**Teaching Notes**

The following learning activity was created to help students meet learning goals contained in both Science 9 and Career Education 9. It was designed to be completed in one lesson, and requires only general grade level skills and knowledge.

**Goals**

*-Students will engage with food chains and nutrient cycling through exploration of the real world process of aquaculture.*

*-Students will consider the sustainability of aquaculture and marine ecosystems.*

*-Students will explore the economics of the aquaculture industry in BC and reflect on the future of work for themselves and their community.*

**The biosphere, geosphere, hydrosphere, and atmosphere are interconnected, as matter cycles and energy flows through them**

**Big Ideas**

***Science 9:***

**-The biosphere, geosphere, hydrosphere, and atmosphere are interconnected, as matter cycles and energy flows through them.**

Science 9 Curricular Competencies/Content Links:

* Sustainability of systems
* Matter cycles within biotic and abiotic components of ecosystems
* First Peoples knowledge of interconnectedness and sustainability

The value of work in our lives, communities, and society can be viewed from diverse perspectives.

***Career Education 9:***

**-The value of work in our lives, communities, and society can be viewed from diverse perspectives.**

Career Education 9 Curricular Competencies/Content Links:

* Local and global needs and opportunities
* Factors affecting types of jobs in the community
* Influence of technology in learning and working

First Peoples Principles of Learning: Learning ultimately supports the well-being of the self, the family, the community, the land, the spirits, and the ancestors.

Traditional Ecological Knowledge and links to modern resource management and sustainability.

Core Competency: Critical Thinking - Question and investigate, consider perspective and ideas.

**Lesson Outline**

**Before the lesson:**

 -Copy or provide digital access to the student materials (Parts 1-3).

 -Provide access to the linked You Tube videos (2) and web-based document.

**Part 1: The Ecology of Aquaculture in Canada** Suggested time: 25 minutes

▢ Direct students to read the introductory paragraph or go over as a class.

▢ Direct students to view the Fisheries Canada video or watch as a class.

▢ Discuss, and provide time for students to complete Part 1 Questions

**Part 2: Aquaculture and Sustainability** Suggested time: 25 minutes

▢ Direct students to read the Vancouver Sun article or go over as a class

▢ Direct students to view the CBC video or watch as a class.

▢ Discuss, and provide time for students to complete Part 2 Questions.

**Part 3: Reflection** Suggested time: 15-20 minutes or homework

▢ Students brainstorm careers connected to aquaculture, and examine their local industry and opportunities.

**Assessment Rubric**

|  |  |  |  |
| --- | --- | --- | --- |
| Goals | 1 | 2 | 3 |
| Considers IMTA in the context of a food web and energy and nutrient cycling | Not done or minimally done. | Demonstrates basic understanding of energy transfer or ecosystem roles.  | Demonstrates in depth understanding of ecosystem dynamics including eutrophication. |
| Analyses the potential risks of modern aquaculture and considers threats to healthy marine ecosystems  | Not done or minimally done | Mentions one risk and one threat to marine ecosystems | Response includes at least 2 risks (ex. excess nutrients, spreading disease) and one threat (ex. microplastics) |
| Brainstorms careers connected to the aquaculture industry in Canada | Not done or minimally done. | Lists at least 3 careers connected to aquaculture | Lists at least 5 careers connected to aquaculture |
| Considers local industry activities and opportunities, and the sustainability of this industry. | Not done or minimally done. | Mentions local aquaculture activities. | Mentions local community specific aquaculture economy and opportunities, and evaluates sustainability. |

Total: /12

**Careers 9/Science 9 Cross-Curricular Lesson:**

**Canadian Aquaculture**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**PART 1: The Ecology of Aquaculture in Canada**

**Background**

Aquaculture, or the farming of aquatic species, has been a practice of coastal peoples around the world for thousands of years. Along the Pacific coast, for example, some First Nations people built specialized beach terraces or “clam gardens” to increase their shellfish harvest2. The construction and management of clam gardens required a detailed understanding of the intertidal ecosystem as well as currents and tides, and is one of many examples of the Traditional Ecological Knowledge of Coastal First Peoples. Contemporary aquaculture in British Columbia ranges from the relatively passive and low impact farming of oysters and other bivalves to the more labour-intensive and ecosystem-altering farming of fin fish such as salmon.

In 2009, aquaculture was responsible for approximately 14000 full-time jobs in Canada, and half a billion dollars in annual labour income3. The value of Canadian aquaculture production increased 63% from 2003 to 2013, and it is expected to continue to grow3.

