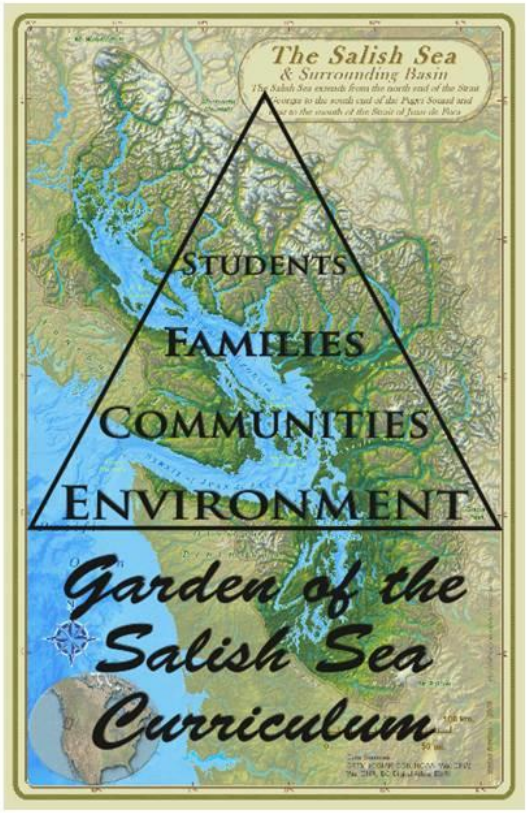
DRAFT
Garden of the Salish Sea Curriculum
Teacher's Guide



Garden of the Salish Sea Curriculum

Pacific Shellfish Institute

Table of Contents

Introduction

Garden of the Salish Sea Curriculum (GSSC) is an integrated action based K-12 environmental science and stewardship initiative that provides meaningful context to teach ocean acidification literacy. GSSC uses shellfish as a vehicle to teach stewardship, centered upon hands-on learning through field experience focused on near shore intertidal ecosystems. Through education and outreach, GSSC empowers students, families and communities to practice watershed healthy habits in stewardship of healthy oceans globally and a thriving Salish Sea ecosystem that is a source of healthful foods using a Salish Sea Stewards Challenge.

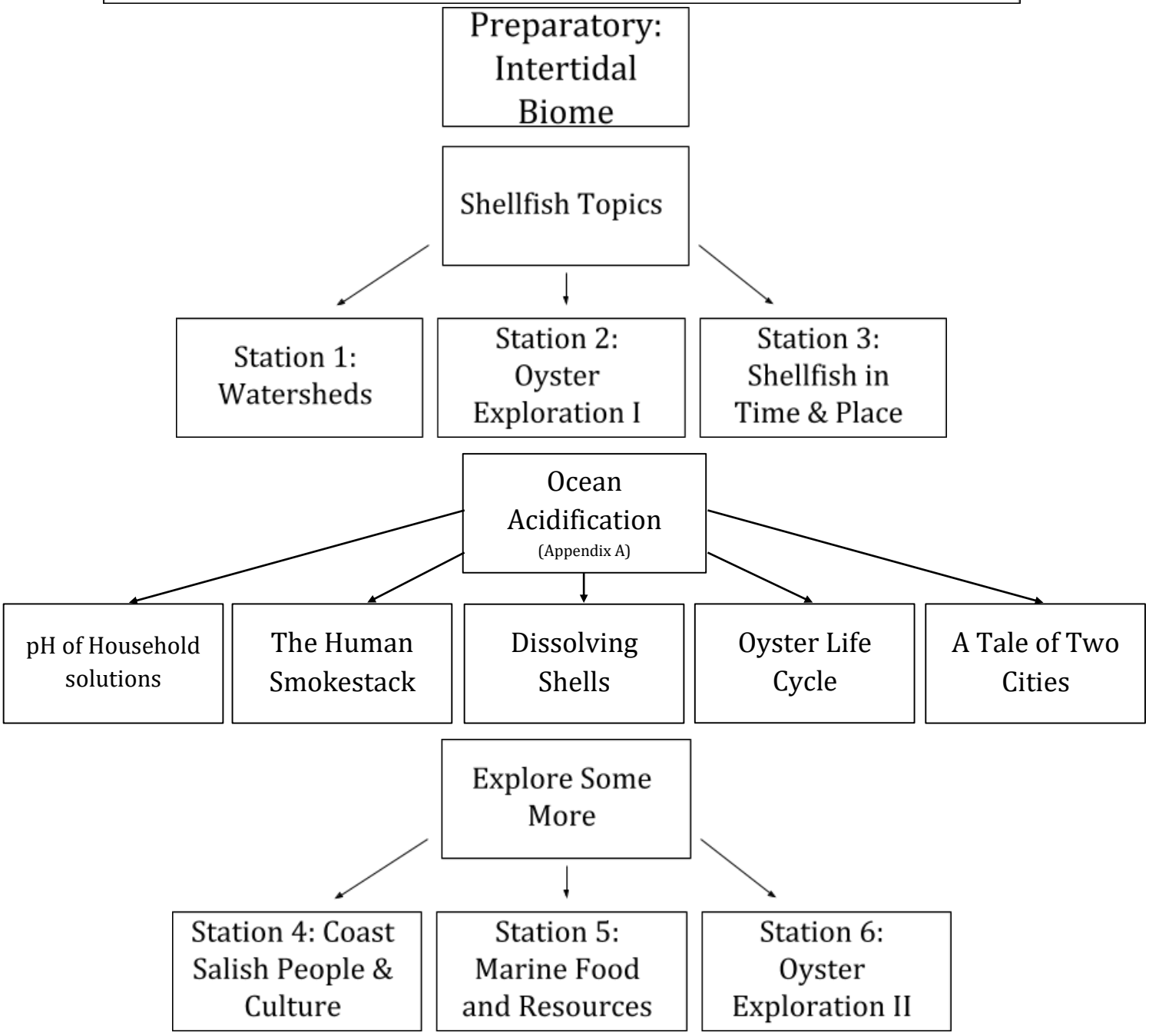
Web-based lessons (gardensalishsea.org) are supported by classroom presentations, hands-on laboratories, local intertidal field experiences and scientific learning activities that culminate in student commitments to practicing watershed healthy habits. All web-based materials are posted for download and viewing. Links to resources (including NOAA) are combined with classroom and field lessons tailored to participating classrooms. Our web-pages compile links to existing resources combined with lessons tailored to participating classrooms. The classroom laboratory inquiry lessons focus on ocean acidification. Each program is place based and geared towards the local watershed and near-shore environment. Not included in this document are the curriculum guides for the ocean acidification lessons, this is located on the website as a separate document.

Ideally, the unit is delivered as a continuum of learning over a period of weeks. Ultimately teachers would deliver the unit using GSSC resources with the support of guest speakers and field coordination.

Marine Marathon Sequence:

- Week 1: Introductory presentation and hands-on lab stations, introduce, Salish Sea Challenge
- Week 2: Classroom laboratory inquiry, pH & ocean acidification
- Week 3: Field Inquiry, visit to a local near shore marine environment, data collection & connect with community. Examples of Field Inquiry Experiences:
    - Local tidelands beach exploration.
    - Visit to tribal or local aquaculture, shellfish hatchery and tideland where field observations and identifications enhance understanding and appreciation of the intertidal zone.
    - Visit local shellfish gardens.
    - Conduct intertidal clam survey in partnership local with Marine Resource Committee volunteers.
- Week 4: Wrap up, Salish Sea Challenge reflection
    - Use resources on the website that preface laboratories and field inquiry as directed in our website.
    - Throughout the unit teachers integrate shellfish studies using resources on website; select at least 3 tie – in lessons.

Salish Sea Stewards Challenge: **ONGOING**



Overview Table of Activity Standards

Activity	Common Core Standards	Next Generation Science Standards	Integrated Environmental and Sustainability
1 - Salish Sea Stewards Challenge	CCSS.ELA-LITERACY.W.5.2: Write informative/explanatory texts to examine a topic and convey ideas and information clearly.	5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment	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.
2 - Intertidal Biome	CCSS.ELA-LITERACY.SL.5.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.	5-ESS2-2: Describe and graph the amounts of saltwater and freshwater in various reservoirs to provide evidence about the distribution of water on Earth	Standard 2: 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.
3 - Shellfish Topics	CCSS.ELA-LITERACY.RI.5.1 - Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. CCSS.ELA-LITERACY.W.5.2.B - Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic. CCSS.ELA-LITERACY.SL.5.1 - Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.	5-ESS3-1- Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	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.

Activity	Common Core Standards	Next Generation Science Standards	Integrated Environmental and Sustainability
3.2 - Watersheds	CCSS.ELA-LITERACY.W.5.2: Write informative/explanatory texts to examine a topic and convey ideas and information clearly. CCSS.ELA-LITERACY.SL.5.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 5 topics and texts*, building on others' ideas and expressing their own clearly.	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.	Standard 1: Ecological, Social, and Economic Systems - 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.
3.3 – Oyster Exploration	CCSS.MATH.CONTENT.5.OA.A. Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols. CCSS.ELA-LITERACY.W.5.2.D Use precise language and domain-specific vocabulary to inform about or explain the topic.	5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	Standard 1: Ecological, Social, and Economic Systems 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.
3.4 – Shellfish in Time & Place	CCSS.ELA-LITERACY.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.	5-PS1-3. Make observations and measurements to identify materials based on their properties	Standard 2: 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.

Activity	Common Core Standards	Next Generation Science Standards	Integrated Environmental and Sustainability
3.5 – Shellfish & Coast Salish Culture	CCSS.ELA-LITERACY.RI.5.3: Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.		
3.6 – Marine Food and Resources	CCSS.ELA-LITERACY.SL.5.1.D - Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.		Standard 1: Ecological, Social, and Economic Systems
3.7 – Oyster Dissection	CCSS.ELA-LITERACY.SL.5.1.D - Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.	5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.	Standard 1: Ecological, Social, and Economic Systems
3.8 – Food Web Foundations	CCSS.ELA-LITERACY.SL.5.1.D - Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.	5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.	Standard 1: Ecological, Social, and Economic Systems
4 – Ocean Acidification			
4.1 - pH of Household Solutions	CCSS.ELA-LITERACY.SL.5.1.D - Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.	5-PS1-3. Make observations and measurements to identify materials based on their properties.	Standard 2: 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.
4.2 – The Human Smokestack	CCSS.ELA-LITERACY.SL.5.1.D - Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.	5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.	Standard 2: 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.

Activity	Common Core Standards	Next Generation Science Standards	Integrated Environmental and Sustainability
4.3 – Dissolving Shells	CCSS.ELA-LITERACY.W.5.2.D Use precise language and domain-specific vocabulary to inform about or explain the topic.	5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.	Standard 2: 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.
4.4 – Oyster Life Cycle	CCSS.ELA-LITERACY.SL.5.1.D - Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.	5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.	Standard 1: Ecological, Social, and Economic Systems. 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.
4.5 – A Tale of Two Cities	CCSS.ELA-LITERACY.W.5.2.D Use precise language and domain-specific vocabulary to inform about or explain the topic.	5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment	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.
5 – Field Activities			
5.1 – Preparation for Field Inquiry	CCSS.MATH.CONTENT.5.MD.B.2		
5.2 – Low Tide Food Web Hunt		5-LS2-1 Ecosystems: Interactions, Energy, and Dynamics	
5.3 – Who Lives in the Square?		5-ESS2-2 Earth's Systems	

Activity	Common Core Standards	Next Generation Science Standards	Integrated Environmental and Sustainability
5.4 – Field Notes	CCSS.ELA-LITERACY.W.5.8 - Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.		
5.5 – Beach Scavenger Hunt			Standard 2: The Natural and Built Environment
5.6 – Water Quality	CCSS.ELA-LITERACY.W.5.7 - Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.		
5.7 – Macro-invertebrates	CCSS.ELA-LITERACY.W.5.8 - Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.		
5.8 – Clam Survey	CCSS.ELA-LITERACY.W.5.8 - Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.		
Salish Sea Stewards Reflection	CCSS.ELA-LITERACY.W.5.7 - Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.		
6 – Games			Standard 1: Ecological, Social, and Economic Systems

1 – Salish Sea Stewards Challenge

Section 1: For the teacher

This will be the introduction to the entire curriculum. The Garden of the Salish Sea Curriculum (GSSC) begins with the Salish Sea Stewards Challenge. This challenge will take place during the entirety of the curriculum. The challenge will be revisited at the end of the curriculum.

To encourage participation in the Salish Sea Stewards Challenge, the class could do the challenge together while in school. Teachers should ask students about their Challenge on a regular basis during the unit (at the beginning and end of each week.) This will help them practice being stewards during and outside of school.

- Guiding Question: What actions can we take with our families and communities to help protect the environment?
- Key Concept: We can take responsibility for a healthy environment with actions and habits that can have positive impacts on the local scale.
- Useful links:
    - Salish Sea Watersheds Challenge paper - Can be found online at: https://static1.squarespace.com/static/540cdc7ce4b0dacce66959fe/t/58d018be29687f982c540a16/1490032832066/SalishSeaChallenge2017b.pdf; Map of Salish Sea (can be found at the end of this lesson);
    - Videos:
        - What is Carbon Footprint? https://www.youtube.com/watch?v=YseZXKfT_yY
        - Water Pollution by Smart Learning for All https://www.youtube.com/watch?v=93BqLewm3bA
        - PBS Kids Eekoworld
            - https://www.youtube.com/watch?v=93BqLewm3bA
    - PowerPoint slides - All About Shellfish 26-34

Section 2: For the students

You will be learning about many different topics that are related to the Salish Sea. Take a look at the map of the Salish Sea that is on the cover page of your GSSC Notebook. What do you know about the Salish Sea? Do you know about any environmental problems that are affecting the Salish Sea?

The Salish Sea is facing two serious problems - water pollution and ocean acidification (a result of air pollution from carbon dioxide emissions). Read about carbon dioxide emissions on this website (https://climatekids.nasa.gov/menu/carbons-travels/). Then, check out the Carbon Gallery (https://climatekids.nasa.gov/carbon-gallery/). What did you learn? What are carbon emissions?

Don't worry, you can do something about it! You and your peers will learn how to be environmental stewards, which are people who take care of the environment and practice sustainable ways to help protect their environment for future generations.

How will you be an environmental steward and help protect the Salish Sea? You will be completing the Salish Sea Stewards Challenge! You will be taking this home and working on this with your families and communities. This challenge is an ongoing challenge and will last until at least to the end of the curriculum to help you and your families develop sustainable habits.

Discussion questions:

- What do you know about the Salish Sea?
- Do you know about any environmental problems that are affecting the Salish Sea?
- What does it mean to be a steward? What will you do as stewards?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Salish Sea Stewards Challenge</td></tr>
<tr><td>ESSENTIAL QUESTION</td><td colspan="3">What actions can we take with our families and communities to help protect water bodies and the marine environment?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="4">We can take responsibility for a healthy environment with actions and habits that can have positive impacts on the local scale.</td><td>Water is interconnected around the world.

Water connects living organisms and ecosystems around the world</td><td rowspan="4">Students will identify and act on the different actions to help protect the environment. These actions can be done individually, with family, or with their communities.

Students will develop a practice of environmental stewardship and sustainability.. They will choose and take actions in daily life to help protect the environment.

Students are encouraged to engage their families and communities in this practice.</td><td>Steward
Conservation</td></tr>
<tr><td>STANDARDS</td><td>ASSESSMENTS</td></tr>
<tr><td><u>COMMON CORE STATE STANDARDS</u>
-CCSS.ELA-LITERACY.W.5.2

<u>NEXT GENERATION SCIENCE STANDARDS</u>
- 5-ESS3-1:

<u>INTEGRATED ENVIRONMENTAL AND SUSTAINABILITY</u>
- Standard 3</td><td>Exit Ticket/Discussion
- What does it mean to be a steward? What will they do as stewards?
- What is the Salish Sea?
- What is at least one problem the Salish Sea is facing?

Exit ticket - completed Salish Sea Challenge discussion</td></tr>
</table>

Lesson: Salish Sea Stewards Challenge

Guiding Question: What actions can we take with our families and communities to help protect water bodies and the marine environment?

Key Concepts

- We can take responsibility for a healthy environment with actions and habits that can have positive impacts on the local scale.

Standards

Common Core State Standards	CCSS.ELA-LITERACY.W.5.2: Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
Next Generation Science Standards	5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment
Integrated Environmental and Sustainability	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.

Setting: Inside and/or outside

Time: 30 minutes

- However, the Salish Sea Stewards Challenge will continue to the end of the unit with the goal of extending these practices as ongoing habits.

Materials

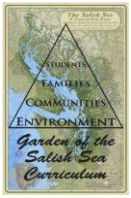
- Salish Sea Watersheds Challenge paper (one per student)
    - Can be found online at: https://static1.squarespace.com/static/540cdc7ce4b0dacce66959fe/t/58d018be29687f982c540a16/1490032832066/SalishSeaChallenge2017b.pdf
- Computer
- Screen, whiteboard, or something to project video onto
- Map of Salish Sea (can be found at the end of this lesson)
- What is Carbon Footprint? https://www.youtube.com/watch?v=YseZXKfT_yY
- Water Pollution by Smart Learning for All https://www.youtube.com/watch?v=93BqLewm3bA
- EekoWorld PBSKids https://www.youtube.com/watch?v=93BqLewm3bA

Vocabulary

- Steward - a caretaker or person who practices sustainable ways to help protect our environment for future generations
- Conservation - protection of things found in nature

Procedure

- Warm Up



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- The students will be working on the Garden of the Salish Sea Curriculum for the next month. They will be learning about many different topics that are related to the Salish Sea.
- Show your students the map of the Salish Sea (this is also on their cover page of their science notebook).
    - What do they know about the Salish Sea? Do they know where their school is located on the map? Do they know about any environmental problems that are affecting the Salish Sea?

- Activity
    - The Salish Sea is facing a serious problem - water pollution. Watch Water Pollution by Smart Learning for All to understand the meaning of water pollution. The link is here: https://www.youtube.com/watch?v=93BqLewm3bA
        - Discuss new things the students learned from the video. What could they do to help decrease the water pollution?
    - Another problem the Salish Sea is facing is carbon dioxide emissions.
        - .This website is a great way to introduce carbon dioxide emissions. https://climatekids.nasa.gov/menu/carbons-travels/. There are a couple listed below, but please use what you think will best attend to your students' needs.
            - 10 Things About Air: https://climatekids.nasa.gov/10-things-air/
            - Carbon Gallery: https://climatekids.nasa.gov/carbon-gallery/
            - What did they learn? What are carbon dioxide emissions?
        - Extra: This video introduces carbon footprint. https://www.youtube.com/watch?v=YseZXKfT_yY
            - What did they learn? What is carbon footprint?
    - They will be environmental stewards! What is a steward? How will they be stewards?
        - Steward - a person who takes care of the environment and practices sustainable ways to help protect our environment for future generations
    - Introduce the Salish Sea Stewards Challenge. They will be taking this home and working on this with their families and communities. Please emphasize that this challenge is an ongoing challenge and will last until at least to the end of the curriculum designed to help students and families develop sustainable habits.
        - Please encourage them to continue being stewards when the challenge is over!
    - As a class, you could continue this challenge for the rest of the school year!

Assessment

- Exit Ticket/Discussion
    - What does it mean to be a steward? What will they do as stewards?
    - What is the Salish Sea?
    - What is at least one problem the Salish Sea is facing?
- At the end of the unit, each student will write a paragraph describing their challenge action(s) and why it is important. Optionally students can draw a picture of themselves doing a Challenge action. Teachers will ask for student volunteers to share their Challenge with the class and discuss each individual's Salish Sea Challenge results. What did they learn? Why is practicing watershed healthy habits important for the ecosystem and for people? How can our choices impact the environment? What is at least one take-away they have from this activity?

2 - Intertidal Biome

Section 1: For the Teacher

This lesson will be talking about the intertidal biome. Biomes are distinct biological communities that have formed in response to a shared physical climate. An intertidal zone is the area between tide marks - the area that's above water at low tide and under water at high tide. There are different types of intertidal zones - coral reefs, eelgrass, sandy beaches, rocky shores, kelp forests, and salt marshes.

Section 2: For the Student

In each intertidal zone there are different organisms and food chains, such as the shellfish food chain. At the bottom of the shellfish food chain is phytoplankton, then zooplankton, then shellfish, which are then eaten by humans.

Within each intertidal zone, there are different zones or depths and each have their own unique set of organisms. The zones are from highest to lowest: the spray zone (the highest high tide), the high tide zone (lowest high tide), middle tide zone (highest low tide), and low tide zone (lowest low tide).

There are different types of intertidal ecosystems around the world from rocky shores to sandy beaches, coral reefs and kelp forests. Intertidal ecosystems are important nurseries for diverse organisms.

Questions

- What is the intertidal zone or ecosystem?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Preparatory: Intertidal Biome</td></tr>
<tr><td>ESSENTIAL QUESTION</td><td colspan="3">What is a biome, what is the intertidal zone or ecosystem?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="4">The Earth has a number of different biomes, formations of plants and animals with common characteristics due to similar climates that can be found over a range of continents. Any biome can comprise a variety of habitats.

All living things live in a certain biome</td><td>There are different types of intertidal habitats

The intertidal biome is a diverse ecosystem found along all coastlines around the world.</td><td rowspan="4">Students will develop knowledge of the intertidal ecosystem and the different zones within the ecosystem.

Students will identify different intertidal zones and organisms that characterize this habitat.</td><td rowspan="2">Intertidal biome
Intertidal zone
Diversity
Keystone species
Watershed
Phytoplankton
Zooplankton
Adaptation
Organism
Substrate
Spray zone
High tide zone
Middle tide zone
Low tide zone</td></tr>
<tr><td>STANDARDS</td></tr>
<tr><td><u>COMMON CORE STATE STANDARDS</u>
-CCSS.ELA-LITERACY.SL.5.1

<u>NEXT GENERATION SCIENCE STANDARDS</u>
- 5-ESS2-2

<u>INTEGRATED ENVIRONMENTAL AND SUSTAINABILITY</u>
- Standard 2</td><td>ASSESSMENTS</td></tr>
<tr><td>Formal
- “My Intertidal Ecosystem” on page 8
- In groups, each group will have to make their own intertidal zones in a creative way</td></tr>
</table>

Lesson: Intertidal Biome

Guiding Question: What is the intertidal zone or ecosystem?

Key Concepts

- The Earth has a number of different biomes.
- All living things live in a certain biome.

Standards

Common Core State Standards	CCSS.ELA-LITERACY.SL.5.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.
Next Generation Science Standards	5-ESS2-2: Describe and graph the amounts of saltwater and freshwater in various reservoirs to provide evidence about the distribution of water on Earth
Integrated Environmental and Sustainability	Standard 2: 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.

Setting: Inside

Time: 45 minutes

Materials

- Computer
- Whiteboard
- GSSC Science Notebook Chapter 1

Vocabulary

- Intertidal Zone – the area above water at low tide and under water at high tide.
- Diversity - the number and variety of species found within an ecosystem.
- Keystone species – an important species in an ecosystem which many other species depend on, if removed the ecosystem would drastically change
- Watershed – the area drained by a river, stream, run-off, etc.
- Phytoplankton- microscopic drifting plants.
- Zooplankton-tiny free-floating animals.
- Adaptation – the process by which an organism becomes better suited to its environment
- Organism – a form of life (plant, animal, fungus, plankton)
- Substrate – the surface on or from which an organism will grow, live, or get nourishment
- Spray zone - the highest high tide

- High tide zone - lowest high tide
- Middle tide zone - highest low tide
- Low tide zone - lowest low tide

Procedure

- Warm Up (15 minutes)
    - Watch Intertidal Biome Video on GSSC website (https://www.youtube.com/watch?time_continue=1&v=TCzys2xM6WI)
    - The students can turn and talk to their neighbor about intertidal biomes.
        - What is an intertidal biome? Why are they important? Any interesting facts or questions from the video?
    - The partners can turn and talk to another group nearby, or across the room, to talk about their answers
    - Share answers as a class, or write each question on the whiteboard and have the groups write their answers on the board and have a discussion.
- Activity
    - Complete the preparatory section of GSSC Science Notebook (pages 5-8)
        - This can be done together as a class, in groups, or individually

Assessment

- "My Intertidal Ecosystem" on page 8 could be used as an assessment to determine their understanding of intertidal zones.
- In groups, each group will have to make their own intertidal zones in a creative way (acting, drawing, painting, etc.).

3 - Shellfish Topics

Section 1: For the Teacher

The introduction PowerPoint will cover shellfish, ranging from their history to their vital role in the ecosystems. A few of the slides are a review from previous lessons. This would be a good time to check for understanding! Please take your time going through this PowerPoint - there is a lot of information! This will be an introduction to the six labs following this PowerPoint. On day 1, there will be three labs (watersheds, oyster exploration, and shellfish in time & place). On day 2, there will be three labs (Coast Salish people & culture, oyster exploration 2 and food web connections).

Section 2: For the Student

The introduction PowerPoint will cover shellfish, ranging from their history to their vital role in the ecosystems. A few of the slides are a review from previous lessons. There is a lot of information! This will be an introduction to the six labs following this PowerPoint. On day 1, there will be three labs (watersheds, oyster exploration, and shellfish in time & place). On day 2, there will be three labs (Coast Salish people & culture, oyster exploration 2 and food web connections).

