

RESOURCE BOOKLET FOR TEACHERS LEADING CHANGE

Grade: 10/11	Sustainable Seafood Unit
Big Ideas:	<ul style="list-style-type: none"> ● Energy is conserved, and its transformation can affect living things and the environment (Science 10). ● The distribution of water has a major influence on weather and climate (Gr.11 Earth Sciences) ● Human practices affect the sustainability of ecosystems (Gr.11 Environmental Science) ● Humans can play a role in the stewardship and restoration of ecosystems. (Gr. 11 Environmental Science) ● Scientific knowledge can be used to develop procedures, techniques, and technologies that have implications for places of employment (Gr. 11 Science for Citizens). ● Scientific processes and knowledge inform our decisions and impact our daily lives (Gr. 11 Science for Citizens). ● Physical features and natural resources influence demographic patterns and population distribution (Exploration in Social Studies 11). ● Questioning what we hear, read, and view contributes to our ability to be educated and engaged citizens (Gr.10/11 English Language Arts: Composition 11; Literary Studies 10/11). ● Social, ethical, and sustainability considerations impact design (Applied Design, Skills, and Technologies 10: Food Studies 10) . ● Tools and technologies can be adapted for specific purposes (Applied Design, Skills, and Technologies11; Food Studies 11). ● Services and products can be designed through consultation and collaboration (Applied Design, Skills, and Technologies 11; Food Studies 11).
Critical Questions:	<ul style="list-style-type: none"> ● How are we connected to the ocean? ● What is aquaculture? ● How do we rely on the ocean? ● What jobs rely on the ocean? ● What is sustainability? ● What is sustainable aquaculture? ● What is the difference and similarities between wild fishing and aquaculture? ● How do you know you are consuming sustainable seafood? ● What is the process of aquaculture? ● How can aquaculture improve/be more sustainable in the future?

<p>Unit Rationale:</p>	<ul style="list-style-type: none"> • The seafood industry is an expansive business that touches upon many corners of human life; ranging from supplying protein in our diets, to providing employment for communities to being a tool of creativity and history for seafood chefs. With the many avenues seafood shapes, it is significant to highlight how the growing demand for it is contributing to declining fish populations. Especially, as the planet faces environmental challenges such as climate change, ocean acidification and habitat destruction, conversations about resource extraction have become particularly relevant. In this section, students will learn about key terms related to aquaculture and wild fishing, the criteria of sustainable and unsustainable seafood, the social and economic factors that influence the industry to thereafter analyze, interpret and apply their findings in hands-on and inquiry based activities. The ultimate objective being to educate, equip and empower students to be stewards for sustainable seafood choices.
<p>Students will do the following CURRICULAR COMPETENCIES:</p>	<ul style="list-style-type: none"> • Applying and innovating: Contribute to care for self, others, community, and world through individual or collaborative approaches (Science 10/Science for Citizens 11). • Applying and innovating: Generate and introduce new or refined ideas when problem solving (Science 10). • Applying and innovating: Contribute to finding solutions to problems at a local and/or global level through inquiry (Science 10/Science for Citizens 11). • Communicating: Communicate scientific ideas, claims, information, and perhaps a suggested course of action, for a specific purpose and audience, constructing evidence-based arguments and using appropriate scientific language, conventions, and representations (Science 10/Science for Citizens 11). • Ideating: critically evaluate how competing social, ethical, economic, and sustainability considerations impact choices of food products, techniques, and equipment (Applied Design, Skills, and Technologies 11: Food Studies 11). • Ideating: analyze impacts of competing social, ethical, economic, and sustainability factors on food choices and preparation (Applied Design, Skills, and Technologies: Food Studies 10). • Assess the short- and long-term causes and expected and unexpected consequences of people's actions, events, phenomena, ideas, or developments (cause and consequence) (Explorations in Social Studies 11). • Processing and analyzing data and information- seek and analyze patterns, trends, and connections in data (Science 10).
<p>Students will know the following CONTENT:</p>	<ul style="list-style-type: none"> • Local and global impacts of energy transformations from technologies (Science 10). • Environmental, political, and economic policies (Social Studies 10).

