

My River My Home

An activity kit for educators about the sustainability of the Fraser River



Created by:



Acknowledgements

This guide is a collaborative project between scientists and educators at the Global Rivers Observatory (GRO www.globalrivers.org), the University of the Fraser Valley (UFV), and the Fraser River Discovery Centre (FRDC). Many people contributed to this document:

Shannon King, Director of Education, FRDC
Luyi Wang, Contract Exhibit and Design Coordinator, FRDC
Dr. Alida Janmaat, Assistant Professor, Department of Biology, UFV
Steven Marsh, Associate Professor, Department of Geography, UFV
Dr. Bernhard Peucker-Ehrenbrink, Senior Scientist, Marine Chemistry & Geochemistry, Woods Hole Oceanographic Institution
Britta Voss, Graduate Student, Woods Hole Oceanographic Institution
Dr. Sharon Gilles, Associate Professor, Department of Biology, UFV
Kathleen Bertrand, Exhibit and Design Coordinator, FRDC
Chris Linder, Chris Linder Photography

The following educators also contributed to this resource by reviewing and editing drafts, attending pilot programs and providing feedback, creating an assessment rubric, and/or offering advice:

Stephanie Chong, Museum Educator, University of British Columbia Masters of Museum Education graduate	Jean Johnson, Retired Teacher, FRDC volunteer
Joan Parsonson, Retired Teacher, Retired Faculty Associate, Professional Programs, Simon Fraser University (SFU)	Mike Hoyer, Retired Teacher, FRDC volunteer
David Barnum, Teacher, District #46 (Sunshine Coast)	Raph Choi, Teacher Candidate (UBC)
Sandra Tee, Teacher, District #40 (New Westminster)	Vinay Sharma, Teacher Candidate (UBC)
Liz Kim, Teacher, District #40 (New Westminster)	Narae Eun, Teacher Candidate (UBC)
Anita Lau, Teacher, District #38 (Richmond)	Jeanny Park, Teacher Candidate (UBC)
Michael Wolfe, Teacher, District #38 (Richmond)	David Giesbrecht, SFU Faculty Associate, Professional Programs (Teaching)
Andrew Livingston, Teacher, District #38 (Richmond)	Tiana Hesmert, Teacher Candidate (SFU)
James Thesiger, Teacher, District #38 (Richmond)	Jared Steven, Teacher Candidate (SFU)
Peter Langbroek, District #35 (Langley)	Joshua Gibson-Fraser, Teacher Candidate (SFU)
Julie Hearn, Teacher, District #42 (Maple Ridge)	Bilijana Tepic, Teacher Candidate (SFU)
Enid McBurney, Retired Teacher, FRDC volunteer	Daniel Flores, Teacher Candidate (SFU)

© 2014 Fraser River Discovery Center

This project was made possible by the following funding sources and sponsors:



CHRIS SPENCER FOUNDATION

Table of Contents

Introduction	i
How to Use this Kit	i
Section I: Connect	1
Activity 1.1 Is Water Important to Me?	2
Activity 1.2 How Much Fresh Water Do I Need?	4
Activity 1.3 What is my Ecological Footprint?	8
Activity 1.4 What is my Local Watershed?	9
Activity 1.5 What are my Connections to the Fraser River?	11
Activity 1.6 Inspired by the River	13
Activity 1.7 What am I Curious About?	14
Section II: Develop Knowledge and Explore Sustainability	17
Environmental Facets	
Activity 2.1 Geography	18
Activity 2.2 Create a Travel Brochure	21
Activity 2.3 The Salmon Forest	24
Activity 2.4 The Carbon Cycle	27
Activity 2.5 Climate Change and the Mountain Pine Beetle	30
Cultural Facets	
Activity 2.6 Indigenous Connections to the Fraser River	34
Activity 2.7 Living Along the Fraser	37
Activity 2.8 Human Impacts on the Environment - Sturgeon Survival Game	40
Economic Facets	
Activity 2.9 Industry and the Environment - a Pulp Mill Role Play	48
Activity 2.10 The Fraser River is Part of a Global Trade Network	50
Activity 2.11 Divergence - Sharing a Limited Resource	54
Activity 2.12 Ground Water - How Much is it Worth?	56
Section III: Investigate Water Quality	58
Activity 3.1 A Blood Test Metaphor	59
Activity 3.2 Introduction to Water Quality Measures	60
Activity 3.3 Taking the Pulse of the Fraser	65

Section IV: Putting the Fraser on the Global Map 68

Activity 4.1 Global Rivers Observatory.....69

Activity 4.2 Global Rivers Art70

Activity 4.3 People’s Relationship to the Environment73

Activity 4.4 Global Rivers Data from Around the World74

Section V: What’s Next? 76

Activity 5.1 Becoming an Active Citizen in Water Issues.....77

Appendix A: Vocabulary..... 78

Appendix B: Recommended Activities by Grade..... 81

Appendix C: Assessment Rubrics..... 91

Introduction to the Guide

The Fraser River Discovery Centre (FRDC) is a hands-on interpretive centre in New Westminster, British Columbia that celebrates the living, working Fraser River. In 2012-2013, the FRDC partnered with the Global Rivers Observatory (GRO) and University of the Fraser Valley (UFV) to create an exhibit and this activity kit about research being conducted by the Global Rivers Observatory on the Fraser, Amazon, Ganges-Brahmaputra, Congo, Lena and Kolyma Rivers.

How to Use the Kit:

This kit provides the information you need to facilitate an inquiry unit about the Fraser River and offers a wide selection of activities and topics to explore the sustainability of the Fraser River. The activities address BC's new cross-curricular core competencies (critical, creative and reflective thinking, personal and social awareness and responsibility, and communication). All of the activities can be used as pre- and post-visit activities when you book a workshop at the Fraser River Discovery Centre or can be used independently to teach about the Fraser River into your classroom.

Section I: Connect is designed to activate prior knowledge and develop a connection to the Fraser River. Students explore the questions "Is water important to me?" and "What is my connection to the Fraser River?" using one or more of the following activities: a memory art project, a watershed tourist activity, measuring their water use, recording their ecological footprint, completing a K-W-L chart, and/or attending a workshop at the Fraser River Discovery Centre.

Section II: Develop Knowledge and Explore Sustainability provides a holistic look at the sustainability of the Fraser River. Lesson plans include classroom activities and suggestions for attending Fraser River Discovery Centre workshops on the industry, cultures, and environment of the Fraser River.

Section III: Investigate Water Quality introduces how water quality is defined and measured and provides simple in-class activities to share these concepts. The Fraser River Discovery Centre offers a water quality workshop during which students follow the scientific method while testing a sample of water from the Fraser River. Teaching materials related to this workshop are provided in this kit so that the activities can be replicated by teachers at their local waterway.

Section IV: Putting the Fraser on the Global Map includes activities to place the Fraser River in a global perspective. Activities include an international comparison of people and environment, a study of art created by students in the Global Rivers Observatory project, and a comparison of water quality data from the Amazon, Ganges-Brahmaputra, Congo, and Kolyma rivers.

Section V: What's Next? includes suggestions to encourage students to become active citizens in local water issues in their communities.

How to book a visit to the *My River My Home* exhibit at the Fraser River Discovery Centre: for workshop details and booking forms visit www.fraserriverdiscovery.org/education For more information call 604-521-8401x108 or e-mail programs@fraserriverdiscovery.org.

Section I: Connect

The Fraser River basin is unparalleled in its environmental, cultural, and economic importance to British Columbia. Its basin spans 25% of the land mass of the province and is more geographically and climatically diverse than any other watershed in the province. 80% of BC's economic output is generated within the Fraser River basin. In this section, students explore their views about water, their dependence on fresh water, and their own connections to the Fraser River.

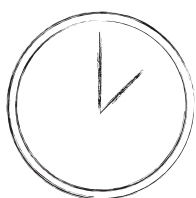


Activity 1.1 Is Water Important to Me?	2
Activity 1.2 How Much Fresh Water Do I Need?	4
Activity 1.3 What is my Ecological Footprint?	8
Activity 1.4 What is my Local Watershed?	9
Activity 1.5 What are my Connections to the Fraser River?.....	11
Activity 1.6 Inspired by the River.....	13
Activity 1.7 What am I Curious About?	14

Activity 1.1 Is Water Important to Me?

Students explore the importance of water in their lives by recalling a memory about water and recording the sights, smells, sounds and emotions they experienced. The memories might be a first swimming lesson, a cold drink on a hot day, or a jump in their favourite lake. Memories help shape our opinions about a place or thing. This activity prepares students for a discussion about the importance of water and how experiences and memories influence our values about water.

What You Need:



25-40 minutes



1.1.1



**Optional: art supplies
for creating art
about their memory**

What You Do:

- Brainstorm a memory about water.
- What do you remember seeing? Smelling? Hearing? Tasting? Touching?
- What feelings does it bring up? Record your thoughts on the graphic organizer.
- Share with a partner or as a class.

Discussion

- Why did you choose this memory?
- Is water important to you? Discuss.
- Discuss the theme of flow: of water, of time, of memories.
- Talk about values. How do your experiences and memories help shape your values about a place or thing?

Extension

- Create a 2-D or 3-D art piece that represents your memory.

1.1.1 My Memory Organizer



Sound



Smell



Touch

My Memory:



Taste



Sight



Emotions

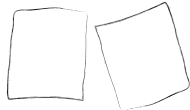
Activity 1.2 How Much Fresh Water Do I Need?

How much water do I use in an average day, week, or month? This exercise is designed to make students more aware of their dependence on fresh water.

What You Need:



A few minutes per day for a week, 20-30 min for intro and conclusion



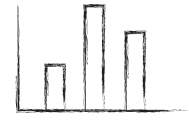
1.2.1, 1.2.2, 1.2.3



2 different ribbons per student



Tape



Graph in the classroom to record results

What You Do:

- See instruction page to prep and make the water meter 1.2.1
- Brainstorm how people use water (bathing, cleaning, cooking, flushing toilet, drinking etc.).
- For younger students: tell a story of a person's day, and have students practice their water meters to estimate the amount of water the person uses.
- Ask students to estimate the amount of water they use throughout the day and record their estimates on the worksheet.
- Ask students to include when their clothes or dishes are washed by parents or a sibling.
- Have students compare their results to their predictions.
- As a class, compare the results.

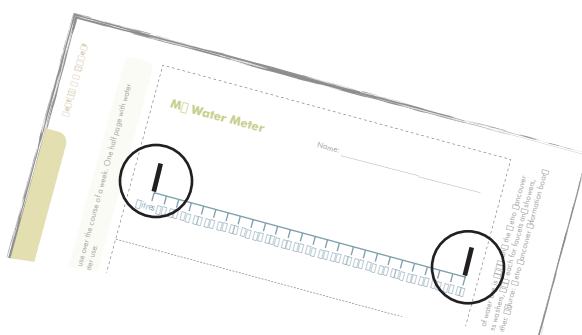
Discussion

- How did the results compare to the prediction? How does it compare to the national or local per capita average?
- What was the class average? The most? The least? What caused the differences?
- What were some things that used a lot of water? Are there ways to reduce this water usage? (i.e. low flow appliances)
- Consider local and global differences. Do people in different countries use water differently?

Extensions

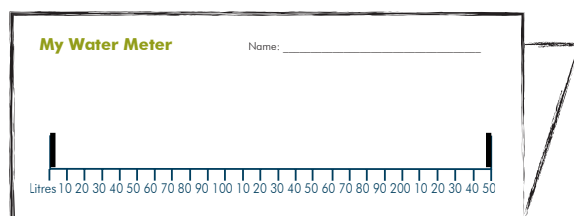
Ask students to make one change and keep track for another week. Did the class reduce water consumption? Which changes had the biggest impact? Find more resources about personal water use on the BC Government's Livingwatersmart.ca website including an electronic home water assessment.

1.2.1 Water Meter Prep



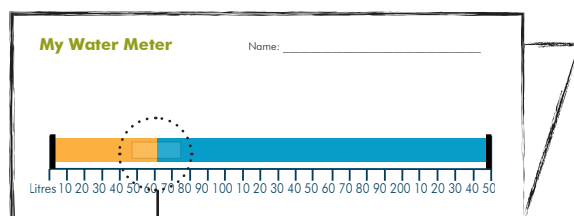
Step 1:

Cut the ribbon slots in the water meter before giving to students.



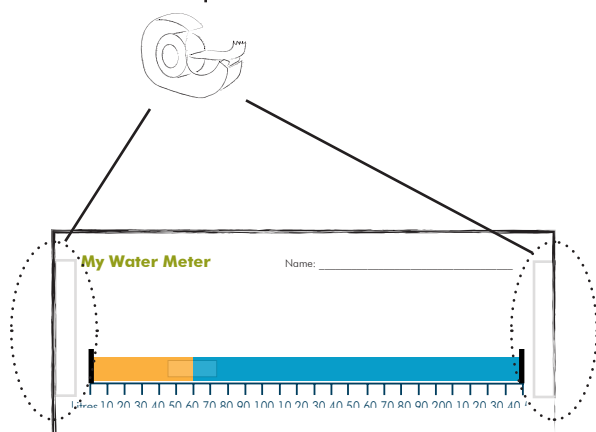
Step 2:

Have the students cut out the water meter and fold it in half.



Step 3:

String the two pieces of ribbon through the slots and join them together with tape on both ends.



Step 4:

Tape the edges of the water meter together to protect the ribbons.

1.2.2 Water Meter

Use this water meter to track your water use over the course of a week.

My Water Meter

Name: _____

Litres 10 20 30 40 50 60 70 80 90 100 10 20 30 40 50 60 70 80 90 200 10 20 30 40 50

Standard toilet 1 flush: 18 L/flush

Low flow toilet: 6 L

1 load in standard top loading washing machine: 125 L

1 load in front loading washing machine: 50 L

1 load of in a high efficiency, energy-star washing machine: 23 L

1 load of dishes in non-energy efficient dishwasher: 60 L

1 load of dishes in energy efficient dishwasher: 15 L

1 load of dishes in sink 1/2 full: about 25 L

1 load of dishes in sink if water is kept running, calculate per minute: _____ min x 6 L per min = _____ L

Running tap: about 6 L per minute

of litres per minute of shower with a standard shower head: 15 L/minute

of litres per minute of shower with a low flow shower head: about 8 L/minute

of litres per bath: about 80 L

of litres used when brushing teeth with the tap on (2 minutes): 12 L

Dripping tap: a drip every second wastes about 4 L/day

Food preparation: about 15 L/day

Drinking: up to 2 L/day

Face/hand washing: about 15 L/day

In 2013 the Canadian per capita domestic daily average of water use was 343L, and the Metro Vancouver average is 325L. 30% of this is flushing toilets, 23% clothes washers, 14% each for faucets and showers, 10% for leaks, 6% for baths, 2% is dishwashers, and 1% other. (Source: Metro Vancouver Information board at Coquitlam Reservoir)

1.2.3 My Water Use Worksheet

Name: _____ Date: _____

Brainstorm the ways people use water:

I predict I will use _____ litres of water in one day and _____ litres of water in one week.

Keep Track:

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Total
_____ L	_____ L	_____ L	_____ L	_____ L	_____ L	_____ L	_____ L

Ways I used water this week:

Reflect: How do I feel about my water use?

What now? How can I reduce my water use?

Activity 1.3 What is my Ecological Footprint?

Water is just one part of our ecological footprint that is based on how much energy and natural resources we use. The Department of Fisheries and Oceans has developed a comprehensive tool for students to calculate their ecological footprint. Students add up points for their water use, food, housing, transportation, and entertainment choices which are translated into an ecological footprint. See the full lesson plan and other resources at <http://www.pac.dfo-mpo.gc.ca/education/lessonplans-lecons/empreinte-eco-footprint-eng.html>.

What You Need:



**at least
60 minutes**



**download the ecological footprint
calculator from the Department of
Fisheries and Ocean website:**

<https://www.pac.dfo-mpo.gc.ca/education/lessonplans-lecons/empreinte-eco-footprint-eng.html>

What You Do:

- Have students fill out the ecological footprint handout. Younger students may need to complete the form at home with their family.
- What choices have the biggest impact on our ecological footprint? What changes would reduce our eco-footprints?
- How are our ecological footprints connected to the health of the Fraser River? In addition to water use, think about transportation choices, and imported foods and goods, etc.
- Optional: Choose an on-line ecological footprint calculator and compare results.
<http://www.myfootprint.org>
https://wwf.panda.org/act/live_green/footprint_calculator/
- Optional: Tim Turner's "How Big is my Ecological Footprint" provides a good alternative (Teaching Green, The Middle Years)

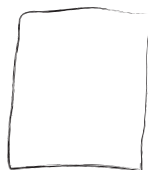
Activity 1.4 What is my Local Watershed?

In this activity, students find out what watershed they live in, and become “watershed tourists” as they take a real or imaginary journey to find their local stream or lake. Students then use maps, an atlas, or the internet to discover how the water in their local waterway travels to the ocean. Students create one or more post cards to document the trip.