Throughout this PowerPoint and for the rest of the unit, you will learn how intertidal ecosystems are important sources of food when healthy and clean. You will also learn that shellfish play a vital role in ecosystems. Have fun learning about your local marine ecosystem!

Questions

- Why are intertidal ecosystems important?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Shellfish Topics</td></tr>
<tr><td>ESSENTIAL QUESTION</td><td colspan="3">Why are intertidal ecosystems important?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="3">Intertidal ecosystems are important sources of food when healthy and clean.</td><td>Shellfish play a vital role in ecosystems.</td><td rowspan="3">Students will understand the importance of shellfish and their role in ecosystems.</td><td>Intertidal zone
Organism
Invertebrate
Ecosystem
Ecosystem services</td></tr>
<tr><td>STANDARDS</td><td>ASSESSMENTS</td></tr>
<tr><td><u>COMMON CORE STATE STANDARDS</u>
-CCSS.ELA-LITERACY.RI.5.1
-CCSS.ELA-LITERACY.W.5.2.B
-CCSS.ELA-LITERACY.SL.5.1

<u>NEXT GENERATION SCIENCE STANDARDS</u>
-5-ESS3-1

<u>INTEGRATED ENVIRONMENTAL AND SUSTAINABILITY</u>
Standard 3</td><td>Informal
- Slides 3, 5, 14 are reviews from the previous lesson (intertidal biome). These slides can be used to check for understanding.

Formal
- What are three things you learned about shellfish and other organisms who make their homes in the intertidal habitat? What are you looking forward to for the rest of the unit?</td></tr>
</table>

Lesson: Introduction to Shellfish

Guiding Question: Why are intertidal ecosystems important?

Key Concepts:

- Intertidal ecosystems are important sources of food when healthy and clean.

Standards

Common Core State Standards	CCSS.ELA-LITERACY.RI.5.1 - Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. CCSS.ELA-LITERACY.W.5.2.B - Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic. CCSS.ELA-LITERACY.SL.5.1 - Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.
Next Generation Science Standards	5-ESS3-1- Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
Integrated Environmental and Sustainability	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.

Setting: Inside

Time: 45 minutes

Materials

- "Intro PowerPoint" on GSSC website
- Whiteboard
- Computer

Vocabulary

- Intertidal zone - the area above water at low tide and under water at high tide.
- Organism - a form of life (plant, animal, fungus, plankton)
- Invertebrate - an animal lacking a backbone
- Ecosystem - a system that includes all living things (animals, plants, organisms) in an area
- Ecosystem Service(s) – the benefits humans receive from ecosystems

Procedure

- Explain to the students that after this lesson, they will be doing six different labs.

- Open “Intro PowerPoint”
    - On slide 2, on the second click, there will be a star that will land on where your location.
        - Before you click for the second time, ask: Where are we located on the map?
    - Slides 3, 5, 14 are reviews from the previous lesson (intertidal biome)
        - Check for understanding (turn & talk, class discussion)
    - Slide 16 - Why *Garden* of the Salish Sea?
        - Discuss this question with your class. Record their answers.
    - Slides 18-23
        - Discuss the history and record any thoughts, comments, and/or questions your students have
    - Before slide 27
        - Do you think the shellfish population is in trouble? Why or why not? What threats are affecting shellfish?
    - Slide 29, 31-33
        - Relate back to the Salish Sea Stewards Challenge - is this something they, their families, and/or communities can commit to doing as a habit? Ask students which Challenge actions apply to them individually and their household?
    - Slide 34
        - This is an overview of the curriculum and these are the activities and skills the students will be learning.

Assessment

- Informal
    - Slides 3, 5, 14 are reviews from the previous lesson (intertidal biome). These slides can be used to check for understanding.
- Formal
    - What are three things you learned about shellfish and other organisms who make their homes in the intertidal habitat? What are you looking forward to for the rest of the unit?

3.2 - Watersheds

Section 1: For the Teacher

On day 1, there will be three labs (watersheds, oyster exploration, and shellfish in time & place). On day 2, there will be three labs (Coast Salish people & culture, oyster exploration 2 and food web connections).

This lab is number 1 of the 4 labs on day 1. This is broken into two parts (1a and 1b). In 1a, the students will use a watershed model. The students will add "pollution" (food coloring) and rain (water) to track downstream impacts on water bodies. In 1b, students will look at a watershed map and locate their home in the watershed. They will also determine the proximity of their houses to water bodies by putting a pushpin in their watershed map.

This shellfish connection can be used with Whatcom Conservation Water Explorer to explain impacts on the marine environment and shellfish harvest.

This could also be connected to the Mountain School trip your students went on at North Cascades Environmental Learning Center. The key concept from Mountain School is "everything's connected - what you do in the mountains is going to eventually make it to the oceans." What students are finding in the oceans could have come from the waterfall they visited while hiking during Mountain School.

Section 2: For the Student

On day 1, there will be three labs (watersheds, oyster exploration, and shellfish in time & place). On day 2, there will be three labs (Coast Salish people & culture, oyster exploration 2 and food web connections).

This lab is number 1 of the 4 labs on day 1. This is broken into two parts (1a and 1b). In 1a, the students will use a watershed model. The students will add "pollution" (food coloring) and rain (water) to track downstream impacts on water bodies. In 1b, students will look at a watershed map and locate their home in the watershed. They will also determine the proximity of their houses to water bodies by putting a pushpin in their watershed map.

In this activity, you will learn that from mountains to oceans water connects all life. Also, there are different components that make up a healthy watershed. Last, but not least, you will learn how human activities can impact the water downstream, which can be affected by the two different types of surfaces - pervious and impervious.

Questions

- How does a watershed function?
- How do human activities impact downstream ecosystems?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Station 2: Watersheds</td></tr>
<tr><td>ESSENTIAL QUESTIONS</td><td colspan="3">How does a watershed function? How do human activities impact downstream ecosystems?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="3">There are different components that make up a healthy watershed.

Human activities can impact the water downstream.

From mountains to oceans water connects all life.</td><td>There are two different types of surfaces - pervious and impervious.</td><td rowspan="3">Lab 1a: Watershed model - Watershed activity

Students explore components of watersheds, local watersheds and our place in them.

- Students track downstream impacts on water bodies.

Lab 1b: Watershed map
- Students locate their home in the watershed and proximity to water-bodies.</td><td rowspan="2">Watershed
Run-off
Pervious surfaces
Impervious surfaces
Storm drain
Riparian habitats
Nonpoint source pollution
Point source pollution</td></tr>
<tr><td>STANDARDS</td></tr>
<tr><td><u>COMMON CORE STATE STANDARDS</u>
-CCSS.ELA-LITERACY.W.5.2
-CCSS.ELA-LITERACY.SL.5.1

<u>NEXT GENERATION SCIENCE STANDARDS</u>
- 5-ESS2-1
- 5-ESS3-1

<u>INTEGRATED ENVIRONMENTAL AND SUSTAINABILITY</u>
- Standard 1</td><td>ASSESSMENTS

Formal
- Watershed Healthy Design Activity
- Students will paint or draw what a healthy watershed would look like compared with an unhealthy watershed and write about the watershed they have created using the vocabulary terms they have learned thus far
- After doing the watershed activity and locating their homes or school on the map, have the students think about where they are in relation to water bodies and what potential sources of pollution might be important to think about for their location.</td></tr>
</table>

Lesson: Lab 2: Watersheds

Guiding Questions: How does a watershed function? How do human activities impact downstream ecosystems?

Key Concepts

- Human activities can impact the water downstream.
- There are different components that make up a healthy watershed.
- From mountains to oceans water connects all life.

Standards

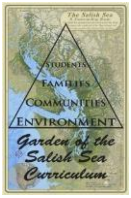
Common Core State Standards	CCSS.ELA-LITERACY.W.5.2: Write informative/explanatory texts to examine a topic and convey ideas and information clearly. CCSS.ELA-LITERACY.SL.5.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 5 topics and texts*, building on others' ideas and expressing their own clearly.
Next Generation Science Standards	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.
Integrated Environmental and Sustainability	Standard 1: Ecological, Social, and Economic Systems - 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.

Setting: Inside

Time: 30 minutes per station, 1 hour total

Materials

- GSSC Science Notebook, page 10
- Station 1a
    - Watershed model (Legos and white plastic bag)
    - Food coloring
    - Chocolate jimmies (poop)
    - Toy animals, buildings, vehicles, boats etc
    - Spray bottle filled with water
    - Sponges - with green scrubber
- Station 1b



- Watershed map
- Push pins

Vocabulary

- Watershed - the area drained by a river, stream, runoff, etc.
- Run-off - when water drains away from the surface of an area
- Pervious surfaces - surfaces that allow storm water to soak into the ground
- Impervious surfaces - surfaces that don't allow storm water to soak into the ground
- Storm drain - drains excess rain and ground water from impervious surfaces. Many lead the water to rivers, streams, or oceans.
- Riparian habitats - Areas surrounding or near bodies of water, such as rivers, lakes, and streams.
- Nonpoint source pollution - pollution resulting from many sources; this is the more commonly identified source of pollution
- Point source pollution - pollution resulting from a single source

Procedure

- Station 1a
    - Students will use a watershed model. The students will add "pollution" (food coloring) and rain (water) to track downstream impacts on water bodies.
    - Students will use sponges to represent vegetation and observe/compare runoff patterns.
- Station 1b
    - Students will look at a watershed map and locate their home in the watershed. They will also determine the proximity of their houses to water bodies by putting a pushpin in their watershed map.
- Complete page 10 in the GSSC Notebook individually, groups, or as a whole class

Assessment

- Watershed Healthy Design Activity
- Students will paint or draw what a healthy watershed would look like compared with an unhealthy watershed and write about the watershed they have created using the vocabulary terms they have learned thus far (i.e. pervious/impervious surfaces, watershed, runoff, etc.).
- After doing the watershed activity and locating their homes or school on the map, have the students think about where they are in relation to water bodies and what potential sources of pollution might be important to think about for their location.

3.3 - Oyster Exploration

Section 1: For the Teacher

On day 1, there will be three labs (watersheds, oyster exploration, and shellfish in time & place). On day 2, there will be three labs (Coast Salish people & culture, oyster exploration 2 and food web connections).

This lab is number 2 of the 4 labs on day 1. There are two parts to this lab - live tank and life cycle. Part 1 is the live tank. The students will be observing the shellfish and algae in the live tank system. Part 2 is about the life cycle. Students will be observing samples of various stages of oyster growth using shells from seed to 5 years. In this part of the lab, there will be an emphasis on motile and attached life stages.

Section 2: For the Student

On day 1, there will be three labs (watersheds, oyster exploration, and shellfish in time & place). On day 2, there will be three labs (Coast Salish people & culture, oyster exploration 2 and food web connections).

This lab is number 2 of the 4 labs on day 1. There are two parts to this lab - live tank and life cycle. Part 1 is the live tank. The students will be observing the shellfish and algae in the live tank system. Part 2 is about the life cycle. Students will be observing samples of various stages of oyster growth using shells from seed to 5 years. In this part of the lab, there will be an emphasis on motile and attached life stages.

In this activity, you will learn that shellfish eat, breathe, and clean the water using their gills. Also, shellfish have a certain life cycle and seasonal growth patterns. Their life cycles are influenced by seasons, which influences the intertidal ecosystems they live in.

Questions

- How do shellfish interact with their ecosystem?
- What are the various stages in the life cycle of shellfish?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Station 3.3: Oyster Exploration (Part 1 - Live Tank; Part 2 - Life Cycle)</td></tr>
<tr><td>ESSENTIAL QUESTIONS</td><td colspan="3">Part 1: How do shellfish interact with their ecosystem?
Part 2: What are the various stages in the life cycle of shellfish?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="4">Shellfish eat, breathe, and clean the water using their gills.

Shellfish have a certain life cycle and seasonal growth patterns.</td><td>Shellfish life cycles are influenced by seasons.

Shellfish influence the intertidal ecosystem in many ways.</td><td rowspan="4">Part 1 - Live Tank
- Students observe and diagram shellfish and algae in the live tank system.

Part 2 - Life Cycles
- Students observe samples of various stages of oyster growth.</td><td><u>Part 1</u>
Habitat
Ecosystem
Intertidal Zone
Ecosystem services
Filter Feeder
<u>Part 2</u>
Mollusk
Life cycle
Motile (free swimming)
Larvae
Spat</td></tr>
<tr><td>STANDARDS</td><td>ASSESSMENTS</td></tr>
<tr><td><u>COMMON CORE STATE STANDARDS</u>
-CCSS.MATH.CONTENT.5.OA.A.1
-CCSS.ELA-LITERACY.W.5.2.D

<u>NEXT GENERATION SCIENCE STANDARDS</u>
5-ESS3-1.

<u>INTEGRATED ENVIRONMENTAL AND SUSTAINABILITY</u>
Standard 1</td><td>-Pages 13-14 in GSSC Science Notebook
<u>Writing prompts:</u>
- Your local river has been contaminated by nonpoint source pollutants. Would you use shellfish to help clean up the river? Why or why not?
-How could you incorporate what you've just learned about shellfish into your Salish Sea Stewards Challenge activities?</td></tr>
</table>

Lesson: Oyster Exploration

Guiding Questions:

- Part 1
  - How do shellfish interact with their ecosystem?
- Part 2
  - What are the various stages in the life cycle of shellfish?

Key Concepts

- Shellfish eat, breathe, and clean the water using their gills.
- Shellfish have a certain life cycle and seasonal growth patterns.

Standards

Common Core State Standards	CCSS.MATH.CONTENT.5.OA.A. Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols. CCSS.ELA-LITERACY.W.5.2.D Use precise language and domain-specific vocabulary to inform about or explain the topic.
Next Generation Science Standards	5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
Integrated Environmental and Sustainability	Standard 1: Ecological, Social, and Economic Systems 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.

Setting: Inside

Time: 10 minutes

Materials

- GSSC Science Notebook (pages 13-14)
- Part 1: Live Tank
  - Computer for video
  - Youtube video: https://www.youtube.com/watch?v=yXFOMil3uZM (on GSSC website > 5th grade) OR https://www.youtube.com/watch?v=DxEpyjWDB6I
  - Tank
  - Aerator
  - Carboy filled with seawater
  - Algae from seawater collection beach
  - Hand lenses (2)
  - 2-3 Oysters (from Drayton Harbor Oyster Company)

    - Laminates
        - Kelp forest
- Part 2: Life Cycle
    - Laminates
        - Life cycles
        - Growth rings
        - Evolutionary tree
        - Oyster seed - sized shells
        - Hand lens

Vocabulary

Part 1: Live Tank

- Habitat – the home of an animal, plant, or organism
- Ecosystem – a system that includes all living things (animals, plants, organisms) in an area
- Intertidal Zone – the area above water at low tide and under water at high tide.
- Ecosystem services – the benefits humans receive from ecosystems
- Filter Feeder – Type of animal that gets its nutrients from sorting out tiny plants and animals from the water as it breathes by filtration through gills.

Part 2: Life Cycle

- Mollusk – a phylum of invertebrate animals including snails, slugs, shellfish, and octopus
- Life cycle – a series of physical changes during the life of an organism
- Motile (free swimming) – capable of motion
- Larvae – an immature form of an organism, especially one which differs greatly from its adult form.
- Spat - a juvenile oyster that has changed into an adult develops its shell and attaches to a substrate like a rock or shells. This is the life stage that is most vulnerable to ocean acidification. At this point, attachment and shell formation are interrupted

Procedure

- Part 1: Live Tank
    - When looking at the shellfish and algae in the live tank, the students will be making observations and drawing their observations of what they see in the live tank.
    - After they have spent a couple minutes making observations, they are going to complete page 13, individually or in a group.
- Part 2: Life Cycle
    - Students will use the laminates provided at the station to observe various stages of oyster growth. There will be shells that range from seed to 5 years. They can make hypotheses on which part of stages the shells are in.
    - Students will use their observations to complete page 14.

Assessment

- Pages 13 and 14 can be used to assess their knowledge and understanding on the two parts of the station.
- Writing prompts:
    - Your local beach has been closed for shellfish harvest. Why do you think it is closed? What can be done to reopen the area for shellfish harvest safely?

- How could you incorporate what you've just learned about shellfish into your Salish Sea Stewards Challenge activities?

3.4 - Shellfish in Time & Place

Section 1: For the Teacher

On day 1, there will be four labs (Salish Sea Stewards, watersheds, oyster exploration, and shellfish in time & place). On day 2, there will be three labs (Coast Salish people & culture, oyster exploration 2 and food web connections). This lab is number 4 of the 4 labs on day 1. This activity will focus on the fossils and location of shellfish around the world.

Section 2: For the Student

On day 1, there will be four labs (Salish Sea Stewards, watersheds, oyster exploration, and shellfish in time & place). On day 2, there will be three labs (Coast Salish people & culture, oyster exploration 2 and food web connections). This lab is number 4 of the 4 labs on day 1. This activity will focus on the fossils and location of shellfish around the world.

Marine shellfish live or lived along coastlines around the world, for as long as 500 million years, which can help us learn about the planet earth over geologic time. Fossils are the remains of buried prehistoric animals like shellfish. Did you know fossil records can be used to examine the differences in shellfish from the past and today?

In this activity, you will be looking at three different types of maps (interactive map, world map, and Salish Sea map). You will be exploring shell samples from different coastal environments around the world. Also, you will observe and relate fossils to modern day shellfish.

Questions

- In what ecosystem can shellfish be found now and where did they live in the past?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Station 4: Shellfish in Time & Place</td></tr>
<tr><td>ESSENTIAL QUESTION</td><td colspan="3">In what ecosystem can shellfish be found now and where did they live in the past?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="3">Shellfish are found along coastlines all around the world.

Fossil records can be used to examine the differences in shellfish from the past and today</td><td>Shellfish biomes in different areas of the world have unique characteristics based on its location.

Shellfish have lived on Earth for more than 500,000 years. They can help us learn about the planet earth over geologic time</td><td rowspan="3">Interactive map, world map, and Salish Sea map - students will be exploring shell samples from different coastal environments around the world. Students will observe and relate fossils to modern day shellfish.</td><td rowspan="2">Fossil
Reef
Diversity
Growth bands
Midden</td></tr>
<tr><td>STANDARDS</td></tr>
<tr><td><u>COMMON CORE STATE STANDARDS</u>
CCSS.ELA-LITERACY.RI.5.7

<u>NEXT GENERATION SCIENCE STANDARDS</u>
5-PS1-3

<u>INTEGRATED ENVIRONMENTAL AND SUSTAINABILITY</u>
Standard 2</td><td>ASSESSMENTS

- Pages 15 & 16 in GSSC Science Notebook
- Exit Ticket: Name 2 locations where shellfish can be found. Were your hypotheses right?
- How could we incorporate this into the Salish Sea Stewards Challenge?
- Students create a world map. They will label and describe at least 3 shellfish they chose</td></tr>
</table>

Lesson: Shellfish in Time & Place

Guiding Question: In what ecosystem can shellfish be found now and where did they live in the past?

Key Concepts

- Shellfish are found along coastlines all around the world.
- Fossil records can be used to examine the differences in shellfish from the past and today

Standards

Common Core State Standards	CCSS.ELA-LITERACY.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.
Next Generation Science Standards	5-PS1-3. Make observations and measurements to identify materials based on their properties
Integrated Environmental and Sustainability	Standard 2: 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.

Setting: Inside

Time: 10 minutes

Materials

- GSSC Science Notebook (Pages 15 & 16)
- World map
- Salish Sea map
- Shell box
- Fossil box
- Interactive map
    - Found on http://www.gardensalishsea.org/5th-grade/ > II. INTRODUCTION TO SHELLFISH > Map: Shellfish Around the World

Vocabulary

- Fossil – the remains of a prehistoric organism that is cast in a rock or preserved in a petrified form.
- Growth bands – a line found in many organisms which marks seasonal growth.
- Midden - a mound of shells, bones and refuse that indicates where people lived.
- Reef – a ridge of rock, coral, or sand just above or below the surface of the sea.
- Diversity - the number and variety of species found within an ecosystem.

Procedure

1. Students will make and share their observations about the fossil records and the shell samples from different countries around the world.
2. Pull up the world map and have the students make hypotheses about where shellfish can be found around the world.
3. Pull up the interactive map from the GSSC website and compare the students' hypotheses to the locations on the interactive map. Were any of the students' hypotheses correct?
4. Use the world map, Salish Sea map, and the fossil box to complete pages 15 & 16 in the GSSC Science Notebook.

Assessment

- Pages 15 & 16 in GSSC Science Notebook
- Exit Ticket: Name 2 locations where shellfish can be found. Were your hypotheses right?
- How could we incorporate this into the Salish Sea Stewards Challenge?
- Students create a world map. They will label and describe at least 3 shellfish they chose

3.5 - Shellfish & Coast Salish Culture

Section 1: For the Teacher

On day 1, there will be three labs (watersheds, oyster exploration, and shellfish in time & place). On day 2, there will be three labs (Coast Salish people & culture, oyster exploration 2 and food web connections). This lab is number 1 of the 3 labs on day 2. This lab focuses on Coast Salish Peoples and their use of shellfish.

Section 2: For the Student

On day 1, there will be three labs (watersheds, oyster exploration, and shellfish in time & place). On day 2, there will be three labs (Coast Salish people & culture, oyster exploration 2 and food web connections). This lab is number 1 of the 3 labs on day 2. This lab focuses on Coast Salish Peoples and their use of shellfish.

The Salish Sea is named for the Coast Salish Peoples, Native Americans (First Nations in Canada) who have lived near its shores for over 10,000 years eating and growing shellfish. The First Peoples have a saying "When the tide goes out, the table is set." This was especially important during shellfish harvesting season. In this activity, you will use shell middens and pictures to gather information about the historical use of shellfish and seasonal harvest.

Questions:

- Why are shellfish important to Coast Salish Peoples today and historically?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Station 5: Shellfish & Coast Salish Culture</td></tr>
<tr><td>ESSENTIAL QUESTION</td><td colspan="3">Why are shellfish important to Coast Salish Peoples today and historically?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="3">Shellfish have been an important food and economic resource for Coast Salish Peoples since time immemorial.

“When the tide goes out, the table is set”</td><td>Shell middens provide information about the historical use of shellfish and seasonal harvest.

Clam gardens demonstrate current indigenous practices that cultivate shellfish and improve water quality.</td><td rowspan="3">Students observe pictures of Tribal Shellfish aquaculture and historical uses of shells.

Reflect on shellfish aquaculture and ecosystem services.</td><td>Coast Salish
Clam garden
Midden</td></tr>
<tr><td>STANDARDS</td><td>ASSESSMENTS</td></tr>
<tr><td><u>COMMON CORE STATE STANDARDS</u>
CCSS.ELA-LITERACY.RI.5.3</td><td>GSSC Notebook, page 20</td></tr>
</table>

Lesson: Shellfish & Coast Salish Culture

Guiding Question: Why are shellfish important to Coast Salish Peoples today and historically?

Key Concepts

- Shellfish have been an important food and economic resource for Coast Salish Peoples since time immemorial.
- “When the tide goes out, the table is set”

Standards

Common Core State Standards	CCSS.ELA-LITERACY.RI.5.3: Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.

Setting: Inside

Time: 10 minutes

Materials
- Laminates
- Clam garden
- Tools
- Aquaculture on tidelands (Lummi Nation)
- GSSC Notebook, page 20
- Coast Salish Peoples map (Portage Bay Intro slide show, slide 13)

Vocabulary
- Coast Salish – a group of indigenous people of the Pacific Northwest Coast
- Shell Midden: These are often found by archaeologists, and are left over shells and other deposits from people who ate shellfish and disposed of the shells in a pile. Shell middens are like ancient garbage dumps and provide insight on what people used to eat and where they lived.
- Shellfish Garden: A form of shellfish management designed to ensure a reliable food source for the large populations of First Nations and Native Americans that inhabited the Northwest Coast.

Procedure
- Students will observe the materials provided, talk amongst their peers about their observations and discoveries.
- Students will locate the Coast Salish Tribe where they are and acknowledge the people who have been here Since Time Immemorial.
- Students will complete page 20 in GSSC Notebook

Assessment
- GSSC Notebook, page 20

Extra resources
- http://www.skagitbeaches.org/history/coast-salish-food-traditions.html
- http://folklore.bc.ca/when-the-tide-goes-out/

3.6 - Marine Food and Resources

Section 1: For the Teacher

On day 1, there will be four labs (Salish Sea Stewards, watersheds, oyster exploration, and shellfish in time & place). On day 2, there will be three labs (Coast Salish people & culture, oyster exploration 2 and food web connections). This lab is number 2 of the 3 labs on day 2.

Section 2: For the Student

On day 1, there will be four labs (Salish Sea Stewards, watersheds, oyster exploration, and shellfish in time & place). On day 2, there will be three labs (Coast Salish people & culture, oyster exploration 2 and food web connections). This lab is number 2 of the 3 labs on day 2.

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, you 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.

Questions

- How can organisms found in the intertidal zone be sources for food and beneficial for humans?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Station 6: Marine Food and Resources</td></tr>
<tr><td>ESSENTIAL QUESTION</td><td colspan="3">How can organisms found in the intertidal zone be sources for food and beneficial for humans?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="3">A variety of nutritious foods are grown in the intertidal zone and eaten by people around the world.

