Salmon, the Environment and Society An Education Module on Salmon Aquaculture in BC

by Jim Wiese



Copyright

Copyright © April 2006, British Columbia Ministry of Agriculture and Lands PO Box 9120, STN PROV GOVT, Victoria, British Columbia V8W 9B4.

All rights reserved. No part of this publication may be added to, deleted, reproduced, stored in a retrieval system, or transmitted, in any form or by any means whatsoever, without prior permission from the BC Ministry of Agriculture and Lands. A limited copyright is granted for not for profit reproduction and distribution of the complete teachers manual and accompanying student sheets, for use by classroom educators. This document is to be used for its intended use only.

While every effort has been made to ensure that the information contained in this publication is correct, the author and the publisher caution against the use of the information contained in this publication in any particular application and accept no responsibility or liability for errors, omissions, or representations, expressed or implied, contained herein or in any written communication associated with this publication. Errors brought to the attention of the publisher will be corrected in periodic updates to this guide.

Publication Information

This guide is produced as a joint project between the BC Ministry of Agriculture and Lands (BCMAL), and the BC Agriculture in the Classroom Foundation (BCAITC). The technical portion is copyright © by the BCMAL. This document may be downloaded or purchased from the BC Agriculture in the Classroom Foundation at www.aitc.ca/bc. For more information on the contents of this document contact the BCMAL Aquaculture Development Branch at (250) 897-7540.





www.aitc.ca/bc



Contents

Introduction	4
Aquaculture in British Columbia	4
Goals and Objectives of the Module	5
Critical Thinking in the Module	6
Teaching Strategies Used in the Module	7
Curriculum Connections for the Module	8
Grade 5 Science	8
Grade 5 Social Studies	8
Grade 7 Science	9
Grade 7 Social Studies	9
Grade 8 Science	10
Cooperative Groups and Salmon, the Environment and Society	10
Teaching Activities	11
Orientation and Elicitation	11
Background Information	11
Presentation Suggestions and Notes for the Teacher	11
Restructuring	13
Application and Review	22
Assessment and Evaluation of Salmon, the Environment and Society	24
Appendix	25
Salmon Farming in British Columbia	27

Introduction

Introduction

Aquaculture in British Columbia

Wild Salmon have lived in the waters of western Canada and the Pacific Northwest for thousands of years. There are five different species of Pacific salmon that are commercially fished, coho, sockeye, chinook, pink and chum, each with its own unique characteristics in life history, appearance, size, color and flesh characteristics. There are two additional salmonids species, steelhead and cutthroat, although they are not fished commercially. There are two salmon species in the Atlantic - Atlantic salmon and brown trout. The unique taste and popularity of salmon is created by a combination of high protein content and a rich supply of oil and Omega-3 fatty acids. These provide numerous health benefits. For the salmon, the protein and oil provide the muscle and fuel for their migration, which can be thousands of kilometres.

Salmon are anadromous. This means they are born in fresh water streams and rivers then migrate to the saltwater ocean and after several years return to their fresh water birthplace to spawn. The length of time a salmon spends in freshwater and then saltwater varies, depending on their species. During spawning, salmon eggs are placed by the female in gravel areas of a stream, called a "redd", where they are fertilized by the male. The eggs hatch after between 2 to 4 months, depending on temperature, into the alevin stage, then progress to become fry. They remain in the fry stage for 1-2 months, before being considered as juveniles. Pink and chum salmon migrate to sea as fry, while other salmon juveniles spend 1 – 4 years In freshwater, eventually becoming smolts. The smolt stage is when they are ready to leave their fresh water streams and rivers and move into the salt-water ocean. They live in the ocean for 2 – 8 years. Between 1 and 15% of the fish that migrate to sea will return to the streams they were born in to perform their final act: spawning the next generation of salmon. After spawning, adult salmon and brown trout can live to spawn a second time.

The availability of salmon played an important role in the exploration and expansion of British Columbia. Early settlers, including the Hudson's Bay Company, caught and dried salmon for sale in the rest of Canada. Today, salmon are still an important part of British Columbia's fishing industry. Individuals, communities, businesses and governments committed to fisheries conservation and habitat renewal ensure that wild salmon remain an integral part of our natural environment, culture and economy. Additionally, First Nations people have traditionally enjoyed a close relationship with the salmon for food as well as ceremonial and cultural purposes.

However, in recent decades, the market for salmon has grown significantly. Some salmon stocks have also decreased in abundance and there is a desire for fresh salmon throughout the year, rather than just during the fishing season. These factors have led to a situation in which the wild fishery cannot satisfy the demand for salmon. In simple terms, people want



more salmon than can be caught. Even in a peak catch year wild salmon can only supply about one-third of the worldwide demand. Because of these changes in the salmon market, new ways to raise salmon were explored, including aquaculture (aquatic agriculture).