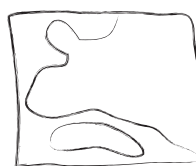
What You Need:



**approximately
60 minutes**



1.4.1



**Ask your City's
Engineering Department
to provide a map with
your school showing the
local watersheds**

What You Do:

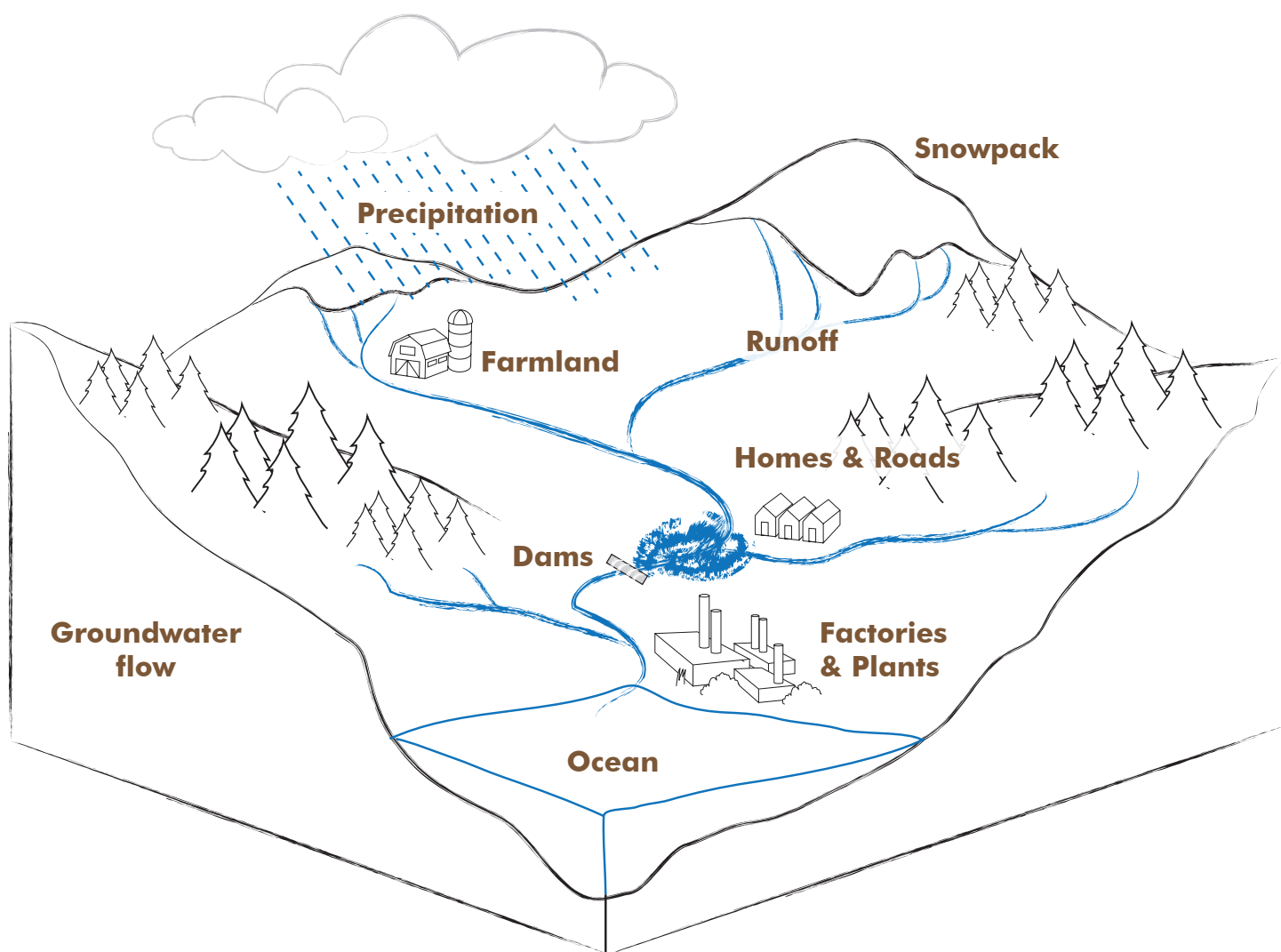
- Use handout 1.4.1 to teach about watersheds.
- Have students research the local watershed to find out where the water comes from and how it travels to the ocean.
- Ask students to create a postcard illustrating one part of the river's journey to the ocean.
- Optional: create a large map of the watershed and place the postcards along the route of the river to the ocean.
- Highly recommended: take students outside to explore their local watershed.
- Discuss the impact that different environments might have on the health of the water (parks/natural environments, farmland, residential, and industrial areas).

Additional Resources

- Map of some of the larger watersheds within Fraser Basin:
http://www.fraserbasin.bc.ca/basin_watersheds.html
- Map of some of the watersheds in the province of BC:
https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/fish-data-information/prov_wsgs.pdf

1.4.1 Becoming a Watershed Tourist Handout

A **watershed** is a basin-like region of land where all the rain, snow, surface and groundwater in the area drains into the same place (e.g., a river). The river may flow into a lake, another river, or the ocean. The water will either evaporate and return as rain, or make its way to the ocean.



During a river's journey, it may flow through many landscapes, from alpine peaks, forests, grasslands, farmland, and cities. Each of these environments can affect the health of the river as it passes by adding different things to the water. In natural areas, leaves, logs and other natural debris might fall in the river. In cities, run-off from roads or waste water from factories might enter the river. How might these different environments affect the health of the waterway?

Activity 1.5 What are my Connections to the Fraser River?

The majority of British Columbians are connected to the Fraser River basin. The basin is a vital trade and transportation corridor, a food source, a place for people to live, one of the largest salmon spawning rivers in the world and habitat for other species, a source of many jobs, and a tourism or recreational destination. In this activity, students consider their personal connections to the Fraser River.

What You Need:



60 minutes



1.5.1

What You Do:

- As a class, brainstorm some ways that people may be connected to the Fraser River.
- Break a class into small groups and assign each group a category (i.e., jobs). There will be overlap between the categories.
 - Basic needs (human survival): air, water, food, habitat, etc.
 - Jobs (think industries, tourism, port operations, scientists, etc.)
 - Imports (food, cars, clothing, computers etc.)
 - Natural resources (timber, mining products, salmon, water, gravel, hydroelectric power etc.)
 - Recreation (fishing, boating, hiking, camping)
 - Cultural/Spiritual (Indigenous culture, museums, tourist attractions)
- Have groups create and present a mini-poster or a collage about their category.
- Ask students to consider which ways they feel most connected to the Fraser River
- Provide an opportunity for students to share their personal connections.
- Optional: Attend an *Inspired by the River* workshop at the Fraser River Discovery Centre which includes a game about this topic.

Discussion

- How might these different uses/needs compete? How do you think that might impact the health of the Fraser River?
- How have the students' feelings about the Fraser River changed after completing this activity?

Extensions

Ask students to find out why their families live in the Fraser River basin? Have they always been here? Were they drawn by opportunities related to the Fraser River? Look historically; share Indigenous origin stories, also consider what opportunities drove settlement in the past?

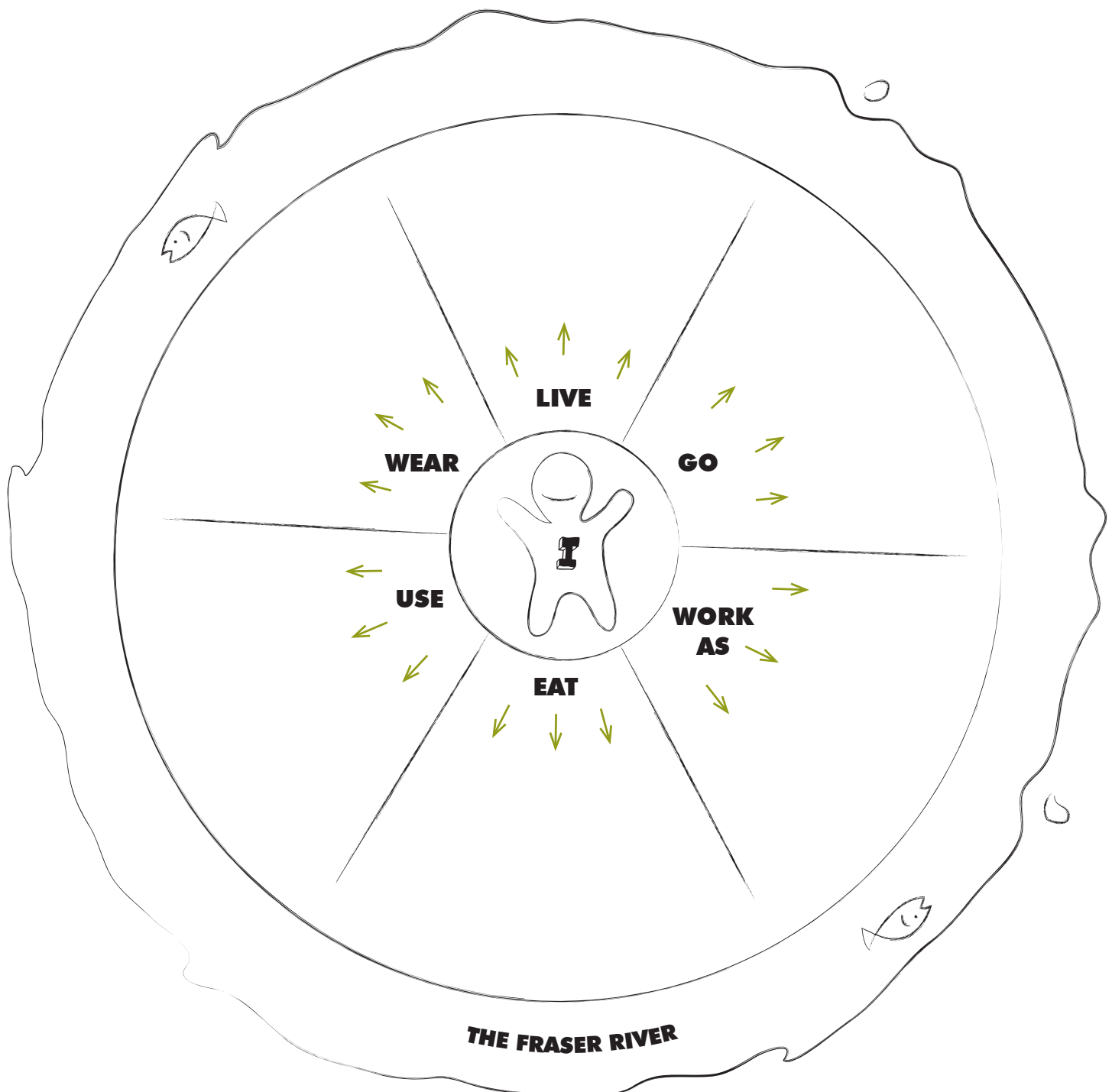
1.5.1 Fraser River Connections Handout

Example:

I live in New Westminster near the Fraser River.

I eat salmon from the Fraser River.

I go hiking along the Fraser River.



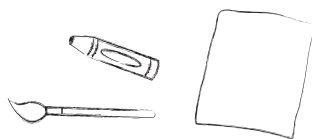
Activity 1.6 Inspired by the River

This activity gets students outdoors to observe the Fraser River or their local waterway. Students first explore using their senses, and then are asked to think like a photographer and scout out their environment looking for that “picture-perfect shot”. Students use this inspiration to create a collaborative river mural.

What You Need:



**1 Frame
per student**



**Paper, printer,
art supplies**

**Optional: Disposable
or digital cameras for
capturing final shot**

What You Do:

- Bring your students to the *Inspired by the River* workshop at the Fraser River Discovery Centre which includes this activity.
- To lead this activity yourself, buy small used frames or have students create a paper frame.
- Take students on a fieldtrip to explore a local water body.
- Ask students to explore the environment using their sense (sight, hearing, touch, etc.)
- Next, ask the students to think like a photographer.
- Give students time to explore the environment with their frame looking for patterns
- (Optional) Take a picture using a digital device or camera capturing each student’s final photo choice (through their frame). Print the photos and arrange them into a large collage.
- Create a river template using 8.5”x11” paper with some land and some water on each sheet. Ask students to colour the paper creating one pattern for the water, and one for the land. Use cool colours for the water and warm colours for the land.
Download template here: <https://fraserriverdiscovery.org/wp-content/uploads/2021/04/River-Mural.pdf>

Discussion

- What stood out most in your mind? Why?
- Why did you choose to take the picture that you did? (Optional: give students time to share their choices with other students).
- What is a pattern? How many patterns could you find? Which ones were from nature, and which were made by people?

Extensions

Discuss how people can use art to express values and how memories and experiences might influence a person’s values. Ask the students to “take a picture” with the frame that communicates their values about water.

Activity 1.7 What am I Curious About?

In this activity, students are encouraged to activate previous knowledge about the Fraser River and consider what else they would like to learn during further study.

What You Need:



**20-30
minutes**



**Know-Wonder-Learn
chart**

What You Do:

- Ask students to fill in the first two sections of the K-W-L chart with “What I already know about the Fraser River”, and “What I would like to know about the Fraser River”.
- If students will be working on individual inquiry projects, use this exercise to help students narrow down their interests and pick a topic for further study.

Discussion

- Discuss the results as a class.
- Together as a class, discuss how this exercise can be used to determine what other activities in this kit the students will complete during their Fraser River inquiry.

Extensions

Have students return to the K-W-L chart after completing their inquiry to finish the last section. Then repeat! What else do students want to know and how might they continue learning about the Fraser River on their own or with their families?

1.7.1 K-W-L Chart

Name: _____ Date: _____

What I Learned

What I Want to Know

What I Know



Section II: Develop Knowledge and Explore Sustainability

The activities in this section provide resources and activities to explore the multi-faceted nature of sustainability as it relates to the Fraser River and provides the background for students to pursue separate lines of inquiry. Pick and choose the activities that relate to the interests students identified on their Know-Wonder-Learn chart (Activity 1.7) or use these activities to help students shape their individual inquiries.

Sustainability concerns the ability of people to meet the needs of the current generation without compromising the ability of future generations to meet their needs. Often linked with the environment, sustainability cannot be separated from economic and social factors.

The Fraser Basin Council (FBC) works to advance sustainability in the Fraser River basin. It defines sustainability as: “social well-being, supported by a vibrant economy and sustained by a healthy environment”. Formed in 1997, the FBC raises awareness of sustainability issues, offers opportunities for action and supports government, agencies, businesses and community groups in their work in the Fraser Basin and across BC. For a more in-depth look at various facets of sustainability and some associated metrics, check out the FBC’s sustainability snapshots:

Sustainability Snapshot 4: The Many Faces of Sustainability (*Basin-wide: 2009*)

http://www.fraserbasin.bc.ca/_Library/Comm_Indicators/report_ss4_2009.pdf

Sustainability Snapshot 2010: Living and Working in the Lower Mainland

http://www.fraserbasin.bc.ca/_Library/Comm_Indicators/report_sslm_2010.pdf



Environmental Facets

Activity 2.1 Geography	18
Activity 2.2 Create a Travel Brochure.....	21
Activity 2.3 The Salmon Forest	24
Activity 2.4 The Carbon Cycle	27
Activity 2.5 Climate Change and the Mountain Pine Beetle	30

Cultural Facets

Activity 2.6 Indigenous Connections to the Fraser River.....	34
Activity 2.7 Living Along the Fraser	37
Activity 2.8 Human Impacts on the Environment - Sturgeon Survival Game.....	40

Economic Facets

Activity 2.9 Industry and the Environment - a Pulp Mill Role Play	48
Activity 2.10 The Fraser River is Part of a Global Trade Network	50
Activity 2.11 Divergence - Sharing a Limited Resource	54
Activity 2.12 Ground Water - How Much is it Worth?	56

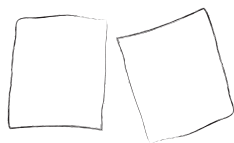
Activity 2.1 Geography

From the Rocky Mountains to the Salish Sea, the Fraser River is one of the most diverse watersheds in North America. It can be broken down into five main geographic regions: the Headwaters, Upper Fraser, Middle Fraser, Canyon, and Lower Fraser. In this activity, students examine the different geographic features of each region of the Fraser River.

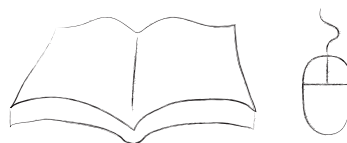
What You Need:



1-2 hours



2.1.1 and 2.1.2



**internet access and
library books for research**

What You Do:

- Introduce the concept of a geographical region by using your local region as an example.
- Have students identify each of the 5 geographic regions.
- Optional: ask students to add more details to the map such as major cities and population.
- Students choose which geographic region they would like to know more about.
- Students research the geography, population, major cities, typical climatic conditions, major industries and natural resources, and common plants and animals in each zone.
- Optional: use the book *Fin's Swim* to introduce the Fraser River
<https://rivershed.com/get-involved/support-us/fins-swim-book-2/>

Discussion

- What is a geographic region?
- What are some of the unique non-living features of each geographic region?
- How is the Fraser River's path impacted by the geographic features of each region?
- Consider the relationships between the Fraser River and the land around it. How do the land and water interact?
- How do non-living features of each region contribute to the water quality of the Fraser River?
- What species thrive in the various regions?

Extension

- Students work in small groups to create a short promotional video or skit about the region they studied, or build a 3D model showing the river's journey through the region.
- As a class, create a large mural of the river and place plants/animals and climate on the map.