Foods from the intertidal zone are important for our economy.

Products from made from shells of marine organisms can be used to condition soils in gardens.</td><td>How different foods from the intertidal zone contribute to your nutrition.</td><td rowspan="3">Students have opportunities to:
- sample dried seaweed
- observe a variety of products from the intertidal zone
- build (draw) a meal with food including ingredients from the intertidal zone/ Salish Sea</td><td>Sea vegetables
Clams
Mussels
Oyster
Conch</td></tr>
<tr><td>STANDARDS</td><td>ASSESSMENTS</td></tr>
<tr><td><u>COMMON CORE STATE STANDARDS</u>
CCSS.ELA-LITERACY.SL.5.1.D

<u>INTEGRATED ENVIRONMENTAL AND SUSTAINABILITY</u>
Standard 1</td><td>GSSC Notebook, page 21</td></tr>
</table>

Lesson: Marine Food and Resources

Guiding Question: How can organisms found in the intertidal zone be sources for food and beneficial for humans?

Key Concepts

- A variety of nutritious foods are grown in the intertidal zone and eaten by people around the world.
- Foods from the intertidal zone are important for our economy.
- Products from made from shells of marine organisms can be used to condition soils in gardens.

Standards

Common Core State Standards	CCSS.ELA-LITERACY.SL.5.1.D - Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.

Integrated Environmental and Sustainability	Standard 1: Ecological, Social, and Economic Systems

Setting: Inside

Time:

Materials
- 2 food/nutrition demo boxes
- Seaweed snack samples (2 boxes per class)
- Nitrile gloves (food grade for serving snacks)
- Laminates - food & nutrition
- GSSC Notebook, page 21
- Oyster shell and diatomaceous earth samples

Vocabulary
- Sea vegetables – edible algae or seaweed
- Clams – a common bivalve, usually live underwater buried in sand or mud
- Mussels – a marine bivalve mollusk with a dark elongated shell
- Oyster – a name for a number of bivalve mollusks with rough irregular shells
- Conch – a common name for a number of large edible sea snails.

Procedure
- Students will sample dried seaweed and observe a variety of products from the intertidal zone.
- Using their GSSC Notebook on page 21, students will draw a meal with food including ingredients from the intertidal zone.

Assessment
- GSSC Notebook, page 21

3.7 - Oyster Dissection

Section 1: For the Teacher

On day 1, there will be four labs (Salish Sea Stewards, watersheds, oyster exploration, and shellfish in time & place). On day 2, there will be three labs (Coast Salish people and culture, oyster exploration 2, food web connections and amazing algae). This lab is number 3 of the 4 labs on day 2.

Section 2: For the Student

On day 1, there will be four labs (Salish Sea Stewards, watersheds, oyster exploration, and shellfish in time & place). On day 2, there will be three labs (Coast Salish people & culture, oyster exploration 2 and food web connections). This lab is number 3 of the 4 labs on day 2.

In this activity, you will learn that shellfish and clams are part of the marine food web. In part 3, you will identify, draw, and label oyster body parts using shucked/labeled oysters. You will learn that shellfish have body parts with certain functions.

In part 4, you will observe and diagram phytoplankton under microscopes. Also, in your notebook on page 25, you will draw food web connections using the "Food Web Foundations Reflection" activity. In this part of the oyster exploration, you will learn two things: phytoplankton use sunlight to grow and become food for shellfish and many other organisms and algae, plants, and animals are all part of the intertidal food web.

Questions

- What are the functions of different body parts in a shellfish? How do the body parts of a shellfish show adaptation to the intertidal habitat?
- Why are food chains and food webs important? What roles do phytoplankton and zooplankton play in food webs?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Station 7: Oyster Exploration</td></tr>
<tr><td>ESSENTIAL QUESTION</td><td colspan="3">What are the functions of different body parts in a shellfish? How do the body parts of a shellfish show adaptation to the intertidal habitat?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="4">Shellfish have body parts with certain functions.</td><td>Shellfish and clams are part of the marine food web.</td><td rowspan="4">Students identify, draw, and label oyster body parts using shucked/labeled oysters.</td><td rowspan="2">Invertebrate
Bivalve
Exoskeleton
Gills
Mantle
Tentacles
Hinge
Adductor Muscle
Heart
Labial Palps</td></tr>
<tr><td>STANDARDS</td></tr>
<tr><td rowspan="2">COMMON CORE STATE STANDARDS
CCSS.ELA-LITERACY.SL.5.1.D

NEXT GENERATION SCIENCE STANDARDS
5-LS2-1.

INTEGRATED ENVIRONMENTAL AND SUSTAINABILITY
Standard 1</td><td>ASSESSMENTS</td></tr>
<tr><td>- GSSC Notebook, pages 12-14</td></tr>
</table>

Lesson: Oyster Dissection

Guiding Question:

- What are the functions of different body parts in an oyster?
- How do the body parts of a shellfish show adaptation to the intertidal habitat?

Key Concepts

- Shellfish have body parts with certain functions.

Standards

Common Core State Standards	CCSS.ELA-LITERACY.SL.5.1.D - Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.

Next Generation Science Standards	5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
Integrated Environmental and Sustainability	Standard 1: Ecological, Social, and Economic Systems

Setting: Inside
Time:
Materials

- GSSC Notebook, pages 22-24
- Dissection kit
- Atlas gloves (2 pr)
- Shucking knives
- Exacto knife
- Hammer
- Labels
- Paper plates
- Hand sanitizer
- Hand lenses (3)
- Giant magnifiers (2)
- Dissection flip cards

Vocabulary

- Invertebrate – an animal lacking a backbone
- Bivalve – a mollusk with two parts of a shell attached by a hinge; mussels, clams and oysters are examples
- Exoskeleton – a rigid external skeleton covering the body of some invertebrates
- 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)

Procedure

- Students will observe the dissected oysters and talk amongst their peers about their observations.
- Using the materials provided, students will complete pages 22-24

Assessment

- GSSC Notebook, pages 22-24

3.8 – Food Web Foundations

Section 1: For the Teacher

On day 1, there will be four labs (Salish Sea Stewards, watersheds, oyster exploration, and shellfish in time & place). On day 2, there will be three labs (Coast Salish people and culture, marine foods and resources, oyster dissection, and food web foundations). This lab is number 4 of the 4 labs on day 2.

Section 2: For the Student

On day 1, there will be four labs (Salish Sea Stewards, watersheds, oyster exploration, and shellfish in time & place). On day 2, there will be three labs (Coast Salish people and culture, marine foods and resources, oyster dissection, and food web foundations). This lab is number 4 of the 4 labs on day 2.

In this activity, you will learn that shellfish and clams are part of the marine food web. In part 3, you will identify, draw, and label oyster body parts using shucked/labeled oysters. You will learn that shellfish have body parts with certain functions.

In part 4, you will observe and diagram phytoplankton under microscopes. Also, in your notebook on page 25, you will draw food web connections using the "Food Web Foundations Reflection" activity. In this part of the oyster exploration, you will learn two things: phytoplankton use sunlight to grow and become food for shellfish and many other organisms and algae, plants, and animals are all part of the intertidal food web.

Questions

- What are the functions of different body parts in a shellfish? How do the body parts of a shellfish show adaptation to the intertidal habitat?
- Why are food chains and food webs important? What roles do phytoplankton and zooplankton play in food webs?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Station 8: Food Web Foundations</td></tr>
<tr><td>ESSENTIAL QUESTION</td><td colspan="3">Why are food chains and food webs important? What roles do phytoplankton and zooplankton play in food webs?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="4">- Phytoplankton use sunlight to grow and become food for shellfish and many other organisms.
- Algae, plants, and animals are all part of the intertidal food web.</td><td>Shellfish and clams are part of the marine food web.</td><td rowspan="4">- Students observe and diagram phytoplankton under microscopes.
- Students draw food web connections using “Food Web Foundations Reflection” activity in GSSC Notebook, page 25.</td><td>Photosynthesis
Plankton
Food web
Predator
Food chain</td></tr>
<tr><td>STANDARDS</td><td>ASSESSMENTS</td></tr>
<tr><td><u>COMMON CORE STATE STANDARDS</u>
CCSS.ELA-LITERACY.SL.5.1.D

<u>NEXT GENERATION SCIENCE STANDARDS</u>
5-LS2-1.

<u>INTEGRATED ENVIRONMENTAL AND SUSTAINABILITY</u>
Standard 1</td><td>- GSSC Notebook, pages 25</td></tr>
</table>

Lesson: Food Web Foundations

Guiding Question:

- Why are food chains and food webs important?
- What roles do phytoplankton and zooplankton play in food webs?

Key Concepts

- Phytoplankton use sunlight to grow and become food for shellfish and many other organisms.
- Algae, plants, and animals are all part of the intertidal food web.

Standards

Common Core State Standards	CCSS.ELA-LITERACY.SL.5.1.D - Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.
Next Generation Science Standards	5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
Integrated Environmental and Sustainability	Standard 1: Ecological, Social, and Economic Systems

Setting: Inside

Time:

Materials

- Microscope
- Slides (plankton)
- Plankton tow sample
- Laminates
- GSSC Notebook, pages 25

Vocabulary

- Photosynthesis-Process used by plants, including phytoplankton to make food from light and carbon dioxide in the air.
- Plankton- Greek for drifter, microscopic plants, animals or bacteria that are carried with the current. They provide a crucial source of food to larger organisms.

- Food web – shows how an ecosystem interacts between different organisms. It contains many food chains, where most plants and animals will be a part of several food chains.
- Predator – an animal that preys on other animals
- Food chain - describes which organism eats which, usually starting with a plant and ending with an animal

Procedure

- Students will observe the dissected oysters and talk amongst their peers about their observations. What did you find in the oyster's stomach?
- Using the materials provided, students will complete pages 25

Assessment

- GSSC Notebook, pages 25

4 – Ocean Acidification

Section 1: For the Teacher

This lesson will be talking about ocean acidification. Ocean acidification is the ongoing increase in the acidity of the Earth's oceans, caused by the uptake of carbon dioxide (CO2) from the atmosphere. For a more in depth overview of ocean acidification see Appendix A which contains background information as well as the notes for the PowerPoint (this chapter was developed separately). This lesson is split into three sections: pH of household solutions, human smokestack, and I'm melting.

Section 2: For the Student

Ocean acidification is the ongoing increase in the acidity of the Earth's oceans, caused by the uptake of carbon dioxide (CO2) from the atmosphere. This lesson is split into three sections: pH of household solutions, human smokestack, and I'm melting. During this process you will learn about the acidity of products you may use every day, learn about processes that release CO2 into the atmosphere, and how acidic solutions effect the life cycle of oysters.

Questions:

- What did you learn from these activities?
- What can be done to reduce the impacts of ocean acidification?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Ocean Acidification</td></tr>
<tr><td>ESSENTIAL QUESTION</td><td colspan="3">How do our actions impact the health of our oceans?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="3">Nature has natural cycles that support life when balanced.

All living things require a certain water quality to survive.

Human actions can impact natural cycles.</td><td>All living things are made of Carbon.

Carbon dioxide is a natural byproduct of life.</td><td rowspan="3">Students will use different tools to measure the dissolved oxygen, temperature, and turbidity of a watershed.
pH of Household Solutions:
Students test the pH of household liquids to develop an understanding of what is an acid or a base.
Human Smoke Stack:
Students blow into water with a pH indicator to monitor the change in pH induced by the CO2 in breath.
Dissolving Shells:
Students compare shells soaked in distilled water and in vinegar.</td><td>Ocean acidification
pH
acid
base (alkaline)</td></tr>
<tr><td>STANDARDS</td><td>ASSESSMENTS</td></tr>
<tr><td></td><td>Formative
“Tale of Two Cities” felt board group activity.

Summative
Day 2 Reflection: Thinking about today’s activities</td></tr>
</table>

Lesson: Ocean Acidification

Guiding Question:

- How do OUR actions impact the health of our oceans?

Key Concepts

- Nature has natural cycles that support life when balanced.
- All living things require a certain water quality to survive.
- Human actions can impact natural cycles.

Standards:

Setting: Classroom

Time:

Ocean Acidification	**Estimated Time**
Ocean Acidification Power Point (Part 1)	15 minutes
pH Experiment	20 minutes
Ocean Acidification Power Point (Part 2)/ Human Smokestack/I'm Melting	30 minutes
Becoming stewards and the Salish Sea Challenge	5 minutes
TOTAL CLASS TIME	**70 minutes**

Materials

- For the class presentation
    - Computer and projector with internet connection.
    - Ocean Acidification Power Point
    - Chart from Lesson 1 on "How humans are connected to the ocean."
    - Chart with guiding question "How do OUR actions impact the health of our oceans?" to record student ideas
    - Sentence strips with key concepts written on them
    - A hard copy of the Salish Sea Watershed Challenge
- For each student
    - Science notebook
    - Pencil
- For each group
    - pH of Household Solutions experiment
        - Solutions to test: vinegar, lemon juice, club soda, pure water, baking soda, tums, and seawater
        - 4 sets of labelled cups (36 total)
        - Litmus paper cut into 1/2 to 1 inch lengths in a cup
        - Be careful not to handle the end of the litmus paper that will be dipped into the solution as that can change the results.
        - A laminated pH scale that goes with the litmus paper
        - A discard cup for used litmus paper.
        - White surface (paper or cardboard).
    - Human Smokestack demonstration
        - One set of clear plastic cups per student (#1 cup, #2 cup, plastic lid, and straw)
        - Mineral water
        - Red cabbage pH indicator in a dropper bottle.
        - White surface (paper or cardboard).
    - I'm Melting demonstration
        - A pair of plastic jars with oyster shells in them.
        - One jar is filled with vinegar
        - One jar is filled with water

Vocabulary

- Ocean acidification: The decrease in the pH of the Earth's oceans, caused by the absorption of carbon dioxide (CO_2) from the atmosphere.
- pH: the power of hydrogen
- Base (Alkaline): Have a pH greater than 7 and a low concentration of hydrogen ions.
- Acid: Have a pH of less than 7 and a high concentration of hydrogen ions.

Procedure

- See appendix A for full slideshow lesson plan.

Assessment

- Felt Board activity on Slide 30
  - This class activity gives students the opportunity to share the understanding of the impact of too much CO_2 in the atmosphere. Teachers check for understanding and misconceptions of key points including:
    - CO_2 is part of the natural balance of the Carbon Cycle.
    - CO_2 is also created by cars and factories. This puts more CO_2 into the atmosphere causing the Carbon cycle to be out of balance.
    - Ocean acidification is the result of too much CO_2 in the atmosphere.
    - Ocean acidification is harmful to shellfish.
- Day 2 Reflection: Thinking about today's activities in science notebook. Can be filled out at your convenience.

5 - Field Activities

5.1 - Preparation for Field Inquiry

Section 1: For the Teacher

After the lessons have been taught, students complete the preparation for the field inquiry activities. GSSC Notebook pages 40-42 are preparation for the field inquiry activities. Page 40 is an identification key for small clams. Page 41 has clam sort and distribution activities. Page 42 is about tips on what to wear and rules on how to collect data on the beach.

Section 2: For the Student

After the lessons have been taught, students complete the preparation for the field inquiry activities. GSSC Notebook pages 40-42 are preparation for the field inquiry activities. Page 40 is an identification key for small clams. Page 41 has clam sort and distribution activities. Page 42 is about tips on what to wear and rules on how to collect data on the beach.

In this activity, you will identify and sort clams based on their characteristics. You will realize that learning how to identify plants and animals using a key is an important skill to be able to quickly and accurately make identifications in the field. While you are identifying clams in the field, you will also learn and follow beach etiquette techniques.

Questions

- How can clams be identified?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Preparation for Field Inquiry</td></tr>
<tr><td>ESSENTIAL QUESTION</td><td colspan="3">How can clams be identified?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="3">Learning how to identify plants and animals using a key is an important skill to be able to quickly and accurately make identifications in the field</td><td>Beach etiquette techniques</td><td rowspan="3">Students identify and sort clams based on their characteristics.</td><td></td></tr>
<tr><td>STANDARDS</td><td>ASSESSMENTS</td></tr>
<tr><td><u>COMMON CORE STATE STANDARDS</u>
CCSS.MATH.CONTENT.5.MD.B.2</td><td>- GSSC Notebook pg 41</td></tr>
</table>

Lesson: Field Inquiry (Preparation for Field Inquiry)

Guiding Question: How can we identify clams?

Key Concepts

- Learning how to identify plants and animals using a key is an important skill to be able to quickly and accurately make identifications in the field

Standards

Common Core State Standards	CCSS.MATH.CONTENT.5.MD.B.2

Setting: Inside

Time:

Materials

- GSSC Notebook, pages 40-42
- Bag of clam shells
- Laminates of different clam species
- Hand clam key
- Calipers

Vocabulary

Procedure

1. Have students read pages 40-42 individually, in small groups, or as a whole class.
2. Discuss any observations and/or thoughts they have after reading pages 40-42.
3. Students will complete 41.
4. Before students start field inquiry activities, they will read page 42.

Assessment

- Notebook page 41

5.2 - Low Tide Food Web Hunt

Section 1: For the Teacher

This is one of seven field inquiry activities that can be done after the unit is over. Students will use their outside environment to complete these activities. These activities are designed to allow students to have hands-on experiences with their local environment.

This activity focuses on food webs. Students will search along the intertidal zone to find the organisms on page 43 and find connections between the different organisms. The connections will then create a food web.

Section 2: For the Student

Your fifth grader brains are an important source of knowledge! You all have spent time learning about your local watersheds, shellfish, and ocean acidification. You're not done learning though! You will be doing activities outside. Doesn't that sound so interesting?!

There are seven field inquiry activities: Low Tide Food Web Hunt, Who Lives in the Square?, Field Notes, Beachfront Scavenger Hunt, Water Quality, and Macro invertebrates. All of these activities will be done outside and results will be recorded in your GSSC Notebook.

This activity focuses on food webs. You will search along the intertidal zone to find the organisms on page 43 and find connections between the different organisms. The connections will then create a food web.

What did you learn from this activity? How did this activity influence your position as a steward of the environment? These inquiry activities were created to help you have more hands-on experiences. These hands-on experiences should inspire you to go home and explore your local environment in your background, and maybe travel to new places and explore them!

Don't forget you are a life-long steward of the environment! Continue to practice environmentally-friendly actions so you and your friends and family can enjoy the environment in the future. You have learned so much information, which hopefully has inspired you to pass this information onto others.

Questions:

- What did you learn from this activity?
- How did this activity influence your position as a steward of the environment?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Low Tide Food Web Hunt</td></tr>
<tr><td>ESSENTIAL QUESTION</td><td colspan="3">How are food webs created?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="3">The marine food web can be observed in the field.</td><td></td><td rowspan="3">Students identify food web connections and organisms in the food web that they observe in the field.</td><td>Plankton
Food web
Predator</td></tr>
<tr><td>STANDARDS</td><td></td></tr>
<tr><td><u>NEXT GENERATION SCIENCE STANDARDS</u>:
5-LS2-1</td><td>ASSESSMENTS
- GSSC Notebook pg 43</td></tr>
</table>

Lesson: Low tide food web hunt

Guiding Question:

- How are food webs created?

Key Concepts

- The marine food web can be observed in the field.

Standards

Next Generation Science Standards	5-LS2-1 Ecosystems: Interactions, Energy, and Dynamics

Setting: Outside

Time:

Materials

- GSSC Notebook page 43
- Pencil

Vocabulary

- Plankton - Greek for drifter, microscopic plants, animals or bacteria that are carried with the current. They provide a crucial source of food to larger organisms.

- Food web - a system of food chains
- Predator - an animal that preys on other animals

Procedure

- Students will need to go outside, by an intertidal zone.
- They will search for the animals and plants found on GSSC Notebook pg 43.
- Once they have found a plant or animal, they will draw a line to connect them to what they eat or what eats them to create a food web of the nearshore ecosystem.

Assessment

- GSSC Notebook page 43

5.3 - Who Lives in the Square?

Section 1: For the Teacher

This is one of seven field inquiry activities that students will be able to access depending on their field site(s). Students will use their outside environment to complete these activities. These activities are designed to allow students to have hands-on experiences with their local environment.

This activity requires the students to use page 44 in the GSSC notebook. Students will pick an area on the ground. The size of the area should be close to the size of the GSSC notebook. Once they have picked an area, they will sketch a map that will show the type of ground found in their plot (rock, gravel, sand, or mud). Students will also draw the location of organisms (animals, plants, and algae) they find in their plot. After they have finished drawing, they will list them below the map.

Section 2: For the Student

Your fifth grader brains are an important source of knowledge! You all have spent time learning about your local watersheds, shellfish, and ocean acidification. You're not done learning though! You will be doing activities outside. Doesn't that sound so interesting?!

There are seven field inquiry activities: Low Tide Food Web Hunt, Who Lives in the Square?, Field Notes, Beachfront Scavenger Hunt, Water Quality, and Macro invertebrates. All of these activities will be done outside and results will be recorded in your GSSC Notebook.

In this activity, you will use page 44 in the GSSC notebook. You will pick an area on the ground. The size of the area should be close to the size of the GSSC notebook. Once you have picked an area, you will sketch a map that will show the type of ground found in their plot (rock, gravel, sand, or mud). You will also draw the location of organisms (animals, plants, and algae) you find in your plot. After you have finished drawing, you will list them below the map.

What did you learn from this activity? How did this activity influence your position as a steward of the environment? These inquiry activities were created to help you have more hands-on experiences. These hands-on experiences should inspire you to go home and explore your local environment in your background, and maybe travel to new places and explore them!

Don't forget you are a life-long steward of the environment! Continue to practice environmentally-friendly actions so you and your friends and family can enjoy the environment in the future. You have learned so much information, which hopefully has inspired you to pass this information onto others.

Questions:

- What did you learn from this activity?
- How did this activity influence your position as a steward of the environment?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Who lives in the square?</td></tr>
<tr><td>ESSENTIAL QUESTION</td><td colspan="3">Why are intertidal organisms important to ecosystems?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="4">Intertidal organisms and substrate cover can be estimated to indicate ecosystem health.</td><td></td><td rowspan="4">Students characterize and estimate percentage of substrate (sediment size, ground cover) and organisms in a PVC quadrat in tideland.</td><td rowspan="2">Habitat
Substrate</td></tr>
<tr><td>STANDARDS</td></tr>
<tr><td><u>NEXT GENERATION SCIENCE STANDARDS</u>: 5-ESS2-2</td><td>ASSESSMENTS</td></tr>
<tr><td>GSSC Notebook pg 44</td></tr>
</table>

Lesson: Who lives in the square?

Guiding Question:

- Why are intertidal organisms important to ecosystems?

Key Concepts

- Intertidal organisms and substrate cover can be estimated to indicate ecosystem health.

Standards

Next Generation Science Standards	5-ESS2-2 Earth's Systems

Setting: Outside

Time:

Materials

- GSSC Notebook

Vocabulary

- Habitat - the home of an animal, plant, or organism

- Substrate - the surface on or from which an organism will grow, live, or get nourishment

Procedure
- Go over the vocabulary terms.
- Explain the activity.
- Prepare for outdoors weather.
- Go outside and do the activity and complete pg 44 in the GSSC notebook.

Assessment
- GSSC notebook page 44

5.4 - Field Notes

Section 1: For the Teacher

This is one of seven field inquiry activities that students will be able to access depending on their field site(s). Students will use their outside environment to complete these activities. These activities are designed to allow students to have hands-on exploration with their local environment.

This activity gives students three opportunities to take field notes on different organisms they find. In this activity, students will practice skills of observation examining organisms in the intertidal ecosystem. They are researchers. In their field notes, they will record: time, date, specific location, common name, scientific name, observations, and a field sketch. These field notes will be recorded in the GSSC notebook on pages 45-47.

Section 2: For the Student

Your fifth grader brains are an important source of knowledge! You all have spent time learning about your local watersheds, shellfish, and ocean acidification. You're not done learning though! You will be doing activities outside. Doesn't that sound so interesting?!

There are seven field inquiry activities: Low Tide Food Web Hunt, Who Lives in the Square?, Field Notes, Beachfront Scavenger Hunt, Water Quality, and Macro invertebrates. All of these activities will be done outside and results will be recorded in your GSSC Notebook.

This activity gives you three opportunities to take field notes on different organisms you find. In this activity, you will pretend you are a researcher. In your field notes, you will record: time, date, specific location, common name, scientific name, observations, and a field sketch. These field notes will be recorded in the GSSC notebook on pages 45-47.

What did you learn from this activity? How did this activity influence your position as a steward of the environment? These inquiry activities were created to help you have more hands-on experiences. These hands-on experiences should inspire you to go home and explore your local environment in your background, and maybe travel to new places and explore them!

Don't forget you are a life-long steward of the environment! Continue to practice environmentally-friendly actions so you and your friends and family can enjoy the environment in the future. You have learned so much information, which hopefully has inspired you to pass this information onto others.