In BC, three main species groups are currently raised in aquaculture environments: salmon and other finfish (i.e. - trout, black cod, sturgeon), shellfish (i.e. - clams, oysters, scallops) and marine plants (i.e. - kelp, algae). In salmon aquaculture, salmon are raised to smolt size in hatcheries then transferred to offshore net-pens (underwater cages) where they are fed until they grow large enough to be harvested for human consumption.

Although it is a relative newcomer among BC resource-based industries, the aquaculture sector has grown rapidly. It has become a vital part of the local economy in many coastal communities. Today, farmed salmon is BC's #1 agricultural export. It accounts for 15% of BC's total agricultural production and hundreds of millions of dollars in economic activity. Salmon aquaculture provides jobs and opportunities for more than 4000 people, many living and working in BC's coastal and First Nations communities.

Goals and Objectives of the Module

This module was created to help students explore the role of aquaculture, including salmon farming, in British Columbia and the relationship between salmon, the environment and society. It will do this through an investigation of the following concepts:

- Salmon have played and continue to play an important role in the lives of British Columbians including many First Nations People
- Eating salmon is part of a healthy diet, in part, because of its high Omega-3 fatty acid content
- As the population of the world is increasing, wild salmon production is decreasing
- Salmon can be raised in salmon farms to offset the decrease in wild salmon numbers
- Just as agricultural practices have changed for land farming and livestock rearing, so fish production must change to meet the increasing demand for food

In addition, the module supports the goals and objectives of a quality science program including a variety of science knowledge, skills and attitudes. *Salmon, the Environment and Society* encourages the following:

- Developing a positive attitude toward science
- Expressing scientific attitude
- Developing science skills and processes that allow for exploration and investigation of the natural world
- Understanding and communicating principles and concepts that provide a scientific perspective on the world
- Understanding how science, technology and society interact and influence one another, creating socio-scientific issues

Introduction

Critical Thinking in the Module

In all grades, across all subjects, students' ability to successfully think through the challenges posed by the curriculum and their daily lives is recognized to be of critical importance. Often, the labels used to describe these challenges differ. Depending on the subject, they may be called problems, issues, decisions, tasks, inquiries or dilemmas. Regardless of the wording, at the heart of these challenges is the ability to think critically – to make thoughtful judgments about what to believe or how to act.

Although there are many definitions and concepts about what critical thinking is, or isn't, recent developments by the BC Ministry of Education and The Critical Thinking Cooperative suggests that critical thinking can be usefully understood as thinking in any situation provided the thinker intends to come to a reasoned judgment.

This definition of critical thinking is based on several assumptions about the nature of critical thinking. Three principles are particularly crucial:

- 1. There is a contextual nature to thinking. A meaningful challenge always arises in a particular context and that context determines what qualifies as a sensible or reasonable response.
- **2. There is an interrelationship between thinking and knowledge**. Critical thinking requires the possession of relevant knowledge in both the background of the subject to be studied and in the principles and concepts that characterize quality thinking.
- **3. There is an importance in the quality of thinking.** In judging the quality of thinking, the key is not whether we agree with the conclusion but rather the quality of thinking that supports the reasoned judgment.

The ability to think critically develops over a lifetime by acquiring and refining the range of "tools" necessary to respond to problems and issues. These tools include:

- 1. Possession of relevant background information: students cannot think critically about a topic if they know nothing about it
- 2. Understanding of appropriate standards of reasoning: students need to understand rational or logical arguments, deliberation, inquiry and justification
- 3. Possession of key critical concepts: students need to understand key concepts so they have the same vocabulary to distinguish issues
- 4. Fluency with regard to heuristics: there are certain strategies that are useful in guiding students through some thinking tasks
- 5. Possession of essential habits of the mind: there are many habits that students should possess, including open-mindedness, an intellectual work ethic, respect for high-quality thinking and performance, fairmindedness, independent-mindedness, and an inquiring attitude



Teaching Strategies Used in the Module

Salmon, the Environment and Society offers 6 complete lessons for teaching minds-on, discovery-oriented science and social studies in the middle school classroom (Grades 5 – 8) using a thematic approach. Each lesson in this module is a fully integrated learning experience with clearly defined science content objectives supported and enriched with links to social studies and other appropriate curricular areas. Each activity includes the following:

Teacher Information

Purpose Curriculum Connections Suggested Time Materials Background Information presentation Suggestions and Notes for the Teacher Suggested Answers for Student Sheets

Student Information

Reproducible Student Activity Pages

These lessons are not designed as a stand-alone curriculum; rather the lessons are intended to complement and enrich your own curriculum. You are encouraged to consider how these lessons can meet the needs of your students, match your specific grade curriculum and fit with your own teaching style.