2.1.1 Map of the Fraser River basin



2.1.2 Geography Background

Headwaters - Mount Robson Provincial Park

The mighty Fraser River begins near Mount Robson in the Rocky Mountains as a fast stream of clear, glacial water. It quickly picks up speed and volume as streams, lakes and other rivers empty into the Fraser. In fact, one quarter of all the streams, creeks and rivers in BC drain into the Fraser.



© Chris Linder

Upper Fraser - Prince George to Quesnel

Leaving the mountains for rolling hills and flatlands, the river enters the Upper Fraser basin. Lush green forests of evergreen trees line the banks of the Fraser. The water has started to change to a brown colour as the strengthening river picks up sediment – dirt, sand, soil and other debris.



© Chris Linder

Middle Fraser - Quesnel to Williams Lake

This semi-arid area is influenced by the high Coastal Mountains to the west. Most rainfall occurs on the western side of the Coastal Mountains, creating a rain shadow in this region. Wide benchlands high on either side of the Fraser River need to be irrigated for crop production.



© Chris Linder

Fraser Canyon - Williams Lake to Hope

As the Fraser River journeys south it cuts deeply through bedrock. To its east are the flanks of the Coastal Mountains and to the West the edge of the semi-arid bunchgrass steppe of the Inland Plateau. The River scours a deep canyon as it flows.



© Chris Linder

Lower Fraser - Hope to Vancouver

The Lower Fraser is an estuary, where the freshwater of the river mixes with the salt water of the sea. In this area, the mountains no longer constrain the river and so the river begins to meander and slow down. As it does, it begins to drop the sediment it has been carrying. Each year the Fraser deposits 20 million tonnes of sediment into the Pacific Ocean.



© Chris Linder/aerial support provided by LightHawk

Activity 2.2 Create a Travel Brochure

The Fraser River is the most climatically diverse watershed in British Columbia. By car, you can travel from wetlands through dry grasslands and lush forests to alpine meadows in one day. Each biome has its own climate, predominant plant and animal species, and geology. In this activity, students choose a biome and create a travel brochure, poster, or skit to promote a visit to the biome of their choice.

What You Need:



1-2 hours



**internet access
and library books
for research**



2.2.1



**Art
supplies**

**For more advanced
study, use the
biogeoclimatic zones of
the Fraser River Basin:**

<https://rivershed.com/wp-content/uploads/BioGeoClimaticZonesBC.jpg>

What You Do:

- Choose a biome (such as alpine, drylands, forest, and estuary) and research the climate, geology, and predominant plant and animal species found there.
- Promote a visit to this region by choosing details about the region to use on a promotional brochure, poster. Consider what the area looks like, typical weather, points of interest, local animals visitors might see, etc.
- Provide an opportunity for students to share their work.
- Use the cards (2.2.1) as inspiration for students to create a skit about a biome.

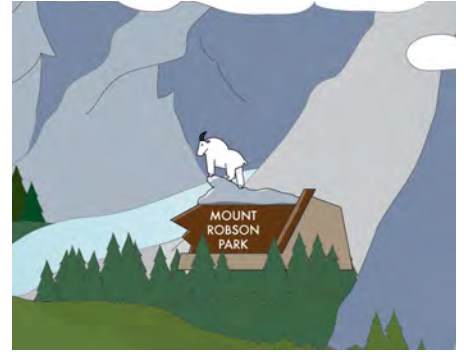
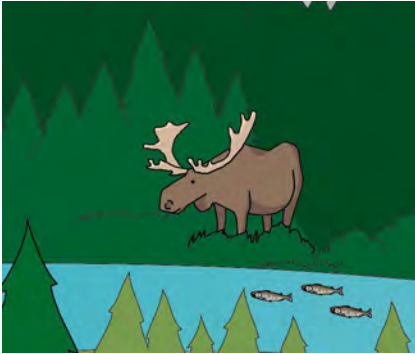
Discussion

- What is a biome or biogeoclimatic zone?
- What plants and animals are adapted to living in that environment?
- Take it further: How do the plants and animals living within a biome interact with each other and with non-living features of the environment? Water quality and climate affect the diversity of species in a region. Discuss the diversity of different species in each region and the success of individual populations in each region.

2.2.1 Biome Characteristics

Each biome is unique. Use these images as inspiration for your travel brochure or to create a skit about your biome.

Headwaters - Mount Robson Provincial Park



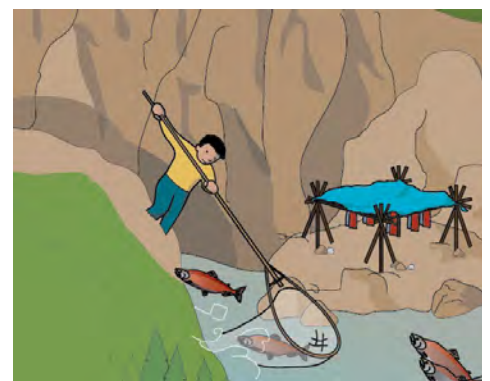
Upper Fraser - Prince George to Quesnel



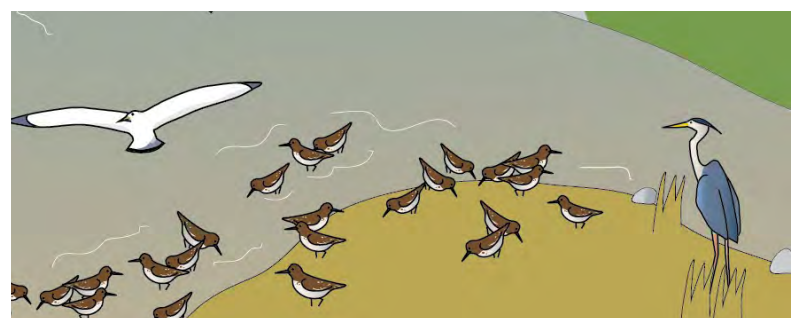
Middle Fraser - Quesnel to Williams Lake



Fraser Canyon - Williams Lake to Hope



Lower Fraser - Hope to Vancouver



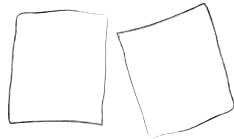
Activity 2.3 The Salmon Forest

In the Fraser River ecosystem, salmon play a vital role in providing nutrients to animals and plants living in riparian zones of salmon-bearing streams. In fact, salmon have been called nature's super-fertilizers because when salmon spawn, they transport tonnes of nutrients from the ocean to inland streams. In this activity, students create a poster that demonstrates how the nutrients in salmon move through the food cycle. Also, by building an arch, students discover just how important salmon are to the Fraser River ecosystem.

What You Need:



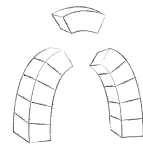
1-2 hours



2.3.1, 2.3.2



Poster making materials



**Optional:
Keystone Blocks &
Pullout 2.3.2**

What You Do:

- Review how a food cycle works.
- Review the salmon life cycle, focusing on how salmon bring nutrients back to their natal streams from the ocean when they spawn.
- Ask students to pick one forest organism from each part of the food cycle that uses nutrients from salmon and create a poster to show how salmon's nutrients move through the food cycle. (consumer, etc.)
- Define "keystone species": a species on which other species in an ecosystem largely depend, such that if it were removed, the ecosystem would change drastically.
- Use the keystone blocks to introduce or review salmon's importance to the forest. The Fraser River Discovery Centre has a set of blocks on display, and a second set to loan out.

Resources

- Video clips of David Suzuki explaining the Salmon Forest phenomenon:
 - <http://www.youtube.com/watch?v=UOtkekP-sxk>
- Book for younger students: Salmon Forest by David Suzuki, Sarah Ellis, Greystone Books, Ltd.
 - <https://www.amazon.ca/Salmon-Forest-David-Suzuki/dp/1553651634>
- Article for secondary students: Reimchen, Tom "Salmon nutrients, nitrogen isotopes and coastal forests" pp 13-16 in Ecoforestry Fall 2001
http://web.uvic.ca/~reimlab/reimchen_ecoforestry.pdf

2.3.1 The Salmon Forest Background

Salmon play a vital role in providing nutrients to animals and plants living in riparian zones of salmon-bearing streams in the Fraser River Basin. In fact, salmon have been called nature's super-fertilizers because when they spawn, salmon transport tonnes of nutrients from the ocean to inland streams.

Each species of Pacific salmon has a similar life cycle, but the length of each stage varies by species. Adult salmon will choose a site where the eggs will be deposited based on the depth and velocity of the river and gravel particle size. Once hatched and out of the redd, young salmon (alevin) make their way down river on the way to the ocean. As smolts, the salmon spend time in the estuary, where the fresh river water mixes with salty ocean water. Smolts undergo physiological changes in this brackish water that allow them to live in salty water. Salmon spend 1-4 years in the ocean where they grow and mature. When they are fully mature, salmon return to their natal rivers to spawn. When they enter the fresh water of the river, they stop eating and their bodies begin to deteriorate. They use up stored fat to fuel the journey up-river to their natal streams to spawn before they die. Their decaying bodies provide food for many species of animals and birds, and also nutrients to the growing alevin.

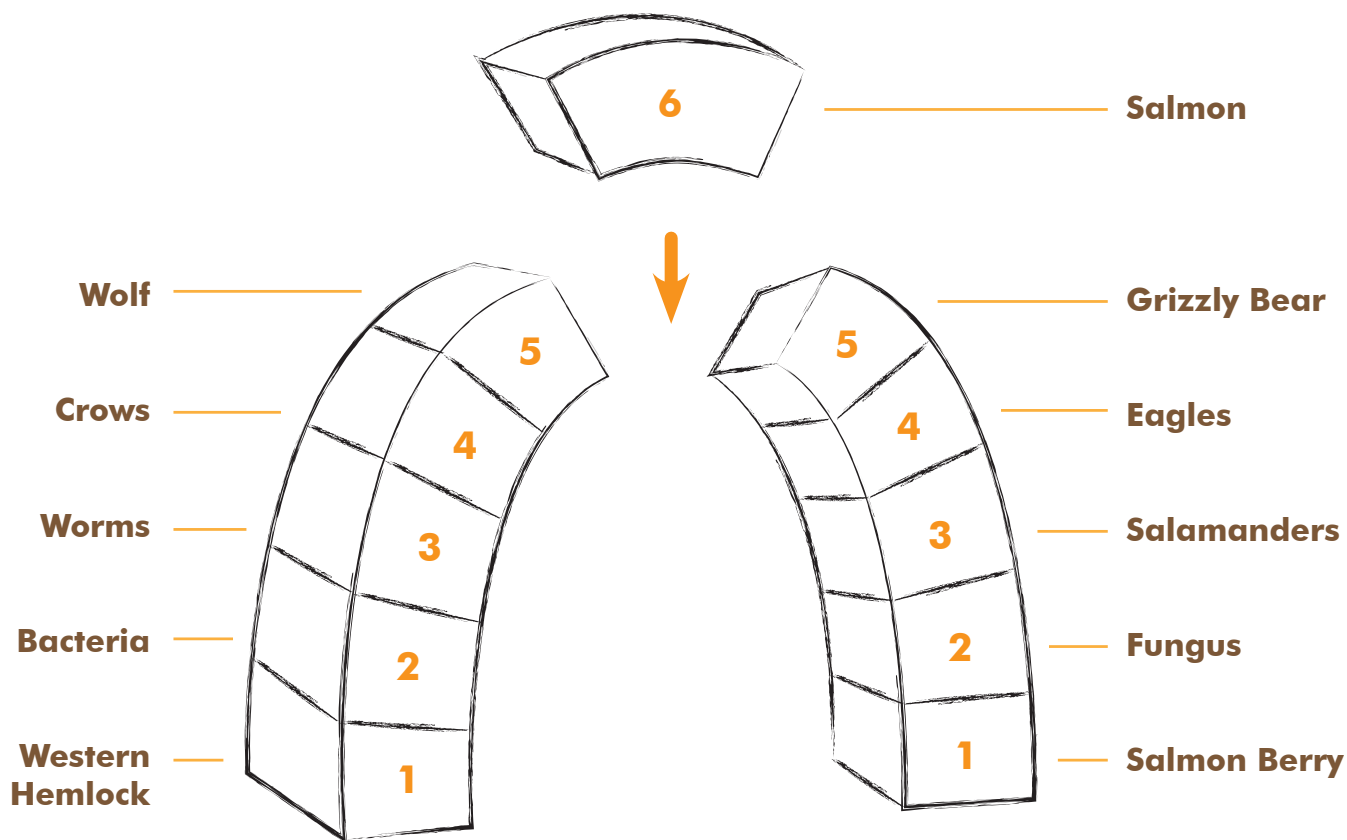
The decaying bodies of the salmon provide ocean nutrients for many species of inland animals and birds, and are even found in the trees and plants of the riparian zone. Bears take salmon from the streams into the forests to feed on the fattiest parts of the salmon. About half of each fish is feasted upon by other animals and decomposers.

The nutrients become available to many different organisms as they move through the food cycle. The food cycle describes a community of organisms where there are several interrelated food chains. In the case of the salmon forest, some of the animals that eat the salmon alive include grizzly bears, black bears and wolves (consumers). Eagles, gulls, crows, ravens, beetles and worms eat the dead salmon and break down the salmon's bodies into smaller pieces (detritivores). Decomposers such as bacteria, fungus and soil micro-organisms convert dead organic matter into CO₂ and nutrients that become part of the soil and available for producers such as western hemlock, red huckleberry, devil's club, and salmon berry.

2.3.2 Keystone Arch Activity

A **keystone** is the stone piece at the top of an arch, which is the final piece placed during construction and locks all the stones into position, allowing the arch to bear weight.

A **keystone species** is a species on which other species in an ecosystem largely depend, such that if it were removed, the ecosystem would change drastically. Salmon are a keystone species in the Fraser River Basin.



See Pullout 2.3.2 for Keystone Arch activity instructions and template. Also available for download: <https://fraserriverdiscovery.org/wp-content/uploads/2021/04/MRMH-Salmon-Arch.pdf>



Make a food web with string using the Salmon Bears teaching guide
<http://orcabook.com/greatbearbooks/pdfs/thesalmonbears-teachersguide.pdf>

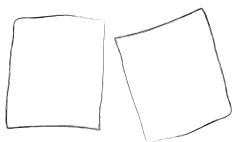
Activity 2.4 The Carbon Cycle

How does carbon move through the Fraser River watershed? Carbon is a necessary substance for life. Carbon compounds provide living things with food energy and building materials. Carbon is found in the air and water (as carbon dioxide), in rocks on land, in sediments on the ocean floor, and in every living thing. No new carbon is being produced, so carbon is constantly being recycled through the ecosystem. In this activity, students will investigate how the Fraser River contributes to the movement of carbon from land to ocean.

What You Need:



30-60 minutes



2.4.1 and 2.4.2



**Optional: Additional paper
for carbon cycle activity**

What You Do:

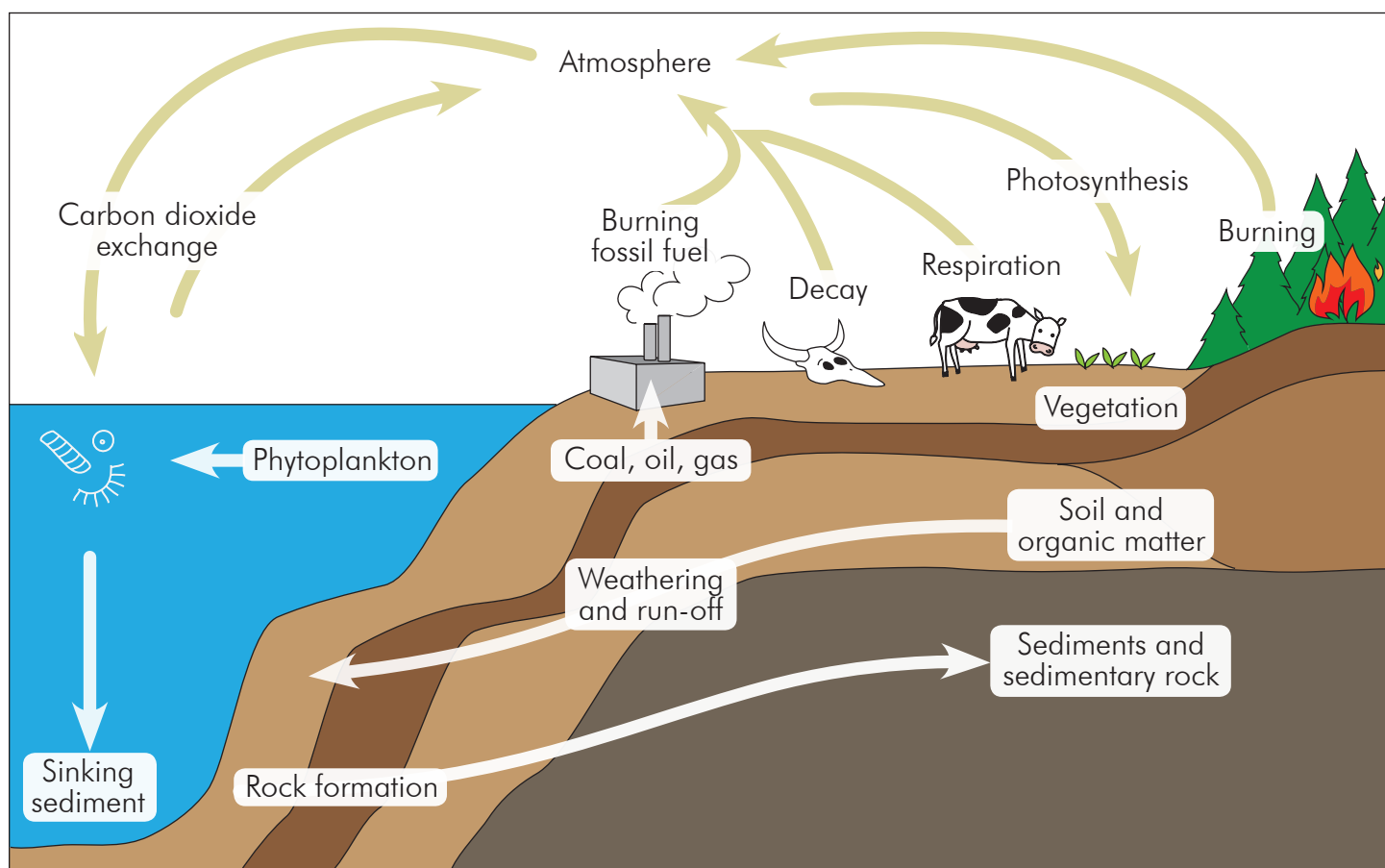
- Use handout 2.4.1 to review the carbon cycle.
- Ask students to cut out the carbon cycle images, and create a storyline for the route of their carbon and explain the logic they used to order the steps. Paste on a separate sheet (optional).

