to build their shells. This imbalance in water chemistry can affect species survival. Have the student holding the oyster drop their card. All organisms that are connected to the web after the oyster also drop their card.
  - Sea Star Wasting Syndrome: Recently in the Pacific Northwest, many sea stars have gotten sick from infections from microscopic organisms like viruses and died. This is becoming more of a problem as the ecosystem is warming since viruses grow faster in warmer water. Have the student holding the sea star drop their card. All organisms that are connected to the web after the sea star also drop their card.

Next Generation Science Standards

Performance Expectations		
5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.		
Scientific and Engineering Practices	Disciplinary Core Ideas	Cross-cutting Concepts
Developing and Using Models Science models, laws, mechanisms, and theories explain natural phenomena	LS2.A Interdependent Relationships in Ecosystems LS2.B Cycles of Matter and Energy Transfer in Ecosystems	Systems and System Models Science Addresses Questions About the Natural and Material World

Other Standards

Standard 1: Ecological, Social, and Economic Systems
Standard 2: The Natural and Built Environment

Graphics

Eat or Be Eaten Cards

Vocabulary

- Microscopic
- Plankton
- Phytoplankton
- Zooplankton

Extension

- Have students collect a plankton tow
- Have students use microscopes and draw organisms
- Have students do a close reading about ocean acidification effects on oysters or sea star wasting syndrome.