Salmon, the Environment and Society is based on a learning model called "constructivism" or "concept change learning." Constructivism believes that the learner constructs knowledge and understanding through interacting with meaningful experiences.

Constructivism assumes that students always have previous ideas and that they learn by combining new information with earlier ideas, creating new knowledge and understanding. Often, new ideas challenge or conflict with original ones. This leads to questioning, which in turn leads to modification and reorganization of ideas into new understandings. This way of learning is adaptive. People make sense of the world for themselves. Constructivism suggests that the best way to teach is not simply to transmit knowledge to students but to help them expand or reconstruct their original beliefs with more sophisticated ones.

Salmon, the Environment and Society activities themselves are organized into five phases to help students acquire and use new ideas:

- 1. Orientation helps students focus attention on the problem or idea to be introduced
- 2. Elicitation allows students to identify their original thoughts

Introduction

and ideas — this is their starting place for learning

- 3. Restructuring is where student activities are focused on new learning
- 4. Application is where students use their new understanding to draw conclusions, make decisions, or summarize their understanding of the topic
- Review students recap their new ideas to see how them have added to their understanding

In order to maximize learning, it is important to include all of these elements when teaching an educational unit. Although you do not need to undertake all the activities in this module, try to include ones that represent all phases of constructivism to maximize student learning and understanding.

In addition, *Salmon, the Environment and Society* holds to several other learning principles that form its educational philosophy:

- Learning requires the active participation of the learner
- People learn in a variety of ways and at different rates
- Learning is both an individual and a group process
- Active learning in hands-on and minds-on
- Integrated curriculum incorporates real-life learning situations

Curriculum Connections for the Module

There are several specific connections between this module and the British Columbia curriculum for grades 5 – 8 in science and social studies. They include the following Prescribed Learning Outcomes for 2006:

Grade 5 Science

Earth and Space Science: Renewable and Non-renewable resources

- analyse how BC's living and non-living resources are used
- identify methods of extracting and harvesting and processing BC's resources
- analyse how the Aboriginal concept of interconnectedness of the environment is reflected in responsibility for and caretaking of resources
- describe potential environmental impacts of using BC's living and nonlivivng resources

Grade 5 Social Studies

Applications of Social Studies

- identify and clarify a problem, issue, or inquiry
- gather and record a body of information from a variety of primary and secondary sources



- develop alternative interpretations from varied sources
- defend a position on a regional issue in light of alternative perspectives
- use an outline to organize information into a coherent presentation

Economy and Technology

- analyse the relationship between development of communities and their available natural resources
- explain how supply and demand are affected by population and the availability of resources
- analyse how people are influenced by and influence mass media messages

Environment

- natural resources in Canada
- demonstrate understanding of sustainability, stewardship, a renewable versus non-renewable natural resource
- assess effects of lifestyles and industries on local and global environments

Grade 7 Science

Life Science: Ecosystems

- analyse the roles of organisms as part of interconnected food webs, populations, communities and ecosystems
- assess survival needs and interactions between organisms and the environment
- assess the requirements for sustaining healthy local ecosystems
- evaluate human impacts on local ecosystems

Grade 7 Social Studies

Applications of Social Studies

- identify and clarify a problem, issue or inquiry
- defend a position on a global issue by considering reasons from various perspectives
- organize information into a formal presentation using several forms of representation

Economy and Technology

• identify economic systems, trade, exploration, technology and physical environments

Environment

- construct, interpret, and use graphs, tables, scales, legends and various types of maps
- evaluate the impact of natural processes and human-induced changes on communities

Introduction

Grade 8 Science

Applications of Science

- represent and interpret information in graphic form
- demonstrate ethical, responsible, cooperative behavior
- demonstrate competence in the use of technologies specific to investigative procedures and research

Earth and Space Science: Water Resources

 explain variations in productivity and species distribution in marine environments

Cooperative Groups and Salmon, the Environment and Society

The Salmon, the Environment and Society module is an excellent place to use cooperative group teaching. Cooperative small group learning is an approach that organizes classroom activities so students can interact with and learn from one another, as well as from the teacher and the world around them. Whether working in pairs, or groups of three or four, students in a cooperative setting build on one another's ideas and strengths to learn more effectively.