	<ul style="list-style-type: none">● Food trends, including nutrition, marketing, and food systems (Applied Design, Skills, and Technologies: Food Studies 10).● Simple and complex global food systems and how they affect food choices, including environmental, ethical, economic, and health impacts (Applied Design, Skills, and Technologies: Food Studies 10).● Food labelling roles and responsibilities of Canadian government agencies and food companies (Applied Design, Skills, and Technologies 11: Food Studies 11).● Human actions and their impact on ecosystem integrity (Environmental Science 11).● Resource stewardship (Environmental Science 11).● Human impact on Earth's systems (Science for Citizens 11):<ul style="list-style-type: none">○ natural resources○ effects of climate change● Practical applications of science in the workplace (Science for Citizens 11).● Beneficial scientific innovations (Science for Citizens 11).
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LESSON PLANS: #1-7

	Topic	Objectives	Information & Activities	Resources	Assessment
1	<p>The Earth has one big ocean with many features ~</p> <p>The ocean is the largest feature on our planet and thus has a large impact on all life.</p>	<ul style="list-style-type: none"> ● Acknowledge that the ocean provides a valuable resource for humanity. ● Identify how we are connected globally via the seafood industry. ● Discuss how the ocean contributes to sustaining human life. 	<p>Critical Questions: Why is the ocean important? How are we connected to the ocean? How do we rely on the ocean? What resources come from the ocean? Where around the world is seafood produced?</p> <p>Background Information: The ocean is a massive body of water that connects all forms of human life; both locally and globally. A major link humans have worldwide is our dependence on the ocean for seafood. This lesson will emphasize the wide reach the seafood industry truly has through the use of maps, stats and videos. Moreover, the overarching theme of this lesson highlights how the actions of the students are part of the seafood industry, therefore the end of the activity is reflective to showcase how they are included in these interactions; proving that we are all connected to the ocean.</p> <p>Task:</p> <ol style="list-style-type: none"> 1) Discuss: Ask students whether they know where their seafood is from? Bring the short video clip by Sea Around Us that demonstrates how industrial fisheries' have expanded globally. <i>Optional:</i> Afterwards, play Ocean Wises' Sustainable Shrimp Farming in Vietnam to show how Ocean Wise Executive Chef Ned Bell went to the source of the shrimp he uses in Vancouver restaurants. 2) Activity: Divide the class into groups and assign each group a focus area: North America, Europe or Asia. 3) Workbook Page 1&2: With information sheet on page 1 & 2, the group must write down their answers to the scenarios listed based on their assigned location to explore local and global connections and challenges of the seafood industry. 4) Reflection: Have each group share how their area are affected by the discussion questions. Emphasize how Asia (particularly underdeveloped areas) would be the first to be significantly hit if the seafood industry collapsed due to exhausted fish populations. <p>Action: Be aware my local seafood choices have a global impact.</p>	<p>Websites:</p> <ul style="list-style-type: none"> - SOFIA 2018: Stats of global consumption and production of seafood - Food and Agriculture Organization of the United Nations: The State of World Fisheries and Aquaculture 2018 - Musqueam: An Introduction-Hunting and Fishing <p>Videos:</p> <ul style="list-style-type: none"> - Quartz: Farms under the sea could feed the world in 2050 	<p>Formative; Students analyze data relating to fishing and aquaculture internationally.</p>

2	<p>The ocean made Earth habitable ~</p> <p>Aquaculture mimics the rhythms of the ocean in order to successfully farm seafood.</p>	<ul style="list-style-type: none"> Recognize the goal of aquaculture in regards to food stability Assess the differing methods/techniques of aquaculture Critically analyze the impacts of aquaculture 	<p>Critical Questions: What is aquaculture? Why was aquaculture created? What are the methods/techniques of aquaculture? What are the challenges and benefits of aquaculture?</p> <p>Background Information: Aquaculture has the objective of meeting the growing global demand for seafood by creating reliable farming systems. These systems use different techniques to mimic natural aquatic ecosystems. Conversations about benefits, challenges and possible improvements to make aquaculture sustainable remain. This lesson facilitates learning about different aquaculture systems and prompts students to critically assess the pros and cons of each to reflect upon the importance of being informed consumers.