Discussion

- How do plants and animals use carbon?
- How is carbon stored in the environment?
- How does carbon move through the environment?
- Did everyone choose the same path for their carbon in the carbon cycle activity? What were some of the links that students made for how the carbon cycled through the environment?

2.4.1 The Carbon Cycle Handout

Take a deep breath. By doing so, you are part of the carbon cycle - moving carbon from one spot to another. Carbon is found in rocks and sediments, oceans, air, and in every living thing. Carbon makes up the food that we eat and the energy that fuels the global economy. It moves from one storage reservoir to another in many different ways. Look closely at the diagram below to see some of the ways that carbon cycles through the ecosystem.



2.4.2 The Carbon Cycle Handout

Carbon molecules cycle through different parts of an ecosystem from living to non-living things. Cut out these cards. Put these stages in order so that each step is a logical progression. You may start on any step you like. Be prepared to explain why you chose the order you did.

You are used by an algae plant for photosynthesis



Rushing water erodes the rock that you are in and you flow in to the Fraser River



You journey within the salmon out to the ocean for 4 years before returning to spawn



You become part of the salmon fry's tail as the salmon grows



You live for 100,000 years in the rock of the Fraser Canyon



The algae you are in is eaten by a salmon fry



You are part of a greenhouse gas molecule, CO_2



You find your way to a small side stream and evaporate in the summer



After the salmon dies, you are carried by a grizzly bear to the river's edge where you decompose



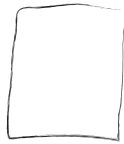
Activity 2.5 Climate Change and the Mountain Pine Beetle

The Mountain Pine Beetle is native to British Columbia and in the past its population has been kept in check because of BC's cold winters. However, milder winters have caused an outbreak of the beetle since the late 1990s that is still affecting much of the province. Students learn about the connection between the Mountain Pine Beetle outbreak and climate change, and reflect on the impact that deforestation has on the Fraser River.

What You Need:



30-60 minutes



**2.5.1
and/or
2.5.2**



Optional: find useful videos about Mountain Pine Beetle at

https://testwww.for.gov.bc.ca/hfp/mountain_pine_beetle/video.htm

What You Do:

- Introduce the Mountain Pine Beetle. Check out these resources for more information: <https://www.naturallywood.com/resource/mountain-pine-beetle/>
- Read *The Life of Pine* story. Divide class into groups with enough students to cover each main event. Ask each student to illustrate one event so that together they create a storyboard of the main events in the story.
- Discuss how Mountain Pine Beetles and temperature are connected. Discuss the impact of deforestation on the Fraser River and other organisms in the ecosystem.
- For older students: Ask students to read the June 2013 Canadian Geographic article excerpt and create an oral or written response to the reading. You may want to ask them to write their own story from the perspective of a pine tree or a pine beetle.

Discussion

- Mountain Pine Beetles are native to the Fraser River basin. However an outbreak of Mountain Pine Beetle in BC's central interior begun in the late 1990s continues to affect large areas of the province. Why is it now a problem when it was not before?
- Why are rising levels of greenhouse gases causing milder winters and warmer summers in British Columbia?
- What consequences will the Mountain Pine Beetle outbreak have on wildlife? On people? On the Fraser River?
- What can people do to reduce emissions and prevent further climate change?

2.5.1 The Life of Pine

"In the past 80 years, I have grown tall and branched out. I have seen a lot of change. This is my story:

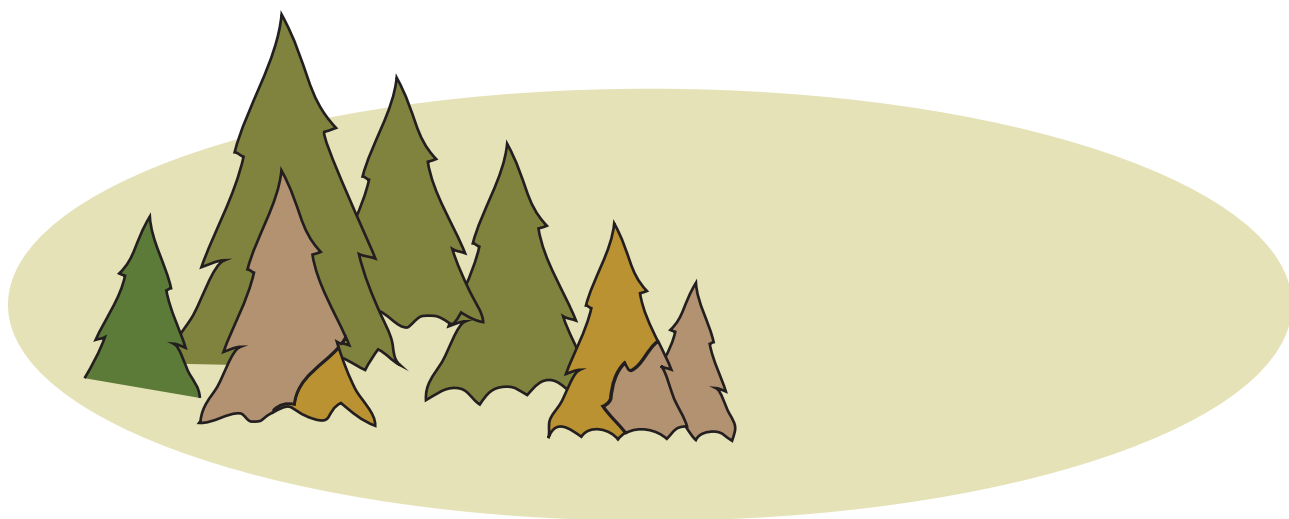
My life began many years ago when my 300 year old mother made a pinecone with many seeds high on one of her tallest branches. Pollen from my father tree floated by and my seed was fertilized and I was ready to grow. My mother tree let go of the pine cone and it fell to the earth where it lay in the moist soil.

Before long, a small red squirrel came sniffing around the forest floor for something to eat. As she picked up the pinecone and started gnawing on it, I gently slipped out of the safety of my little home and onto the earth.

I grew a little at a time, slowly starting to stretch up towards the light that I could see through my mother's swaying branches. Year after year, my roots took hold, soaking up the moisture from the soil, and transporting nutrients to my tiny branches. My mother used to praise me for how fast I was growing. Each spring, tufts of bright green new growth would sprout from the ends of my branches.

I watched as blue jays, squirrels, and the occasional pine beetle the size of a grain of rice, made their home in my mother's deep bark. During the cold and long winters when temperatures dipped below -30 degrees Celsius for months at a time, the birds would fly south, the red squirrel would nestle into a natural cavity in my mother's branches, and the pine beetles would die off, to be replaced in the spring with a new generation. My mother and I grew side by side like this for fifty years.

That was a long time ago when we had colder, longer winters. The climate change started so slowly that I hardly noticed. Each year we felt the sun's warmth a bit more than the year before, and we relished in the warm embrace of her rays earlier in the spring. What we didn't know is that the change in temperatures were also affecting the tiny Mountain Pine Beetle larvae hidden in my mother's bark. They did not die off the way they had in previous years, and so their population started to grow very quickly.



You might wonder why a mighty pine tree is concerned about the life cycle of a tiny beetle the size of a grain of rice. Well, I watched as my mother defended herself from the pine beetle by producing resin. When the beetles tunneled through her bark in to her sapwood, her resin would push the beetle out of her trunk. She fought off many beetles this way. But, as more and more beetles survived the winters, she couldn't create enough pitch to get rid of them all.

I said good bye to my ancient mother who was close to the end of her natural life and whose old trunk could not fight off the beetles and the blue stain fungus that followed. She wasn't the only pine tree to end like this. Many other followed.

The trees died, they turned red and then grey, losing all their needles. The dead forests no longer protect the soil from the sun in the summertime, and so the once moist soil has dried up and is more easily washed away when the rain comes.

My own sons and daughters now grow near my roots. I wish for the return of colder winters, and I ask you to think about why the winters are not as long and cold as they used to be. What actions can you take to prevent further climate change?



2.5.2 Mountain Pine Beetle Handout



Upstream across the Fraser's headwaters, climate change has dramatically altered the Fraser River by triggering the largest mountain pine beetle outbreak in North America. Cold weather typically kills the beetle larvae, but warmer winters have seen the insect's numbers spread unchecked across 18.1 million hectares in British Columbia (an area more than five times the size of Vancouver Island), and the outbreak now affects 60 per cent of the river's 248,035-square-kilometre watershed. The dead forests of lodgepole pine left behind, and the salvage logging there, have made the Fraser basin vulnerable to erosion and flooding, both of which could have serious downstream consequences for wildlife and people.

-Anne Casselman and Chris Linder, June 2013 Canadian Geographic Article



© Chris Linder

Activity 2.6 Indigenous Connections to the Fraser River

“In the words of our old people, we have been here forever. We have no stories that bring us over land, or across the water, or any other means of being here. We have always been here.”

- Musqueam Elder Larry Grant

Indigenous people have lived along the Fraser River since time immemorial. Although there are many different groups, languages, and cultures, the people share important links to the Fraser River as a source of life, food, transportation, and spirituality. Archaeological evidence of human activity along the Fraser River dates back about 10,000 years. To help students comprehend the span of 10,000 years, build a rope timeline. Watch *Hiq̓w' Stó:lo*, a 12-minute film recounting the Musqueam and Stó:lo oral histories of how salmon came to the Fraser River.

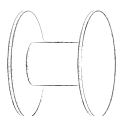
What You Need:



2.6.1, 2.6.2



**10.3m long
thick rope**



spool



tape

sharpie

fabric tags

***Hiq̓w' Stó:lo* film**

<https://vimeo.com/106639607>

What You Do:

- Attach the rope to the spool using the first 30 cm of length.
- Measure out and mark the rope each metre, starting at the spool.
- Create fabric tags with the following labels: 10 years, 40 years, 70 years, 150 years, 200 years, 4,000 years, 6,000 years, and 10,000 years. Place them on the rope at 1cm, 4 cm, 7 cm, 15cm, etc. from the end farthest from the spool. Change the first three tags to suit the age of your students.
- Unravel the rope while discussing the significance of each tag. See 2.6.1.
- Watch the short film *Hiq̓w' Stó:lo*. Use 2.6.2 to discuss as a class.

Extensions

- Book a visit to the Fraser River Discovery Centre for Our Bones are Made of Salmon, a 1.5 hour workshop that includes this timeline activity and the *Hiq̓w' Stó:lo* film. The workshop includes hands-on experience with salmon fishing technology.
- Contact your school district's Indigenous Education Coordinator, your local university or college Indigenous Department, or the local Indigenous Band and ask if an Elder is available to speak to your class.
- Consult the following resources:
 - *I am Stó:lo*, by Keith Thor Carlson and Alber (Sonny) McHalsie, Douglas and McIntyre.
 - A Stó:lo Coast Salish Historical Atlas (most suitable for secondary students)
 - Bridge Between Nations: A history of First Nations in the Fraser River Basin
www.fraserbasin.bc.ca/_Library/Ab_NonAb_Relations/bridge_between_nations.pdf

2.6.1 Rope Timeline Instructions and Interpretation Notes

Start with the rope wound on the spool, and slowly unravel the rope while discussing the placement of each tag:

- **10 years**

the approximate age of your students: emphasize that their entire lifetime and all of its events fits in a single centimeter of this timeline.

- **40 years**

the approximate age of your students' parents

- **70 years**

the approximate age of your students' grandparents. Do your students' consider their grandparents old? "Old" is a relative concept as students will soon discover.

- **150 years**

an important mineral was discovered on the Fraser River approximately 150 years ago which spurred the Fraser River Gold Rush (1858). The discovery of gold brought 30,000 non-Indigenous people to the Fraser River basin from the US, China, and other countries. The same year, the Crown Colony of British Columbia was established and British citizens began to buy and settle the land.

- **200 years**

approximately 200 years ago, Simon Fraser was the first non-Indigenous person to travel the length of the Fraser River (1808). First Nations people all along the river helped him and his men complete the journey.

- **4,000 years**

this is how long people have lived continuously at the main village site of Musqueam at the mouth of the Fraser River

- **6,000 years**

this is approximately how long Indigenous people along the Fraser have relied on salmon as their main food source.

- **9,000-10,000**

there is archaeological evidence of human activity along the Fraser dating back approximately 10,000 years

- **Time Immemorial (no tag)**

Musqueam Elder Larry Grant said "In the words of our old people, we have been here forever. We have no stories that bring us over land, or across the water, or any other means of being here. We have always been here."

Discuss what it means to be from a place. Consider the impacts of the change that has occurred in the Fraser River basin in the last 200 years.

2.6.2 Discussion for Hiqw' Stó:lō

Hiqw' Stó:lō is a 12-minute film narrated by Musqueam Elder Larry Grant and Stó:lō Cultural Historian Sonny McHalsie. In the film, Larry and Sonny share what the Fraser River means to them, two oral histories about how salmon came to the Fraser River, and an overview of the Stó:lō First Salmon Ceremony.

After watching the film, use the Indigenous teaching method of oral tradition to review the film by asking students to reflect on what they have just heard and respond orally to the following questions:

- What did you learn from the film? Instead of asking a specific question, allow the students to identify what they remember from the film. Discuss the film in more detail as students mention what they remember.
- Ask students to recall what they remember about the two salmon stories. What are some of the similarities and differences?
- Ask students to provide examples of how the animals were given human qualities in the film. According to Larry, in Indigenous culture animals are people who have spirits.
- What did Larry and Sonny say that describes their connections to the Fraser River?
- What do students remember about what Sonny said about the First Salmon Ceremony? According to Sonny, sharing the fish with as many people as possible is an important part of the ceremony. Why do they put the bones and unused portions of the fish back in the river?

Indigenous knowledge is personal. Larry and Sonny have their own memories, stories, and connections to the Fraser. Other Indigenous people will have different opinions and knowledge based on their own experiences and family histories.

Oral tradition uses listening and speaking to transfer knowledge, without needing to write down the information. It was an effective teaching method in Indigenous communities for thousands of years and continues to be today. Using this teaching method to review the film reinforces the importance of oral tradition.

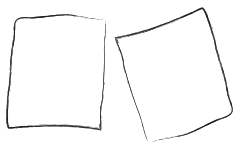
Activity 2.7 Living along the Fraser

Approximately 60% of the population of British Columbia lives in the Fraser River Basin. From the sprawling metropolis of Greater Vancouver to many smaller towns along the length of the Fraser, each community is shaped by the Fraser in different ways. In this exercise, the students choose a community along the Fraser and explore what services the Fraser River provides for the community, and how the Fraser has shaped the community through time.

What You Need:



60+ minutes



2.7.1 and 2.7.2



**Optional: Pullout 2.7.1
Map of the Fraser**

What You Do:

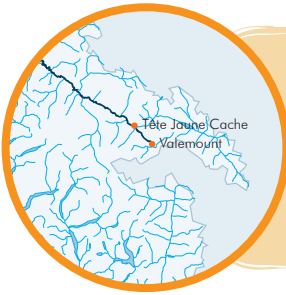
- Ask students to pick a community, town, or Indigenous reserve along the Fraser River. Choose what is most relevant for your class.
- Students will research the community by using internet resources, contacting local Chambers of commerce, municipal governments, local museums, and by consulting maps and photos of the community.
- Create a poster or summary about the community's interaction with the Fraser.
- Ask students to consider some of the following questions:
 - Who are the local Indigenous groups? What are some of their connections to the Fraser?▫ Why did non-Indigenous people settle in this area? Were they drawn by opportunities linked to the Fraser River?
 - What industries are present in the community that use the Fraser River as a water source, for transportation, or for other reasons?
 - Where does sewage outflow and storm water outflow enter the Fraser?
 - Is the Fraser important for local tourism or recreation?
 - How is the waterfront used?
- How do these activities impact the Fraser?