Cooperative small group learning is based on five principles. Teachers whose group work is successful generally find they are applying these principles intuitively. Using these five principles intentionally to structure classroom activity enables teachers to improve the effectiveness of their small group activities. The five principles are:

- 1. Students work in positive interdependence
- 2. Students work in small heterogeneous groups
- 3. Students are accountable both as individuals and as a group
- 4. Students learn through ample opportunity for purposeful talk
- 5. Students learn and practice cooperative skills as they study and explore subject matter together



Orientation and Elicitation

What do students already know about salmon and aquaculture?

Purpose – to have students examine their own lives in order to become aware of the role fish, especially salmon, play; to have students express their own knowledge about fish, aquaculture, and the environment.

Curriculum Connections – science, social studies, language arts

Suggested Time – 1 to 2 class periods

Materials – materials needed depend on the activity chosen.

Student sheet Chart paper Felt pens and/or colored pencils

Background Information

Students will come to this learning experience with a variety of levels of knowledge and understanding about salmon, the environment and society. By doing one or more of these activities, students will begin to examine what they already know. The teacher can use this information as the module progresses to direct their instruction.

Presentation Suggestions and Notes for the Teacher

Choose one or more of the following orientation and elicitation activities.

- You may wish to have students use a journal or learning log. Have them divide a sheet of paper into two parts. Label the top of one section with, "What I know about salmon and aquaculture" and the other with "What I want to know about salmon and aquaculture."
- 2. Have students create a mind map. They may have little previous knowledge on aquaculture, so you may wish to start by having them explore a simpler term, like fish. Have students put the word "FISH" in the middle of a sheet of paper and have students write and connect all the words and concepts that they already know about fish. You may suggest that students include links for both fresh water and salt-water fish. The location of salmon on the mind map may lead to an interesting discussion.

- 3. Another way to record students' understanding is through the use of an elicitation poster. The following outline suggests it be done as a group activity. However, it can also be done individually, prior to group work by using student sheet number 1.
 - **a.** After dividing the class into groups of four, hand out pieces of chart paper or other large writing surface to each group
 - b. Have students fold their paper so that it forms four quadrants
 - **c.** Have students represent their knowledge of fish and aquaculture by doing the following:
 - In quadrant 1, list 5 fish and 5 other sea products that people eat
 - In quadrant 2, draw a picture of an aquarium tank with fish in it Include any other plants or animals that you'd normally find in the tank. List the things that fish need to survive in the aquarium tank
 - In quadrant 3, write any questions they may have about salmon, aquaculture and fish farming
 - In quadrant 4, write a poem about a fish in the ocean
 - **d**. Have the groups share what they did in the activity. Post their work around the classroom. Refer to it during the rest of the module, whenever appropriate

Student elicitation poster. Responses will vary. Responses could include the following:

In quadrant 1, list 5 fish and 5 other sea products that people eat.
 Tuna, salmon, goldfish, trout, shark, etc.
 Sea weed, clams, oysters, scallops, crab, shrimp, etc.

• In quadrant 2, draw a picture of an aquarium tank with fish in it. Include any other plants or animals that you'd normally find in the tank. List the things that fish need to survive in the aquarium tank.

Food, water, oxygen in water, filter to clean water, etc.

- In quadrant 3, write any questions they may have about salmon, aquaculture and fish farming. Students questions will vary. They may include how they can live in both fresh and salt water or how they are caught.
- In quadrant 4, write a poem about a fish in the ocean.
 Student poems will vary. For example:
 - Fish in the ocean Fish on a hook
 - Fish in the market
 - Ready to cook



Restructuring

Activity 1 – Salmon in our lives

Purpose – To allow students to investigate, through a reading and reflection activity, the life cycle of the salmon and the role that salmon play in their lives.

Curriculum Connections - science, social studies

Suggested Time – 1 – 2 class periods

Materials -

Sort and Predict Student Sheet number 2 Scissors Glue sticks White paper Student Sheet number 3 - Salmon in Our Lives

Background Information

Salmon have an interesting life. Because they are anadromous, they live part of their lives in fresh water and part in salt water. In their egg, alevin and fry stages they live in fresh water. When they become smolt, they begin a transition to life in salt water by first living in an estuary. They spend their adult lives in the salt water ocean, only returning to their fresh water streams when it's time to spawn.

Salmon have played an important part in the history of British Columbia, supplying food locally and for export for over 150 years. For 1000's of years, salmon also played an important part of the lives of First Nations people.

Presentation Suggestions and Notes for the Teacher

- 1. Before students read the material, have them use the sort and predict worksheet. The reason for using this technique is to:
 - focus students' attention on the subject matter;
 - engage students actively with the subject matter; and
 - arouse students' curiosity about the subject matter.
- 2. After handing out the sort and predict student sheet, scissors and other materials, inform students that these words are from the section they are about to read. In groups, have students cut out each word from the list and sort them into four or five categories. Once students have put the words into categories, they glue the groups of words on a separate piece of paper and name each group. Students should be prepared to explain why they put certain words together

into a category. Finally, students should list three or four questions they want to have answered as they read the assignment and work through the unit.