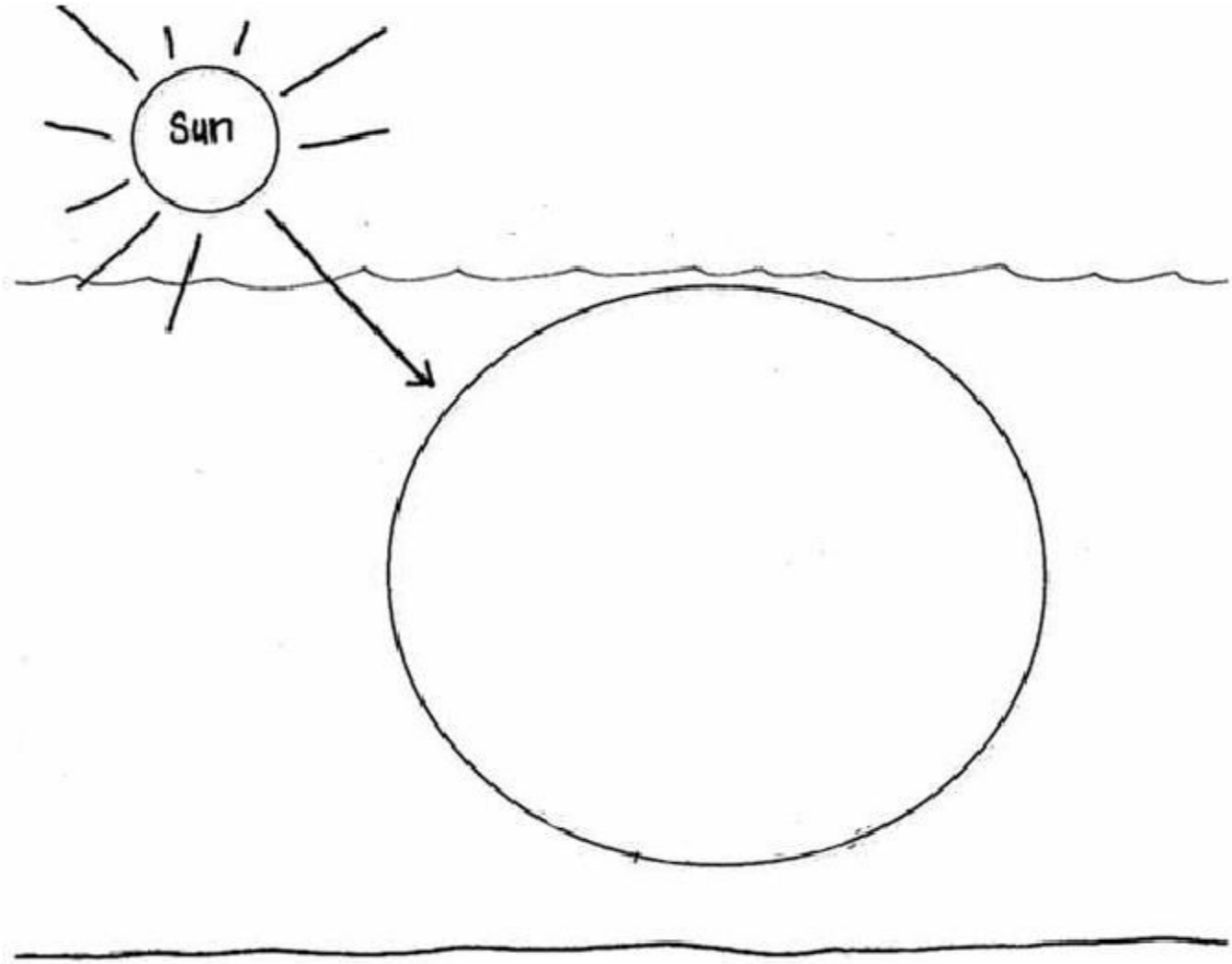
Worksheet

Food Web Foundations

Look through the microscope and at the pictures of microscopic organisms at your station.

What do you see? _____

Make a scientific drawing of your microscopic plankton below.



Microscopic Plankton Enlarged

Connection: What microscopic organisms might an oyster eat? _____

Beach Exploration Rotations

Lesson 11: Microscopy

Subject

Plankton

Objectives

The students will:

- Observe phytoplankton and zooplankton under a microscope
- Learn about the role of phytoplankton in the food chain.

Materials

- Microscope with computer
- Microscopes
- Phytoplankton sample
- Prepared slides

Size/setting/duration

One third of class/Birch Bay State Park BP Heron Center/15 minutes

Background

Phytoplankton are essential to life in the ocean since they act as the base of the food chain. Students get an introduction to these microscopic organisms which are food the shellfish they have learned about.

Procedure

- Show students plankton under the microscope. Plankton are small organisms that drift with the ocean current. Phytoplankton are the base of the food chain. Just like plants on land, phytoplankton are green because they make their own energy from the sun.
- Students can also observe other microscopic organisms
- Students will draw an organism that is under the microscope.

Next Generation Science Standards

Performance Expectations		
5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment		
Scientific and Engineering Practices	**Disciplinary Core Ideas**	**Cross-cutting Concepts**
Developing and using models Science models, laws, mechanisms, and theories explain natural phenomena	LS2.A: Interdependent relationships in ecosystems LS2.B: Cycles of Matter and Energy Transfer in Ecosystems	Systems and System Models

Graphics

None

Worksheet

Microscopy

Look through the microscope and at the pictures of microscopic organisms at your station.

What do you see? _____

Connection: What microscopic organisms might an oyster eat? _____

In the circles below draw the organisms you observe under the microscopes.

Lesson 12: Oyster Anatomy

Subject

Form and Function

Objectives

The students will:

- Learn the function of different shellfish body parts.

Materials

- Live tank
- Dissected clam
- Dissected oyster
- Dissection kit
    - Atlas gloves (2 pr)
    - Shucking knives
    - Scalpel
    - Hammer
    - Labels
    - Paper plates
    - Hand sanitizer
- Hand lenses (3)
- Giant magnifiers (2)
- Dissection flip cards

Size/setting/duration

One third of class/Birch Bay State Park BP Heron Center/15 minutes

Background

Students have already compared and contrasted shells of different clam species. This lesson takes a look at the internal anatomy of live shellfish.