2.7.1 Map of the Fraser River

See Pullout 2.7.1 for large scale Map of the Fraser River. Also available for download:
<https://fraserriverdiscovery.org/wp-content/uploads/2021/04/Map-of-the-Fraser-River.pdf>



2.7.2 Living along the Fraser Backgrounder



Headwaters

The communities of Tête Jaune Cache and Valemount are in this area, at the base of the Rocky Mountains. Valemount calls itself “a year-round playground” demonstrating that tourism is a main economic driver with mountain sports and lodges to attract tourists.



Upper Fraser

The first large city along the Fraser River is Prince George, found at the junction of the Fraser and Nechako Rivers. The traditional home of the Lheidli T'enneh and Carrier Sekani First Nations people, Prince George is the largest city in Northern BC. The economy of Prince George was driven by the lumber industry with several pulp mills along the Fraser in this area before the Mountain Pine Beetle infestation of the 1990s.



Middle Fraser

The city of Quesnel is located at the confluence of the Fraser and Quesnel rivers. Beef and cattle production (ranching) is the primary agricultural activity in this area. Mining has strong historic roots in the Quesnel area since the major gold rush to Barkerville in the mid-1800s. Williams Lake is also in this region, and its main industries are forestry, logging, milling, mining, and ranching. The Williams Lake Stampede on the Canada Day long weekend brings international rodeo competitors to the region.



Fraser Canyon

Narrowing significantly at Lytton, after the junction with the Thompson River, the economy of the Fraser Canyon is dominated by tourism with Hell's Gate, several river rafting businesses, and interpretive centres celebrating Indigenous culture and the gold rush. Indigenous fishing and wind-drying salmon in the Fraser Canyon continue to be very important near Lillooet and Yale.



Lower Fraser

The Lower Fraser begins at Hope, when the river exits the canyon and slows considerably through the flat Fraser Valley. The nutrient-rich soils of the Fraser Valley make it some of the most productive farmland in the country. Agriculture is significant to the economy of towns like Chilliwack and Abbotsford. Just a little farther towards the Pacific Ocean, the sprawling metropolis of Greater Vancouver is home to approximately 2.5 million people.

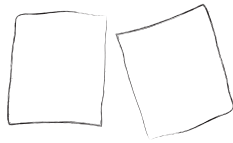
Activity 2.8 Human Impacts on the Environment

How do I impact the Fraser River? Human activities affect the health of the environment and the plants and animals living within it by using resources, altering the environment, and adding waste products. With almost 3 million people living in the Fraser River basin, we are removing resources faster than the ecosystem can replace and adding more waste than the Fraser River can naturally take care of. Human needs and interests often take priority over the needs of other plants and animals. In this activity, students play a Sturgeon Survival Game to assess how human activities affect the survival of a prehistoric fish in the Lower Fraser River.

What You Need:



30-60 minutes



2.8.1-2.8.4

**Optional: Pullout 2.8.2
Sturgeon Survival Game board**

What You Do:

- Brainstorm how human activities affect the Fraser River.
- Discuss human activities on the Fraser that might affect sturgeon survival.
- Divide class into groups of 4 or 6 to play the sturgeon survival game. Copy one board and one set of cards per group.

Discussion

- What actions caused you to gain or lose a health point?
- What can humans do to ensure the future survival of sturgeon?
- Discuss the balance between human needs and wants and the needs of animal species.
- Do you think enough is being done to protect sturgeon in the Fraser River?

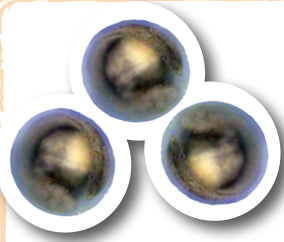
Extensions

Attend a *Shadows of the Fraser* (K-3) or *Living Dinosaurs* (4-7) workshop at the Fraser River Discovery Centre which includes the Sturgeon Survival Game along with sturgeon life cycle and anatomy activities.

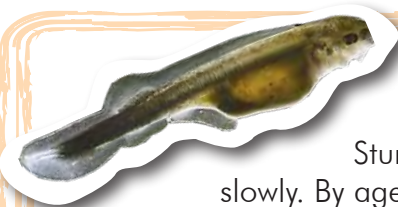
2.8.1 Sturgeon Backgrounder

Sturgeon have existed for millions of years, but human influences over the past 150 years have threatened their survival.

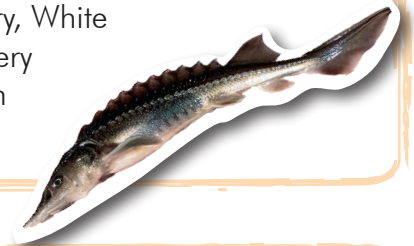
White Sturgeon can live over 100 years, reach over 6m in length, and weigh as much as a small car. They are the largest freshwater fish in North America and have unique physical characteristics including five rows of sharp armour-like plates on their bodies used for protection, four sensitive whisker-like barbels that help to locate food on the murky river bottom, and the ability to protrude their toothless mouths to suck up prey.



Mature adults gather to spawn during spring and early summer. With no nest being created, fertilized eggs fall to the bottom of the river and quickly stick to solid materials on the river bottom (rocks, gravel, sticks, and logs). Larger female White Sturgeon can release up to 4 million eggs. Eggs hatch into larvae with a yolk sac and these larvae swim or drift with the water's current.



A month after hatching the larvae develop into fry (young of the year or first stage for a juvenile). As growing fry, White Sturgeon are easy prey for larger fish. They grow very slowly. By age 5 they are only about 50cm in length and then grow about 5cm per year after that.



Despite slow growth, adult White Sturgeon can reach incredible lengths and weights because they never stop growing over their long lifespans. The largest White Sturgeon caught in the Fraser River on record weighed in at 640kg.



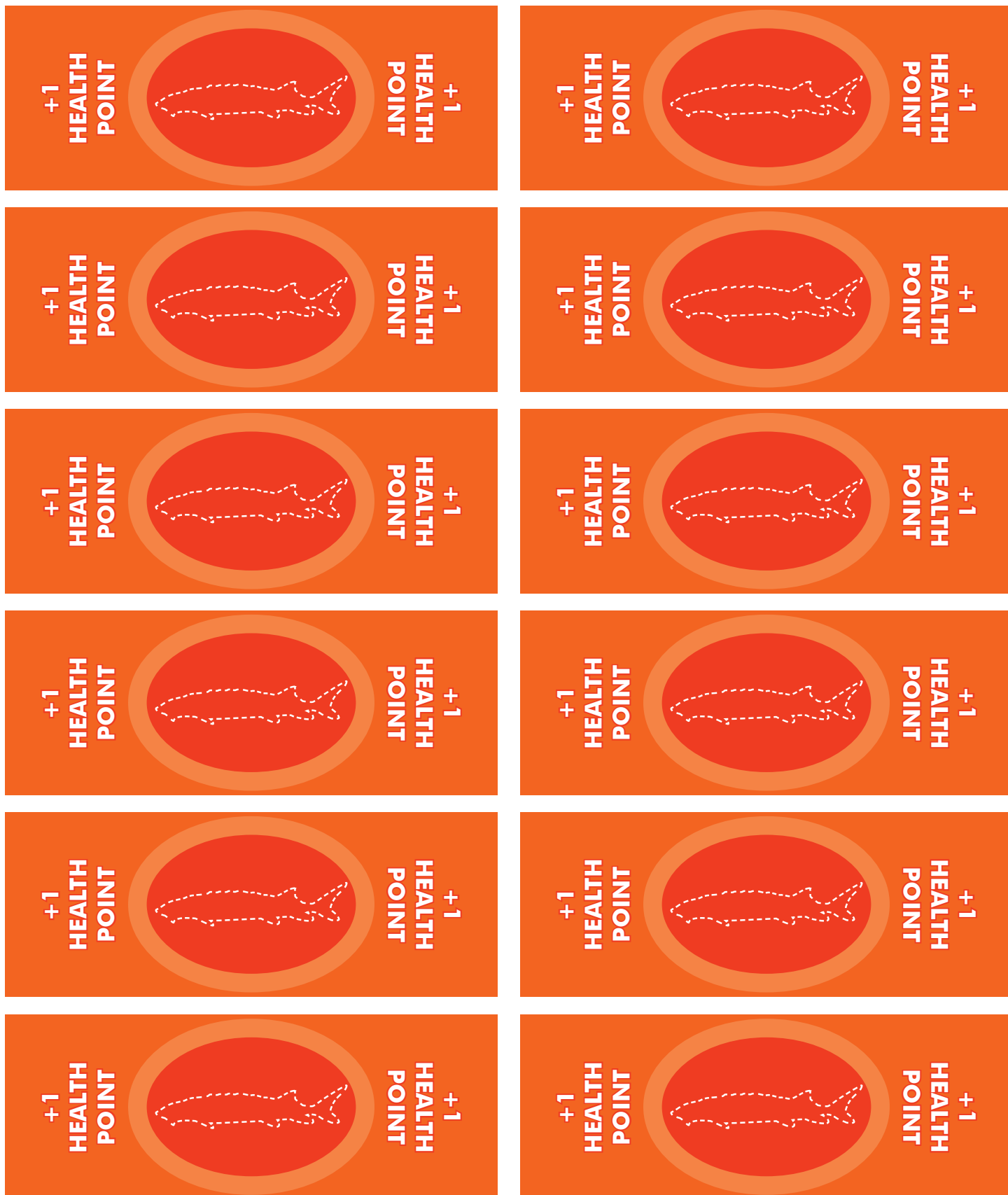
Due to its declining numbers and the threats to White Sturgeon survival it has been listed as a Species at Risk in Canada. A Species at Risk has the potential to be lost from our natural environments. Efforts are underway in BC to help protect and conserve the White Sturgeon populations of the Fraser River. Government and independent conservation organizations are working together in BC to monitor the Fraser River White Sturgeon and to make sure that the sturgeon population remains healthy in the future.

2.8.2 Sturgeon Survival Game

See Pullout 2.8.2 for large scale game board. Also available for download:
<https://fraserriverdiscovery.org/wp-content/uploads/2021/04/Sturgeon-Survival-Game.pdf>



2.8.3 Sturgeon Survival Game - Health Points



2.8.4 Sturgeon Survival Game - Action Cards

Eggs/Larvae

Comfy! The water is just the right temperature.
Move ahead 1 space

Eggs/Larvae

A farm that is close to the river takes water for their plants.
Lose a health point

Eggs/Larvae

The water flow is fast and turbid at the spawning grounds; this provides good fertilization for eggs after they are released.
Move ahead 1 space

Eggs/Larvae

A Northern Pikeminnow is preying on sturgeon larvae!
Lose a health point

Eggs/Larvae

Pesticides have run off from a nearby farm into side streams of the Fraser River, polluting your habitat.
Move back 1 space

Eggs/Larvae

Water drainage from your favourite marsh habitat is occurring for farming.
Lose a health point

Eggs/Larvae

A large house is built near your river home. Trees are cut down and soil goes into the river.
Lose a health point

Eggs/Larvae

As an egg you are broadcast spawned into a side channel of the Fraser River with lots of undisturbed gravel to stick to.
Gain a health point

Eggs/Larvae

Your dark colour as a larva has given you excellent camouflage against a hungry salmon fry.
Move ahead 1 space

Eggs/Larvae

You have successfully made it to the larvae stage! So far, so good.
Gain a health point

Eggs/Larvae

The water is too cold this year due to the weather. Less of you are able to survive.
Lose a health point

Eggs/Larvae

Your mom, a large older female, was able to release a million eggs. This means you have a better chance to survive.
Gain a health point

Eggs/Larvae

The place in the river where you live has lots of gravel on the bottom. It's a great home for you!

Gain a health point

Juvenile

A slough you like to visit for food and places to hide has just been protected from industry development.

Gain a health point

Juvenile

A grade 2 class at an elementary school is learning about you in their class.

Gain a health point

Juvenile

The Fraser River Sturgeon Conservation Society has started a school education program. Over 3500 students are learning about how to help sturgeon.

Gain two health points

Juvenile

You find a large colony of freshwater shrimp to eat.

Move ahead 1 space

Juvenile

The storm drains leading to the river have been marked with yellow fish. This means people know to not put chemicals there.

Gain a health point

Juvenile

People that live near the river are working hard to clean it up. This means there is less garbage in the river.

Gain a health point

Juvenile

People decide not to build factories near the swamp where you like to eat.

Gain a health point

Juvenile

The number of fishing boats on the river is at an all time high this season.

Lose a health point

Juvenile

The forest by a side stream where juvenile sturgeon feed has recently been clear-cut. There is less shade now and the water temperature is too high.

Lose a health point

Juvenile

OH NO. Everyone is worried the river is going to flood. Dredgers are removing gravel everyday and they are taking all your food and some sturgeon with it.

Lose a health point

Juvenile

A new development along the banks of the Fraser River has drained and filled in a side stream where you used to hunt for food.

Move back 2 spaces

Juvenile

You can't breathe because there are chemicals floating in the water.

Move back 2 spaces

Juvenile

A salmon fisher catches you by accident.

Lose a health point

Juvenile

All the trees from the river bank have been cut down. There is no shade to hide from the sun.

Lose a health point

Adult

Poacher caught! Fisheries officers are checking to make sure sturgeon are not being taken out of the lower Fraser River by fishermen.

Gain a health point

Adult

There is a group working on a campaign called the "Heart of the Fraser". They have bought and protected the entire slough you like to live in.

Gain a health point

Adult

You are caught by a sport fisher who takes your picture and hands you to a biologist on the boat, who measures and tags you before setting you free.

Move ahead two spaces

Adult

When returning to the spawning grounds you are greeted by many other healthy adult sturgeon ready to spawn.

Gain a health point

Adult

The swamp you are hanging out in is warm enough and there is lots of good.

Move ahead 3 spaces

Adult

Toxic paint has entered the river from a storm drain, polluting the water near your summer feeding grounds.

Lose a health point

Adult

Someone has decided to dump their car in the slough. It's old and it needs too much work. This is cheaper than paying to have it sent to the dump.

Lose a health point

Adult

To build a new bridge over the Fraser River, a stream where you used to find food was filled in.

Move back 2 spaces

Adult

The weather is warmer this year and your favourite slough is completely dry. You are unable to spawn in that side channel this year.

Lose 1 health point

Adult

Gravel, important for spawning habitat, is being removed from the river bottom to increase the depth of the river and prevent flooding.

Lose a health point

Adult

Where are all the salmon? It looks like there aren't many of them spawning this year. You don't have enough food to eat.

Lose a health point

Adult

Eulachon is one of your favourite foods but you cannot seem to find any to eat.

Move 2 spaces back

Adult

Lots of people are building houses by the river. This gets dirt into the stream and makes it hard to see.

Move back two spaces

Adult

Lots of salmon come back to spawn... yummy... there is lots of food for you to eat.

Move 2 spaces forward

Adult

You are coming up to a good spawning area and there are lots of other sturgeon friends around you!

Gain a health point

Activity 2.9 Industry and the Environment - a Pulp Mills Role Play

How can we balance industry with other uses of the Fraser? Owners of the Fraser Reach Pulp and Paper Mill would like to open a new mill on the Fraser River. Many different groups have an opinion on the proposal including local townsfolk, mill owners, agriculturalists, the Green Earth environmental group, the local Indigenous group, and the business beside the proposed site. A town hall meeting has been set up for each group to support or oppose the development. In this activity, students will take on one role in this meeting, research and prepare a series of arguments to support their position that will be presented in class.

What You Need:



2+ hours



2.9.1



research materials

What You Do:

- Talk about how pollution enters the Fraser River. A pulp mill is an example of point source pollution, where the source of the pollution is identifiable, and can be measured and controlled.
- Discuss how a pulp mill uses water, and what potential pollution it might create.
- Brainstorm the scenario as a group to help students see the complexities of the issue. Use handout 2.9.1 to begin the discussion. Students will need to do additional research, or flesh out the stories to create their position.
- Break class into six groups to present at the town hall meeting.
- Ask each student group to prepare a presentation on how they think their group would respond to the pulp mill development.
- Decide as a class whether the project will be approved.

Extensions

Research how the situation of pollution from pulp mills was handled in the 1990s on the Fraser River. It is a success story for industry and the environment that resulted in the reduction of pollution by effluent containing chlorine and toxic chlorinated organic compounds. Pulp and paper mills continue to operate along the Fraser. Research their environmental policies and discuss whether they are doing enough to protect the environment.

2.9.1 Pulp Mills Role Play Backgrounder

A **pulp mill** is the first part of the process in manufacturing paper and tissue. It converts wood chips and other plant materials into a thick board which is then sent to a paper mill for further processing. The pulp can be bleached or unbleached.

Pollution from a pulp mill is called **point source pollution**, because the source of the pollution can be pinpointed. In the past, pulp mills were built beside rivers for several reasons - transportation, a water source, and a way to get rid of waste water, or effluent, that contains chemicals used in pulp processes.

In the not so distant past, people used to believe that the Fraser River diluted and removed waste water with no harm to the environment. The Fraser became heavily polluted. In the 1990s, the government implemented a new policy to reduce the amount of pollution from pulp mills, by tightening up the environmental regulations. The result was a reduction of pollution.