</p> <p>Task:</p> <ol style="list-style-type: none"> Discuss: Relate aquaculture to agriculture: just like agriculture has differing methods and animals involved. Review the videos in the resource section. Workbook Page 3-5: Divide the class into small groups. This workpage outlines differing aquaculture systems. You can bring the following slideshow up about what criteria to keep in mind when creating a sustainable aquaculture system. Workbook Page 6: Assign each group one aquaculture system for them to answer the prompts to pick the fish farm method they believe to be the most sustainable (consider life span, reliability of crop, input to harvest etc). To walk the student through this process they will list the following: <ol style="list-style-type: none"> Pros of the system Cons of the system Potential solutions Reflection: Share answers with the class. Review the Best Aquaculture Practices: OW Responsible Aquaculture to discuss measures taken to certify sustainable aquaculture locally. What would the students do the same and differently in creating a fish farming system? <p>Action: I will ask where my seafood comes from when I'm at the grocery store or restaurant.</p>	<p>Websites:</p> <ul style="list-style-type: none"> Sea Choice: Aquaculture Methods Fishing and Farming Methods <p>Videos:</p> <ul style="list-style-type: none"> CEFAS: Sustainable aquaculture PBS: Aquaponic farming saves water, but can it feed the country? <p>To Do:</p> <p>DIY Aquaponics in the classroom</p> <p>Aquaponics systems</p>	<p>Formative; Students understand and can evaluate aquaculture practices.</p>
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3	<p>The ocean and humans are inextricably interconnected ~</p> <p>Sustainable seafood is important for feeding the world and caring for the ocean.</p>	<ul style="list-style-type: none"> Define sustainability in connection to ocean health Explore how aquaculture can be sustainable and unsustainable Collaboratively identify solutions to further sustainable aquaculture. 	<p>Critical Questions: What is sustainability in connection to ocean health? What is the difference between sustainable and unsustainable aquaculture? What role can we play individually and/or collaboratively to be a steward for sustainable aquaculture?</p> <p>Background Information: A substantial step towards supporting our oceans is defining sustainable seafood and learning how choosing sustainable seafood has such a large impact on our oceans and has a large ripple effect on society. This module addresses sustainability as it pertains to aquaculture, to facilitate a creative project to showcase how aquaculture can further improve. Moreover, the students will share strategies and ideas to maximize economic and social growth in connection to aquaculture.</p> <p>Task:</p> <ol style="list-style-type: none"> Discuss: In a group discussion, define what being sustainable means in terms of ocean health. Write their answers on a whiteboard/ poster paper to discuss. Activity: Divide the class into small groups. Each group is going to be a team of the ‘Ocean Wise Sustainable Seafood Department’ and they must review aquaculture facilities to be Ocean Wise recommended. To do so they will create their own sustainability criteria. <i>Example:</i> fish must be a local species, no use of chemicals, limit destruction of natural habitats, regulations in place to ensure health of stock etc. Workbook Page 7-8: On these pages, there are real candidates that were reviewed by the Ocean Wise Seafood team. The students must review the candidates to determine whether it will be recommended or not based on the criteria they created. Reflection on Workbook Page 9: Share with the rest of the class which candidates were recommended or not by your team and explain why. Review the following slideshow that breaks down the Ocean Wise criteria for sustainable aquaculture. The first candidate was recommended by the official Ocean Wise Seafood Team while the second candidate was declined a recommendation. <p>Action: I will check out the Ocean Wise recommendation web page</p>	<p>Websites:</p> <ul style="list-style-type: none"> Ocean Wise To Eat or Not to Eat Farmed Fish? Ocean Wise Feeding Farmed Finfish Sustainably VA: Ocean Wise and Sustainable Seafood Ocean Wise Seafood Recommendations for Sustainability Ocean Wise Our Standards <p>Videos:</p> <ul style="list-style-type: none"> Ocean Wise What is an Ocean Wise Assessment? 	<p>Formative; Students collaborate to create criteria for aquaculture sustainability and recommend aquaculture facilities for recommendation</p>