 Aquaculture practices that include the feeding of organisms (such as fish-farming) introduce waste or excess nutrients into ecosystems, and can have negative consequences. In addition, concentrated living conditions can lead to increases in parasites and disease, with the potential to spread to and harm wild organisms. The environmental sustainability of aquaculture practices is studied by scientists and fundamental to preserving healthy marine ecosystems5.

Please watch the following Fisheries Canada video: [Aquaculture Research: Integrated Multi-Trophic Aquaculture](https://www.youtube.com/watch?v=U5AYTCMP0r4)\*\* (approx. 9 minutes long). Then, answer the following questions:



1. The IMTA video does not discuss the source of food for the farmed sablefish, but they are generally fed food pellets made from other fish species such as herring or anchovies, combined with wheat and added nutrients. The food web shown here includes fish feed (pellets), sablefish, California Sea Cucumbers, mussels, and kelp.

a) What is the original source of energy for this ecosystem?

b) What ROLE are the sea cucumbers playing in this ecosystem?

c) If you were to add humans to this food web, where would you put them and why?

2. Integrated Multi-Trophic Aquaculture (IMTA) aims to reduce the ecological impact of aquaculture while increasing the earning potential of the industry. How does it plan to accomplish both of these goals simultaneously?

**PART 2: Aquaculture and Sustainability**

Please read the following Vancouver Sun article, and then watch the short CBC video. Then, answer the questions that follow.

Vancouver Sun: [Drug resistant sea lice ‘out of control’ on BC coast: Report](https://vancouversun.com/news/local-news/drug-resistant-sea-lice-out-of-control-on-b-c-coast-report)

CBC Video: [Microplastics entering the food chain](https://www.youtube.com/watch?v=Yu5Dw6rwZvE) (~ 4 mins)

1. Are there any negative outcomes or risks associated with fin fish aquaculture? What about a more passively farmed species, such as oysters? Feel free to look up more details if needed. Compare these two very different aquaculture activities (Salmon Farming vs. Oyster Farming) in the following ways:

Energy input (food source)

Waste products (nutrients added to ecosystem)

Risks to wild species

2. Can you think of any factors that threaten the future of the aquaculture industry in Canada? What actions can be taken to reduce these risks?

**PART 3: Reflection**

1. Brainstorm as many jobs as you can that are in some way related to the aquaculture industry in Canada. Don’t forget equipment, harvesting, transport, environmental management and monitoring, and science!

2. Does your local community practice aquaculture, or does aquaculture occur nearby? Ask around or research aquaculture activities in your region, and describe them briefly.

3. Do you think think aquaculture is a sustainable local industry? Why or why not? Consider both ecology and economics.

**Multimedia Resources**

Fisheries and Oceans Canada: *Aquaculture Research: Integrated Multi-trophic Aquaculture* <https://www.youtube.com/watch?v=U5AYTCMP0r4>

Vancouver Sun: *Drug resistant sea lice ‘out of control’ on BC coast: Report*

<https://vancouversun.com/news/local-news/drug-resistant-sea-lice-out-of-control-on-b-c-coast-report>

CBC: *Microplastics entering the food chain*

<https://www.youtube.com/watch?v=Yu5Dw6rwZvE>

Vancouver Sun: Drug resistant sea lice ‘out of control’ on BC coast: Report

<https://vancouversun.com/news/local-news/drug-resistant-sea-lice-out-of-control-on-b-c-coast-report>

**References**

1. Canadian Broadcasting Corporation (CBC). (2017, March 10). *Microplastics entering the food chain.* [Video File]. Retrieved from: <https://www.youtube.com/watch?v=Yu5Dw6rwZvE>

2. First Nations Education Steering Committee (2016). Science First Peoples Teacher Resource Guide, 2016. Retrieved from: <http://www.fnesc.ca/science-first-peoples/>

3. Fisheries and Oceans Canada. (2013, June 4). *Aquaculture Research: Integrated Multi-trophic Aquaculture (IMTA).* [Video File]. Retrieved from: <https://www.youtube.com/watch?v=U5AYTCMP0r4>

4. Fisheries and Oceans Canada. (2013). Aquaculture Statistics, January 2013. Retrieved from:

<http://www.dfo-mpo.gc.ca/aquaculture/sector-secteur/stats-eng.htm>

5. Vancouver Sun. (2018, October 30). *Drug resistant sea lice ‘out of control’ on BC coast: Report.* Retrieved from:

<https://vancouversun.com/news/local-news/drug-resistant-sea-lice-out-of-control-on-b-c-coast-report>