- 3. When the students are finished, ask each group for one or more of their categories and the words they put into it. What do they think the reading will be about?
- 4. Finally, create a list with the students' questions. During the study of the module, refer to the questions as you discover their answers.
- 5. Hand out the "Salmon in our lives" student sheets and have students read and answer the Check for Understanding and Reflection questions. The Reflection questions are a good place to start a learning log.

Suggested Answers for Student Sheets

Check for Understanding

1. Define anadromous.

Anadromous means salmon are born in fresh water streams and rivers, migrate to the saltwater ocean where they live as adults, and then return to their fresh water to spawn.

- 2. Create a diagram that shows the life cycle of the salmon. Indicate the parts of their life when they are in fresh water and the parts that are in salt water.
- 3. In what ways have the First Nations people used salmon?

Salmon have been used for food and ceremonial purposes.

4. List several reasons why salmon should be included in a healthy diet.

Salmon are high in protein and low in fat. The fat they have includes Omega-3 fatty acids that help keep the heart healthy.

Reflections

1. Why do you think salmon important in our daily lives?

Salmon are important for food. They are also an important industry that employs many people.



Activity 2 – Salmon population in BC

Purpose – To allow students to investigate the populations of both wild and farmed salmon in British Columbia. To think critically about the increase in world population and its effect on the food supply.

Curriculum Connections - science, social studies

Suggested Time – 1 class period

Materials

Graph paper Ruler Pencils Student Sheet number 4 - Salmon population in BC

Background Information

A graph of the wild salmon population in British Columbia will show that there has been a steady decrease over the last 20 years. During the same time, the world's population has increased by almost 30% to 6.5 billion people. This increase in population at the same time as a decrease in wild salmon numbers has been suggested as one of the driving forces behind the need for salmon farms. Salmon farms have begun to take a larger share of the world market in salmon so that today there are more salmon grown on salmon farms than are caught in the wild fisheries.

Presentation Suggestions and Notes for the Teacher

- 1. Before you begin, review the steps in creating a line graph from data. These steps include:
 - a. Draw the two axes, one vertically and one horizontally.
 - b. Label the axes. The horizontal axis contains the independent variable

 in this case the years for each data point. The vertical axis contains the dependent variable in this case the tones of salmon produced.
 - c. Create a scale for each axis so all the data points can be entered.
 - d. Make a title for the graph.
- 2. Graph the first two points as a class to ensure that everyone understands the graphing process.
- 3. Once the data points have been plotted, have students draw a line of best fit to connect them.

Suggested Answers for Student Sheets

Investigation Questions

1. What trend does the graph of Wild Salmon Production in British Columbia suggest?

The graph suggests that wild salmon production is decreasing.

2. What trend does the graph of Farmed Salmon Production in British Columbia suggest?

The graph suggests that farmed salmon production is increasing.

 Can you think of other reasons why the graphs have the shape they do? Research the topic of salmon populations in British Columbia. Be prepared to suggest other reasons for these trends.

There was a growing need for salmon so when wild salmon production decreased, there was an opportunity to increase farmed salmon production. Government support for farmed salmon encouraged their increase.

Extensions

 Research and graph human population in the world from 1985 – 2003. What is the shape of this graph? Explain how the information on this graph relates to the previous graphs you created.

The world population has also increased and this increased the need for food. One way to meet this need is to increase the amount of salmon produced through farmed salmon practices.

 Research and graph salmon consumption in the world from 1985 - 2003. What is the shape of this graph? How does the information on this graph relate to the previous graphs you created.

Salmon consumption has increased world wide due in part to its health benefits. This increase in consumption has increased the need for salmon and encouraged the expansion of farmed salmon.





Activity 3 – Salmon Farming in 2005

Purpose – To give student background information about the history and practice of salmon farming. This information will be used in later discussions and will allow students to use a common vocabulary when discussing the issue.

Curriculum Connections – science, social studies

Suggested Time – 1 – 2 class periods

Materials

Student Sheets number 5 - Salmon Farming in 2005

Background Information

Although commercial salmon farming began in BC In the early 1970's on a small scale, Norway is generally credited with the creation of the first commercial scale salmon farms. Using Norwegian technology and expertise, the salmon aquaculture industry expanded significantly in our coastal waters in the early 1980's.