Questions:

- What did you learn from this activity?
- How did this activity influence your position as a steward of the environment?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Field Notes</td></tr>
<tr><td>ESSENTIAL QUESTION</td><td colspan="3">How can observations help us reveal more information about an organism?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="4">Focused observation of intertidal organisms in their habitat reveals more information.</td><td></td><td rowspan="4">Students find an intertidal organism to identify, record observations, diagram and label in the field using hand lenses.</td><td>Common name
Scientific name
Genus
Species</td></tr>
<tr><td>STANDARDS</td><td>ASSESSMENTS</td></tr>
<tr><td><u>COMMON CORE STATE STANDARDS</u>: CCSS.ELA-LITERACY.W.5.8</td><td>GSSC Notebook pgs 45-47</td></tr>
</table>

Lesson: Field Inquiry Activity (Field notes)

Guiding Question:

- How can observations help us reveal more information about an organism?

Key Concepts

- Focused observation of intertidal organisms in their habitat reveals more information.

Standards

Common Core State Standards	CCSS.ELA-LITERACY.W.5.8 - Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.

Setting: Outside

Time:

Materials

- Hand lenses
- GSSC Notebook pgs 45-47

Vocabulary

- Common name
- Scientific name
- Genus
- Species

Procedure

- Provide an example of an organism with its common name, scientific name, genus and species. Discuss what each term means.
- Explain the activity.
- Prepare for outdoors weather.
- Go outside and do the activity.

Assessment

- GSSC Notebook pages 45-47

5.5 Beach Scavenger Hunt

Section 1: For the Teacher

This is one of seven field inquiry activities that students will be able to access depending on their field site(s). Students will use their outside environment to complete these activities. These activities are designed to allow students to have hands-on experiences with their local environment.

This activity, on page 48, in the GSSC notebook is a scavenger hunt. Students will search the beach for to find the 5 clam shells listed (Native littleneck clam, Manila littleneck clam, Varnish clam, Butter clam, and Cockle clam). After they have found all five clam shells, they will answer two other questions stated on page 48.

Section 2: For the Student

Your fifth grader brains are an important source of knowledge! You all have spent time learning about your local watersheds, shellfish, and ocean acidification. You're not done learning though! You will be doing activities outside. Doesn't that sound so interesting?!

There are seven field inquiry activities: Low Tide Food Web Hunt, Who Lives in the Square?, Field Notes, Beachfront Scavenger Hunt, Water Quality, and Macroinvertebrates. All of these activities will be done outside and results will be recorded in your GSSC Notebook.

This activity, on page 48, in the GSSC notebook is a scavenger hunt. You will search the beach for to find the 5 clam shells listed (Native littleneck clam, Manila littleneck clam, Varnish clam, Butter clam, and Cockle clam). After you have found all five clam shells, you will answer two other questions stated on page 48.

What did you learn from this activity? How did this activity influence your position as a steward of the environment? These inquiry activities were created to help you have more hands-on experiences. These hands-on experiences should inspire you to go home and explore your local environment in your background, and maybe travel to new places and explore them!

Don't forget you are a life-long steward of the environment! Continue to practice environmentally-friendly actions so you and your friends and family can enjoy the environment in the future. You have learned so much information, which hopefully has inspired you to pass this information onto others.

Questions:

- What did you learn from this activity?
- How did this activity influence your position as a steward of the environment?
- Did you find any other animals? If so, what were they?
- Do you think it's important to preserve these creatures? Why or why not?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Beach scavenger hunt</td></tr>
<tr><td>ESSENTIAL QUESTION</td><td colspan="3">How can clam species be identified?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="3">Clam species can be identified using shell characteristics and anatomical features.</td><td></td><td rowspan="3">Students find and identify clam types on checklist while out in the field.</td><td rowspan="2"></td></tr>
<tr><td>STANDARDS</td></tr>
<tr><td><u>INTEGRATED ENVIRONMENTAL AND SUSTAINABILITY</u>: Standard 2</td><td>ASSESSMENTS</td></tr>
<tr><td colspan="2"></td><td>GSSC Notebook pg 48</td></tr>
</table>

Lesson: Field Inquiry Activity (Beach scavenger hunt)

Guiding Question:

- How can clam species be identified?

Key Concepts

- Clam species can be identified using shell characteristics and anatomical features.

Standards

Integrated Environmental and Sustainability	Standard 2: The Natural and Built Environment

Setting: Outside

Time:

Materials

- GSSC notebook

Vocabulary

Procedure

- Write the terms on the board “hinge,” “umbo,” “radiating ridges,” “growth rings,” and “ligament” on the board. Ask how these terms are related to clams.
- Brainstorm and record their thoughts.
- Go over the definition of each term to make sure everyone knows what they mean.
- Explain the activity.
- Prepare for outdoors weather.
- Go outside and do the activity.

Assessment

- GSSC Notebook page 48

5.6 - Water Quality

Section 1: For the Teacher

This is one of seven field inquiry activities that students will be able to access depending on their field site(s). Students will use their outside environment to complete these activities. These activities are designed to allow students to have hands-on experiences with their local environment.

In this activity, students will be testing the water quality of their local waters. They will be making watershed observations using their senses. They will also be recording the dissolved oxygen, temperature, and turbidity (cloudiness). These will be recorded on pages 49 and 50 in the GSSC notebook.

Section 2: For the Student

Your fifth grader brains are an important source of knowledge! You all have spent time learning about your local watersheds, shellfish, and ocean acidification. You're not done learning though! You will be doing activities outside. Doesn't that sound so interesting?!

There are seven field inquiry activities: Low Tide Food Web Hunt, Who Lives in the Square?, Field Notes, Beachfront Scavenger Hunt, Water Quality, and Macroinvertebrates. All of these activities will be done outside and results will be recorded in your GSSC Notebook.

In this activity, you will be testing the water quality of your local waters. You will be making watershed observations using your senses. You will also be recording the dissolved oxygen, temperature, and turbidity (cloudiness). These will be recorded on pages 49 and 50 in the GSSC notebook.

What did you learn from this activity? How did this activity influence your position as a steward of the environment? These inquiry activities were created to help you have more hands-on experiences. These hands-on experiences should inspire you to go home and explore your local environment in your background, and maybe travel to new places and explore them! Don't forget you are a life-long steward of the environment! Continue to practice environmentally-friendly actions so you and your friends and family can enjoy the environment in the future. You have learned so much information, which hopefully has inspired you to pass this information onto others.

Questions:

- What did you learn from this activity?
- How did this activity influence your position as a steward of the environment?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Field Inquiry (water quality)</td></tr>
<tr><td>ESSENTIAL QUESTION</td><td colspan="3">How can the health of a watershed be determined?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="3">Different components of water quality can be observed in the field.

Dissolved oxygen, temperature, and turbidity of a watershed can be measured to determine the health of a watershed.</td><td rowspan="3">STANDARDS

<u>COMMON CORE STATE STANDARDS</u>: CCSS.ELALITERACY.W.5.7</td><td rowspan="3">Students will use different tools to measure the dissolved oxygen, temperature, and turbidity of a watershed.</td><td>Dissolved oxygen
Turbidity</td></tr>
<tr><td>ASSESSMENTS</td></tr>
<tr><td>GSSC Notebook pgs 49-50</td></tr>
</table>

Lesson: Field Inquiry (water quality)

Guiding Question:

- How can the health of a watershed be determined?

Key Concepts

- Different components of water quality can be observed in the field.
- Dissolved oxygen, temperature, and turbidity of a watershed can be measured to determine the health of a watershed.
- Organisms have certain requirements for dissolved oxygen, temperature and water clarity.

Standards

Common Core State Standards	CCSS.ELA-LITERACY.W.5.7 - Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.

Setting: Outside

Time:

Materials

- GSSC notebook
- Water sample
- Hach testing kit

Vocabulary

- Dissolved oxygen - oxygen held in water, temperature
- Turbidity - cloudiness of water

Procedure

- Write the three terms on the board “dissolved oxygen,” “temperature,” and “turbidity” on the board. Ask how these terms are related to the health of the watershed.
- Brainstorm and record their thoughts.
- Go over the definition of each term to make sure everyone knows what they mean.
- Explain the activity.
- Prepare for outdoors weather.
- Go outside and do the activity.

Assessment

- GSSC Notebook pages 49-50

5.7 - Macro-invertebrates

Section 1: For the Teacher

This is one of seven field inquiry activities that students will be able to access depending on their field site(s). Students will use their outside environment to complete these activities. These activities are designed to allow students to have hands-on experiences with their local environment.

In this activity, students will be observing macro invertebrates. Answers will be recorded on page 51 in the GSSC notebook. Once they have a macro invertebrate, they will be drawing a picture and using a dichotomous key to identify their macro invertebrate. As a group, using their observations, they will determine if the macro invertebrates came from a healthy stream.

Section 2: For the Student

Your fifth grader brains are an important source of knowledge! You all have spent time learning about your local watersheds, shellfish, and ocean acidification. You're not done learning though! You will be doing activities outside. Doesn't that sound so interesting?!

There are seven field inquiry activities: Low Tide Food Web Hunt, Who Lives in the Square?, Field Notes, Beachfront Scavenger Hunt, Water Quality, and Macro invertebrates. All of these activities will be done outside and results will be recorded in your GSSC Notebook.

In this activity, you will be observing macro invertebrates. Answers will be recorded on page 51 in the GSSC notebook. Once you have a macro invertebrate, you will be drawing a picture and using a dichotomous key to identify your macro invertebrate. As a group, using all of your observations, you all will determine if the macro invertebrates came from a healthy stream.

What did you learn from this activity? How did this activity influence your position as a steward of the environment? These inquiry activities were created to help you have more hands-on experiences. These hands-on experiences should inspire you to go home and explore your local environment in your background, and maybe travel to new places and explore them!

Don't forget you are a life-long steward of the environment! Continue to practice environmentally-friendly actions so you and your friends and family can enjoy the environment in the future. You have learned so much information, which hopefully has inspired you to pass this information onto others.

Questions:

- What did you learn from this activity?
- How did this activity influence your position as a steward of the environment?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Macro-invertebrates</td></tr>
<tr><td>ESSENTIAL QUESTION</td><td colspan="3">What can macro invertebrates tell us about the water quality?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="4">Macro-invertebrates can be identified using dichotomous keys</td><td></td><td rowspan="4">Students will use dichotomous keys to identify macro invertebrates and use the information they’ve learned to determine whether the macro invertebrates came from a healthy stream.</td><td>Macro-invertebrate</td></tr>
<tr><td>STANDARDS</td><td>ASSESSMENTS</td></tr>
<tr><td><u>COMMON CORE STATE STANDARDS</u>: CCSS.ELA-LITERACY.W.5.8</td><td>GSSC Notebook pg 51</td></tr>
</table>

Lesson: Macro-invertebrates

Guiding Question:

- What can macro invertebrates tell us about the water quality?

Key Concepts

- Macro invertebrates can be identified using dichotomous keys

Standards

Common Core State Standards	CCSS.ELA-LITERACY.W.5.8 - Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.

Setting: Outside

Time:

Materials

- Dichotomous keys

- macro invertebrates
- Tray
- Magnifiers
- GSSC notebook

Vocabulary

- Macro invertebrate: an organism that lacks a spine and is large enough to be seen with the naked eye

Procedure

- Present pictures of different macro invertebrates and the term “macro invertebrates”
- As a class, share similarities and differences. Why are these macro invertebrates?
- Brainstorm and record their thoughts.
- Explain the activity and how to use a dichotomous key.
- Prepare for outdoors weather.
- Go outside and do the activity.

Assessment

- GSSC Notebook page 51

5.8 - Clam Survey

Section 1: For the Teacher

This is one of seven field inquiry activities that students will be able to access depending on their field site(s). Students will use their outside environment to complete these activities. These activities are designed to allow students to have hands-on experiences with their local environment.

In this activity, students will be conducting a local clam survey with Whatcom Marine Resources Committee members. If the MRC members aren't available, this can be done with the class. 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.

Section 2: For the Student

Your fifth grader brains are an important source of knowledge! You all have spent time learning about your local watersheds, shellfish, and ocean acidification. You're not done learning though! You will be doing activities outside. Doesn't that sound so interesting?!

There are seven field inquiry activities: Low Tide Food Web Hunt, Who Lives in the Square?, Field Notes, Beachfront Scavenger Hunt, Water Quality, and Macroinvertebrates. All of these activities will be done outside and results will be recorded in your GSSC Notebook.

In this activity, you will be conducting a local clam survey with Whatcom Marine Resources Committee members. If the MRC members aren't available, this can be done with the class. The clam surveys will help determine the health of clam populations. You will learn how the surveys can also help estimate the health of clam populations over time.

What did you learn from this activity? How did this activity influence your position as a steward of the environment? These inquiry activities were created to help you have more hands-on experiences. These hands-on experiences should inspire you to go home and explore your local environment in your background, and maybe travel to new places and explore them!

Don't forget you are a life-long steward of the environment! Continue to practice environmentally-friendly actions so you and your friends and family can enjoy the environment in the future. You have learned so much information, which hopefully has inspired you to pass this information onto others.

Questions:

- What did you learn from this activity?
- How did this activity influence your position as a steward of the environment?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Clam Survey</td></tr>
<tr><td>ESSENTIAL QUESTION</td><td colspan="3">How can scientists predict the health of clam populations?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="3">Health of clam populations can be estimated and followed over time.

MRC clam survey protocols are taught.</td><td></td><td rowspan="3">Students conduct a local clam survey with Whatcom MRC members or a simpler version with the class.</td><td></td></tr>
<tr><td>STANDARDS</td><td>ASSESSMENTS</td></tr>
<tr><td><u>COMMON CORE STATE STANDARDS</u>: CCSS.ELA-LITERACY.W.5.8</td><td>- GSSC Notebook pg 40</td></tr>
</table>

Lesson: Field Inquiry Activity (clam survey)

Guiding Question:

- How can scientists predict the health of clam populations?

Key Concepts

- Health of clam populations can be estimated and followed over time.
- MRC clam survey protocols are taught.

Standards

Common Core State Standards	CCSS.ELA-LITERACY.W.5.8 - Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.

Setting: Outside

Time:

Materials

- GSSC notebook

Vocabulary

Procedure
- Explain the activity.
- Discuss the vocabulary terms and the tools that will be used.
- Prepare for outdoors weather.
- Go outside and do the activity.
- After the activity, present the “Clam Survey Distribution 2004-2015” graph. What is this graph showing?
- Complete page 52 in the GSSC notebook together or individually

Assessment
- GSSC notebook page 52

Salish Sea Stewards Reflection

Section 1: For the Teacher

This is the final activity of the unit - the Salish Sea Challenge Sharing and Reflection. Students will reflect on what they've learned during the unit. This activity is found in the GSSC notebook on page 54. How have they been Salish Sea Stewards? This would be a great time to remind them that they are never finished being stewards. This was just the beginning!

Section 2: For the Student

Guess what?! You have completed the unit! You have learned so much since day 1. You started with learning what it's like to be a Salish Sea Steward and that's how you're going to finish today.

In this activity, you will be reflecting on your actions as a steward during the unit. You have had many opportunities to be a steward, especially during the activities you did with your class. Did you do anything outside of school that makes you a Salish Sea Steward? Maybe you influenced your family or friends to take an environmentally friendly action, such as turning off the water when brushing their teeth - that's a great action as a steward!

Just because this unit is over, it doesn't mean you're finished! You are a life-long steward of the environment! Continue to practice environmentally-friendly actions so you and your friends and family can enjoy the environment in the future.

Questions:

- What did you learn from this activity?
- What actions did you do that makes you a Salish Sea Steward?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Salish Sea Stewards (Unit) Reflection</td></tr>
<tr><td>ESSENTIAL QUESTION</td><td colspan="3">What would happen if there were changes in the food web?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="3">As STEWARDS, we can take actions in our everyday lives that support healthy water bodies and ocean ecosystems.</td><td></td><td rowspan="3">Students reflect and write about what they've learned about how their actions can impact intertidal and marine ecosystems.</td><td></td></tr>
<tr><td>STANDARDS</td><td>ASSESSMENTS</td></tr>
<tr><td><u>COMMON CORE STATE STANDARDS</u>: CCSS.ELA-LITERACY.W.5.7</td><td>GSSC Notebook pg 54</td></tr>
</table>

Lesson: Salish Sea Stewards (Unit) Reflection

Guiding Question:

- What would happen if there were changes in the food web?

Key Concepts

- As STEWARDS, we can take actions in our everyday lives that support healthy water bodies and ocean ecosystems.

Standards

Common Core State Standards	CCSS.ELA-LITERACY.W.5.7 - Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.

Setting: Inside

Time:

Materials

- GSSC notebook

Vocabulary

Procedure

- On a board, or in partners/groups, ask students about the actions they have done to protect they are The

Salish Sea?
- Brainstorm and record their thoughts.
- Explain the activity on page 54 in GSSC notebook and have students do the activity.

Assessment:
- Each student draw a picture of one of their Salish Sea Challenge actions and explain to their classmates why it is important to a healthy environment. (GSSC Notebook page 54)

6 - Games

Section 1: For the Teacher

In the extended activities section of the GSSC are games that students can play. The options are: Whale Jenga, Krill - A Whale of a Game!, Oyster Life Cycle, Clam Life Cycle, and Food Web Jumbo Checkers. These games will be loaned to your class when you are ready to play the games.

In this section, students will be using their GSSC notebook pages 55-59. The purpose of these games is to show that games can be used to understand the challenges to survival of marine organisms. Also, these games can prove that small changes can impact the stability of a whole system.

Section 2: For the Student

Did you know that games can be used a source of knowledge? Not only are you having a ton of fun, but you're also learning at the same time! That's exactly what's going to happen in this section - you're going to play fun games and learn, too!

You will have five games provided - it is up to your teacher and/or your class whether you want to play all five, a few, or only one. The options are: Whale Jenga, Krill - A Whale of a Game!, Oyster Life Cycle, Clam Life Cycle, and Food Web Jumbo Checkers.

As you play each game, you will want to use your GSSC notebook to complete a written activity afterwards. These written activities are towards the end of the notebook, pages 55-59. Enjoy the games!

Questions:

- What did you learn from the game?
- Which game was your favorite? Why?
- Which game was your least favorite? Why?

Quick Look Lesson Chart

<table>
<tr><td>LESSON NAME</td><td colspan="3">Games</td></tr>
<tr><td>ESSENTIAL QUESTION</td><td colspan="3">How can we use the resources we have to understand the challenges marine organisms face?</td></tr>
<tr><td>KEY CONCEPTS</td><td>STUDENTS WILL ALSO LEARN</td><td>SCIENCE INQUIRY</td><td>SCIENCE VOCABULARY</td></tr>
<tr><td rowspan="3">Challenges to survival of marine organisms can be understood by playing games about life cycles and food chain and/or webs.

Small changes can impact the stability of the system.</td><td></td><td rowspan="3">Students play games and complete their GSSC Notebook.</td><td>Phytoplankton
Zooplankton
Food web
Spat</td></tr>
<tr><td>STANDARDS</td><td>ASSESSMENTS</td></tr>
<tr><td><u>INTEGRATED ENVIRONMENTAL AND SUSTAINABILITY</u>: Standard 1</td><td>- GSSC Notebook 55-59</td></tr>
</table>

Lesson: Games

Guiding Question:

- How can we use the resources we have to understand the challenges marine organisms face?

Key Concepts

- Challenges to survival of marine organisms can be understood by playing games about life cycles and food chain and/ord webs.
- Small changes can impact the stability of the system.

Standards

Integrated Environmental and Sustainability	Standard 1: Ecological, Social, and Economic Systems

Setting: Inside

Time:

Vocabulary

- Phytoplankton - microscopic drifting plants

- Zooplankton - tiny free-floating animals
- Food web - a system of food chains
- Spat - a juvenile oyster that has changed into an adult develops its shell and attaches to a substrate like a rock or shell. This is the life stage that is most vulnerable to ocean acidification. At this point, attachment and shell formation are interrupted.

6.1: Whale Jenga

Materials

- 1 set of Jenga
- 21 green blocks (Phytoplankton), 12 blue blocks (Zooplankton), 12 red blocks (Krill and small fish)
- 1 purple block (Whales)
- 1 stack of playing cards
- Informational whale cards

Procedure

- Place the green blocks on the bottom, then blue, then red and the purple block on the very top.
- Shuffle the playing cards and stack them upside down.
- The first player picks a card, reads it aloud and follows the instructions written on the card. Only the block being removed or returned may be touched. (You are not allowed to hold the rest of the stack together while removing the blocks.)
- Put the used cards into a discard pile.
- Place removed wood blocks into a discard pile off to the side.
- Continue to take turns until the tower falls and the food web collapses or all cards are used up.

Assessment

- GSSC Notebook 55

6.2: Krill - A Whale of a Game!

Materials

- Krill Game Cards
- Krill Game Instructions

Procedure

- There are five different games all using the playing cards and directions provided.

Assessment

- GSSC Notebook 56

6.3: Oyster Life Cycle Game

Materials

- 1 sheet with instructions and board game
- 1 six-sided die
- 4 oyster player pieces
- Playing cards (30)

Procedure

- Roll die
- If an even number is rolled (2,4, or 6) draw a card; if an odd number is rolled (1,3, or 5), the turn is over
- If a card was drawn, read the card and follow the instructions
- First player to get to “reproduce: sperm and egg” final square wins!

Assessment

- GSSC Notebook 57

6.4: Clam Life Cycle Game

Materials

- 1 sheet with instructions and clam life cycle
- 7 life stage cards

Procedure

- Try to place the different stages of a clam's life cycle in order. When students think they have the correct order, flip over the sheet to check if their answer is correct.

Assessment

- GSSC Notebook 58

6.5: Anemone Life Cycle Game

Materials

- 1 sheet with instructions and life cycle diagram
- 1 bag of play dough

Procedure

- Anemones can reproduce two different ways. Mold the different stages of anemone's life out of the dough.

Assessment

- GSSC Notebook 58

6.6: Food Web Jumbo Checkers

Materials

- 1 set of jumbo checkers pieces
- 1 game rug

Procedure

- Set up pieces however student would like as in a normal checkers game
- Each piece can jump the organisms on the underside of their picture. (You can only jump what you can eat!)

Assessment

- GSSC Notebook page 59

Appendix A. Ocean Acidification

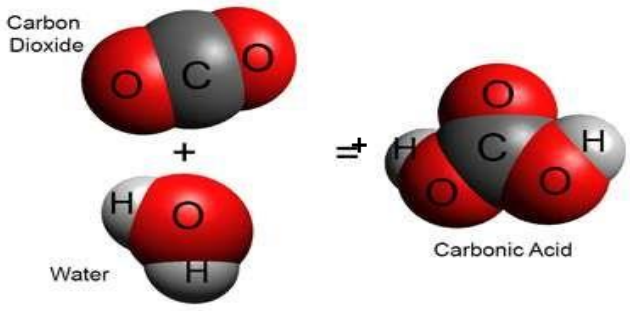
Science Content Background

Shellfish
Ocean Acidification

Video Resource: http://www.whoi.edu/home/oceanus_images/ries/calcification.html
Background: Ocean acidification is the ongoing increase in the acidity of the Earth's oceans, caused by the uptake of carbon dioxide (CO_2) from the atmosphere.[2] All life forms on earth are carbon based so that an understanding of the **carbon cycle** will help students recognize different sources of carbon dioxide and how excess carbon emissions can impact oceans.
Shellfish are *calcifiers* that make their shells by removing calcium carbonate ($CaCO_3$) from water and depositing it as the shell or exoskeleton. The mollusc shell is formed and repaired by the organ called the *mantle*. The mantle deposits calcium carbonate minerals that are extracted from water through the gills to form the shell, a process that requires cellular energy. A high pH environment favors shell formation. Increased atmospheric carbon dioxide from fossil fuel combustion, causes ocean acidification. A shift to lower pH (higher H+) conditions make the carbonate ion, CO_3, unavailable for shell formation. That means, the mantle has to pump the excess hydrogen ions (H+) out in order to make the carbonate ion, CO_3, available to make the shell which requires a lot of cellular energy. As a result, shell formation may be interrupted or shells may be thinner, putting organisms at greater risk of predation. Shellfish life cycles can be disrupted: for instance, motile oyster larvae (spat) may not be able to attach to a substrate and survive to adulthood. As oceans become warmer and more acidic their shells will either thin, or the animals will have to expend more energy on making producing thicker shells. This will affect shellfish populations, the ocean food web and the shellfish industry.

$Ca^{++} + CO_3^{--} \Longleftrightarrow CACO_3$

Calcium ion + Carbonate ion $\Longleftrightarrow$ Calcium carbonate (used for shell formation in *calcification.*)



H^+ - free hydrogen ions increase acidity, decrease carbonate needed to form shells.

Overview/Background:
Human actions have created an excess of CO2 in the atmosphere. The ocean absorbs CO2 as part of the natural carbon cycle, but the excess amount is changing the pH of the ocean from slightly alkaline to acidic. This change is already impacting the bottom of the food web by threatening organisms with shells including oysters and clams.

Lesson Plan

Before the Lesson

Have students watch and answer questions in the science notebook for

"The Other CO2 Problem" https://www.youtube.com/watch?v=kvUsSMa0nQU

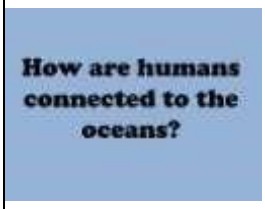
(7.5 min) is a fun clay stop motion animation. Subsea creatures are suffering as the ocean becomes more acidic as a result of human activity. Produced by Ridgeway School (Plymouth, UK) and Plymouth Marine Lab for primary grades & above. **3rd grade+**

Other optional videos are listed on the Garden of the Salish Sea website.
http://www.gardensalishsea.org/

Day of Lesson

The Power Point is set up to guide you through the content of the lesson prompting discussion and content. Pictures of each slide with its corresponding number are included to help you keep track of where you are. The notes in the lesson plan can also be seen in the Power Point if used in presenter's view.