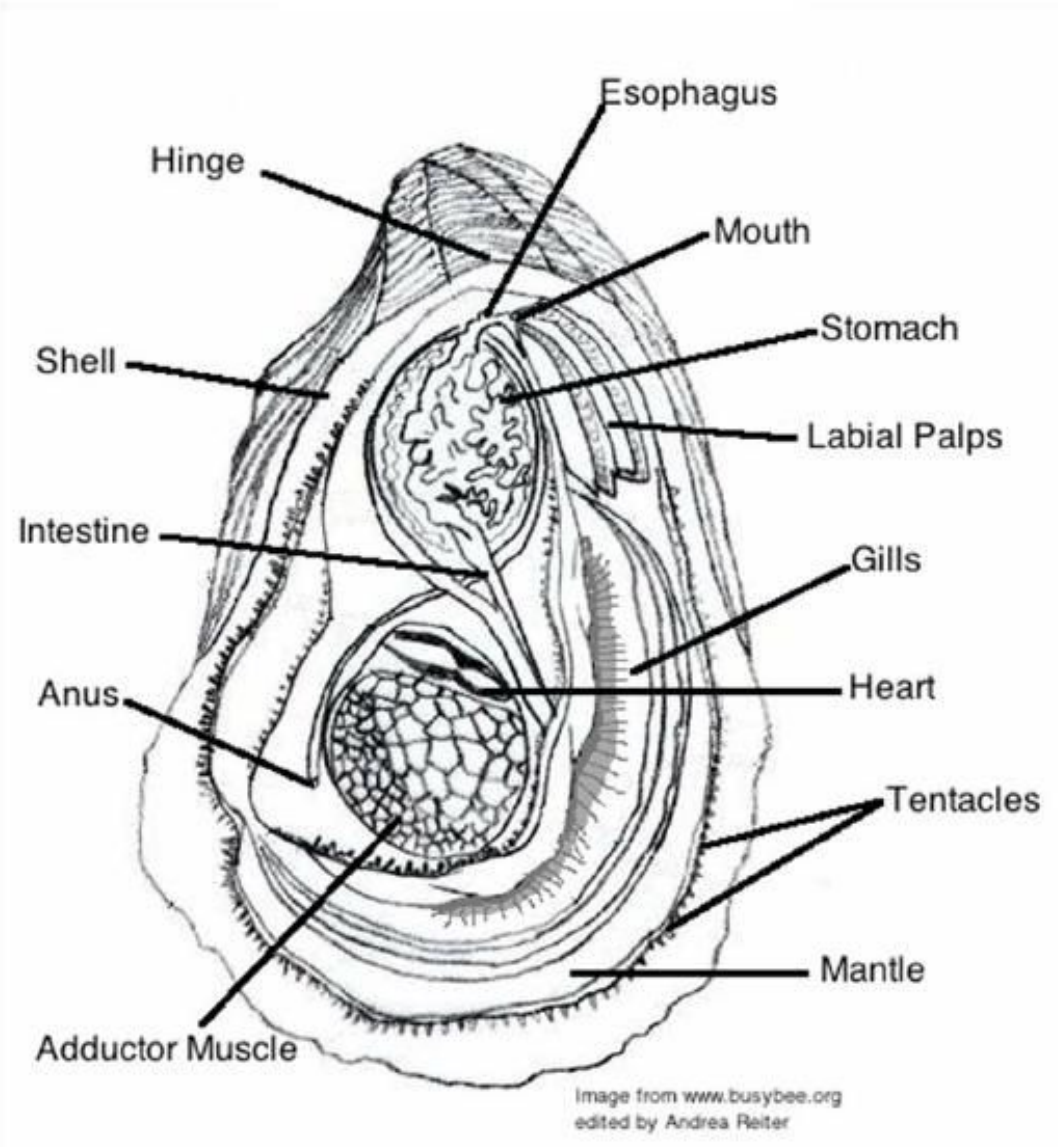
Procedure

- Have students observe the live tank which has both clams and oysters. Unlike the shells that they have seen previously, students can observe the gills of the oysters and siphon of the clams.
- Show students dissected clams and oysters that are labelled. Using the graphic of the labelled oyster students can read the functions of the different body parts. Shellfish are filter-feeders. Show students the gills which enable shellfish to filter the water to eat.
- Ask students to compare the anatomy of the clams and oysters and make observations as they fill in their worksheets.
- Students will do a gut analysis to determine what clams and oysters eat.

Next Generation Science Standards

Performance Expectations		
5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment		
Scientific and Engineering Practices	Disciplinary Core Ideas	Cross-cutting Concepts
Developing and using models Science models, laws, mechanisms, and theories explain natural phenomena	LS2.A: Interdependent relationships in ecosystems LS2.B: Cycles of Matter and Energy Transfer in Ecosystems	Systems and System Models

Graphics & Worksheet



Gills – breathing and filtering. Beating cilia move water across the gills

Mantle – membrane that secretes calcium carbonate, which forms the shell

Tentacles – sensory organ, feels things

Hinge – part of the oyster that allows it to open and close

Adductor Muscle – closes shell

Heart – pumps oxygen and nutrients to other parts of the body

Labial Palps – sorts food (like fingers)

Oyster Exploration

Live Tank

Draw a picture of at least one organism in the live tank.