Salmon are raised in the same way we raise many animals. We hatch their eggs, feed them a special diet so they grow quickly and harvest them when they are adults. In salmon aquaculture, salmon are raised to the smolt size in freshwater fish hatcheries, then transferred to offshore net-pens (underwater cages) where they are fed for about 20 months, until they grow large enough to be harvested for human consumption, at about 4.5 to 5 kg.

Atlantic salmon are usually raised in BC's salmon farms for a number of reasons:

- they have better growth and survival rates than Pacific salmon
- they are more docile than Pacific species and are easier to raise in net-pens
- there is a strong international demand for Atlantic salmon
- processors find that Atlantic salmon provide more meat and create less waste per fish

In 1995 a two-year comprehensive study of the salmon aquaculture industry was undertaken. In the Salmon Aquaculture Review, the British Columbia Environmental Assessment Office recommended proceeding with salmon farms, but with caution. In 1997, a moratorium was imposed, capping the number of salmon farm licenses in British Columbia. In 2002, the BC government moved slowly to allow salmon farms to expand, but only with stringent environmental controls including tightened escape regulations and improved wastedischarge standards

Presentation Suggestions and Notes for the Teacher

There are many writing-to-learn strategies. They can be used to:

- engage students actively with the subject matter;
- help students make their own meaning from subject matter;
- and ensure that students are better prepared for subject matter discussions.

To help students learn to think and understand concepts, you can have them do one of the following while reading this section.

- 1. Summarize concepts and ideas. Tell students that there are an introduction and two sections in the reading. Have them summarize the main ideas after reading each section. They can use this summary when they discuss the concepts later.
- 2. Question what the text means. Tell students to list at least three things from the reading that aren't clear to them, or write three questions they would like to ask the author. These questions can be used as the basis for a class discussion or as topics for further research.

As an extension activity, give students a copy of the map of Salmon Farming in British Columbia provided in the Appendix. Ask students what they notice about the locations of the salmon farms. Can they think of a reason why salmon farms are located where they are?

Suggested Answers for Student Sheets

Check for Understanding

1. What three main species groups are raised in aquaculture environments in British Columbia?

The main species groups are salmon and other finfish (i.e. - bass, trout), shellfish (i.e. - clams, oysters, scallops) and marine plants

2. What is aquaculture?

Aquaculture is aquatic agriculture, the growing of aquatic plants and animals for human consumption.

3. Summarize how a salmon farm works. Where are they usually located in British Columbia?

A salmon farm uses a net-pen to raise salmon. Salmon are raised from egg to smolt in a hatchery then transferred to a net-pen where they are raised until they are big enough to eat. Most salmon farms are located off the west coast of Vancouver Island and in an area northeast of the island called the Broughton Archipelago.



4. What country is credited with the first commercial salmon farms? What is their link to BC?

Commercial salmon farming began in Norway. In the early 1980's, the BC government encouraged Norwegian investment in the development of salmon farming in British Columbia

5. What is the main species of salmon raised in BC? What are the main advantages to raising this species?

Atlantic salmon are most commonly raised because of their higher survival rate in salmon farms and a world-wide demand for the species.

Extensions

- 1. One common size of net-pen is 30 m-by-30 m-by-15 m deep.
 - a. What is the volume of water in this net-pen?

13,500 m³

- b. How many of your classrooms could fit in the net-pen?Answers will vary. You could fit 30 classrooms in a net-pen.
- c. A fish farm will have a density of Atlantic salmon in the water of 16 kg/m3 in the net-pens. If each salmon has a mass of 5 kg, how many salmon would you expect to find in a net-pen this size?

An average net-pen could hold 216,000 kg of salmon or 43,200 fish.

2. Does the increase world population relate to the creation of salmon farms and their increase in number during the past three decades? Explain.

The increase in world population created a need for more food. One way to get more food is to raise it in confined areas, like salmon farms.



Activity 4 - You Are What You Eat

Purpose – To allow students to investigate the issues in aquaculture and salmon farming. To begin to examine the views that various stakeholders have on these issues.

Curriculum Connections – science, social studies

Suggested Time - 2 – 3 class periods

Materials

Student Sheets number 6 - You Are What You Eat Access to the Internet if other sources of information are being used – see the Appendix for resource web sites

Background Information

Few of us think about the plants and animals around us. Yet they play an important part in our lives. They supply the food that we need to live and grow. Trees supply the raw materials we need to build our homes and businesses. In addition to food, animals give us materials we use for clothing and provide companionship. We use plants and animals every day and seldom give them a thought.

Although plants and animals are important, agricultural land to raise them is disappearing all over the world because of many factors such as soil erosion, the spread of cities, and pollution. In British Columbia, only 5% of the total land is suitable for various agricultural practices. The remaining 95% is mostly mountainous, rocky or forested. Similarly, there are only a few locations where salmon farms can be located.