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4	<p>The ocean supports a great diversity of life and ecosystems ~</p> <p>Aquaculture and wild fishing are both prominent forms of cultivating seafood.</p>	<ul style="list-style-type: none"> ● Identify key methods of wild fishing ● Evaluate the impact of wild fishing and aquaculture ● Analyze the relationship between wild fishing and aquaculture 	<p>Critical Questions: What are the key methods/techniques of wild fishing? What are the differences and similarities between aquaculture and wild fishing? What improvements can be put in place to support ocean health?</p> <p>Background Information: With the many articles, conversations and critiques of the seafood industry, it can generate confusion about the facts of farmed seafood and wild fishing; especially in raising awareness of their impact on aquatic life. This activity prompts critical thinking and analysis of the correlation between the seafood industry and the health of diverse ecosystems and species. Students will reflect to form independent opinions and ideas concerning the seafood industry’s influence on social, economic and environmental spheres.</p> <p>Task:</p> <ol style="list-style-type: none"> 1) Introduction: Watch the Ocean Wise Wild vs. Farmed Seafood: Mythbusters to prompt the concept that further investigation of these fishing methods are required. 2) Workbook Page 10-11: Divide the class into groups, they will review the articles provided to prepare for a class debate. The links in the resource section of this lesson can also be used. 3) The debate will be based on the following statement: Farming fish addresses declining wild fish populations. 4) Workbook Page 12: The debate will be organized into 3 sections outlined in the workbook to cover social, economic and environmental factors. Use this teacher’s guide to introducing debates to help facilitate the activity if needed. 5) Reflection: Host the debate with the teacher as a mediator and reflect upon the value of both aquaculture and wild fishing in meeting the rising demand for seafood due to the growing global population. <p>Action: I will equip myself with the knowledge to recognize different methods of sustainable seafood extraction.</p>	<p>Websites:</p> <ul style="list-style-type: none"> - Ocean Wise Fishing and Farming Methods - Global Aquaculture Alliance: Environmental Impact of Aquaculture - Environmental Science: Environmental Consequences of Fishing Practices <p>Videos:</p> <ul style="list-style-type: none"> - Ocean Wise Wild vs. Farmed Seafood: Mythbusters - Ocean Wise Haidi Gwaii Shore Lunch w/ Ned Bell - TED-ed: Will the ocean ever run out of fish? 	<p>Formative; Students prepare for and debate: BIRT (Be It Resolved That) farming fish addresses declining wild fish populations.</p>
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5	<p>The ocean is a major influence on weather and climate ~</p> <p>The seafood industry can have various short term and long term impacts on the environment.</p>	<ul style="list-style-type: none"> • Compare and contrast different environmental phenomena • Assess the short term and long term environmental impacts of aquaculture • Learn how climate change relates to aquaculture 	<p>Critical Questions: What are some of the positive and negative effects of aquaculture on the environment? How does aquaculture compare to agriculture? How does aquaculture affect the climate?</p> <p>Background Information: How and where we receive our seafood is directly affected by environmental forces and in turn environmental forces are impacted by how we produce and consume seafood. This link is significant to understand how personal actions have a tangible impact on marine ecosystems. These impacts can be seen in the short and long term and comparing these outcomes demonstrates to students the importance of ocean stewardship.</p> <p>Task:</p> <ol style="list-style-type: none"> 1) Introduction: In groups, assign each group an aquaculture system (as outlined on page 3-5 of the workbook) and provide the students with workbook page 10 outlining key environmental challenges aquaculture systems could encounter to explore the impacts climate change has on the seafood industry. 2) Workbook Page 13 & 14: The students must critical analyze how their aquaculture system will be affected by the key impacts (Rising sea levels, ocean acidification and microplastics). 3) Reflection: Have students share their findings and reflect upon how they can play a role in mitigating the impacts discussed. <p>Action: Advocate for sustainable choices at my school and in my community.</p>	<p>Websites:</p> <ul style="list-style-type: none"> - Ocean Wise Spot Prawn Fishery - Impacts of climate change on fisheries and aquaculture: Pg. 623-626 <p>Videos:</p> <ul style="list-style-type: none"> - Bon Appetit: Brad Explores an Oyster Farm - National Lobster Hatchery: The Lobster Process and Release - TED-Ed: Underwater farms vs. climate change? - Coast Salish Peoples Clam Gardens (scroll to bottom of page for video) 	<p>Formative; Students summarize impacts of climate change on the seafood industry.</p>