How do clams and oysters eat? _____

Oyster Dissection

In the box, make a scientific drawing of the oyster.
Find and label at least 3 body parts.

_____ _____ _____

Lesson 13: Marine Foods and Resources

Subject

Marine Foods

Objectives

The students will:

- Learn about the variety of foods that the Salish Sea provides.
- Taste dried seaweed.

Materials

- Marine food packaging
- seaweed samples

Size/setting/duration

One third of class/Birch Bay State Park BP Heron Center/15 minutes

Background

Connecting students to the resources that the Salish Sea provides helps give more context to why this ecosystem is so important. A variety of nutritious foods are grown in the intertidal zone and eaten by people around the world. Thus, foods found in the intertidal zone are important for our economy. In this activity, students will have opportunities to sample dried seaweed, observe a variety of products from the intertidal zone, and build (draw) a meal with food including ingredients from the intertidal zone/ Salish Sea.

Procedure

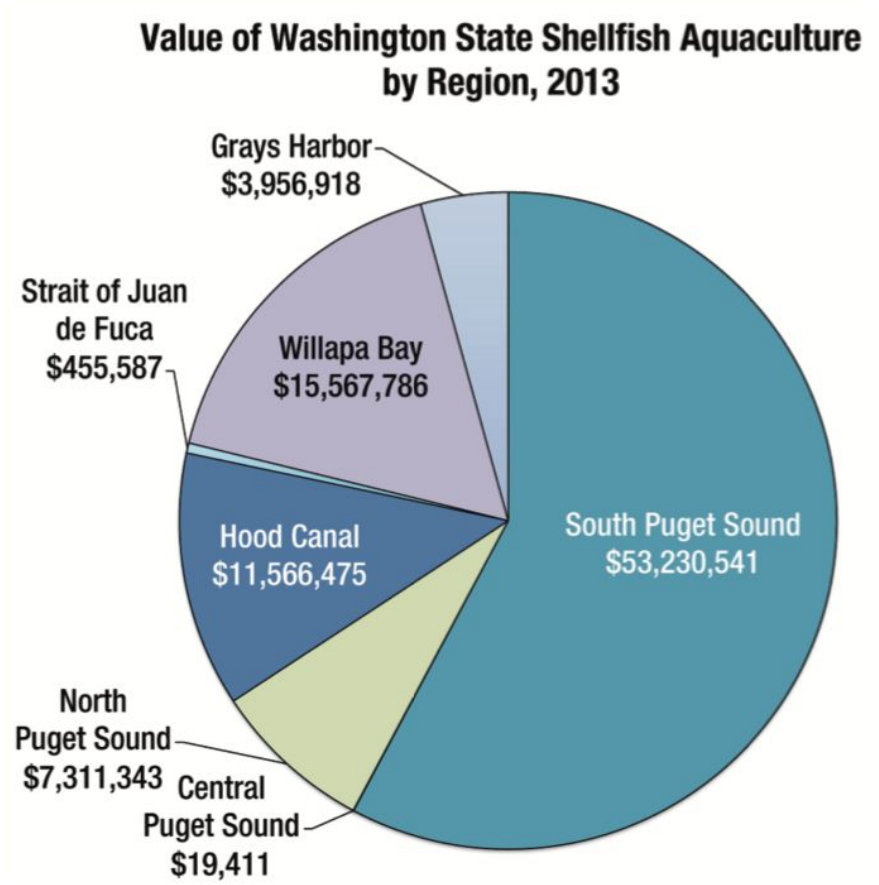
- The oceans are filled with many different delicious foods! Show students examples of foods and ask students if they like them. Ask students if they like ice cream. Ice cream has carrageenan which is derived from red algae to make it thicker. Give students the option to taste dried seaweed.
- The Salish Sea is also very important to our economy. Shellfish aquaculture contributed $184 million to Washington's economy and 2,710 jobs in 2010.
- There are many other uses for shellfish. Shells can be used in paving, jewelry and decoration,as a soil amendment, and as a supplement for chickens.