Population and economic pressures have caused farming, ranching, and fishing practices to change over the years. Limited space and an increased need for low-cost food have caused more intensive agricultural techniques. These techniques have both benefits and risks.

Presentation Suggestions and Notes for the Teacher

Writing-to-Learn strategies allow students to assemble information by taking notes about subject matter. Before students begin the reading, have them draw a line down the center of a piece of paper. Label the left column "Benefits of the New Agricultural Practices" and the right column "Risks of the New Agricultural Practices." As they read this section, have them write notes about the information in the appropriate column. They can use these notes to answer the *Check for Understanding* questions, as well as later in the *Application and Review* section.



Suggested Answers for Student Sheets

Check for Understanding

1. Why have agricultural practices changed over the years?

Agricultural practices have changed to meet an increased need for food by raising more food per acre of land.

2. What agricultural practices have increased the amount of food that farmers, ranchers, and fishers can produce?

Intensive farming practices (i.e.: greenhouse production) use increased fertilizers and machinery to increases plant production. Confinement rearing raises animals in a smaller area under conditions that ensure rapid growth. Aquaculture techniques provide fish and other sea products by raising them in a smaller, controlled area.

3. What are the positive effects of the new agricultural practices?

They grow more food in a smaller area with fewer people. This will let more people have the food they need.

4. What are the negative effects of the new agricultural practices?

Some of the new agricultural practices have risks. Too much fertilizer, pesticides, etc. can harm the environment. Some think that confined salmon farming can spread diseases and parasites.

5. What alternatives could be used to replace the new agricultural practices?

People in many countries could eat less. Many people from North American over eat and if they ate less, maybe there would be more food for the rest of the world. Some countries could try organic farming practices and free range animal rearing.

Extensions

1. Write an editorial for the local newspaper either for or against one of the new agricultural practices.

Student editorials will vary depending on their point of view on the new agricultural practices. Look for balance in their editorial, an indication that they recognize both sides of the story.

 Research the amount of land (or water) necessary to raise 1 kg of each of the following using the new agricultural practices: beef, poultry, and salmon.
 Which provides the most food protein for the world's population?

Student research will vary, but it generally takes less volume of water to raise 1 kg of salmon than to raise 1 kg of beef or poultry.

Application and Review

Creative Endings

Purpose – To allow students to begin to apply their learning in a case study format

Curriculum Connections - science, social studies

Suggested Time – 1 to 2 class periods, depending on the number of case studies that each group of students discusses.

Materials

Student information sheets Student Sheets number 7 - Creative Endings

Background Information

Students have learned about salmon, the environment and society, and they are now ready to apply their new knowledge in different situations. Although the situations are hypothetical, they are based on current, real issues that British Columbians need to discuss and answer.

Background information on the various points of view has been covered in several of the previous activities. This information may be useful for the students. Students can also look for further information on the Internet using the web sites provided in the Appendix.

Presentation Suggestions and Notes for the Teacher

- 1. Divide students into groups of three or four.
- 2. Give one person in each group one of the Creative Endings scenarios. Have that person read the situation aloud and give his or her opinion. The other students should listen actively without giving their opinion initially. After the first person has had a chance to give his or her opinion, the other students in the group will have a chance to give their opinions.
- 3. Give the groups 10 15 minutes to discuss the situation and to come up with a general consensus.
- 4. Debrief the class by having several groups share their solutions to the situation. Is there a class consensus on a solution? One way to discuss the issue is with a human graph. By requiring students to physically indicate their agreement/disagreement or preference on an issue, the human graph quickly plots the total group response.
 - Post five sheets of paper on the wall they should say "Strongly Agree," "Agree," "Neutral," "Disagree," and "Strongly Disagree"



- As you debrief the questions, have students stand in a line in front of the word that represents their feeling
- Once in position, have different students explain why they are standing in a particular location
- As students give their responses, other students can move as they modify or rethink their opinions. The oral exercise prepares students for later writing activities
- 5. Give another student in each group the next scenario. This way each student will have a chance to be the first to speak
- 6. After two or three situations have been discussed, ask the class which scenario posed the hardest problem and why
- 7. If desired, repeat the lesson the next day with more situations

Salmon, the Environment and Society – The Salmon Farming Debate

Purpose – To allow students to review their understanding and apply their learning in an alternate way using a debate format. To link the module to Science Probe 8 activities.

Curriculum Connections - science, social studies

Suggested Time – 1 to 3 class periods, depending on the amount of time necessary for students to collect information for their part of the debate.