Background on the Role Play Groups:

Local townsfolk: would like to create a river front walkway, and keep air pollution to a minimum, however many people are unemployed and would welcome new jobs.

Mill owners: believe they have a proven track record of taking care of the environment at their other mills, and have followed the provincial government's policies and regulations. They will be bringing 75 jobs to the area.

The Green Earth: the local environmental group believes that a new pulp mill along the Fraser is a threat to salmon and that present government regulations are inadequate to protect the Fraser River from pollution.

The **business** beside the proposed site: A Fishing Lodge Adventure retreat centre that prides itself on its view, and is concerned that a pulp mill nearby will reduce business.

Indigenous groups: The local First Nation group wants to make sure that Indigenous people will have access to some of the new jobs and that the mill will not pollute the river.

Agriculturalists: Farmers using water for their crops are interested to know the steps that the mill will use to treat its effluent.

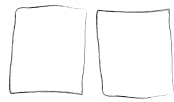
Activity 2.10 The Fraser River Is Part of a Global Trade Network

British Columbia is a province rich in natural resources including fish and seafood, forests, minerals and mining products, agricultural products, natural gas, and hydroelectric power. British Columbians consume some of these products, but BC's economy also relies on trading these goods to other countries. Sometimes the raw materials that BC exports are processed and made into other goods that are sold back to British Columbians. In this activity, students investigate where their favourite foods or latest electronic gadgets come from, identifying which items or components may have originated in BC.

What You Need:



30-60 minutes



**2.10.1
and 2.10.2**



**Internet access for
student research**

What You Do:

- As a class, trace the journey of paper products from the forest to your classroom.
- Identify the transportation: trucks, log barges, tug boats (log booms) etc., and people involved: loggers, truckers, log barge operators, tug boat operators, mill workers, paper processing plant workers, store cashier etc.)
- Ask students to choose something they care about: their favourite food for an electronic gadget and guess its journey or the journeys of its components on the map 2.10.2.
- Through discussion, have them add any steps they may have missed.
- Discuss how natural resources from the Fraser River basin have shaped the economy of BC and influenced Canada's role in the global economy.



Discussion

- BC's economy is heavily based on exporting raw materials. BC exports pulp to Asia and then imports paper from Asia. Why doesn't BC manufacture all the paper we need?
- A quick look at labels in the grocery store will show that we have access to foods from all around the world. Why do we import apples from New Zealand and the United States when we grow apples in BC?
- What do students think about our dependence on products from around the world? (Link with their ecological footprint - Activity 1.3).
- The industrial activity on the Fraser River is an important part of the provincial economy and supports the lifestyles we have come to expect. Discuss how industry supports social and environmental initiatives in the community.



Resources

- Port Metro Vancouver (www.portmetrovancover.com) has great resources including an interactive map and the latest import and export statistics.
- Visit Port Metro Vancouver's Discovery Centre at Canada Place
- British Columbia trade statistics:
https://www2.gov.bc.ca/assets/gov/data/statistics/business-industry-trade/trade/exp_annual_bc_exports.pdf

2.10.1 Backgrounder on Trade

80% of the annual economic transactions in BC occur within the Fraser River Basin. The trade of resources and goods from BC to other countries, and the goods imported from around the world account for a lot of this business.

Port Metro Vancouver (PMV) is Metro Vancouver's port authority. It is Canada's largest and busiest port, servicing more than 3000 vessel calls and handling over 120 million tonnes of cargo per year. PMV has a full range of services including shipyards, freight forwarders and shipping agents.

In 1962, Fraser Surrey Docks opened as a multipurpose marine terminal along the Fraser River, in Surrey. At first the terminal traded mainly breakbulk items such as lumber and pulp and today it also handles containers, steel and agricultural bulk products.

Nearly 100% of all Asian-built vehicles sold in Canada arrive at one of two automobile terminals located on the Fraser River. The cars are transported in huge vessels called Ro-Ro's so named because the cars roll on and the cars roll off. One automobile terminal is located on Annacis Island on the Fraser River, adjacent to the city of New Westminster, and the other is along the Fraser at Steveston, near the mouth of the Fraser on the south arm of the river.

If you are watching the river traffic in the Lower Mainland, you are likely to see a tug boat before too long. Tugboats tow log booms and barges filled with many different products up and down the Lower Fraser River. Barges carry wood chips, saw dust, pulp, petroleum, rock products, and hog fuel. Tugs are able to push or tow vessels that are hundreds or even thousands of times their own size and weight.

After arriving at the port, many imports continue their journey to communities around BC and Canada by rail or truck. Trains are a vital link between marine terminals and inland markets. There are many companies operating trains along the rail line in New Westminster. Southern Railway of BC (SRY) is one of them. Over 40% of SRY's cargo comes from Annacis Island with cars being one of their main cargo. They also transport heavy equipment, steel, forest and building products, grain, grocery and consumer goods, and industrial products.

2.10.1 World Map



Activity 2.11 Divergence - Sharing a Limited Resource

Within the Fraser River basin, the Nicola Valley is located in the rain shadow of the Coast Mountain Range near Merritt BC. During the hottest summer months, water shortages are a very real concern as use increases and the water level in the Nicola River drops. In this exercise, the class must come up with a solution to a water shortage that meets the needs of salmon, ranchers, farmers, and city-folk.

What You Need:



2+ hours



2.11.1



To research the issues surrounding water shortages in the Nicola Valley see resource list below

What You Do:

- Brainstorm how water is used by ranchers, city-dwellers, and salmon.
- Divide students into groups to find out more about the needs of each of these groups.
- Set the scenario that there is an expected water shortage coming.
- Ask each group to make a case for their water needs.
- As a group, decide how all the needs can be met, or how to determine which needs take priority over others.
- For a more in-depth study, find out how the Nicola Valley residents came together in 2004-2009 to create a water use management plan that addressed their water shortages and the competing demands on the Nicola River.

Resources

- Nicola Water Use Management Plan: https://www.nwcr.ca/app/download/14201888333/Nicola_Water_Use_Management_Plan.pdf
- Nicola Valley Watershed Community Roundtable: <https://www.nwcr.ca/>
- Living Water Smart for water reduction ideas: <http://www.livingwatersmart.ca/>
- Summary of the Nicola Valley Water Use Management Plan: https://www.watershed-watch.org/publications/files/Nicola_WUMP_case_study.pdf
- Groundwater and healthy Salmon Streams - It's all connected: <http://watershed-watch.org/publications/files/Groundwater-WWSS-Nov2009.pdf>
- BC Government's Water Sustainability Act <https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/laws-rules/water-sustainability-act>

2.11.1 Nicola Valley Water Issues Background

Within the Fraser River basin, the Nicola Valley, near Merritt BC, is located in the rain shadow of the Coast Mountain Range. During the hottest summer months, water shortages are a very real concern as use increases and the water level in the Nicola River drops.

Water licenses: Water licences are given out by the Province of British Columbia to regulate who is allowed to remove water from a river. In the Nicola Valley, all the surface water licenses have been distributed, so no new licenses are available. Groundwater is not regulated in the same way, so new farmers and residents can dig wells to access water. Digging more wells means removing groundwater that would otherwise flow into the Nicola River, to the Thompson River, and eventually into the Fraser River.

Ranchers: Ranching is an important industry in the Nicola Valley, dating back to the mid-1800s. The grasslands are ideal for ranching. Raising beef requires a lot of water, approximately 15400 litres of water to raise one kilogram of beef. In the Nicola Valley, many ranches have been passed down through generations.

Salmon: Salmon are a picky fish that like water temperatures below 20° Celsius. In the Nicola River, during the hot summer months, temperatures in the river can reach 25°C which is lethal for salmon. Groundwater flows into the Nicola River creating areas where the water is much cooler (about 16°C). These areas provide resting spots for spawning salmon. In summer months, the river water is low, which means that the water temperature will be higher. Salmon need people to leave enough water in the river so that they can survive.

City-folk: People use water for many purposes (see activity 1.2). In addition to regular needs such as dishes and laundry, also consider garden and lawn-watering in this dry grassland. Sufficient water for firefighting is also a concern.

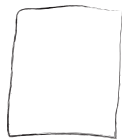
Activity 2.12 Ground Water - How much is it worth?

What do you think groundwater should be worth? In 2012-2013, the Government of British Columbians consulted with BC residents to suggest changes to the 100+ year old Water Act to create the Water Sustainability Act. One of the proposed changes is to charge a fee to companies extracting groundwater, a use that was not regulated in the Water Act. This case study introduces students to a company that operates out of Hope BC, and asks students to consider whether they agree with this practice, and how much the BC Government should charge.

What You Need:



20-30 minutes



2.12.1

What You Do:

- Review the water cycle, identifying groundwater in particular.
- Distribute article (2.12.1) for students to read, or summarize it for them.
- Discuss the main issues in the article.
- Ask students to prepare a response. Discuss as a group.

Discussion

- What is groundwater and how is it connected to surface water?
- Is there an endless supply of groundwater?
- How should groundwater be regulated?
- What environmental impacts could the unregulated use of groundwater have?
- How should the BC Government choose who is allowed to use groundwater and how much they can use?
- What should the cost of using groundwater be?
- Consider the term “renewable resource” in the context of when the water act was first introduced in 1912 and today.

Resources

- <http://www.cbc.ca/news/canada/british-columbia/new-b-c-water-act-to-regulate-industrial-groundwater-use-1.2125774>

2.12.1 Companies Extracting B.C. Groundwater for Free

B.C. Only Jurisdiction in Canada That Does Not Charge for Groundwater Use

Posted: Aug 14, 2013 5:11 PM PT Last Updated: Aug 14, 2013 7:41 PM PT

Several groups are calling on the province to tighten groundwater laws as B.C. is the only jurisdiction in Canada that does not charge major corporations for groundwater use.

Nestle is bottling and selling up to 265 million litres of water from the area around Hope, B.C., every year for free, says Sheila Muxlow of the WaterWealth Project. That's nearly the size of seven Olympic-sized swimming pools, she adds, and Nestle is one of several multinationals bottling B.C.'s fresh water.

"Outside of the fact that they are draining the size of a small lake on an annual basis without any sort of accountability... this is a microcosm of a larger failure with the way B.C.'s water is managed."

Currently, British Columbia has no regulation on groundwater use. Corporations can extract as much ground water as they like without any fees.

Muxlow says no studies have been done to measure the environmental impact of draining that quantity of water every year, and not enough is being done to monitor and regulate the extraction of water.

But Nestle, the largest seller of bottled water in the world, says it is acting responsibly and contributing to the B.C. economy. "Aquifers are not bath tubs. They're water systems deep in the ground that are constantly moving, they're constantly replenishing," says John Challinor, a spokesman for Nestle.

"We're investing millions of dollars in that plant. We employ 75 people [and] we pay millions of dollars in taxes," he added. Challinor says Nestle would be willing to pay for the resource, as long as everybody else did.

The B.C. Environment Ministry says it plans to introduce new regulations [shortly].

<http://www.cbc.ca/news/canada/british-columbia/companies-extracting-b-c-groundwater-for-free-1.1366337>

Section III: Investigate Water Quality

Scientists from the University of the Fraser Valley and the Woods Hole Oceanographic Institution have been testing the water quality of the Fraser River to better understand the impact of climate change on the Fraser River system. This section introduces some of the methods that are used to test the water quality of the Fraser River. Included in this section is a detailed description of the Fraser River Discovery Centre’s Taking the Pulse of the Fraser workshop. The resources are included here so that more distant schools can create a similar learning experience for students at their local water source.



Activity 3.1 A Blood Test Metaphor59

Activity 3.2 Introduction to Water Quality Measures.....60

Activity 3.3 Taking the Pulse of the Fraser65

Activity 3.1 A Blood Test Metaphor

Have you ever had a blood test? Doctors were testing your blood chemistry to see if your organs were working properly. They might also have been checking for certain diseases or conditions. Similar to how doctors test our blood to see if we are healthy, scientists test samples of water to measure water quality. Measuring the health of the Fraser River is a bit like heading to the doctor's office for a blood test.

What You Need:



30 minutes



Group Discussion

Photographs of different water sources (e.g., Congo River, Fraser River, local pond, glacial stream, ocean etc.)

<https://www.chrislinder.com/portfolios>

<https://conservationphotographers.org/?expedition=fraser-river-tis>

What You Do:

- Ask students if they have ever had a blood test? Did they look sick on the outside? What are some reasons that doctors order blood tests?
- Discuss what blood is made of. It isn't just liquid, in fact the liquid part of it isn't even red. The red colour comes from the iron-carrying red blood cells in the blood. There are also white blood cells, nutrients, proteins, and plasma, a yellowish fluid.
- Water's appearance can be similarly deceiving. One of the water's special characteristics is its ability to dissolve and carry a wide range of nutrients and compounds. It can also carry undissolved particles (sediment) from one area to another.
- Because of water's ability to dissolve and carry many substances, water does not always look the same. Look up some examples of different kinds of water (Congo River vs. Fraser River vs. local stagnant pond water) and discuss the differences the student can see.
- Ask students to compile a list of questions about water quality to address in further study and activities.

Extension

- Find out where your drinking water comes from and how it is tested and treated. Compare water quality standards in BC with other countries.

Activity 3.2 Introduction to Water Quality Measures

The common tests for water quality are: temperature, pH, turbidity, dissolved oxygen, conductivity, and nutrient content. In the following pages, each of these measures of water quality is defined, and simple in-class activities are suggested for introducing each test.

The Fraser River Discovery Centre offers a workshop *Taking the Pulse of the Fraser* that includes testing the temperature, pH and, turbidity of a sample of Fraser River water. During the workshop, students follow each step of the scientific method to determine whether the water of the Fraser is ideal for salmon survival.

What You Do:

- Explore measures of water quality using the information provided and simple in-class activities.
- Conclude this section with 3.2.7 “What Affects Water Quality” (answer key below).
- Optional: bring your students to *Taking the Pulse of the Fraser* workshop that includes testing the temperature, pH, and turbidity of the Fraser River described in section 3.3.

Teacher’s answer key for 3.2.7

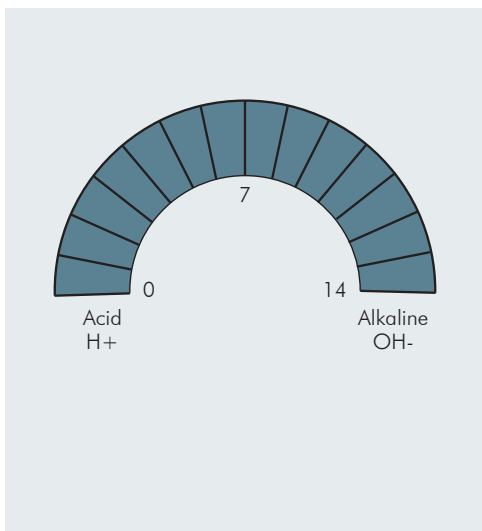
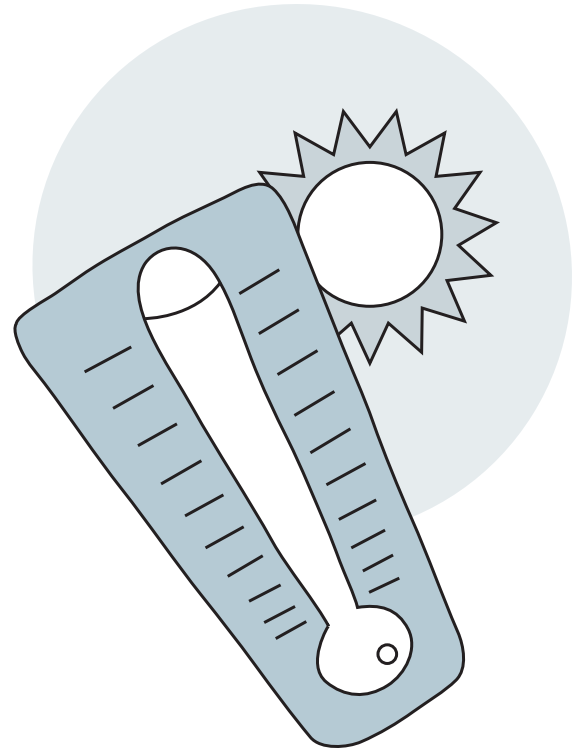
Natural factors that affect water quality	Human effects on water quality
Bedrock composition	Point source pollution (factories, industries)
Soil composition	Non-point source pollution (everyday actions of people in communities i.e., driving, washing cars)
Climate	Deforestation causing erosion
Vegetation	Building of dams
Amount of plant material in the water	Resource extraction
How fast the river is flowing	Irrigation
...	...

3.2.1 Measures of Water Quality

Temperature

Most aquatic animals are ectotherms, they do not control their body temperature, which means their body temperature is affected by the water temperature. If the water temperature is too hot or too cold, the animals cannot survive and will either move on or die. With global warming, the temperature of the Fraser is rising, and is now sometimes surpassing the optimal temperature for salmon during the spawning season.