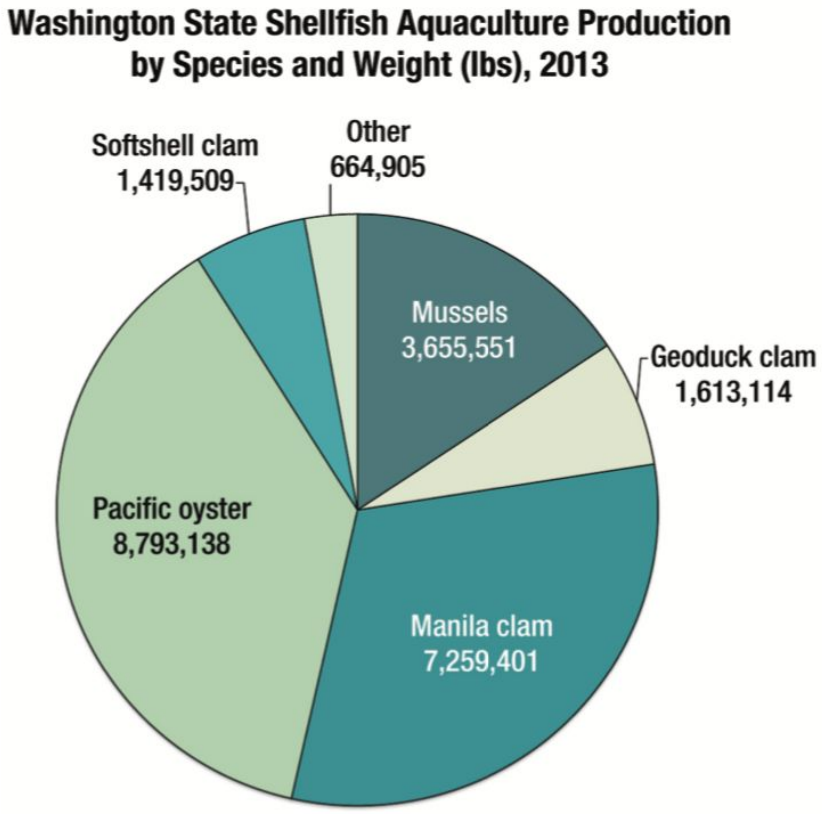
Next Generation Science Standards

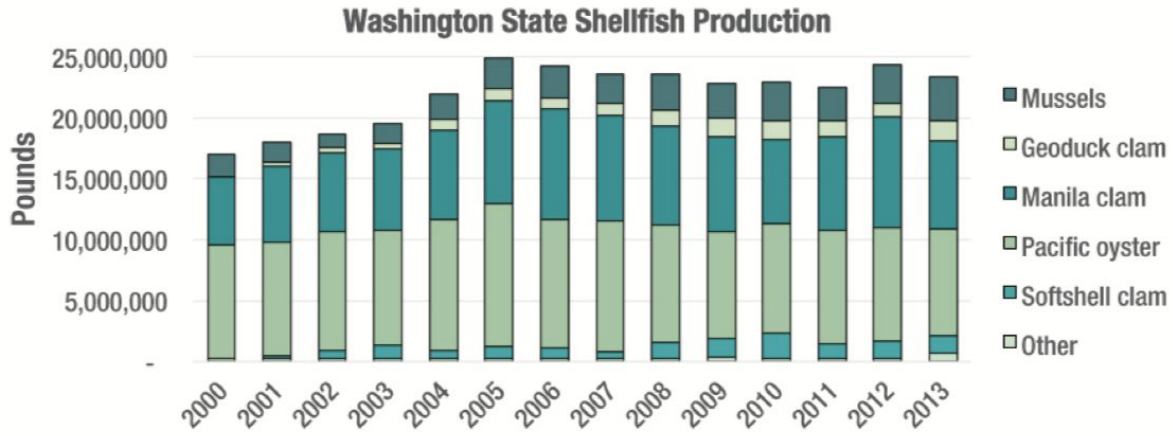
Performance Expectations
5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment

Scientific and Engineering Practices	Disciplinary Core Ideas	Cross-cutting Concepts
Developing and using models Science models, laws, mechanisms, and theories explain natural phenomena	LS2.A: Interdependent relationships in ecosystems LS2.B: Cycles of Matter and Energy Transfer in Ecosystems	Systems and System Models

Graphics







Worksheet

Marine Food and Resources

Your Ocean Menu:

Oysters

Fish

Crab

Ice Cream

Sushi

Sea Vegetables

Caviar

Can you draw and label a meal with at least three shellfish or sea vegetable foods chosen from the menu above?

