



# Environmental Science 3205

## Unit: 4: Water Use and the Environment: Aquaculture

### Specific Curriculum Outcomes

4.04 Compare freshwater and saltwater relation to quantity and quality

4.27 Describe the present state of the world's fishery, include levels of exploitation and resource dependence

4.44 Define Aquaculture

4.45 Describe factors that lead to an increased dependence on aquaculture as the primary source of fish proteins

4.46 ID the main species raised in an aquaculture environment in Newfoundland and Labrador

4.47 Describe the environmental issues associated with aquaculture operations

4.50 Identify negative impacts resulting from marine invasive species. Include: Tunicates, green crab and oyster thief

### **Sustainability**

Whenever possible these questions relating to sustainability should be addressed in relation to the major industries of this province. Fisheries and aquaculture are examples of major industries in Newfoundland where there has been a shift to include **sustainable aquaculture practices** for salmonid and mussel farming, and to actively manage our fisheries through sustainable methods.

### Suggested Teaching and Learning Strategies:

- Use Canada's Sustainable Fish and Seafood Resource to define sustainability and its applications to fisheries and aquaculture in Newfoundland. You could also use the General Aquaculture Presentation (sustainability section) Resource.
- Split the class into 4 or 5 groups and each group has to do a presentation on one of the species that the provincial government has identified as key species for aquaculture in Newfoundland, plus one group for alternate species. Using links under the species tab at <http://www.naia.ca/> and <http://www.fishaq.gov.nl.ca/aquaculture/pdf/aquasite.pdf> Also use the Location of Aquaculture Sites Resource. The presentation should include a brief

description of the species, its life cycle, where and how is it cultured in Newfoundland, what products are made and any ongoing research that is being done in the province.

- Using the lesson plan from the Ocean Market procedure [http://smithsonianeducation.org/educators/lesson\\_plans/ocean/acrobat/market.pdf](http://smithsonianeducation.org/educators/lesson_plans/ocean/acrobat/market.pdf) and the Ocean Market Activity, the students can travel to a local super market or discuss what seafood products are available in the seafood, frozen food, canned and bottled sections. Record what seafood species the products include, whether it was from the wild fishery or grown through aquaculture, the country of origin of the product, and an estimate of the processing/packaging/marketing required.

## Environmental Impacts of Aquaculture

There are many environmental concerns in relation to the aquaculture industry. This includes the physical oceanographic factors that influence where a farm can operate and the water quality needed to keep animals healthy and happy. Temperature, salinity and dissolved oxygen levels are some of the important water parameters.

- Presentation on oceanography factors including, currents and tides and how they affect aquaculture sites (Use the Oceanography and Planktology Presentation (oceanography section) Resource).
- **Effects of Salinity on Species:** To evaluate some of the environmental factors that aquaculture needs to monitor, students can make a hydrometer to measure salinity using instructions from Make a Hydrometer Activity (document provided or go to website <http://www.grandpapencil.net/science/hydrom.htm>)

Then travel to obtain water samples from the ocean, a freshwater site and a brackish estuary site. Measure the salinity with the homemade hydrometer, dissolved oxygen (DO) with a school biology/chemistry kit with a Winkler bottle test (instructions with test, usually found in school labs) and temperature using a thermometer. It is important to complete the water quality of the samples on site, particularly as temperature changes affect the dissolved oxygen content.

If a site visit is not possible, then solutions and the hydrometer can be made in the lab (See Make a Hydrometer Activity). The teacher and/or students can prepare solutions representative of freshwater (0 ppt = 0 %), marine (35 ppt = 3.5 %; 3.5 g salt in 100g water) and brackish (15-20 ppt = 1.5-2.0%; 1.5-2.0 g salt in 100g water). Salinity, temperature and dissolved oxygen can be determined as in the previous section. In addition to the hydrometer activity a thermocline activity can be used to demonstrate the density of cold vs. Warm water (Use the Thermohaline Activity).

- Get the students to research the salinity that certain species best like to live in nature. Discuss the effects of salinity change on species and whether they can adapt to change (e.g. osmoregulation process; euryhaline species, such as salmon and eels, which can move from salt to fresh and adapt; stenohaline species, such as mussels and cod, which are not as tolerant of salinity changes). Discuss how/why we select certain sites for aquaculture based on year-round temperature, salinity (e.g. effects of rivers), dissolved oxygen and other environmental conditions. Focus on the difference in densities of freshwater and saltwater (Use the Thermohaline Activity)
- The introduction and spread of Aquatic Invasive Species is affecting our environment and is posing a threat to habitat, health of natural species and social well being. To identify some important marine invasive species and their negative impact see the DFO AIS Booklet Resource, the DFO Green Crab Synopsis Resource and the Green Crab Life Cycle Resource.
- There are many misunderstood facts about aquaculture. Have students review the following documents (documents provided or go to original websites) and have a discussion about the issues facing the developing Newfoundland aquaculture industry. Invite an aquaculture person (e.g. local person; on-line live Skype session with specialist from Marine Institute, NAIA, etc.) to discuss some of these issues with your students after they have done some of the document review.  
 General Aquaculture Presentation Resource  
 Myths and Realities Resource  
<http://www.dfo-mpo.gc.ca/media/back-fiche/2005/salmon-eng.htm>  
 CAIA FAQ's Resource\_ <http://www.aquaculture.ca/facts/faq.htm>  
 Myths and Realities About Salmon Farming Resource

### *Additional Resources*

- <http://www.fishaq.gov.nl.ca/aquaculture/pdf/aquasite.pdf>
- <http://www.dfo-mpo.gc.ca/aquaculture/aquaculture-eng.htm>
- <http://www.fao.org/fishery/en>
- <http://www.fishbase.org/search.php>

### *Suggested Assessment and Evaluation Strategies*

In the presentation there should be a definition of sustainability and information about the selected Newfoundland aquaculture species.

From the supermarket activity about products that are available in the seafood sections, get the students to present a visual display (chart or diagram) of the number of products that were from the wild fishery and/or aquaculture, where they came from and any trends that they noticed.

Have students do a lab write up on the water parameter tested and explain some of the conditions that are needed for the NL species with respect to salinity. Discuss if any of the sites studied would have the appropriate salinity for the species.

Evaluate students on their discussion/participation as they consider the controversial facts about aquaculture.