Discussion idea: how do humans regulate their body temperature? What do people do when they are too hot or too cold? What would it be like if our body temperature matched the temperature outside? If possible, research the threshold temperatures for different aquatic species, and then test the temperature of a local body of water to see what creatures would be able to live in it. Come to the Fraser River Discovery Centre to test the water of the Fraser River to find out if it is within the acceptable levels for salmon.



pH

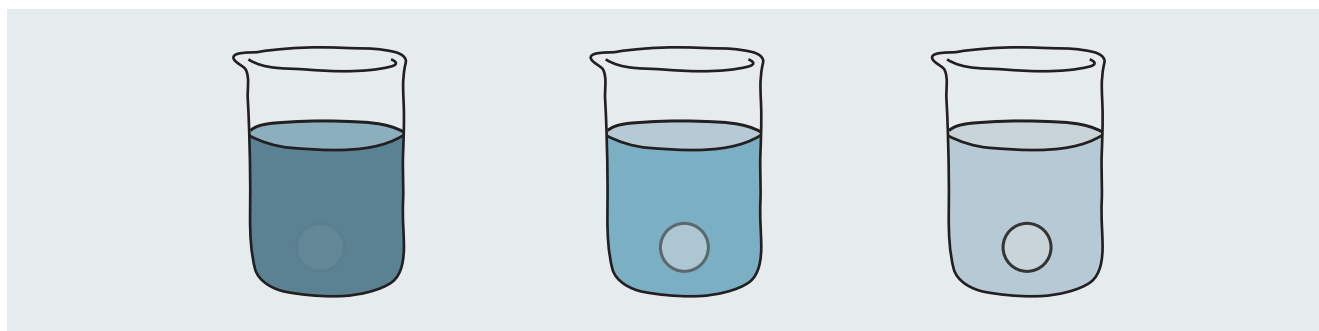
pH is a measure of how acidic or basic a solution is. In more scientific terms, pH, or the “power of hydrogen”, is a measure of the activity of hydrogen (H^+) ions in solutions. The lower the pH, the more hydrogen ions a solution has. pH is measured on a scale from 1-14. pH of less than 7 indicates the substance is an acid, and greater than 7 means the substance is a base. pH of 7 indicates the substance is neutral. Most aquatic animals can only survive within a certain pH range, for example, fish will only live in water with a pH between 5.4 and 11.4.

Discussion/Activity idea: Visit the Fraser River Discovery Centre to test the pH of common household substances and water from the Fraser River using pH indicator paper.

Turbidity

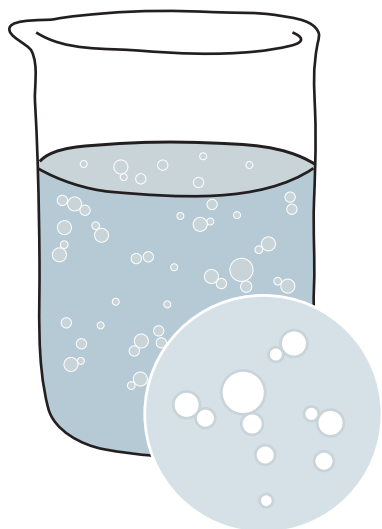
Why isn't the Fraser River clear? Turbidity refers to how cloudy the water is and is a measure of how much suspended material is in the water. The material may be organic like algae and leaves, or it may be inorganic such as clay and sand particles. Have you ever experienced a drinking water advisory? Often that happens when the water is turbid and chlorine can no longer kill harmful bacteria and parasites. The Fraser River is naturally turbid, and so it is never safe for drinking without treatment to remove the sediment. Deforestation and construction projects beside river banks can increase turbidity.

Discussion/Activity idea: to teach the concept of turbidity, have students add small amounts of milk to a glass of water to watch how the water becomes cloudier. Discuss why some rivers are more naturally turbid than others – some rivers have more sediment trapping reservoirs such as lakes which reduce turbidity because the sediment settles in these areas. The Fraser River has very few sediment trapping reservoirs along its main stem.



Dissolved Oxygen

Fish and other aquatic organisms are the same as you, they need to breathe oxygen. Have you heard of high altitude sickness? When humans climb very high mountains, the lack of oxygen in the atmosphere makes us feel sick. That might be what a fish feels like when there is not enough oxygen in the water. Fish can suffocate if the water does not have enough oxygen. The amount of dissolved oxygen is affected by temperature; the warmer the water, the less oxygen it holds. High levels of nutrients from fertilizers and sewage can cause algae and plankton to grow rapidly. After the algae or plankton dies, it decomposes, using up the oxygen.

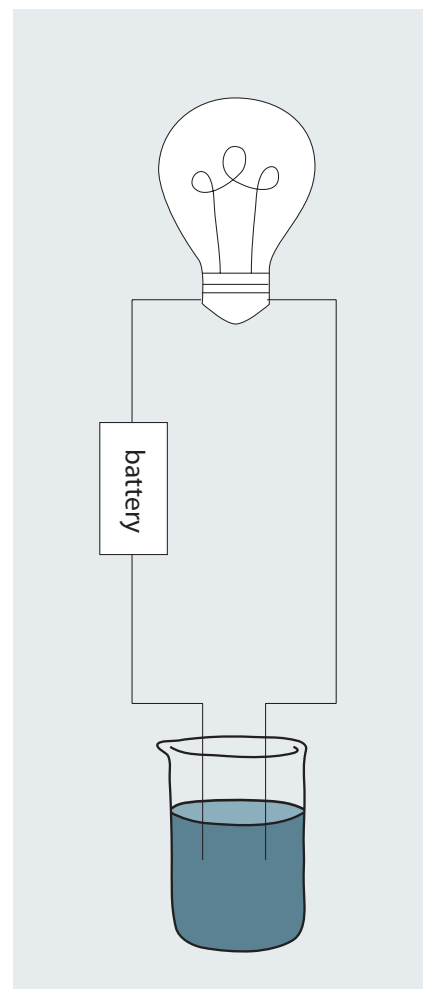


Discussion/Activity idea: Pour cold water into a clear cup, come back in half an hour to see the bubbles that have formed on the sides of the cup. Warmer liquids hold less dissolved oxygen.

Conductivity

Conductivity is a measure of the ability of water to conduct electricity. Pure water is a poor conductor of electricity because it contains no metals or salts which are good conductors. High conductivity is often an indicator of poor water quality. Conductivity is increased by the presence of dissolved solids such as bicarbonate, chloride, phosphate, sodium, magnesium, and calcium. The conductivity can be affected by the local bedrock as some rocks, such as limestone containing calcium, are more easily dissolved by rainwater than others. Irrigation also leads to higher conductivity in river water by evaporating large quantities of water over land. The salts are left behind, and when rains wash over the land they carry the salts back to the river.

Discussion/Activity ideas: Some substances conduct electricity better than others. The ability to conduct electricity has to do with the atoms in a substance. In poor conductors, the electrons of atoms are not allowed to move freely and share heat while in good conductors, the electrons of the atoms can move around. These are good conductors. As an example, have students stand up in a group. Give three students a small bag of marbles each. As a poor conductor, all the students would stay still and would only share marbles with those directly around them. In the second scenario, ask all the students to move around, with the three students handing out several marbles to each student around them. The students who receive marbles then also share their marbles with more students until all the students have a marble.



Nutrient Content

Water quality is affected by the levels of certain nutrients in the water. The major nutrients required for aquatic plants and phytoplankton to grow are nitrogen and phosphorus. Excessive levels of these nutrients can cause algae and plankton to grow rapidly. When the algae and plankton die, they decompose. Decomposition uses up a lot of oxygen and as oxygen levels in water decline, many aquatic organisms suffocate and die. This process is referred to as eutrophication. The major sources of nitrogen in water are urban wastewater, septic tanks, feedlot discharges, animal wastes (livestock, birds, mammals, and fish), fertilized field and lawn runoff, and vehicle exhausts.

Discussion/Activity ideas: Have students heard the expression "Too much of a good thing can harm you" What does this mean to them? What are some examples they can think of? Too much candy leads to cavities or a belly ache? A small amount of medicine can be helpful while a large amount might be toxic. Explore the idea that the presence of these nutrients at certain levels is helpful to plants, and at other levels can be harmful to plants. Explore how human actions affect nutrient levels in the Fraser River by looking at farming practices in the Fraser Valley (e.g., the application of fertilizers, and how agricultural waste is disposed of).

3.2.7 What Affects Water Quality?

Name: _____ Date: _____

- What natural and human-caused factors affect water quality?
- Why is water quality testing important for drinking water? What about for the ecosystem?

There are both natural and human factors that can have an effect on water quality.
What do you think affects water quality?

Natural factors that affect water quality	Human effects on water quality

Water is essential for survival. The health of entire ecosystems is also dependent upon clean water. It is important for us to understand the relationships between the land and ocean, and the essential link between the two: rivers. To maintain a healthy ecosystem we need to both protect and monitor our fresh water sources.

Activity 3.3 Taking the Pulse of the Fraser

Workshop @
Fraser River Discovery Centre

Pre-visit activities:

- Choose from activities in sections I, II, and III of this kit.

This workshop runs for 2 hours and is divided into:

- Observe the Fraser and take a water sample (20 minutes)
Students use their observational skills to become curious about the Fraser River. Together they take a sample of water from the river for further analysis
- Background Research using the Discovery Centre's exhibits (20 minutes)
Inside the Discovery Centre students use the exhibits to learn about turbidity, the importance of salmon, human impacts on the river, and the ecology of the Fraser River.
- Hypothesis (10 minutes)
Students test the pH of the Fraser and several household substances, they test the pH of tap water and the Fraser River using two methods. They compare their results to those generated by the University of the Fraser Valley scientists who have been measuring water quality at Fort Langley.
- Analyze your results/Conclusion (10 minutes)
Students compare results and conclude whether their data supported their hypotheses, ending with a discussion about climate change and its impact on wild salmon and the rest of the ecosystem.

Post-visit Activities:

- Choose from Activities in section IV and V of this kit.

3.3.1 Taking the Pulse of the Fraser River

Name: _____ Date: _____

1. Observation: use your senses to explore your surroundings, write down your observations and what you are curious about.

What do you think about the colour of the water?

2. Background Research:

Acceptable levels for Salmon:

Temperature	pH	Maximum
Migrating salmon mortality goes up at 18 °C	Fish avoid water above pH 11.4 and below 5.4	Fish may die when exposed to 500 NTU or higher for several weeks.

3. Hypothesis: Fill in your hypotheses with the word(s) WILL or WILL NOT

H1 Temperature _____ be within acceptable levels for salmon survival
 H2 pH _____ be within acceptable levels for salmon survival
 H3 Turbidity _____ be within acceptable levels for salmon survival

3.3.1 Taking the Pulse of the Fraser River

4. Experiment: Test the sample

Temperature: _____ °C

Turbidity: How cloudy is the sample?

Water type	Observations	25 mL turbidity tube result (NTU)	Electronic turbidity reader result (NTU)
Tap water			
Fraser River water sample			

pH: How acidic or basic is the sample?

- 1) Fill in the hypothesis column before testing any substances.
- 2) Put on protective gloves and glasses.

Substance	Hypothesis	Observation (e.g. appearance, odors)	pH	Acid/Base/Neutral
e.g. Grape Juice	Acid	Purple, sweet, sticky	3.5	Acid
Tap Water				
Lemon Juice				
Baking Soda and Water				
Fraser River Water				

5. Analyze your results:

6. Discussion Questions:

Why are rising water temperatures a problem for salmon?

What you think might happen if salmon stop spawning in the Fraser River. What impact might that have on the rest of the ecosystem?

Section IV: Putting the Fraser on the Global Map

A universal need for fresh water unites all people on the planet. The Global Rivers Observatory scientists have been studying water quality around the world and have worked with people from many different countries to study water. The *My River My Home* exhibit features their work from five watersheds that span twenty-one countries. In the activities in this section, students begin to appreciate the diversity of human cultures and how we are all connected to water.



Activity 4.1 Global Rivers Observatory.....69

Activity 4.2 Global Rivers Art70

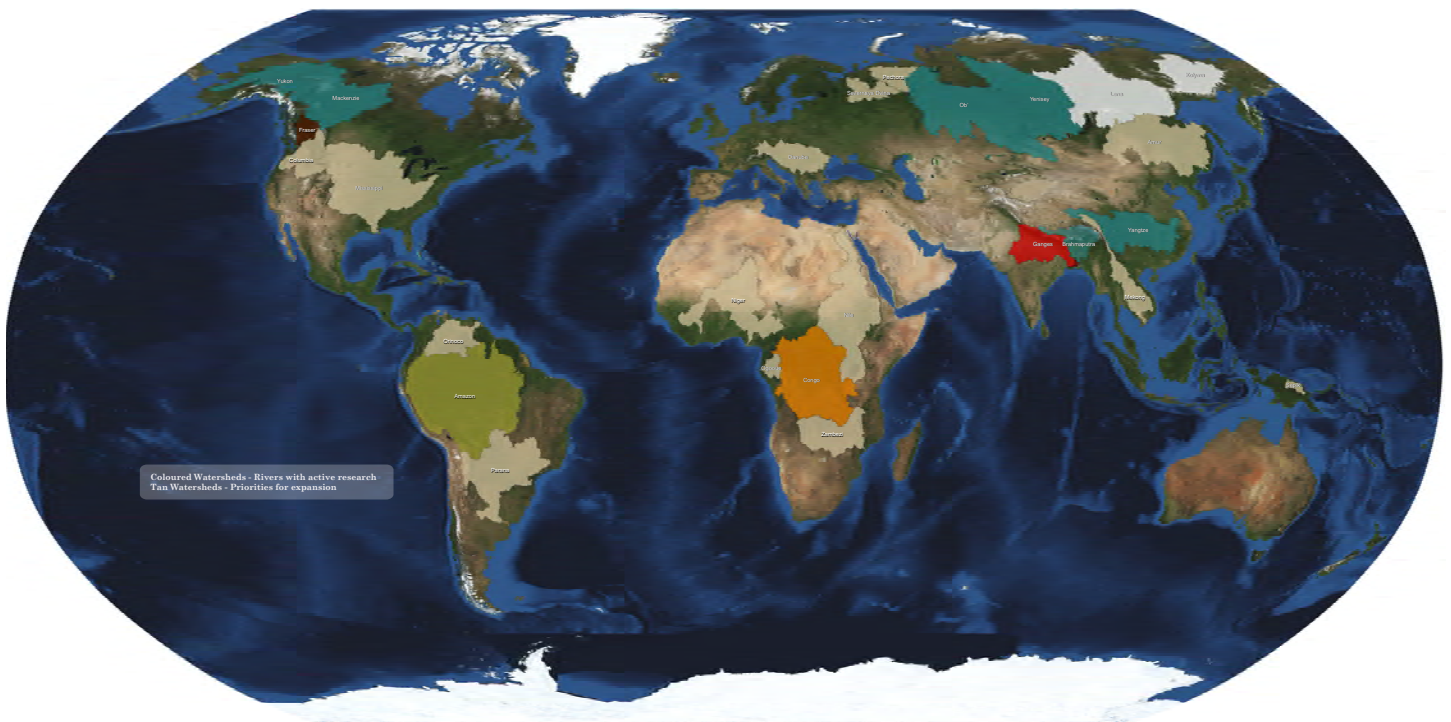
Activity 4.3 People’s Relationship to the Environment73

Activity 4.4 Global Rivers Data from Around the World74

Activity 4.1 The Global River Observatory

Why is the Fraser River part of the Global Rivers Observatory study? The Global Rivers Observatory is tracking the health of the world's most significant river systems, including the Fraser River, in order to advance our understanding of how climate change, deforestation, and other disturbances are affecting rivers and oceans. As the human population approaches 9 billion people, this understanding will be essential.

The Global Rivers Observatory chose to study the Fraser River because of its large salmon runs, high turbidity levels, pine beetle infestation in forests in the basin, and the competing demands of agriculture, logging, hydroelectric power and urban sprawl, all of which affect the river's water chemistry. The water quality testing information in this kit was provided by Global Rivers Observatory Scientists from the Woods Hole Oceanographic Institution in Massachusetts, and their local partners at the University of the Fraser Valley in Abbotsford.



Resources

Short films explaining the project
<https://globalrivers.org/>

Extensions

- Ask students to express why the Fraser River is important
 - How is the Fraser River connected to other rivers? (Amazon, Congo, Ganges etc.)

Activity 4.2 Global Rivers Art

Can art help us to understand people's connections to the environment? Young people have contributed to the Global Rivers Observatory by creating and sharing art that expresses their connection to water. A selection of these art pieces is on display at the Fraser River Discovery Centre in the *My River My Home* exhibit. During this activity, students reflect on this exhibition of student art to open a discussion about how cultural or personal values can be expressed through art.

What You Need:



60 minutes



**4.2.1
Student art**

Visit the *My River My Home* exhibit to view the displays about each watershed

What You Do:

- Discuss how artistic expression can be a reflection of the culture in which it is produced.
- Discuss that the art that they will be viewing was created by children and youth during the Global Rivers project.
- Ask students to assess the art based on colour and theme.
- Ask students to make connections between the artwork and the social, historical, and cultural contexts of the artists who created the images on display. (Students who have completed activity 4.3 may have an easier time with this task.)
- Optional: visit GlobalRivers.org to see a larger selection of artworks.
- Visit the Fraser River Discovery Centre to view the artworks in the *My River My Home* exhibit.