Lesson 14: Beach Exploration

Subject

Intertidal Zone Field Studies

Objectives

The students will:

- Identify clam species and record population data in a clam survey
- Explore local intertidal zone

Materials

- Marine ID Guides
- Clipboards
- Worksheets

Size/setting/duration

Full Class/Birch Bay State Park Beach/30 minutes

Background

In this activity, students will be conducting a local clam survey. The clam surveys will help determine the health of clam populations. Students will learn how the surveys can also help estimate the health of clam populations over time.

Procedure

- Students will work on the food web worksheet and doing the beachfront scavenger hunt to see what organisms they can find and how they relate to each other in the food web.
- Give students an opportunity for free exploration of their intertidal zone. Each chaperone should have a marine ID guide and the instructor can rove between groups answering questions and helping students identify the organisms they find.

Next Generation Science Standards

Performance Expectations		
5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment		
Scientific and Engineering Practices	**Disciplinary Core Ideas**	**Cross-cutting Concepts**
Developing and using models Science models, laws, mechanisms, and theories explain natural phenomena	LS2.A: Interdependent relationships in ecosystems LS2.B: Cycles of Matter and Energy Transfer in Ecosystems	Systems and System Models

Graphics

To download free field guides visit:
NOAA Intertidal Zones Animals Field Guide
LiMPETS Field Guide

Worksheet

Beachfront Scavenger Hunt

Try to find these five different kinds of clam shells and check them as you find them

- o Native Littleneck Clam
- o Manilla Clam
- o Varnish Clam
- o Butter Clam
- o Cockle Clam

Varnish clam
Nuttallia obscurata

Up to 3", with shiny brown coating on the outside, purple on the inside of shell.

Manila littleneck clam
Venerupis philippinarum

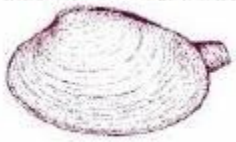
Average size is 1-2", up to 2½". Oblong shell has concentric and radiating lines. May have colored, patterned shells. Siphon tips are split. Found to 4" below surface.

Cockle clam
Clinocardium nuttalli

Prominent, evenly-spaced ridges which fan out from the hinge. Mottled, light brown. Can grow to 5". Found just below surface.

Native littleneck clam
Leukoma staminea

Average size is 1-2", up to 2½". Rounded shell has concentric and radiating lines. Siphon tips are fused. Found 6-10" below surface.



Butter clam
Saxidomus giganteus

Average size is 3-4", up to 6". Shells have no radiating ridges and are usually chalky-white. The siphon can be pulled into its shell. Usually found 12-18" below surface.

Did you find any other animals? If so, list them below.