Materials

Information from magazines, newspaper, and the Internet Explore an Issue 9.7 in B.C. Science Probe 8 textbook, *The Salmon Farming Debate*

Presentation Suggestions and Notes for the Teacher

Many grade 8 science teachers use the Science Probe 8 textbook. If you do, you can use the Explore an Issue 9.7, *The Salmon Farming Debate*, in the B.C. Science Probe 8 textbook, as a culminating activity. The text includes stakeholders and their perspectives, a summary of several issues involved in salmon farming and student information on internet research, oral presentations, debates and role playing. *The Salmon, the Environment, and Society* module and its activities will better prepare students for an informed discussion and debate about Salmon Farming.

Student answers will vary. Look for discussions that recognize both sides of the complex issue of salmon farming and food production.

Assessment and Evaluation of Salmon, the Environment and Society

Assessment and evaluation can be an integral part of a teacher's curriculum provided we invest in educationally useful and valid measures of student learning. The methods and instruments of assessment and evaluation should be varied so that they focus of a broad range to skills, strategies and knowledge, reflecting the various dimensions of learning.

Thus, in addition to the Student Sheets provided with each activity, you may wish to incorporate other activities that may be useful in your assessment. These could include:

- Journals or Learning Logs
- Notebooks
- Self Evaluation Forms
- Presentations
- Portfolios

You may also wish to use a presentation as part of an authentic assessment. An example of a student presentation sheet is provided. Rating scales are similar to checklists except that they also include a measure of the quality of the performance. The scale could be used when observing and rating a student's performance in a presentation. Consideration should be given to the student's finished reports, as well as to the performance. The information collected can be used for diagnostic, reporting, or interview purposes.





Appendix

Agriculture and Agri-food Canada

http://atn-riae.agr.ca/seafood/farmed_salmon-e.htm

BC Ministry of Agriculture and Lands: Fisheries and Aquaculture Division

The mandate of the ministry is to enhance the development and environmental sustainability of the agriculture and food sectors and the use of public land, while delivering safe, high quality products in the best interests of the people of B.C. http://www.agf.gov.bc.ca/fisheries/

BC Ministry of Environment: Oceans and Marine Fisheries Division

The Oceans and Marine Fisheries Division is responsible for the overall leadership of provincial government strategies and initiatives related to ocean resources and marine fisheries. http://www.env.gov.bc.ca/omfd/

BC Salmon Farmers Association - group dedicated to creating an environmentally sustainable fish farming industry. http://www.salmonfarmers.org/

The Coastal Alliance for Aquaculture Reform (CAAR)

This URL connects to The Coastal Alliance for Aquaculture Reform. It involves groups working to promote safe fish farming and a healthy and sustainable coastal ecosystem. http://www.farmedanddangerous.org

Fisheries and Oceans Canada

http://www.pac.dfo-mpo.gc.ca/aquaculture/default_e.htm aquaculture in the Pacific Region http://www.pac.dfo-mpo.gc.ca/aquaculture/topics/atlsalmon_e.htm Atlantic Salmon in BC.

Friends of Wild Salmon

Friends of Wild Salmon is a diverse coalition of commercial fishermen, sport anglers, First Nations and concerned citizens working together to protect the Skeena River's wild salmon heritage. They raise questions about the environmental safety of salmon farming. http://www.friendsofwildsalmon.ca/

Salmon of the Americas

Salmon of the Americas represents salmon-producing companies in Canada, Chile and the United States. Their mission is to improve health, and awareness of consumers in North America by providing timely, complete, accurate and insightful information about salmon. http://www.salmonoftheamericas.com

Sierra Legal Defense Fund

believes in protecting our water resources and promoting strong legislation to protect human health and the environment. http://www.sierralegal.org/water.html

Appendix 25

Rating Scale for Assessing Student Presentations							
Student Name:							
Date:							
	Approaching Expectations		Meets Expectation	Ex ns Expe	Exceeds Expectations		
A. Demonstrates an understanding of the problem or issue	1	2	3	4	5		
B. Introduction	1	2	3	4	5		
C. Materials are relevant to topic	1	2	3	4	5		
D. Materials have been researched in depth	1	2	3	4	5		
E. Materials are clear and concise	1	2	3	4	5		
F. Content is organized in a logical and easy to follow way	1	2	3	4	5		
G. Conclusion is derived from material presented	1	2	3	4	5		
H. Shows an openness to a variety of points of view	1	2	3	4	5		
I. Presentation voice is clear and audible	1	2	3	4	5		
J. Presentation shows confidence in stance and gestures	1	2	3	4	5		
K. Uses notes and aids effectively	1	2	3	4	5		



Salmon Farming in British Columbia





Ministry of Agriculture and Lands



F British Columbia Agriculture in the Classroom Foundation

www.aitc.ca/bc