Activating Prior Knowledge
Slide 2



Use the chart from lesson 1 to review how humans are connected to the oceans emphasizing:

- Intertidal ecosystems provide an important function.
- Shellfish are important for a healthy ocean.
- People eat shellfish for food.

Introducing the Essential Question
Slide 3

Use another chart with the essential question on the top to record student answers. (This chart will be used again at the end to record what they learned.)

Exploring natural cycles in nature
Slide 4

- Other natural cycles may include
- The water cycle to renew our sources of fresh water
- The seasons are a cycle of renewed life after dormancy
- Any plant or animal life cycle.
- The salmon life cycle that keeps a supply of food for many animals and ultimately nourishes the forest when their bodies decay.

Introducing the Carbon Cycle as a natural cycle.
Slide 5

Emphasize the Carbon Cycle is an important part of the natural life cycle in nature and necessary for the balance of the environment and to sustain life on Earth.

Natural ways Carbon is added to the cycle
Slides 6-7

This slide and the next one show natural ways carbon is added to the Carbon cycle.

- "We are a natural part of the Carbon cycle along with all other living organisms."

Emphasize that

- CO2 is a natural byproduct of every life cycle.
- Nature expects and needs these things to happen to sustain life.

Natural ways Carbon is absorbed from the cycle
Slides 8-10

Emphasize that

- In a cycle, what is created is then used or absorbed to start over again.
- Plants absorb and use the CO2 humans and other living things give off and give off the oxygen living things need to survive.

Water also absorbs CO2 as part of the Carbon cycle.

Be sure students understand that CO2 is a natural byproduct of life that nature needs to sustain life using the Carbon Cycle.

Introduce KEY CONCEPT 1: Nature has natural cycles that support life when balanced.
Slide 11

Put up sentence strip with key concept in a permanent visible place so it can be referred

Identify the problem: What could impact the natural balance of the Carbon Cycle?
Slides 12, 13

- Solicit students' answers to the question.
- Ask for ideas on how we would know if something had an impact on the cycle.
- What ideas might change?
- Ideas: Animals might change their habits or start to die, plants in an area might start to die or a different type may flourish.

- Human actions such as driving cars and creating factories have increased the amount of C02 in the atmosphere, shifting the balance of the carbon cycle.
- Do you think it would impact what happens in what happens in the cycle?

Impact and Vocabulary: Ocean Acidification
Slide 14

Have students explain what they think "ocean acidification" means in their own words. Point out the root *"acid"* in the term *acidification* to help students connect the impact to the experiment.

What is pH? Vocabulary: pH, acid, base (alkaline)
Slide 15

"PH stands for the power of hydrogen. We are able to measure if a solution is an acid or a base using the *pH* scale. The pH is measured on a scale from 0 to 14 where a pH of 7 is neutral, pH below 7 is acidic and a pH above 7 is basic or alkaline. Solutions at the extremes of the pH scale are corrosive. "

Be sure students understand the concept of the ranges on the pH scale before moving on. This is important for the following experiment.

What is pH? pH of Household Solutions experiment
Slides 16, 17, 18

Preparation:

- Emphasize the use of the elements of the scientific method listed.
- Let them know this is the way scientists do experiments if they do not already now.
- Why would each element be important?
- PREDICTION: So we know what we are expecting and so will know if we were right or wrong.
- CONTROL AND CHANGING VARIABLES: Change one variable at a time so we know whether or not that variable makes a difference.
- REPEAT: Check to be sure results are consistent and not the result of a mistake.

Procedure:

- Leave this slide up while students are doing the experiment for reference.
- The teacher or helper will pass out (1 or 2) cups with various household solutions to each small group at a time.
- As a group, students will predict the pH of the solution BEFORE measuring.
- Students will take turns measuring and recording the pH of each solution until the procedure is completed 3 times for each solution.
- Students will measure pH by holding the litmus paper in the solution to the count of one - one thousand and match the color of the litmus paper with the laminated pH scale to determine the pH.
- Students should be careful not to handle the end of the litmus paper that will be dipped into the solution as that can change the results.
- Students should identify the pH of each solution with a range on the pH scale; acid, neutral or basic.

Results:

- Go through each of the questions with the students as they come up and have them reflect on their results.
- Emphasize that blood is neutral.
- After answering the last question, make the point "Most living organisms can live in the neutral range between pH 6-8."

Introduce KEY CONCEPT #2: Most living things like an optimal pH range close to neutral like blood or water. Put sentence strip with key concept up next to #1.

Application of Learning
Slides 19

Ask:

- "Now that we know what pH is, let's think about the term 'ocean acidification.'
- "What was the definition?" Have someone read it from their notebook glossary.
- "What do you think happens to the ocean when there is too much CO2?"

Demonstration: Human Smokestack
Slide 20

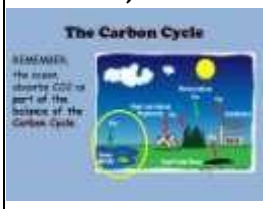
- Tell students "We produce CO2 from burning oxygen as part of our natural life cycle. Cars and factories produce CO2 from burning oxygen too.
- We can use our breath to demonstrate what happens when that natural cycle is out of balance."
- Ask students, "What do we think happens to the water when more CO2 is absorbed?"
- Response: "It becomes more acidic."

Leave this slide up during the experiment and have students follow instructions on the sheet in their science notebooks.

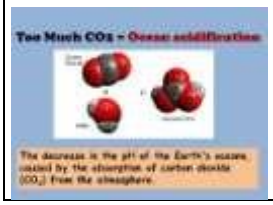
Procedure:

- Each student will receive 2 cups labeled 1 and 2 filled to the bottom line with water, placed on a white surface (paper or cardboard).
- The teacher or helper will add 6 full droppers of RED CABBAGE INDICATOR to each cup and cover cup 2.
- Students will blow their breath through a straw into cup #2 (the changing variable) until there is a change in color from blue to purple or pink, when compared to cup #1 (the control or unchanged solution).
- Students should blow slowly into the cup. The color change could take a couple of minutes. Students should take care not to blow too hard because they can become lightheaded.
- **Students should understand that the CO2 from their breath is a natural source of carbon dioxide and is NOT part of the CO2 problem.**
- Ask students, "Look at the change in color and tell me what the color change means".
    - Response: The water changed color because it absorbed CO2 from my breath that made it more acidic.
- Ask students, "What pH do most living organisms need to survive?"
    - Response: Neutral.
- "Does water that has absorbed a lot of CO2 provide a good environment for living organisms? Why?"
    - Response: No, too acidic.
- "What causes too much CO2 in the ocean making it more acidic?"
    - Response: Too much CO2 in the air from things like cars and factories.

Review
Slide 21, 22



- Tell students, "Remember, the ocean absorbs CO2 as part of the natural Carbon cycle and keeps water close to neutral when in balance creating a supportive balance for life. The ocean does not have an off switch. If there is more CO2 out there, it will keep absorbing it – even if it impacts what happens in the Carbon cycle."



- "When there is more CO2 in the atmosphere, the ocean keeps absorbing it and what happens?"
  Response: Ocean acidification

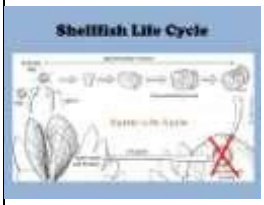
The Impact on Shellfish

Slides 23-28

Ask students, "Do you have any ideas?"

Ask students, "Thumbs up if you like oysters… shrimp… clam chowder?"
Response: Students hold up thumb in response

"What would happen if this seafood went away? Did not exist anymore?"
Responses may be mostly impact to us.
"Would their absence impact other organisms in the sea that eat these shellfish too?



"What is SPAT?"
Response: It is when the baby oyster transitions from its swimming stage to its attached stage.
"What would happen if it did not attach?"
Response: It would not be able to grow into an adult or reproduce to make more shellfish

"This is what SPAT looks like when it is attached and starting to grow."

Shellfish, crabs, and many other sea organisms are called **calcifiers**, because they take calcium from the water to make their shells under neutral pH range.

Impact Demonstration
Slide 29

- Students turn to this page shown on slide in science notebook.
- Students compare shells soaked in vinegar and shells soaked in water and record observations in their notebook.
- Ask "What did you observe?
- Response: Shells are dissolving
- "Why do you think this is happening?"
- Response: Because they are in an acid.
- "What impact do you think it has on the organism?"
- Response: They aren't able to grow or reproduce.
- "Do you think this is this what happens with ocean acidification?"
- Response: Yes

Introduce KEY CONCEPT #3: Human actions can impact natural cycles.

Assessment
Slide 30

Lead a discussion about how two cities with different amounts of CO2 in the atmosphere would look. Have students show their ideas by creating scenes on the story board.

CHECK FOR UNDERSTANDING:

- CO2 is part of the natural balance of the Carbon Cycle.
- CO2 is also created by cars and factories. This puts more CO2 into the atmosphere causing the Carbon cycle to be out of balance.
- Ocean acidification is the result of too much CO2 in the atmosphere.
- Ocean acidification is harmful to shellfish.

Record Learning - Answer the question
Slide 31

Add new student responses on chart under guiding question.

Empowerment and Stewardship
Slides 32-40

Read slide to students

Salish Sea Watershed challenge was introduced in week 1.
Ask for thumbs up, sideways, or down to show how students are doing with it.
"Let's look at a few reminders of things you can do."

"Remember what we learned about cars?"

"All of these things help cut down on the amount of CO2 that goes into the air. Every time you make a choice to do one of them instead of taking your own car, you are helping to keep our world healthier. They are a part of the Salish Sea Watershed Challenge"

These things are in the bottom section of the Salish Sea Watershed Challenge titled "Conserve Energy, Reduce Carbon Dioxide Emissions!"

"What other things are part of the Salish Sea Watershed Challenge that can help the Salish Sea be healthy?"

Read the slide to students.
"This is very important. It is also the law."

"Did you know that when you wash your car in the driveway, all of that dirt and soap goes through the storm drain right out into the Salish Sea? Car washes clean the water before it gets there."

Pledge
Slide 40

"The more we learn, the more we can do. We know how important it is to be a steward of the Salish Sea, so let's commit to doing what we can. Please rise and hold up your right hand."

Students stand and raise their right hand as they read the pledge together.

Assessment: Reflection

At a convenient time, have students complete the reflection to see how they can apply what they have learned.

Optional Activities

Videos

Questions for these three videos are in the science notebook.

- The Other CO_2 Problem https://www.youtube.com/watch?v=kvUsSMa0nQU
- Hermie the Hermit Crab
  https://www.youtube.com/watch?v=RnqJMInH5yM
  (1:36 minute) A short animation from the Great Barrier Reef Marine Park Association (GRMPA). Hermie the Hermit Crab has trouble finding a shell to live in with ocean acidification. **3rd grade+**
- Acidifying Water Takes Its Toll on Northwest Shellfish
  https://vimeo.com/54408927
  (6 minutes) Listen to the news story and view the video to learn more about local impacts.

Other videos on Ocean Acidification

- Alliance for Climate Education https://www.youtube.com/watch?v=Wo-bHt1bOsw
  (3:01) Animation explains ocean acidification chemistry. **3rd grade+**
- Ocean Acidification https://www.youtube.com/watch?v=kxPwbhFeZSw
  (1:50 minutes) This is a short video that explains ocean chemistry and how ocean acidification can affect ocean life.
- Acid Test: The Global Challenge of Ocean Acidification
  https://www.youtube.com/watch?v=5cqCvcX7buo
  (21:34) This groundbreaking NRDC documentary explores the startling phenomenon of ocean acidification. The film, featuring Sigourney Weaver, originally aired on Discovery Planet Green. **5th grade +**

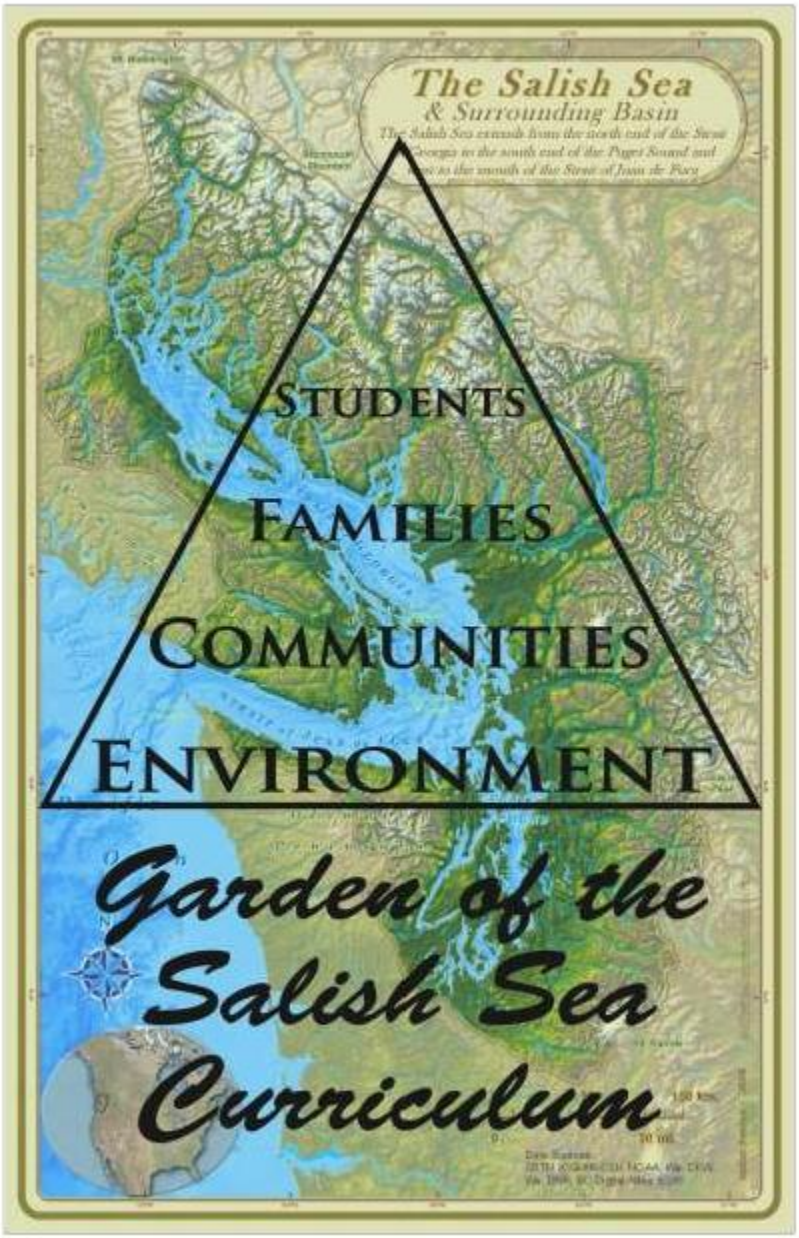
Check out the **Garden of the Salish Sea** website for more information and activities on ocean acidification, shellfish, and stewardship.
http://www.gardensalishsea.org

Appendix B. Whatcom Marine Mammal Stranding Network 8th Grade Lesson

This lesson plan is attached as a separate document.

Appendix C. 5th Grade Student Notebook

My Garden of the Salish Sea Science Notebook



Name _____

Teacher _____

Garden of the Salish Sea Curriculum:

Table of Contents

Sponsored by: Pacific Shellfish Institute

Funded by: Whatcom Community Foundation

and by donations

1. Salish Sea Stewards Challenge

Be a Salish Sea Steward!

- ***RECORD YOUR ACTIONS & YOUR FAMILY'S ACTIONS AT HOME***
- ***Discuss actions you AND your family will DO to keep our waters clean?***
- ***Mark this sheet, fill in the bubbles, and tally each time you DO your action.***

Are you meeting the Challenge?

Scoop the Poop! Pet and livestock waste pollutes water if allowed to RUN OFF, spreading disease and causes algal blooms.

- Scoop it! Bag it! Trash it! I WILL carry a bag and clean up after my dog on the street and in the yard.
- I WILL encourage my cat to use a litter box, scoop the poop, bag it, and empty into the trash (not the compost bin).
- I WILL keep livestock away from creeks and ditches and scoop the poop.
- I WILL discourage wildlife by securing garbage cans, keeping pet food inside and not feeding ducks and geese.

Septic Sense! WE WILL maintain our septic system. Failing systems can cause, property damage and water contamination.

- Keep septic system in top working order. Have it inspected regularly and get my tank pumped when needed.
- Spread out laundry and dishwasher loads to prevent overloading my septic system.

On the Water!

- WE WILL make sure the valve on the boat's holding tank is kept in the closed position.
- WE WILL never dump the holding tank into the water. WE WILL always use the pumpouts provided at the marina.

Pounding the Pavement!

- I WILL NOT dump toxic materials down storm drains or on the ground.
- WE WILL leave buffers of native vegetation at the base of hills and along the water's edge.
- WE WILL position gutters so that they drain rainwater onto grass or garden beds, away from **impervious** surfaces.
- WE WILL use **pervious** spaced paving stones, bricks, sand or gravel in our driveway and walkways.
- We WILL minimize **impervious** surfaces when remodeling or building.

I WILL Conserve Energy & Reduce my Carbon Footprint!

- I WILL ride a bike or walk instead of driving.
- I WILL turn off lights, appliances, and computers.
- WE WILL put high energy-using items like water heaters on timers.
- We WILL buy local products and foods, **support our local farmers**.
- WE WILL plant trees, vegetation, and cover crops.

WE WILL Reduce, Reuse, and Recycle!

- We will minimize the use and purchase of plastics.

2. Intertidal Biome

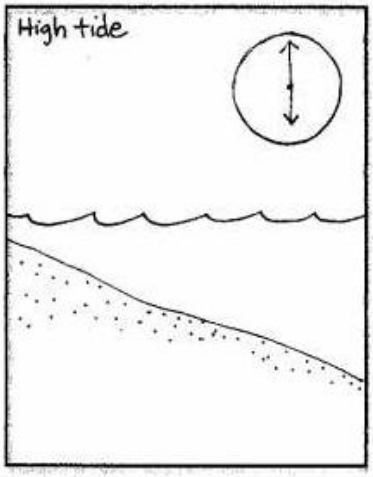
Vocabulary: Diversity – Watershed – Zooplankton – Phytoplankton

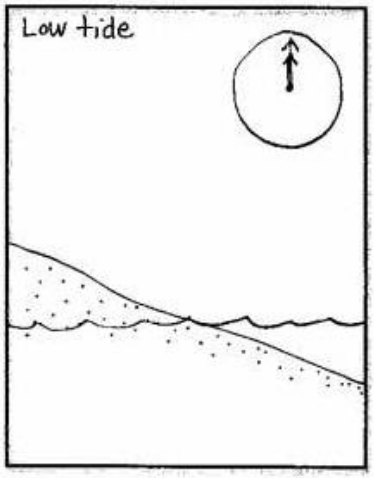
Please complete this chapter's work before the first day of activities.

As a class watch the video "Intertidal Biome" on the 5th grade page, then complete the questions below.

What is the intertidal zone?

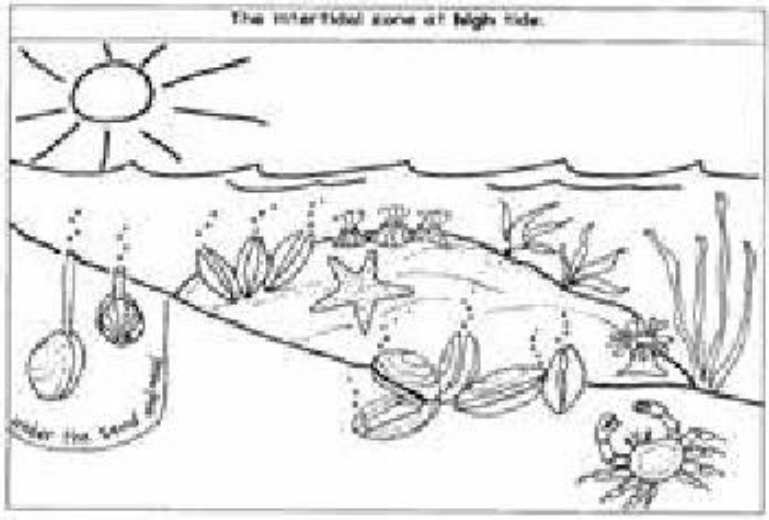
The part of the shore between _____ tide and _____ tide is called the intertidal zone. This marine ecosystsem is found along _____ all over the world. It is rich in nutrients and oxygen and is home to many plants and animals.





Where can you explore the intertidal zone nearby? _____ and _____ _____.

The intertidal zone is an active place. Many organisms must anchor themselves to adapt to this high energy environment. When the tide goes out, shellfish close their shells and animals that can move will follow the water. Plants that waved in the water now lay flat on the sand or rocks. Organisms have to survive being high and dry during low tide. Plants get energy from the sun through photosynthesis to make their own _____.



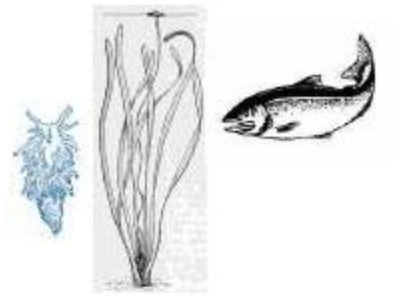
Think about the intertidal zone and give two reasons it is a tough place to live. Use complete sentences.

_____

_____

There are different kinds of intertidal zones, each with their own unique sets of organisms…

Coral Reef

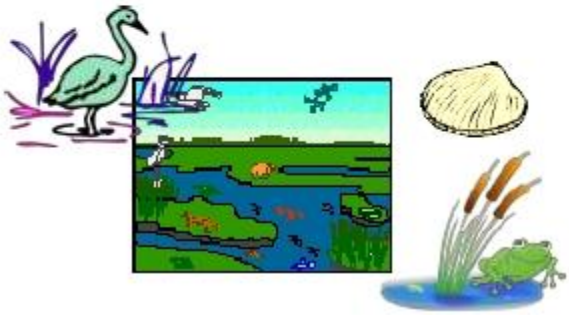


Eel Grass

Sandy Beach

Rocky Shore

Kelp Forest



Salt Marsh

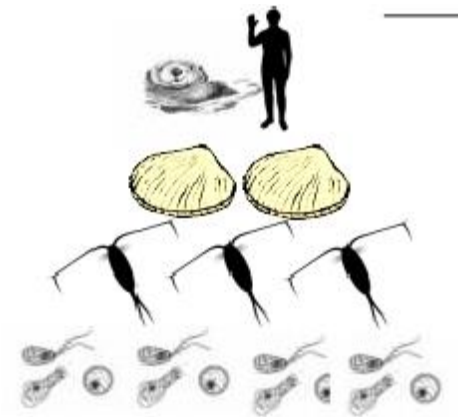
Circle three types of intertidal zones in the Salish Sea then write the names of three animals in those habitats below.

1._____ **2.** _____ **3.** _____

What type is your local intertidal ecosystem?

_____

Shellfish play an important role in the food web.



<u>The Shellfish Food Chain</u>

Human or Otter

Clams & Oysters

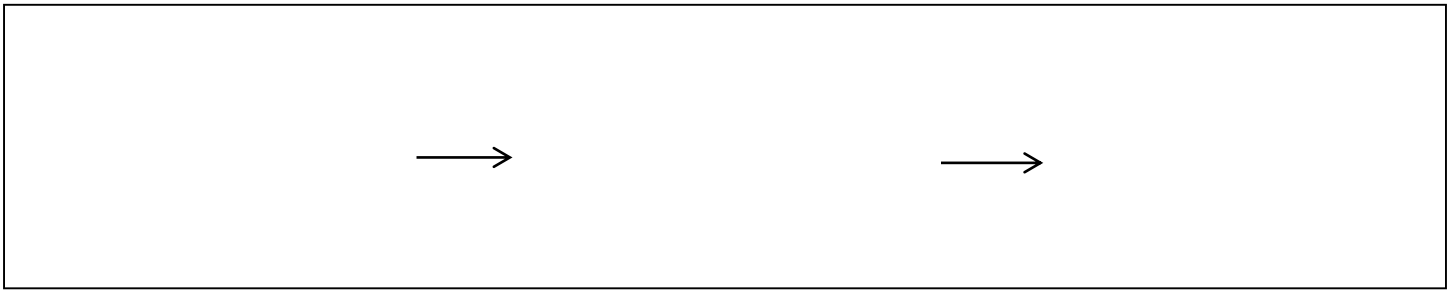
Zooplankton

Phytoplankton

Shellfish eat _____,

and are a source of food for _____.

Draw a simple three organism food chain below using the organisms of the intertidal zone.