_____

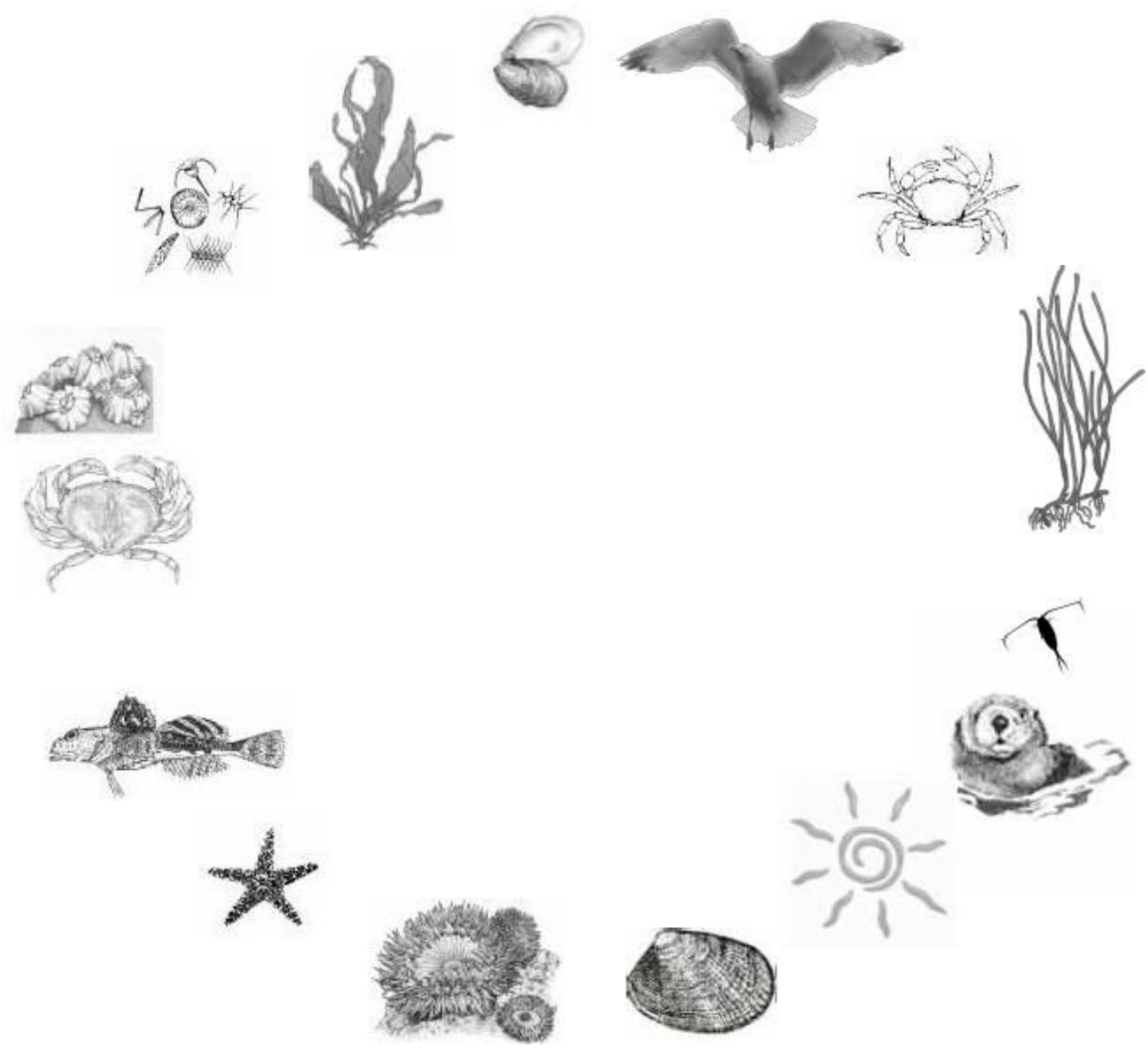
_____

_____

_____

Low Tide Food Web Hunt

Search along the intertidal zone to find the animals and plants below; once you have found one, draw a solid line to connect them to what they eat or what eats them to create a food web of the nearshore ecosystem. If you didn't find a plant or animal on this worksheet draw a dotted line to connect them into the food web. Find something not on the food web? Draw it in and connect it to other plants and animals with a solid line.



Lesson 15: Clam Survey

Subject

Intertidal Zone Field Studies

Objectives

The students will:

- Identify clam species and record population data in a clam survey
- Explore local intertidal zone

Materials

- Shovels
- Gloves
- Clam ID cards
- Clam rings
- Clipboards
- 1 Clam ID kit

Size/setting/duration

Full Class/Birch Bay State Park Beach/50 minutes

Background

In this activity, students will be conducting a local clam survey. The clam surveys will help determine the health of clam populations. Students will learn how the surveys can also help estimate the health of clam populations over time.

Procedure

- Clam ID Review (10 minutes)
    - Show students an example of the different types of shells in the kit and the distinguishing features of each.
- Preparation for survey (10 minutes)
    - Get each student a glove and each group an ID card and clam ring.
- Clam survey (30 minutes)

- Students should be in groups of 4-5 at each hole. Have holes pre-dug so that students are able to pull out the clams, identify them, and count how many of each species are in each hole.
- These surveys are used to determine the health of clam populations over time by comparing the amount and variety of clams found in the clam surveys.

- Review
  - Prompt students:
    - What do clams eat and need to be healthy?
    - What might eat clams?
    - What can we do to keep our clams healthy?