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6	<p>The ocean and the life in the ocean shape the features of the earth ~</p> <p>Aquaculture mimics ocean ecosystems through cycling nutrients in the environment.</p>	<ul style="list-style-type: none"> ● Observe the interconnected nature of ecosystems ● Understand the dynamics of multi trophic aquaculture ● Question and create a sustainable fish farm 	<p>Critical Questions: How are nutrients cycled in aquaculture? How can animal interactions be used to create more sustainable farms? What are the challenges of raising several animals at a time? How can aquaculture improve to be more sustainable in the future?</p> <p>Background Information: Integrated multi-trophic aquaculture systems are a hallmark of farmed seafood and displays key components of marine ecosystems in how animals rely on each other to uphold balance and stability of their habitat. This structure facilitates the cycling of nutrients and energy flow throughout the ecosystem. This lesson will provide students with the tools to learn about the dynamics of multi-trophic aquaculture systems and challenge them to create their own fish farm to include key features that shape ocean life.</p> <p>Task:</p> <ol style="list-style-type: none"> 1) Introduction: Watch the following video from DFO that breaks down multi-trophic aquaculture. 2) Workbook Page 15 & 16: Each student will be given a list of animals that they will then use to create a sustainable multi-trophic aquaculture system. 3) The workbook will break down the process of assembling an Integrated Multi-Trophic Aquaculture system by answering prompts such as: <ul style="list-style-type: none"> -Which animal/s will you ultimately harvest? Why? -What animals outside of the list will you add to your aquaculture system? Why? -List how 3 animals from your system serve you as a fish farmer. After answering the prompts, have the students draw/create the aquaculture system using either poster paper, 3D printing or Canva. 4) Reflection: Share their aquaculture systems with the class and discuss their answers to the questions. <p>Action: I will encourage my family and school to purchase fish from sustainable sources.</p>	<p>Websites:</p> <ul style="list-style-type: none"> - DFO: Communities & Employment - Global Aquaculture Alliance: Multi Trophic Levels <p>Videos:</p> <ul style="list-style-type: none"> - Video by EU Environment: Aquaculture & Sustainability - Video: Ocean Forest-Sustainable Aquaculture - DFO: DFO Aquaculture Research 	<p>Formative; Students design a multi-trophic aquaculture system.</p>
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7	<p>The ocean is largely unexplored ~</p> <p>Aquaculture is continuously innovating to improve its systems.</p>	<ul style="list-style-type: none"> Analyze the social, environmental, and economical impact of aquaculture Innovate new ways to improve seafood sustainability through collaboration 	<p>Critical Questions: What are the different ways people engage with aquaculture? How does the innovation of aquaculture reflect these perspectives? What are the pros and cons when collaborating these perspectives in aquaculture?</p> <p>Background Information: Aquaculture is an innovative form of seafood production that is evolving and improving as the industry explores its strengths and weaknesses. To examine the process of innovation, students will exercise their creativity and entrepreneurship to assess aquaculture and how it can be enhanced for the betterment of our oceans. This will be particularly valuable in having socio-economic factors being the root of the decision making.</p> <p>Task:</p> <ol style="list-style-type: none"> Introduction: Discuss how aquaculture is constantly innovating and changing as we learn more about best practices. What do we currently know about aquaculture and areas of improvement? Watch DFO's video about aquaculture innovation to help facilitate this conversation. Workbook Page 17-19: Divide the class into 4 groups. Assign each group an area of social focus for which aquaculture can have an impact as outlined. On these workbook pages, are resources that reflect the social focus, provide time for the group to review and discuss. Activity: Then divide the group again, this time the new groups should have at least 1 representative from the previous group; the result being the new groups have a mix of social focuses. The group then share their findings and compare how the aquaculture industry impacts them. Reflection: Review outcomes and share what similarities and differences were identified. Additionally, explore how these social focuses are connected via aquaculture. <p>Action: Talk to people in the seafood industry to learn first hand about socio-economic connections.</p>	<p>Websites:</p> <ul style="list-style-type: none"> Forbes: 5 Innovations in Aquaculture Worth Catching On To Now <p>Videos:</p> <ul style="list-style-type: none"> Ocean Wise Variety is the Spice of Aquaculture Ocean Wise Geoduck Aquaculture Ocean Wise Wolf-eels: Sustainable Seafood? DFO: Innovative Tools in Aquaculture Squamish Nation Stewardship 	<p>Formative; Students assess the aquaculture industry from the perspectives of a variety of stakeholders.</p>
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