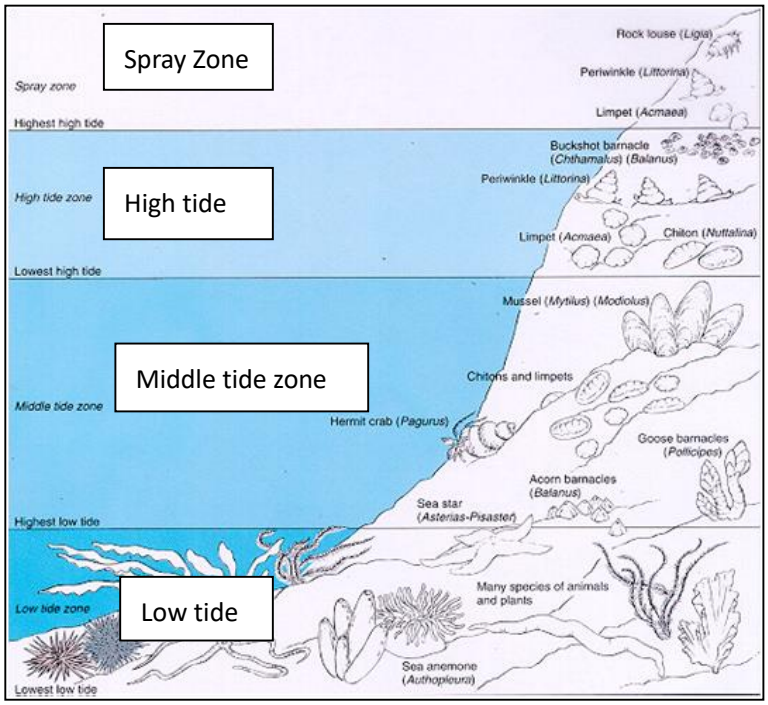
Different organisms survive at different depths or zones within the intertidal ecosystem.

Make an arrow from each organism below to the zone you think they would live in. Make your best guess, answers upside down below!

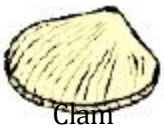
Barnacle

Eel Grass

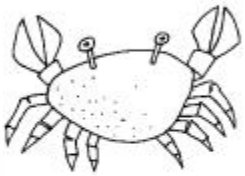
Oyster



Organisms of the Intertidal Zone:


Clam


Hermit Crab

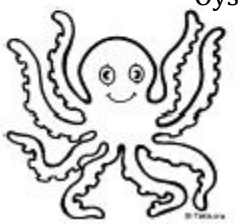

Crab


Salmon


Oyster

Eel Grass


Snail


Octopus


Sea Anemone

Zooplankton


Seastar


Sea Urchin

Draw at least three of the organisms above in your own intertidal zone below.
(Don't forget to draw in the water level, the sun, and seaweed!)

My Intertidal Zone

My intertidal zone is at (circle one):

High Tide Low Tide

3. Shellfish Topics Part 1

Station 3.1 Salish Sea Stewards

Responsibility: Being a steward means making a commitment to **take care of something**.
Think about things you are responsible for in your home. Examples can be chores and caring for a pet.
Draw a picture of yourself being a steward.

Look at the ways we can take care of the Salish Sea on the **Challenge** sheet. Name something that you already do at home with your family to be Stewards of the Salish Sea.

_____

_____

Think about ways you and your family can become better Salish Sea Stewards. Write 2 stewardship goals of practices (habits) you will do with your family during this unit.

1_____

2_____

Station 3.2: Watersheds

First, complete the watershed activity. Then answer the questions below.

Vocabulary: Run-off

What are 3 sources of pollution in the watershed model?

1. _____

2. _____

3. _____

Watershed Map

Put a push pin in the watershed map where you live.
What waterbody do you live closest to? _____

When you added a sponge to the watershed model, the water was soaked up when it "rained" preventing the rainwater from running off into the ocean. The sponge acts like a **Pervious/Impervious** (circle one) surface.

What do you think the sponge represents? _____

Draw and label an example of a **pervious surface** and **impervious surface** on the chart below.

Pervious	**Impervious**
 Forest	 Farm
 Grass	 Rock
	 Road

In a watershed, what can help to soak up water and pollutants to keep them from reaching rivers and the ocean? (Clue: it grows)

_____

Storm Drain (pictured at left & right): drains excess rain and ground water from impervious surfaces. Many lead the water to rivers, streams, or oceans.

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

1. _____

2. _____

Healthy Watershed Design

Draw and label a map of a building lot with a house, or a farm next to a stream or the beach using the elements below. Label the surfaces **P** for **pervious** and **I** for **impervious** Use arrows to draw the path that run-off from rain will take on the site. Explain how your choices minimize impacts to the watershed and minimize carbon dioxide in the air.

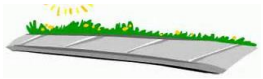
Pervious






Impervious





Energy Choices



Explain how each of your watershed healthy design element choices will help to minimize water and air pollution. Also explain how people living on the property can use lifestyle habits from your Salish Sea Challenge to minimize their impact. Use the following vocabulary: **run-off**, **pervious** and **impervious.**

Station 3.3: Oyster Exploration

Part 1: Live Tank

There's more going on inside this shell than meets the eye.

Vocabulary: Habitat – Ecosystem – Intertidal zone – Filter feeders

Systems: Draw a picture of what the shellfish and algae are doing.

Systems: How is the aquarium in front of you a system? What are the inputs and what are the outputs?

Inputs: _____ Outputs: _____

Draw and label a diagram of the system you see.

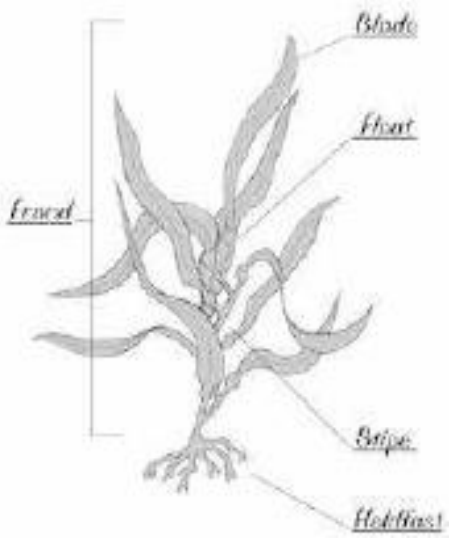
Connection: How does an oyster breathing and filtering the water help other plants and animals in the ocean?

Connection: How does an oyster breathing and filtering the water help other plants and animals in the ocean?

_____

_____

Focus on Math: Focus on Math: One oyster filters 50 gallons of water in a day and one clam filters 40 gallons a day. If you had 2 oysters in one tank and 6 clams in another tank, would the clams or the oysters filter through more water in a week? Show your work.



_____ will filter more water in a week.

Form and Function: Algae's structure differs from that of terrestrial (land) plants. Name one major difference in structure and explain how it works in the life cycle of the algae.

_____

_____

Communities: Algae play an important role in environmental communities. Describe one role algae plays in the success of intertidal animal and plant communities. Function

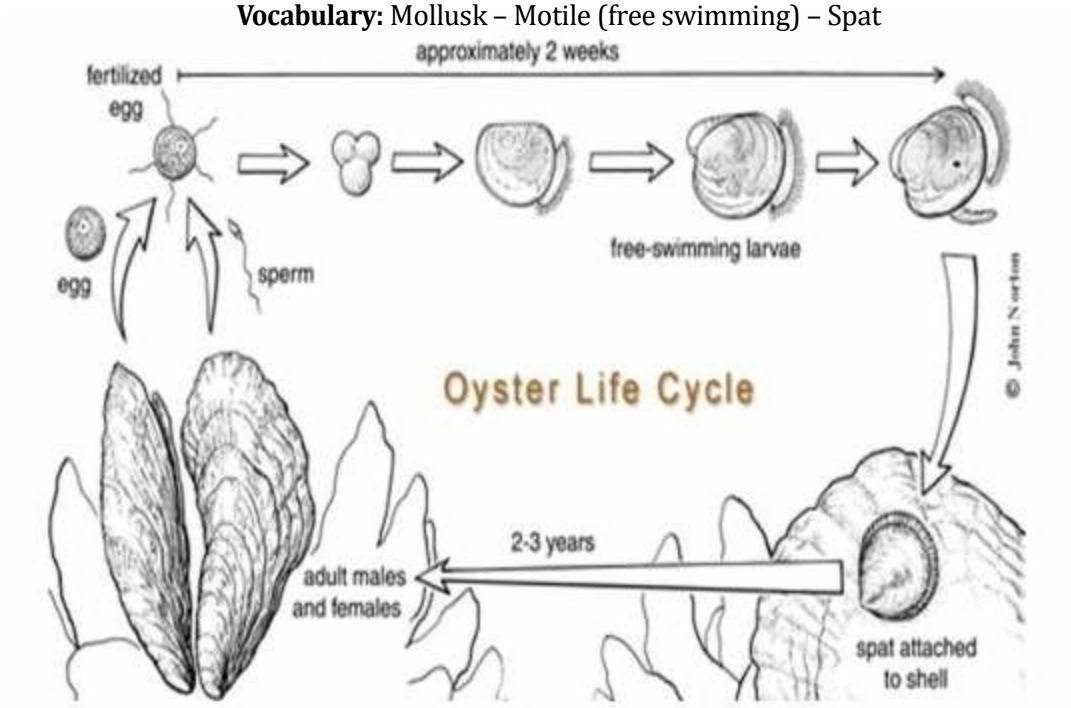
_____

_____

Pacific Shellfish Institute

Part 2: Healthy Life Cycle

Vocabulary: Mollusk – Motile (free swimming) – Spat



Function: How does an oyster move before it becomes an adult?

_____

What is a free-swimming baby oyster called?

_____

What is a baby oyster called when it has just attached to a substrate (rock or shells)? (Clue: rhymes with "splat")

_____

Connection: If oceans become more acidic, shellfish will have trouble forming what part of their body?

_____

Cool Fact: Shellfish have growth rings that record the seasons.

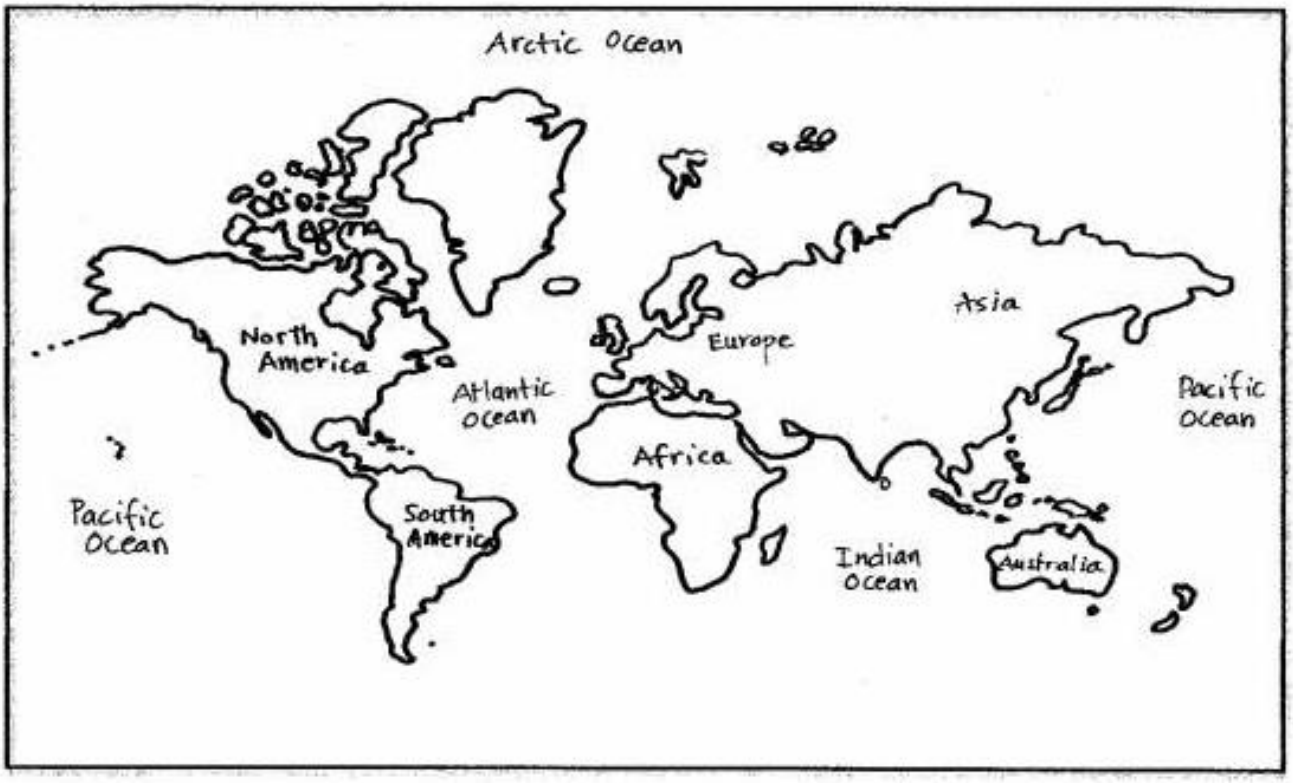
Draw a picture of your shell with its growth rings.

How old do you think your shell is?

Station 3.4: Shellfish in Time and Place

Shellfish are **mollusks** that appeared on earth more than 500 million years ago according to the fossil record.

Marine shellfish live or lived along coastlines around the world,
Trace the shoreline of 3 continents where shellfish are found.



The Salish Sea includes the Puget Sound, Straits of Georgia, Straits of Juan De Fuca, the Gulf Islands, and the San Juan Islands. Name 2 countries within the Salish Sea:

1._____

2._____

Pick a shell on the map to learn more about. Where is it from?

_____

OYSTER TRIVIA:

Q: Which oyster is native to Puget Sound and the Salish Sea?

A:

Q: Pacific oysters are native to which Country?

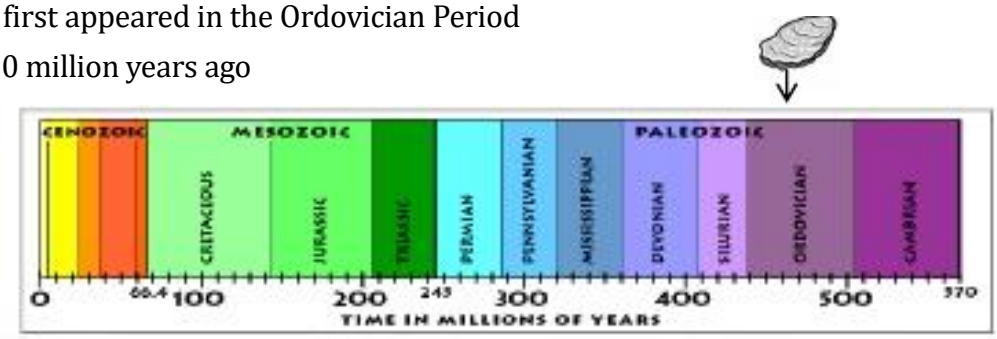
A:

Shellfish have lived on earth for 500 million years. Fossils are the remains of buried prehistoric animals like shellfish.

Cool Fact: *Recent discoveries of ancient clam gardens along the coasts of British Columbia have led to a rebirth of traditional horticulture practices of shellfish harvesting and highlighted the cultural, ecological and economical importance of healthy shellfish gardens.*

Geologic Time:

Shellfish first appeared in the Ordovician Period about 500 million years ago



Choose a fossil. How old do you think your fossil is? _____

What country is it from?

_____

Draw a star on the map where the fossil is from. Was your fossil in the shaded shoreline area on the map?

_____

Why do you think shellfish fossils can be found in places where there is no water today?

_____

_____

Vocabulary: fossil - reef

Part 1 Reflections

Shellfish Topics Reflection

How were the shellfish in the tank eating? _____

How many gallons of water does an adult oyster filters in a day? _____

How do shellfish help the environment? _____

What do algae need to grow? _____

How does an oyster move before it attaches? _____

Thinking about today's activities

Reflection: What are 2 things you learned?

1. _____
2. _____

Reflection: What are two things that you already knew?

1. _____
2. _____

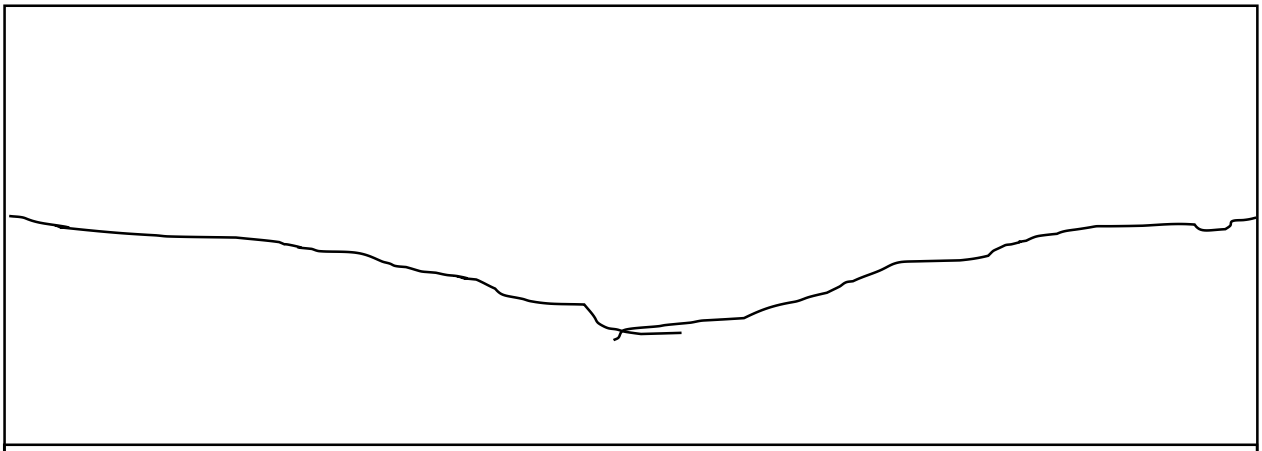
Reflection: What is one thing that surprised you?

1. _____

Draw your favorite thing that you observed.

Watersheds Reflection

Compare & Contrast: Using the watershed activity as an example, draw a picture of a healthy watershed and ocean **intertidal zone** and compare to an unhealthy watershed and ocean **intertidal zone**.



Healthy watershed and intertidal zone

Unhealthy watershed and intertidal zone

What are 3 sources of pollution in the watershed model?

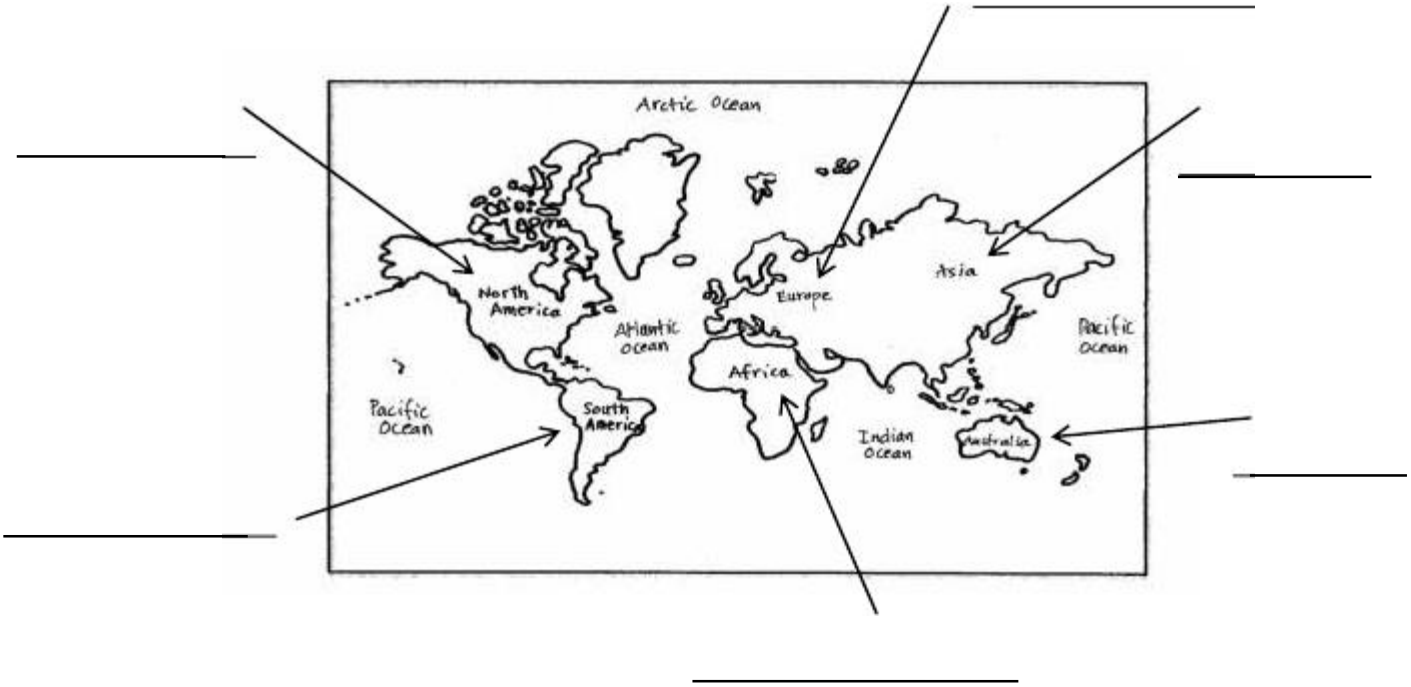
1. _____
2. _____
3. _____

Shellfish in Time & Place Extension

You will need to access a computer for this activity.

1. Go to the website www.gardensalishhsea.org
2. Click on the menu, click on **Multimedia > Videos, Slideshows & Links > Shellfish**
3. Find **Shellfish Around the World** and explore the map!

Find one shell that you like from every continent. Label it below.



What is your favorite shell that you found named?_____

What sea is it from? _____

Can you name one shellfish species near where you live? _____

Shellfish Topics Part 2

Station 3.5: Coast Salish Peoples and Culture

Vocabulary: Coast Salish – midden – clam garden

The First Peoples have a saying… "WHEN THE TIDE GOES OUT, THE TABLE IS SET"

Since Time Immemorial: The Salish Sea is named for the Coast Salish Peoples, Native American tribes (First Nations in Canada) who have lived near its shores for over 10,000 years growing and eating shellfish. Shellfish resources are of central importance to the economy, culture, subsistence, and identity of Tribal members.

Name two things that the Coast Salish Peoples used shells for in the past

1. _____ 2. _____

What was left behind when Coast Salish Peoples travelled along coastlines eating shellfish where they camped?

_____

In 1855, the Point Elliot Treaty stated Indiginous peoples could not take shellfish from areas cultivated by the new settlers. How did that change Coast Salish People's way of life?

_____

_____

Water Quality and Stewardship: What have the Coast Salish People cultivated that improved water quality?

_____

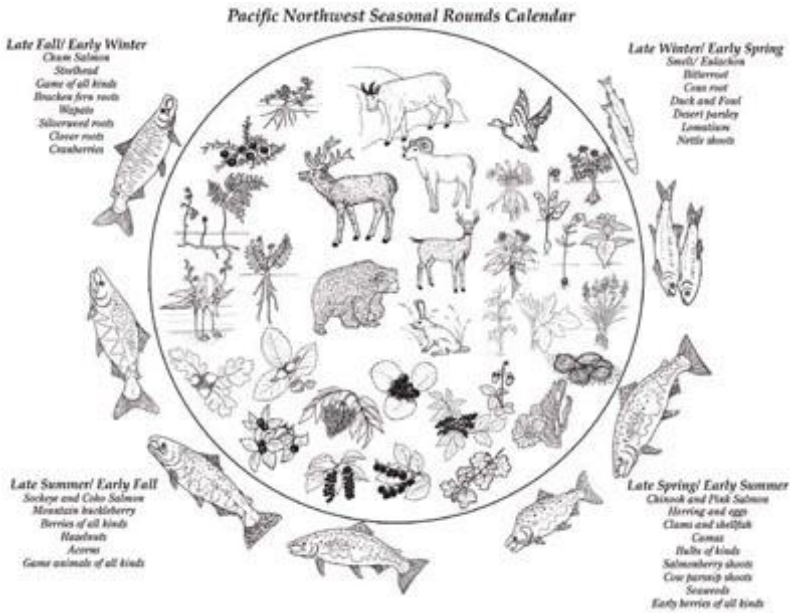
Seasonality: Which foods have the Coast Salish People eaten during the winter? Which did they eat in the summer?