Next Generation Science Standards

Performance Expectations		
5-ESS3-1: Obtain and combine information about ways individual communities use science to protect the Earth's resources and environment.		
Scientific and Engineering Practices	**Disciplinary Core Ideas**	**Cross-cutting Concepts**
Obtaining, evaluating, and communicating information	ESS3.C: Human impacts on earth systems	Systems and System Models Science addresses questions about the natural and material world

Graphics

None

Worksheet

Birch Bay State Park Clam Survey Data

Date:

Researchers:

Clams are considered "large" if they are bigger than 1.5 inches and do not fit through the clam ring.

Type of clam	Hole #	Hole #	Hole #	Hole #
Large purple varnish				
Small purple varnish				
Large native littleneck				
Small native littleneck				
Large manila littleneck				
Small manila littleneck				
Large butter				
Small butter				
Large cockle				
Small cockle				
Large eastern softshell				
Small eastern softshell				
Large macoma				
Small macoma				
Other:				
Other:				

Unit Reflection

Subject
Assessment

Materials/Teacher Preparation
- Posters from Lesson 1
- Students all need dark color markers.
- One printed recording sheet to submit to GSSC staff
- Optional: Print Salish Sea Stewards Certificates

Size/setting/duration
Entire Class/Inside/30 minutes

Background
Collection of challenge/bingo data is extremely important for GSSC to show that education can make a difference to the health of the watershed.

Overview
Students will:
- Reflect on what they learned during this unit and what actions they took to improve their environment

Procedure
- Post-assessment
    - Have students do a "Poster Discussion." (15-20 minutes) Students walk around the room each with a marker, answering the prompts on the various posters in writing. Make sure students read other students' answers and respond to their ideas in writing. Model this behavior. Poster titles include:
        - What waters are included in the Salish Sea? (map included)
        - What are some plants/animals that live in the Salish Sea? (kitchen tray near poster with a bunch of shells/kelps);
        - What do YOU or your family love about the ocean?
        - Areas for shellfish harvest. What do you notice? What do you wonder?
        - What does a "Salish Sea Steward" do/think/say?
        - Why do you think the Salish Sea is important?

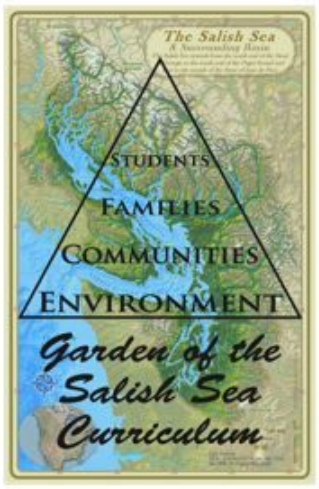
        - Olympia Oyster population map. What do you notice? What do you wonder?
    - Discuss with students how their answers differed between the first lesson and now.
- Collect challenge/bingo data
    - In order to assess the impacts that your class had on the environment through the Salish Sea Challenge we ask that you survey the class and record the answers to be shared with GSSC staff. We recommend that you survey your class by asking them to raise their hands and recording the number for each of the questions below.
        - Raise your hand if you rode your bike or walked instead of taking a car
        - Raise your hand if you picked up your pet's waste
        - Raise your hand if you recycled, reduced, or reused
        - Raise your hand if conserved energy by turning off power or other ways
        - Raise your hand if you purchased less plastic or packaged goods

Graphics
None

Vocabulary
None

Extension
- Teachers can give out Salish Sea Stewards Certificates to students who got bingo.

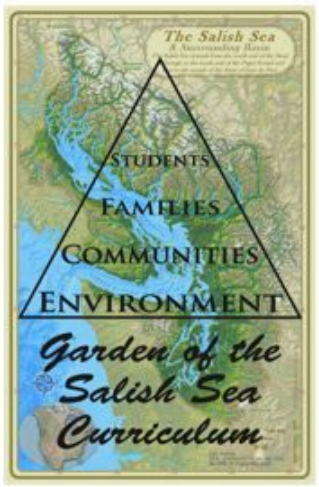
Worksheet



Name_____ is a

Salish Sea Steward

Pacific Shellfish Institute



Name_____ is a

Salish Sea Steward

Pacific Shellfish Institute

Pacific Shellfish Institute