Summer: _____

Winter: _____

Name two ways shellfish are important in the **Coast Salish culture today.**

1. _____
2. _____



Station 3.6: Marine Food and Resources

Vocabulary: sea vegetables

Your Ocean Menu:

Shellfish (oyster, clam, mussel)

Fish

Crab

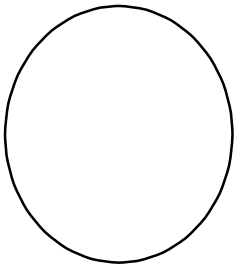
Ice Cream

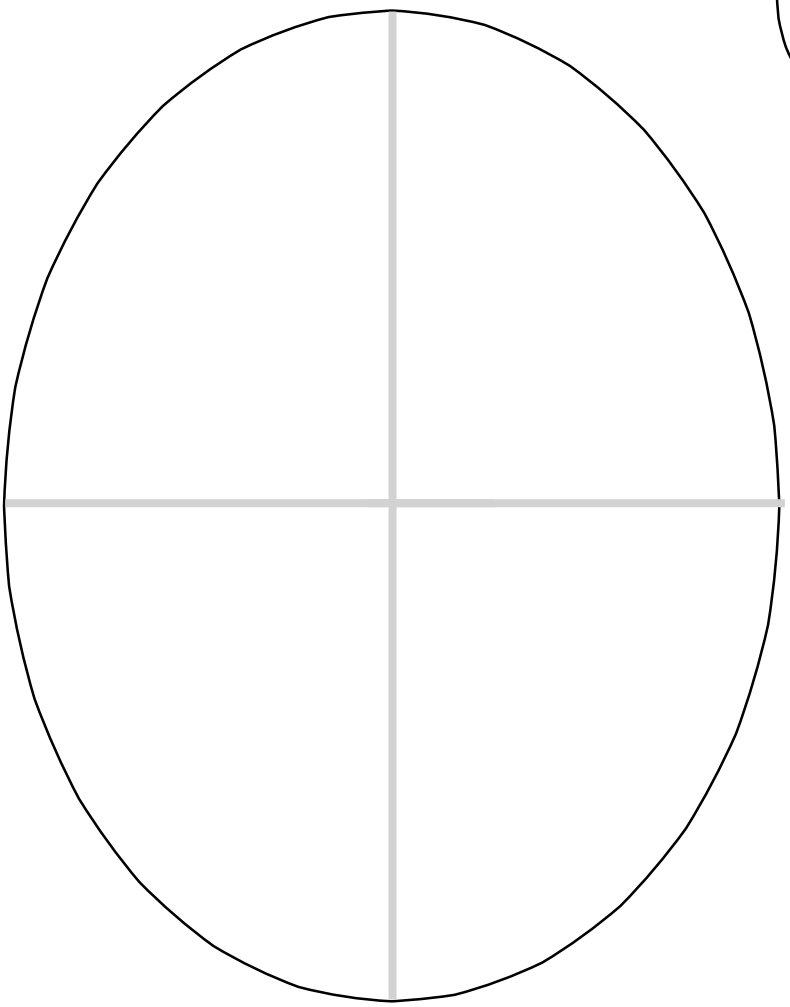
Sushi

Sea Vegetables

Caviar

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

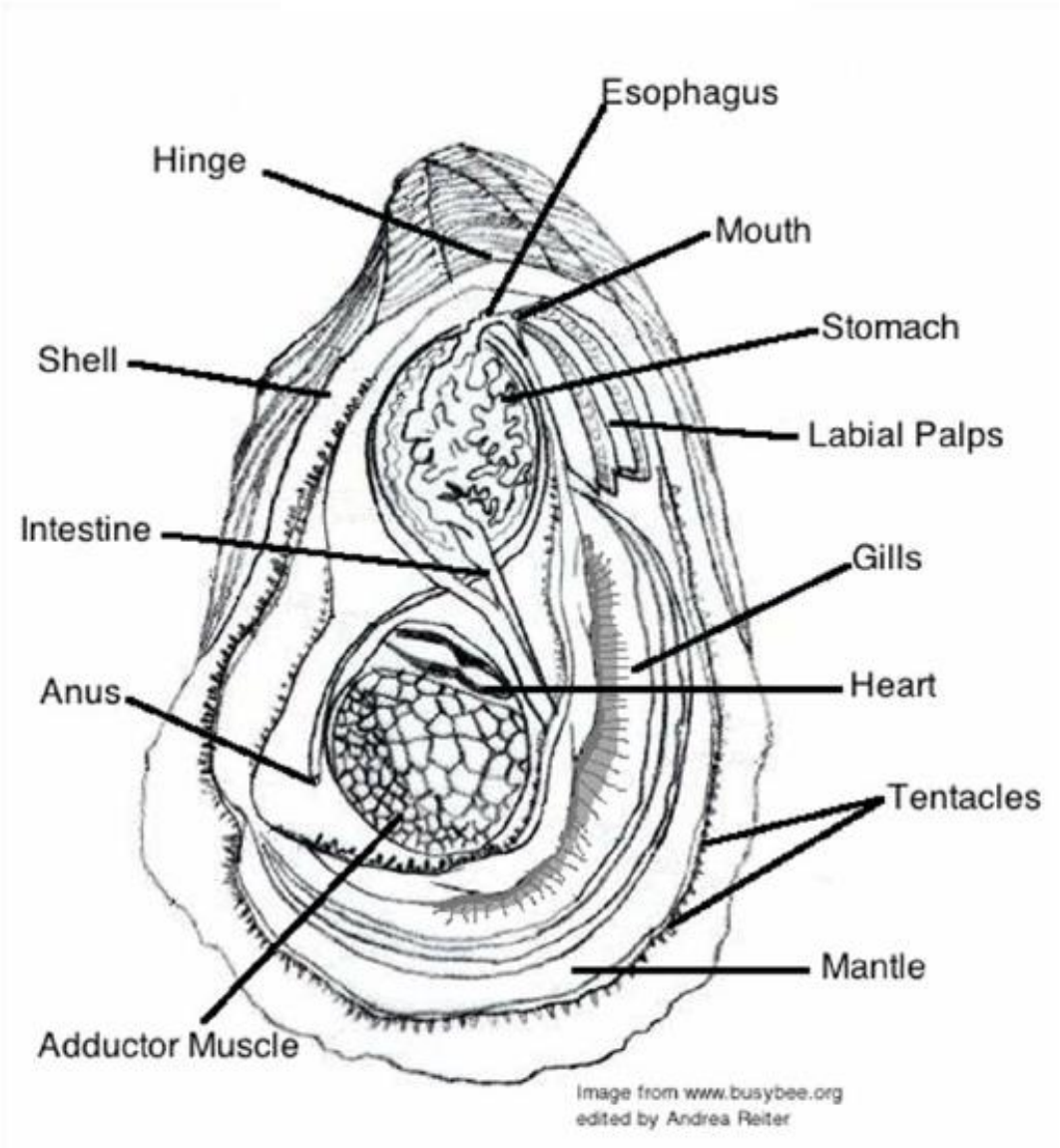




Station 3.7: Oyster Dissection

Vocabulary: invertebrate – bivalve – exoskeleton – gills – mantle – tentacles

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



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)

Deeper Dissection

Gut analysis: Observe the stomach contents of your oyster and evaluate what its primary food source is.

_____

_____

Habitats: Clams and oysters live in different parts of the intertidal zone. Where would an oyster be found? Where would a clam be found?

_____

_____

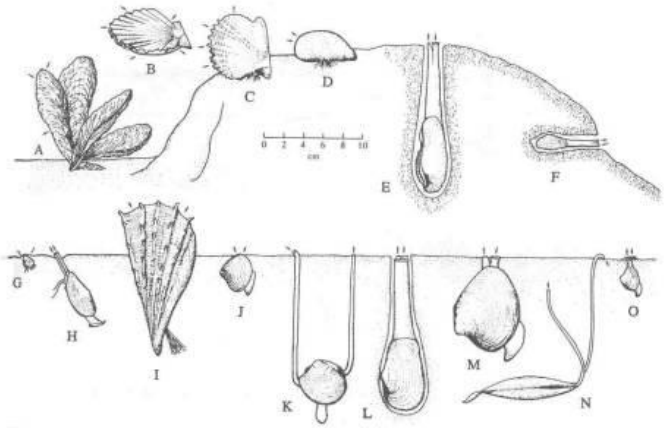
Comparative Anatomy: Now, after thinking about where these creatures live, describe what adaptations they have that allow them to live and function within their chosen substrates.

_____

_____

_____

_____



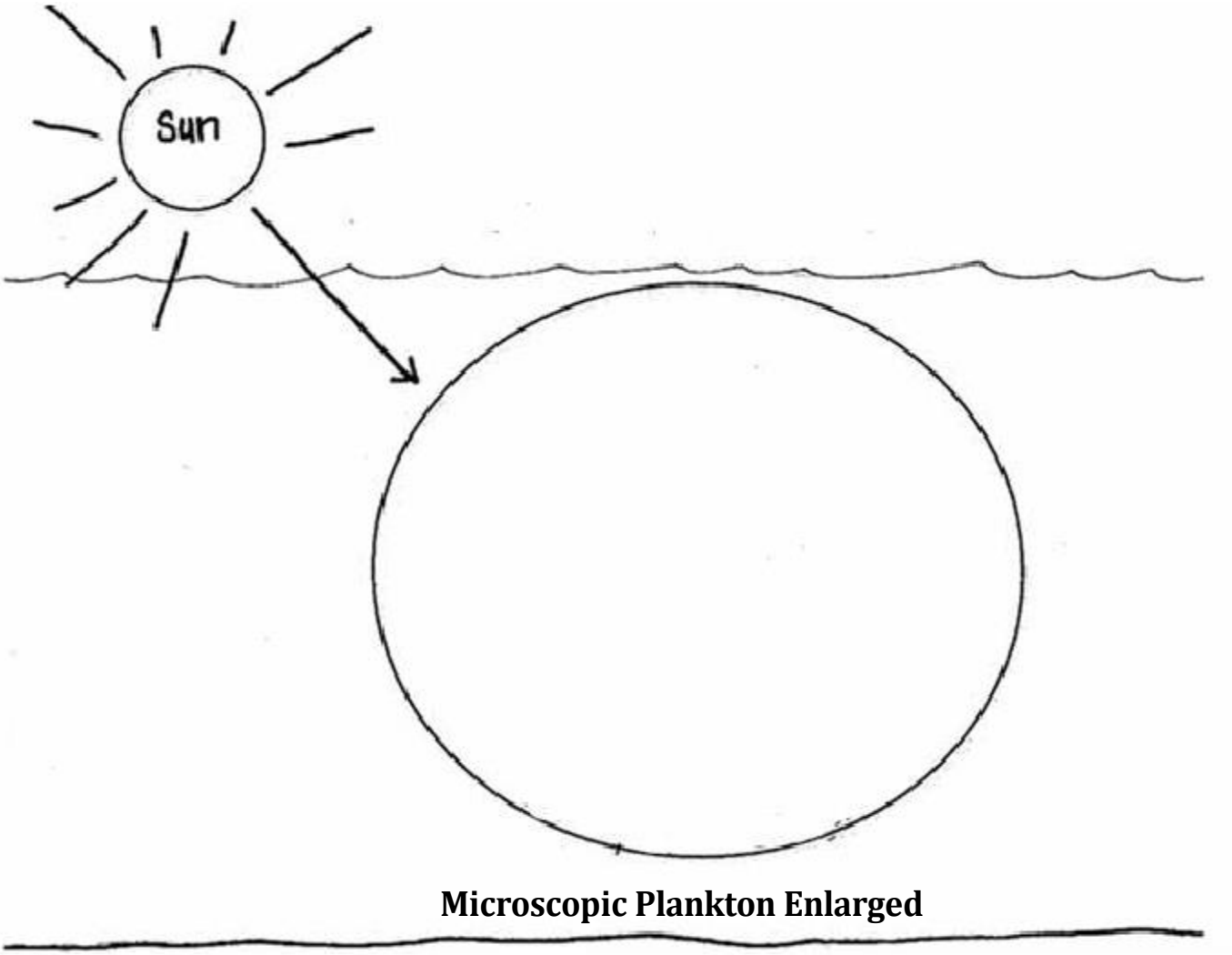
Station 3.8: Food Web Foundations

Vocabulary: photosynthesis – zooplankton – phytoplankton – food web

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

What do you see? _____

Make a scientific drawing of your microscopic plankton below.



Microscopic Plankton Enlarged

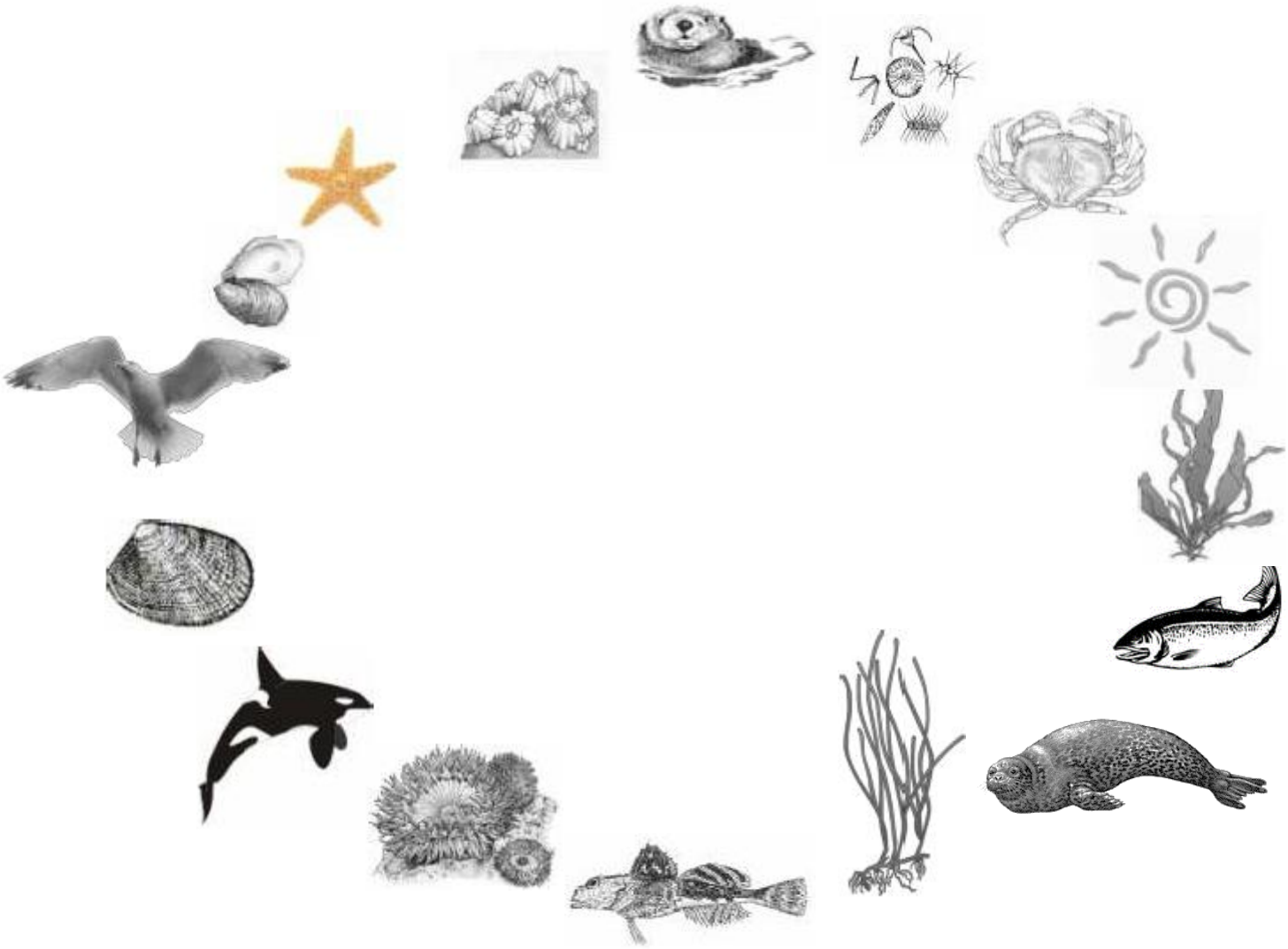
Connection: What microscopic organisms might an oyster eat?

_____

A **food chain** describes which organism eats which, usually starting with a plant and ending with an animal. *EXAMPLE:* grass  → rabbit  → eagle 

A **food web** shows how an ecosystem interacts between different organisms. It contains many food chains, where most plants and animals will be a part of several food chains.

Below is an unfinished food web. Draw a solid line to connect animal and plants to what they eat or what eats them to create a complete food web of the nearshore ecosystem. Remember, you can draw more than one line per organism!



Can you think of another animal or plant that is not in this food web? Draw it in the blank space and connect it to the food web.

Where does the food chain of the ocean begin? _____

What kind of animal might be at the top of the ocean's food chain? _____

Part 2 Reflections

Shellfish Topics Reflection

What does the saying "WHEN THE TIDE GOES OUT, THE TABLE IS SET" mean?

_____

_____

What is one thing you already eat at home that comes from the intertidal zone?

_____

What part of the oyster secretes calcium carbonate, which forms the shell?

_____

Draw and label an intertidal food chain with plankton, shellfish, and a marine mammal.

Connections: What do shellfish do to improve water quality as stewards of the Salish Sea?

_____

_____

Activity: Exploring Shellfish Issues

During computer time, visit **gardensalishsea.org.** Click **Multimedia**, then click **Videos, Slideshows and Links**. Scroll down and watch a video or visit a website that looks interesting. In a paragraph describe what you learned.

SHARING

Coastal Communities Blog

During computer time in class or in the library, visit**: gardensalishsea.org**. Click **Student Center,** then click **Coastal Communities Blog**. Choose a blog post to comment on. Click the title and scroll to the bottom of the page to find the comment box.

Share what you've learned about shellfish and the ocean with students from other schools. Tell what you did for the Salish Sea Challenge, something interesting you learned, or a current event about the ocean. It could even be your favorite seafood recipe!

Make a draft of your comment before posting on the blog, write it below.

_____

_____

_____

_____

_____

_____

_____

_____

Oyster Art

Observe the oyster shell that you received in class. Use a separate piece of paper to draw or paint it. Have your teacher or parent take a photo of your artwork and we will put it on our website! Please send all artwork to: garden.salishsea@gmail.com

4. Ocean Acidification

Pre-lab Video: "Hermie the Hermit"

Watch the video at https://www.youtube.com/watch?v=RnqJMInH5yM

1. What is Hermie's BIG PROBLEM?

---

2. What chemical is entering the ocean?

---

3. Hermie is searching for a home? What is wrong with all the shells?

---

4. The water is becoming more acidic because of CO_2. How can we help Hermie?

Pre-lab Video: "The Other CO_2 Problem"

Watch the video at: ***https://www.youtube.com/watch?v=kvUsSMa0nQU*** and answer the questions.

1. The Octopus comes to tell King Poseidon about an urgent problem? What is it?

---

2. What do shellfish use calcium carbonate for?

---

3. What chemical in the air is causing ocean acidification?

---

4. Which animal in the video eats clams? What will happen to him if he doesn't have any clams?

---

5. How can people reduce carbon dioxide in the atmosphere?

---

6. What can you do to reduce carbon dioxide? (Hint: Look at the Salish Sea Challenge)

Pre-lab Video: "Acidifying Water Takes Its Toll on Northwest Shellfish"

https://vimeo.com/54408927

1. What is Chelsea's family's secret to growing perfect oysters?

2. Explain why farmers having a hard time getting enough oyster seed?

3. What compound do shellfish use to build their shells?

4. What time in the life of the shellfish is corrosive water most dangerous for shellfish?

5. What 3 things did the Governor's Blue Ribbon Panel recommend be done?

1.
2.
3.

OA Lab 1: pH of Household Solutions

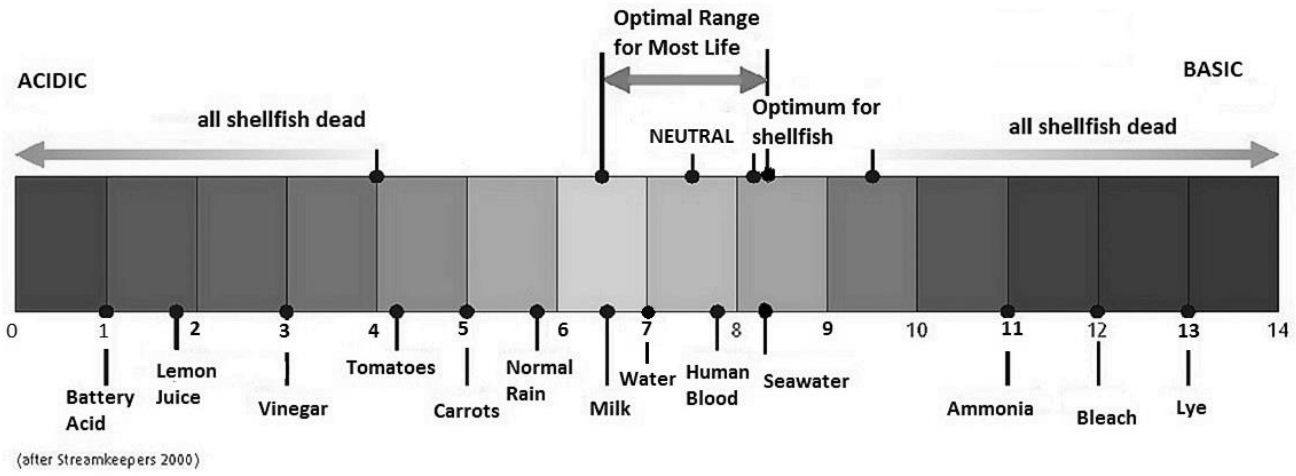
The **pH scale** is used to describe the acidity of a solution. The pH scale changes from **acidic** to **basic** (sometimes called alkaline). Pure water is **neutral**, in the middle. Seawater is slightly basic. Most plants and animals like to grow in environments where the pH is close to the middle. Seawater is slightly basic.

*A **hypothesis** is an educated guess.*

1. **Hypothesize** (predict) where on the pH scale each solution will fall (acidic, neutral, or basic). Look at items on the pH scale and find one you think is similar to your solution to help you guess.

2. **Test your hypothesis.** Dip a piece of litmus paper into each solution. Count "one, one thousand". Lay the litmus paper against scale provided. Record your result with the number corresponding to the color you see.

3. **Repeat step 2** three times (each test is called a "trial") to make sure your results are consistent.



pH SCALE

Vocabulary: pH stands for power of hydrogen

Data Table

Solution	Hypothesis	pH Trial 1	pH Trial 2	pH Trial 3	Mean*
Vinegar					
Lemon Juice					
Club Soda					
Pure Water					
Baking Soda					
Tums					
Seawater					

***Instructions for mean:**

For each solution, add results from each trial. Divide this sum by the number of trials (3).

1. Which solution is most acidic? _____
2. Which solution is most basic?_____
3. Which solution is closest to neutral (7)?_____
4. Which solution is best suited for shellfish to live in (circle one)?

   Highly Acidic, Slightly Acidic, Neutral, Slightly Basic, Highly Basic

Vocabulary: Acidic - Neutral - Basic (or alkaline)

OA Lab 2: The Human Smoke Stack

When you breathe, you exhale **carbon dioxide (CO_2)** (pronounced "C-O-2"). Carbon dioxide from our breath is also one of the chemicals that comes from a car when it burns gas. Some **CO_2** comes from nature, and some comes from burning fuel for factories, cars, and homes. When too much carbon dioxide enters the air, the ocean absorbs the excess carbon dioxide. Carbon dioxide changes the pH of the water, making it more acidic. Too much **CO_2** produced by humans makes it difficult for shellfish to make their shells.

Procedure

1. Gently blow bubbles through a straw into the solution in Cup #1 for **one minute**.
2. Record the color of the solution in each cup.
3. Test the pH with litmus paper by dipping a piece of litmus paper into each solution. Count "one, one thousand". Lay the litmus paper against scale provided. Record your result with the number corresponding to the color you see.

	Control variable: Cup #1 — No breath	**Changing variable:** Cup #2 — Added breath
Color		
pH		

1. How did the solution in Cup #2 change when you breathed into it?

2. Why did the color of the solution change?

3. What chemical changed the pH and color of the solution you breathed into?

OA Lab 3: Dissolving Shells

Compare the shells that were soaked in vinegar (acid) to shells soaked in distilled water (neutral).

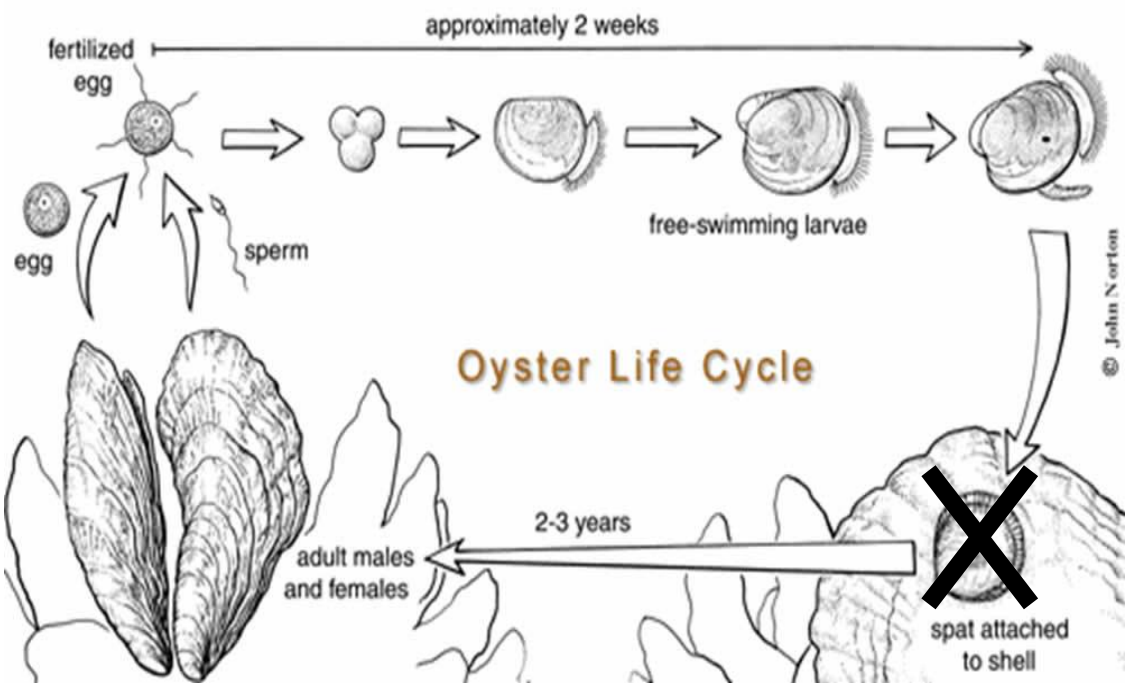
Draw a picture of the jars below and use short sentences to answer the questions.

Shells in Vinegar **Shells in Water**

1. What is happening to the shells in vinegar?

2. Why do you think this is happening?

OA Lab 4: Oyster Life Cycle



If seawater becomes too acidic for shellfish **larvae** (baby shellfish) they can have trouble attaching and building their shells. Fewer shellfish will be able to reproduce and grow into adults.

1) If there are fewer shellfish, what will happen to the animals that eat shellfish?

_____

_____

2) Fill in the food chain below:

_____

_____

_____SHELLFISH_____

_____

OA Lab 5: A Tale of Two Cities

List things the healthy city does differently.

_____

_____

_____

Put an **N** next to each item that is **natural**. **Circle** the items that emit **CO_2**.

COAL
Car

_____

_____

_____

_____

_____

_____

_____

For more OA activities, check out the Dissolving Shells Classroom Experiment on the website!

OA Reflection:

Thinking about today's activities

1) Describe the negative impacts shellfish experience as a result of Ocean Acidification. During which life stage is an oyster or clam most vulnerable to these effects.

_____

_____

_____

2) Think about the felt board activity. In a sentence, describe two things about the watershed that help keep the natural system in balance.

_____

_____

3) Carbon, just like water and many other nutrients in the environment, cycles through many states over time. Name some inputs to the carbon cycle and some items or places that act as carbon 'sinks.'

_____

_____

_____

4) Describe 2 things you can do at home with your family to keep your watershed healthy.

_____

_____

5. Field Inquiry

5.1 Preparation for Field Inquiry

Part 1: Small Clam Identification

Learning how to identify plants and animals using a key is an important skill to be able to quickly and accurately make identifications in the field. Today, we will practice sorting clams with similar characteristics. Below is an example key to help identify some of the clams we will find on the trip. We will be conducting clam survey excersizes in the field which are adapted from citizen science surveys done in the area.

To get started with the key: Can you see a leathery hinge connecting the shells?

If no…

1. Shells are not mirror images, no flaps are present on the tips of siphons. **It is a softshell clam.**

2. Shells are mirror images of each other, flaps are present on the tips of siphons. **It is a Horse Clam.**

If yes…

1. And the rings or ribs are easily seen on the shells..

Shell has heavy ribs and shell is heart-shaped. **It is a cockle,** *Cinocardiym nuttallii.*

Rings and ribs are equally visible. Shell is elongated, there is a flat pit near the umbo. **It is a Manila Clam.**

Shell is rounded and there is no pit near the umbo. **It is a Littleneck Clam.**

2. And if faint rings or ribs are seen on the shells…

Shells are rounded on both ends, no periostracum. **It is a butter clam.**

Shells are pointed somewhat on one end, band of periostracusm is seen along shell edges. **It is a Macoma**

Shell is rounded and has coating like polished mahogany. Hinge is pronounced bump. It is a **Varnish Clam**

Part 2: 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 name, length, width, weight, and write a brief description with a diagram of the clam. Be sure to point out any identifying features.

Name of Clam	Size:	Description:	Diagram of Shell
	Length:_____ (units) **Width:**_____ (units)	**Color:** _____ **Shape:** _____ **Markings:**_____	
	Length:_____ (units) **Width:**_____ (units)	**Color:** _____ **Shape:** _____ **Markings:**_____	
	Length:_____ (units) **Width:**_____ (units)	**Color:** _____ **Shape:** _____ **Markings:**_____	

Part 3: Field Etiquette

In the field and on the beach , LEAVE IT CLEANER THAN YOU FIND IT!

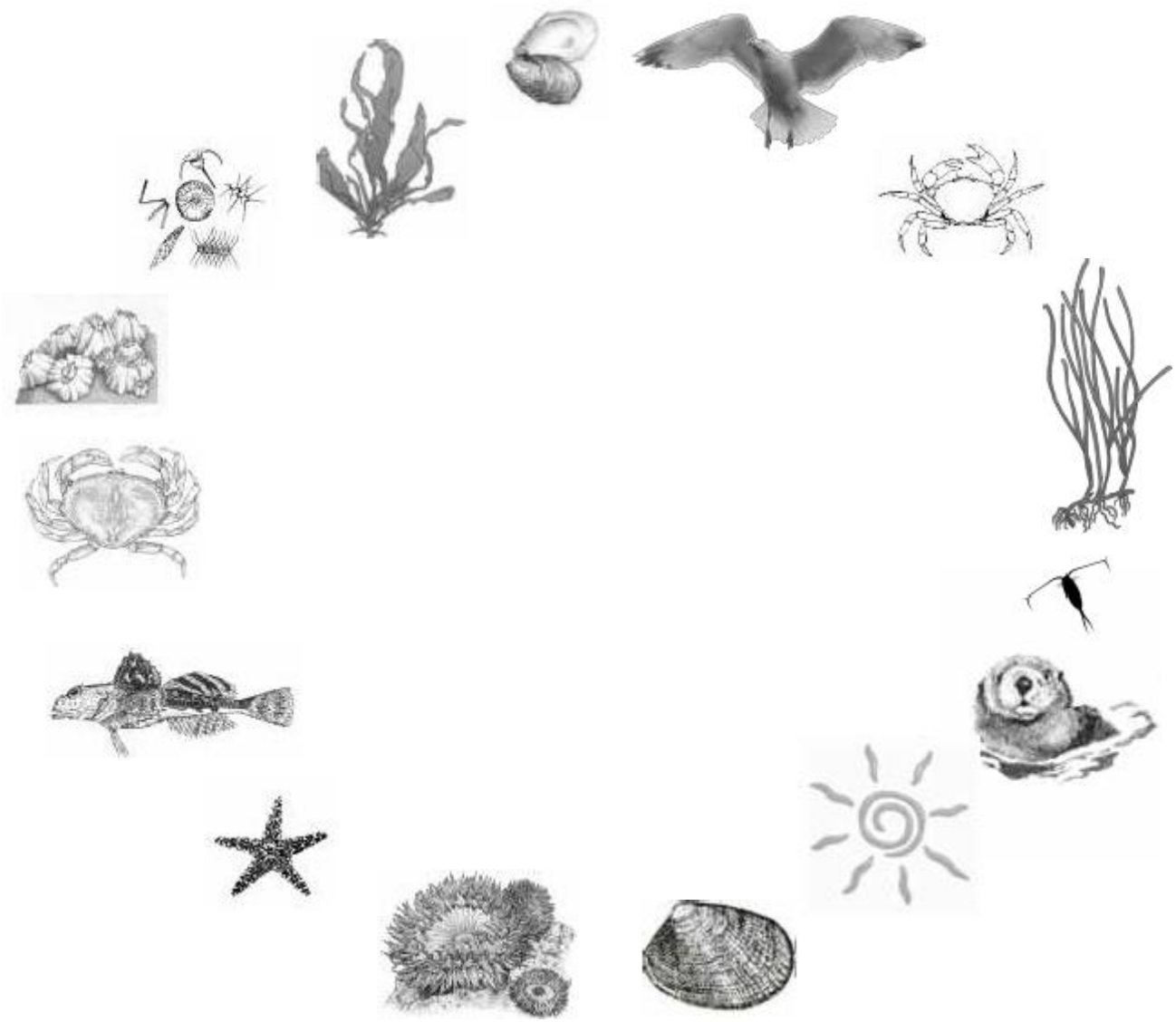
- Pack out what you take in – NO LITTER LEFT ON THE BEACH
- Do not take any living things
- Leave nesting birds and marine mammals alone to rest
- If you turn over a rock, PUT IT BACK AS IT WAS
- RESPECT other people visiting the beach

What Should You Bring and Wear?

- Dress for the Weather - **LAYERS**
- **Rubber Boots or 2 pairs of shoes**
- Play clothes – ok to get **DIRTY**
- Workbook
- Pencil
- Clipboard
- Sack Lunch
- Water
- Sun screen

5.2 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 near shore ecosystem. If you **didn't find** a plant or animal on this work sheet **draw a dotted line** to connect them into the food web. Find something not on the food web already? **Draw it in** and connect it to other plants and animals with a **solid line**.



What shellfish do you think seals eat? _____

What about sea otters? _____

5.3 Who Lives in the Square?

Look down on the ground and imagine a square the size of your notebook. Below sketch a map that shows the substrate (or the type of ground, rock, gravel, sand or mud) and the location of organisms that you find in your plot (animals, plants and algae). List them below your map.

1_____ 4_____

2_____ 5_____

3_____ 6_____

5.4 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):

_____

_____

_____

Field Sketch

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):

_____

_____

_____

Field Sketch

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):

_____

_____

_____

Field Sketch

5.5 Beachfront Scavenger Hunt

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

- Native Little Neck Clam
- Manilla Clam
- Varnish Clam
- Butter Clam
- Cockle Clam

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.

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.

Varnish clam
Nuttallia obscurata

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

Cockle clam
Clinocardium nuttallii

Prominent, evenly-spaced ridges which fan out from the hinge. Mottled, light brown. Can grow to 5". Found just 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, what were they?

_____

_____

_____

Do you think it is important to preserve these creatures? Why or why not?

_____

_____

_____

5.6 Water Quality

Vocabulary: water quality

Watershed name:_____

Watershed Observations: What can you see, hear, or smell? (Circle)

Shade	Cars	Dogs
Trees	Parking Lots	Garbage
Grass	Buildings	Chickens
Cars	Trains	Storm Drains
Animals	Boats	Other_____

The water in the creek is (circle) Fresh Estuarine Marine

Does it look like a healthy watershed?

Poor Fair Excellent

Dissolved Oxygen

Dissolved oxygen is _____ mg/L

<3 mg/L	3-6 mg/L	>6 mg/L
Poor	Fair	Excellent

pH (acidity)

pH is _____.

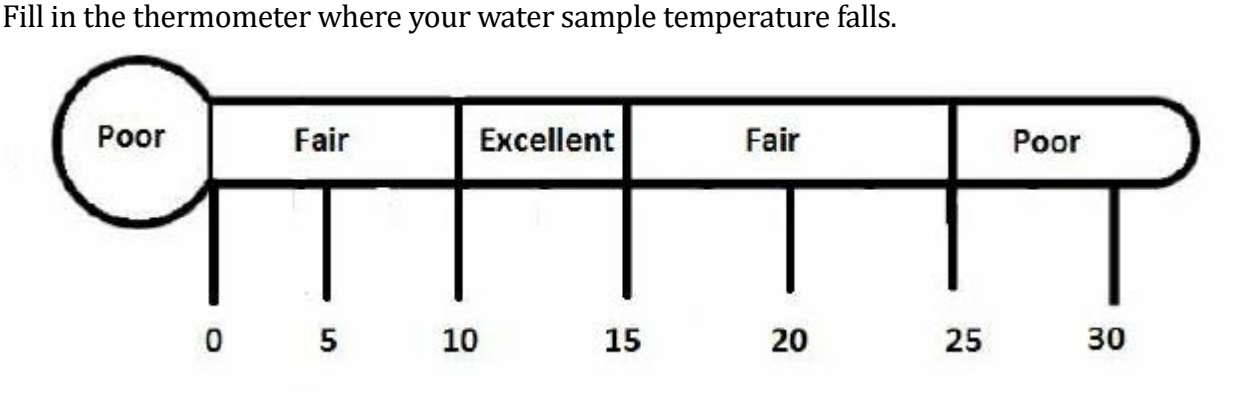
<6.5	>6.5 <8.5	>8.5
Too low	Good	Too high

Temperature

As temperature increases, dissolved oxygen _____

What is the temperature?_____°C

Fill in the thermometer where your water sample temperature falls.



Turbidity (cloudiness)

Turbidity is_____ NTU.

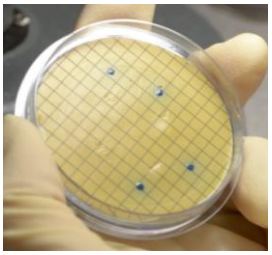
>25	10-25	<10
Poor	Fair	Excellent

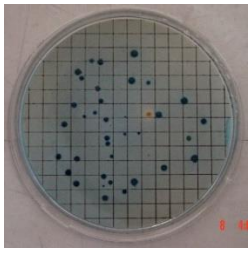
Fecal Bacteria

Fecal bacteria get into streams and estuaries from the poop of warm blooded animals when it rains or from sewage leaks. Fecal bacteria indicate there may be bacteria in the water that can make us sick!

It is safe to eat shellfish and swim in marine water where there are less than 14 fecal bacteria colonies (a single bacteria cell grows into a visible colony) in 100 mLs of water

Circle which sample came from marine water where you could safely swim or harvest shellfish.





5.7 Macro-invertebrates

Macro-invertebrate - *an organism that lacks a spine and is large enough to be seen with the naked eye*

Draw a picture of your macro-invertebrate

Use the dichotomous key provided to identify your macro-invertebrate.

_____

Tolerance Index_____

As a group, determine if the macro-invertebrates come from a stream that is

Poor Fair Excellent

SUMMARY (Water Quality and Macro-invertebrates)

Based on all the data your group collected, is the stream (circle)

Poor Fair Excellent

As a group, discuss why

_____

_____

5.8 Clam Survey Exercise

For all clam categories (except horse clams), indicate the number of clams less than./greater than 1.5 inches in size. For horse clams, indicate # of holes.

Sample Hole	# Paces	Sub[1]	Veg[2]	Water[3]	Varnish	Manila	Native Littleneck	Macoma[4]	Cockle	Butter	Eastern Softshell	Horse	Other Comments
example	*38*	*S*	*P*	*N*	*2/3*	*0/0*	*0/1*	*1/2*	*1/0*	*0/0*	*0/0*	*0*	*Some eelgrass in the sample site*
1													
2													
3													
4													
5													
6													
7													
8													
9													
10 or water													

[1]Substrate codes- M=mud, S=sand, G=gravel, C=cobble, B=bedrock, may also use combination of substrate codes with dominate substrate listed first (e.g. SG= sand/gravel)
[2]Vegetation- P= present, A= absent
[3]Water- deeper than 1 inch at sample site Y/N
[4]Macoma clams include bentnose and other "bay" clams

Graphing Data:

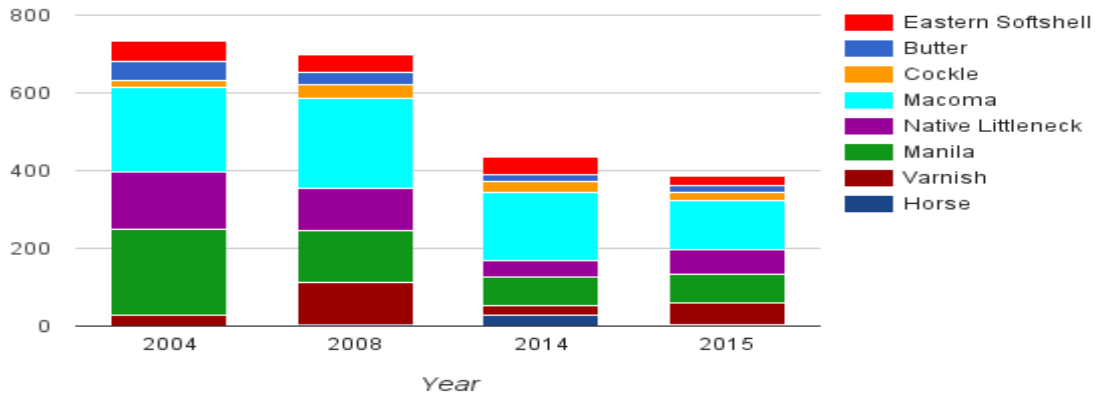
Graph the species distribution for the total number of clams you found during the clam survey exercise. Include a labelled axis with the number of clams in each species. Use the citizen science graph on the right as an example, and use colored pencils the same colors to help your comparison between the graphs.

Your Data

Number of Clams

Total Clams Found

Citizen Science Data 2004-2015



In your class's clam survey exercise what kind of clam was the most plentiful? _____

What kind of clam was the least plentiful? _____

How does this compare to the citizen science data above?

_____

_____

Field Investigation Reflection

Why is having all of the microscopic **plankton** in the water important?

_____

_____

_____

What would happen to the food web if there were too many river otters and gulls, but not enough shellfish?

_____

_____

_____

Name a plant or animal that relies on the intertidal zone to live. (Did you know salmon also live in the intertidal zone for part of their life cycle?)

_____

Name one animal you found in your square. What does it eat?

_____ _____

What macroinvertebrate did you draw? What does it need in the water to breathe?

_____ _____

What are three things you learned while on this field trip:

1._____

_____

2._____

_____

3._____

_____

Salish Sea Challenge Reflection

Write a 3-5 sentence paragraph describing how your actions on the Salish Sea Stewards Challenge help keep ecosystems in balance. Then draw a picture of yourself doing these actions. Use a second piece of paper if you need it.

I am a Salish Sea Steward because...

_____

_____

_____

_____

_____

_____

6. Games

6.1 Whale Jenga

In your own words, what happened to the ocean when you played Whale Jenga?

_____

_____

_____

What did you discover about human impacts on the environment because of this game?

_____

_____

_____

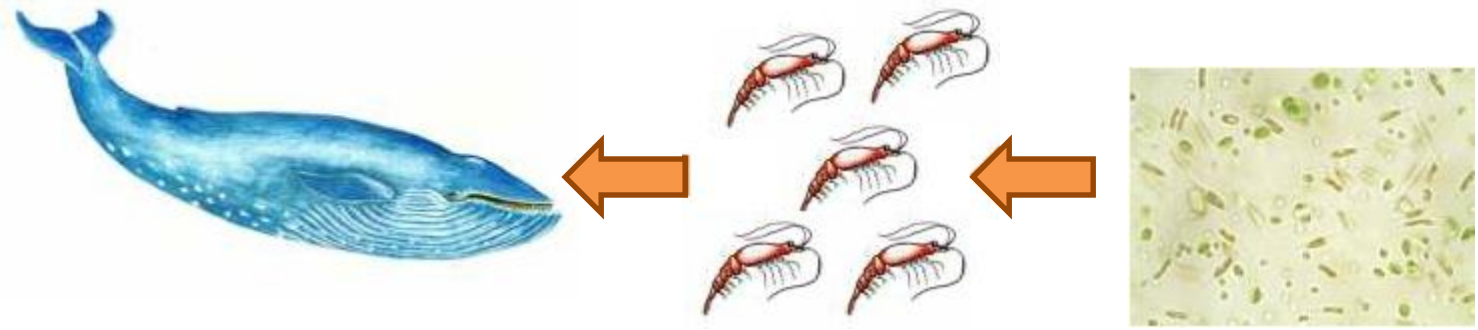
Can you think of some ways you can protect the oceans after playing Whale Jenga? What are they?

_____

_____

_____

Whale Jenga Food Chain:



Baleen Whale | Krill | Phytoplankton

6.2 Krill – A Whale of a Game!

When extra time allows, play Krill – A Whale of a Game, reading the instructions first. After playing the game, use the space below to draw and label a picture of at least one complete food cycle you observed while playing the game.

6.3 Oyster Life Cycle Game

Read the instructions carefully, and then play the Oyster Life Cycle Game.

Why do you think oysters produce so much sperm and egg?

_____

_____

_____

How do humans affect the oyster life cycle?

_____

_____

_____

What can people do to reduce our effect on the oyster life cycle?

_____

_____

_____

6.4 Clam Life Cycle Game

Did anything surprise you about the clam's life cycle?

_____

_____

_____

Name two challenges clams may face in their life cycle:

1._____

2._____

6.5 Anemone Life Cycle

Draw one of the anemone's life cycles below.

Which life cycle did you draw (circle one)?:

Sexual Reproduction Life Cycle Asexual Reproduction Life Cycle

6.6 Food Web Jumbo Checkers

At the end of the game which animals were still there?

_____

_____

Which animals were the first to be "eaten"?

_____

_____

Draw an animal from your checkers on the top of the food chain, and an animal on the bottom of the food chain.

Top of the Food Chain

Bottom of the Food Chain

The Intertidal Zone

- Intertidal Zone – The area that is above water at low tide and under water at high tide (the area between the high and low tide marks).
- Diversity - the number and variety of species found within an ecosystem.
- Keystone species – an important species in an ecosystem which many other species depend on, if removed the ecosystem would drastically change
- Watershed – the area drained by a river, stream, run-off, etc
- Phytoplankton-Microscopic drifting plants.
- Zooplankton-Tiny free-floating animals.
- Adaptation – the process by which an organism becomes better suited to its environment
- Organism – a form of life (plant, animal, fungus, plankton)
- Substrate – the surface on or from which an organism will grow, live, or get nourishment

Introduction to Shellfish

Watersheds

- Water Quality – the state of the water; can be measured in pH, dissolved oxygen, temperature, turbidity, absence or presence of bacteria, and/or salinity.
- Pollution – when harmful or toxic substances enter the environment
- Run-off – when water drains away from the surface of an area
- Estuary – Transition zone between freshwater and marine environment characterized by brackish water where freshwater and salt water are mixed.

Oyster Exploration: Live Tank

- Habitat – the home of an animal, plant, or organism
- Ecosystem – includes all living things (animals, plants, organisms) in an area
- Ecosystem services – the benefits humans receive from ecosystems
- Filter Feeder – Type of animal that gets its nutrients from sorting out tiny plants and animals from the water as it breathes.

Oyster Exploration: Life Cycles

- Mollusk – invertebrate animals including snails, slugs, shellfish, squid and octopus
- Life cycle – a series of physical changes during the life of an organism
- Motile (free swimming) – capable of motion
- Larvae – an immature form of an organism, especially one which differs greatly from its adult form.

- Spat - A juvenile oyster that has changed into an adult develops its shell and attaches to a substrate like a rock or shells. This is the life stage that is most vulnerable to ocean acidification. At this point, attachment and shell formation are interrupted.

Shellfish in Time & Place

- Fossil – the remains of a prehistoric organism that is cast in a rock or preserved in a petrified form.
- growth bands – a line found in many organisms which marks growth
- midden - a mound of shells, bones and refuse that indicates where people lived.
- reef – a ridge of rock, coral, or sand just above or below the surface of the sea.

Coast Salish People & Culture

- Coast Salish – a group of indigenous people of the Pacific Northwest Coast
- Shell Midden: These are often found by archaeologists, and are left over shells and other deposits from people who ate shellfish and disposed of the shells in a pile. Shell middens are like ancient garbage dumps and provide insight on what people used to eat and where they lived.
- Shellfish Garden: A form of shellfish management designed to ensure a reliable food source for the large populations of First Nations and Native Americans that inhabited the Northwest Coast.

Marine Food and Resources

- Sea vegetables – edible algae or seaweed
- Clams – a common bivalve, usually live underwater buried in sand or mud
- Mussels – a marine bivalve mollusk with a dark elongated shell
- Oyster – a name for a number of bivalve mollusks with rough irregular shells
- Conch – a common name for a number of large edible sea snails.

Oyster Exploration: Dissection

- Invertebrate – An animal lacking a backbone
- Bivalve – A mollusk with two parts of a shell called valves that are attached by a hinge; mussels, clams and oysters are examples.
- Exoskeleton – A rigid external skeleton covering the body of some invertebrates
- Gills - Organ responsible for breathing and filtering (eating). Beating cilia move water across the gills to trap food (plankton).
- Mantle - Membrane that secretes calcium carbonate, which forms the shell
- Tentacles - Sensory organ, feels potential food items and current

Oyster Exploration: Food Web Foundations

- Photosynthesis- The process used by plants, including phytoplankton to make food from light and carbon dioxide in the air.
- Plankton-Greek for drifter, microscopic plants, animals or bacteria that are carried with the current. They provide a crucial source of food to larger organisms.
- Food web – A system of food chains
- Predator – An animal that preys on other animals

Stewardship

- Steward – Someone who acts as a caretaker or protector of the environment, place, or region.
- Human Impact – The impact that we, (humans) have on the environment
- Pollution prevention – The efforts of humans to prevent excess pollution

Ocean Acidification

- Ocean acidification: The decrease in the pH of the Earth's oceans, caused by the absorption of carbon dioxide (CO2) from the atmosphere from natural sources and human activities.
- pH: Power of hydrogen or number of hydrogen ions.
- Acid: A substance with a pH of less than 7 and a high concentration of hydrogen ions.
- Base (alkaline): A substance with a pH greater than 7 and a low concentration of hydrogen ions.
- Neutral : A solution that is neither acidic nor alkaline that has a pH of 7.0, such as pure water. Most living organisms thrive in a pH range between 6 to 8.