Discussion

- What colours are predominant in the art? How do the colours make you feel? Compare the art. Do you see similarities between the art pieces? Consider theme and subject matter as well.
- How do you interpret the similarities and differences in colours, themes, and composition?
- What does the art tell you about the social and cultural context in which it was produced? What about the physical environment? What does the art express about people's relationships to rivers? Consider the artists' intent.

Extensions

Choose an image that you connect with. Using your imagination, write a journal entry about the art. Study internationally renowned artists from these areas. Does their work contain similar colours, motifs, and themes?

4.2.1 Student Art



M. Grewal, Grade 9, Abbotsford Collegiate, Fraser River



U. Ivanova, Secondary student, Lena River



Unknown artist, Unknown grade, Congo River



S. Chatterjee, Grade 8, Chetla Girls High School, Ganges River

Activity 4.3 People's Relationship to the Environment

Everyone on the planet needs water, but there is a great diversity in how cultures and communities value and use water. In this activity, students choose a country and a culture to study to begin to appreciate the diversity of human cultures and how they are connected to water.

What You Need:



2+ hours



Art from 4.2.1



**Library books or internet
access to research
cultural groups**

**Materials for
presenting the
research**

What You Do:

- Ask students to choose a country from one of the watersheds featured in the *My River My Home* exhibit to study.
 - Amazon: Brazil, Bolivia, Peru, Ecuador, Colombia, Venezuela
 - Congo: Cameroon, Republic of Congo, Democratic Republic of Congo, Central African Republic, Tanzania, Zambia, Angola, Burundi
 - Fraser: Canada
 - Ganges/Brahmaputra: India, China, Nepal, Bangladesh, Bhutan
 - Lena/Kolyma: Russia
- Students should use library and internet resources to research the relationship the people have with their environment (research climate and how climate might impact transportation, diet, agricultural practices, water use, house style, clothing styles, art etc.).
- Create a collage or mind map about the people's relationship to their environment including the location of the country and where the river runs through the country.
- Optional: use picture books to demonstrate different climates, diet, clothing style etc. from various cultures.

Discussion

- How does environment impact housing, transportation, clothing and diet choices?
- What roles does the river play in these countries (i.e., transportation, agriculture, energy production, and spiritual activities?)
- What are some commonalities between nations and continents? What are some differences?

Extensions

- Attend an *Our Bones are Made of Salmon* workshop at the Fraser River Discovery Centre to learn about Indigenous people's relationship to the Fraser River and to salmon.
- Visit the *My River My Home* exhibit to study the population density of the five watersheds and view the photographs and art that demonstrate people's relationship to the environment in these watersheds.

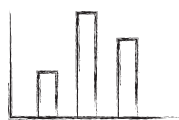
Activity 4.4 Global Rivers Data from around the World

How does the health of the Fraser River compare to other rivers? The Global Rivers Observatory is currently studying the health of eighteen rivers around the world and is hoping to expand into more river basins soon. The Fraser River Discovery Centre's exhibit *My River My Home* features six of them: the Fraser, Amazon, Congo, Ganges-Brahmaputra, and the Lena and Kolyma rivers. Comparative data is provided here to provide a general idea of how the water quality of the Fraser River compares to other rivers around the world. These tables provide a very general comparison. Water quality data fluctuates daily and seasonally therefore more meaningful comparison would require more data, from tests that are conducted on a regular basis throughout the seasons.

What You Need:



20-30 minutes



Water quality data*
from the Fraser River



4.4.1

What You Do:

- *Get water quality data from the Fraser River
 - Attend a *Taking the Pulse of the Fraser* workshop to test water at the Fraser River Discovery Centre or use Activity 3.3
 - Check on-line for recent Fraser River water quality data at <http://aquatic.pyr.ec.gc.ca/realtimebuoys/default.aspx>
- Review what affects water quality (handout 3.2.7)
- Use worksheet 4.4.1 to compare Fraser River data with other rivers

Discussion

- Which rivers had the highest and lowest values for each measure of water quality
- What might account for the differences?

Extensions

Research more about these rivers in regards to population density, communities, main industries, and local water uses that might impact water quality.

4.4.1 Global Rivers Data from around the World

The Global Rivers Observatory is currently studying the health of eighteen rivers around the world and is hoping to expand into more river basins soon. The table below shows water quality test results from the Amazon, Congo, Ganges-Brahmaputra, and the Kolyma rivers. Compare these data to the Fraser River.

Measure	Fraser	Congo	Ganges-Brahmaputra	Kolyma	Amazon
Temperature (°C)	9.7	28	28	7.6	28
pH	7.8	6.4	7.3	7.5	6.8
Turbidity (mg/L)	125	26	1000	100	180
Dissolved Oxygen (mg/L)	11.6	7.0	7.0	9.5	6.5

Fill in the following table:

Water Quality test	Highest	Lowest
Temperature		
pH		
Turbidity		
Dissolved Oxygen		

Do you think the health of rivers is improving or decreasing around the world? Why or why not?

Do you think enough is being done to protect rivers around the world? Why or why not?

If not, what else do you think should be done?

Section V: What's Next?

This section includes suggestions to encourage students to become active citizens in local water issues.



Activity 5.1 Becoming an Active Citizen in Water Issues.....77

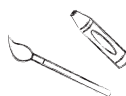
Activity 5.1 Becoming an Active Citizen in Water Issues

Students completing some or all of the activities in this kit will have a much stronger connection to water, more knowledge about the importance of the complexities of environmental, cultural and economic sustainability. This activity includes suggestions for how students can continue the learning and take action to contribute to local and international water issues.

What You Need:



**As much time and imagination
as you are willing to give**



**Supplies will vary
by activity**



What You Do:

- These activities may be completed during school time, for science fair projects, special student projects, for extra credit... work out the details with your students.

Discussion/ Activity ideas

- Write a postcard or send a message to the Prime Minister, Premier, and local politicians to express your concern for the protection of water resources.
- Create a poster to share what you have learned with others.
- Create a collaborative or group art exhibit about water issues. Contact a local mall or art gallery to exhibit the collection.
- Connect with your local streamkeepers group, or other environmental groups in your city, to see if you can volunteer or contribute in other ways to upcoming events.
- Express yourself, through writing, poetry, song or other art and share it!
- Organize an assembly about water for your school that includes some information you have learned and, maybe some skits.
- Host a tap water vs. bottled water challenge (compare flavour as well as resources used to make/transport it).
- Become a Fraser River Discovery Centre volunteer and share your knowledge with others!

Appendix A: Vocabulary

Abiotic: non-living parts of the environment, such as air, water, and rocks

Acid: a compound that forms a sour-tasting solution, which reacts with metals and can cause serious burns on skin; a solution that is acidic turns blue litmus paper red

Acidic: a term used to describe a solution that has a value below 7 on the pH scale; the more acidic the solution, the lower its pH value

Anthropogenic: caused by humans

Base: a compound that forms a bitter tasting solution, which feels slippery, reacts with fats and oils, and can cause serious burns on the skin; a solution that is basic turns red litmus paper blue.

Basic: a term used to describe a solution that has a value above 7 on the pH scale; the more basic a solution, the higher its pH value

Basin: the catchment of a watershed meaning all of the streams, lakes, rivers and land that drain into a particular river

Biotic: living parts of the environment, including animals, plants and micro-organisms

Climate change: a long-term change in the earth's climate, especially a change due to an increase in the average atmospheric temperature

Confluence: the coming together of two rivers

Control: the part of an experiment in which conditions do not change

Dissolved Oxygen: a measure of the amount of oxygen (O₂) gas dissolved in an liquid

Ecosystem: the network of interactions that link together the living and non-living parts of an environment

Ectotherm: an organism that regulates its body temperature largely by exchanging heat with its surroundings

Erosion: the breaking up of rocks into its minerals and the transport of the weathered rock material

Hypothesis: a possible explanation, informed by observations, of how something happens in nature

Hypoxic/Hypoxia: low oxygen conditions

Inference: an explanation that results from an observation

Inorganic: Involving neither organic life nor the products of organic life; not composed of organic matter.

Ion: a charged particle; an atom of an element with an extra (anion) or missing (cation) electron

Junction: a place or point where two or more things meet or converge. In rivers where a tributary meets the main stem or parent river.

Micro-organism: a living thing that is too small to be seen without the help of a microscope; for example, bacteria and some algae are micro-organisms

Molecule: a particle made up of two or more atoms joined together

Neutral: neither an acid nor a base; on the pH scale, a neutral substance has a value of 7

Neutralization: a chemical reaction where a base and an acid react to form a salt

Organic: matter that has come from a once-living organism, is capable of decay or the product of decay, or is composed of compounds that contain carbon atoms bound to hydrogen atoms

Per capita: per person/individual

Predict: to use observations made in the past to describe what you think might happen

pH: a scale that measures the acidity of substances; has values from 0 (strongly acidic) to 7 (neutral) to 14 (strongly basic); the scale is logarithmic meaning that a change in one unit means a 10-fold change

Runoff (surface runoff): the flow of water, from rain, snow melt, or other sources, over land

Sediment: solid particles (such as rock particles, clay, mud, sand, gravel and boulders) that are carried by moving water and gradually settle onto the floor of a lake or ocean

Silt: earthy matter, fine sand, or the like carried by moving or running water and deposited as sediment

Solution: a mixture of two or more substances that appears to be made up of only one substance; for example, clear apple juice (a liquid), clean air (a gas), and a stainless steel (a solid mixture of metals) are all solutions

Species: refers to a group of organisms of the same kind that can breed with one another, or reproduce, and their offspring can also reproduce

Stewardship: taking personal responsibility for something; for example, by caretaking in an ecosystem

Suspension: a cloudy mixture in which clumps of a solid or droplets of a liquid are scattered throughout a liquid or gas; for example, muddy water is a suspension

Sustainability: the ability of ecosystems to bear the impact of the human population indefinitely, through the renewal of resources and the recycling of waste

Temperature: A way of expressing with numbers how hot or how cold something is. Temperature is a measure of the average kinetic energy of all the particles in an object

Threshold: a condition where small changes result in large changes

Tributary: a stream or river that flows into a main stem (or parent) river or a lake. A *tributary* does not flow directly into a sea or ocean

Turbid/Turbidity: the cloudiness or haziness of a fluid caused by suspended solids

Watershed: the area of land where surface water from rain and melting snow or ice all drains to a single point, where the waters join another water body, such as a river, lake, reservoir, estuary, wetland, sea, or ocean

Appendix B: Recommended Activities by Grade, Based on Curriculum

Recommended Activities for Kindergarten		
Based on the big ideas, curricular competencies, concepts and content of the new draft BC Curriculum		
	Science	Selective Curriculum Links
	2.1 Geography 2.3 The Salmon Forest 2.5 Mountain Pine Beetle 2.6 Indigenous Connections 2.8 Sturgeon Survival Game	- Local weather re: effects on familiar animals - Local weather re: temperature, precipitation - Basic needs of plants and animals
	Social Studies	Selective Curriculum Links
	1.1 Is Water Important? 1.4 Local Watershed 1.5 My Connections 2.6 Indigenous Connections	- People, places, and events in their local community, including Indigenous Communities - Rights, roles and responsibilities of individuals and groups
	Visual Arts	Selective Curriculum Links
	1.1 Is Water Important? 1.4 Local Watershed 1.5 My Connections 1.6 Inspired by the Fraser 2.3 Salmon Forest 2.5 Mountain Pine Beetle 2.6 Indigenous Connections 4.2 Global Rivers Art 4.3 People's Relationship to the Environment	- We construct meaning in the arts through looking, listening, and expressive movement - Create artistic works collaboratively and as an individual using ideas inspired by imagination, inquiry, experimentation, and purposeful play - Explore artistic expressions of self, community, and culture through creative processes - Visual art concepts of line, shape, space, colour, principles of design (pattern, repetition)
	Language Arts	Selective Curriculum Links
	1.1 Is Water Important? 1.5 My Connections 1.7 What am I Curious About? 2.3 The Salmon Forest 2.5 Mountain Pine Beetle 4.3 People's Relationship to the Environment	- Express thoughts, feelings, opinions, and ideas through oral, written, and visual presentations and contribute as a member of a classroom community - Exchange ideas, emotions, and perspectives to build shared understanding - Create a variety of texts to deepen understanding of self, family, and community

Recommended Activities For Grade 1

Based on the big ideas, curricular competencies, concepts and content of the new draft BC Curriculum

Science	Selective Curriculum Links
2.1 Geography 2.2 Travel Brochure 2.3 Salmon Forest	- Structural features of living things in the local environment and behavioral adaptations of animals in their area
Social Studies	Selective Curriculum Links
1.1 Is Water Important? 1.2 How Much Water? 1.3 Ecological Footprint 1.4 Local Watershed 1.5 My Connections 2.1 Geography 2.2 Travel Brochure 2.5 Mountain Pine Beetle 2.6 Indigenous Connections 2.8 Sturgeon Survival Game 4.3 People's Relationship to the Environment	- Natural and human-made features of the local environment - Diverse cultures, backgrounds, and perspectives within the local and other communities - Relationships between a community and its environment - Roles, rights, and responsibilities in the local community - Characteristics of the local community, including the structures and systems that provide organization and meet the needs of communities - Key events and developments in the local community, including the Indigenous community
Visual Arts	Selective Curriculum Links
1.1 Is Water Important? 1.4 Local Watershed 1.5 My Connections 1.6 Inspired by the Fraser 2.3 Salmon Forest 2.5 Mountain Pine Beetle 2.6 Indigenous Connections 4.2 Global Rivers Art 4.3 People's Relationship to the Environment	- We create art to express who we are as individuals and community members. - Create artistic works collaboratively and as an individual using ideas inspired by imagination, inquiry, experimentation, and purposeful play - Express feelings, ideas, stories, observations, and experiences through the arts - Describe and respond to works of art - Visual art: line, shape, space, texture, colour, principles of design (pattern, repetition, contrast) - Drama: role, character, action, vocalizations
Language Arts	Selective Curriculum Links
1.1 Is Water Important? 1.5 My Connections 1.7 What am I Curious About? 2.3 The Salmon Forest 2.5 Mountain Pine Beetle 4.3 People's Relationship with the Environment	- Express thoughts, feelings, opinions, and ideas through oral, written, and visual presentations and contribute as a member of a classroom community - Use the writing process to create written forms - Create a variety of texts to deepen understanding of self, family, and community - Develop and use critical thinking skills to make meaning from multiple types of text

Recommended Activities For Grade 2	
Based on the big ideas, curricular competencies, concepts and content of the new draft BC Curriculum	
Science	Selective Curriculum Links
1.4 Local Watershed 2.1 Geography 2.2 Travel Brochure 2.5 Mountain Pine Beetle	- Major landforms in the area - Erosion and deposition by wind and water - Objects move differently in/over/through different materials - Physical ways of changing material
Social Studies	Selective Curriculum Links
1.1 Is Water Important? 1.2 How Much Water? 1.3 Ecological Footprint 1.5 My Connections 2.5 Mountain Pine Beetle 2.6 Indigenous Connections 2.8 Sturgeon Survival Game 2.9 Pulp Mill Role Play 2.10 Global Trade Network 2.11 Sharing a Limited Resource 4.2 Global Rivers Art 4.3 People's Relationship to the Environment 5.1 Active Citizens	- Rights and responsibilities of students as British Columbians and Canadians - Responsibilities of global citizenship - Relationships between people and environment in different communities - Different perspectives on and methods for meeting needs and wants in their community and others - Diverse features of the environment in other parts of Canada and the world
Visual Arts	Selective Curriculum Links
1.1 Is Water Important? 1.4 Local Watershed 1.6 Inspired by the Fraser 2.2 Travel Brochure 2.6 Indigenous Connections 4.2 Global Rivers Art	- Create artistic works collaboratively and as an individual using ideas inspired by imagination, inquiry, experimentation, and purposeful play - Express feelings, ideas, stories, observations, and experiences through the arts - Describe and respond to works of art - Visual art: line, shape, space, colour, pattern, contrast - Drama: relationships, role, and character through space, action, mood, and vocalizations
Language Arts	Selective Curriculum Links
1.1 Is Water Important? 1.2 My Connections 1.7 Know-Wonder-Learn 2.5 Mountain Pine Beetle 2.6 Indigenous Connections 2.9 Pulp Mill Role Play 2.11 Sharing a Limited Resource	- Engage actively as listeners and readers to make meaning and develop thinking and comprehension - Explore stories from a variety of cultures, including Indigenous cultures, to gain an appreciation of identity, family, and community - Draw on prior experience and knowledge to make connections - Exchange ideas, emotions, and perspectives to build shared understanding - Create a variety of texts to deepen understanding of self, family, and community

Recommended Activities For Grade 3

Based on the big ideas, curricular competencies, concepts and content
of the new draft BC Curriculum

Science	Selective Curriculum Links
1.1 Is Water Important? 1.2 How Much Water? 1.4 Local Watershed 1.5 My Connections 1.6 Inspired by the Fraser 2.3 Salmon Forest 2.5 Mountain Pine Beetle 2.8 Sturgeon Survival Game 2.12 Ground Water 3.2 Water Quality Measures	<ul style="list-style-type: none"> - Local water sources - The water cycle, evaporation, condensation, precipitation, run-off - Food chains, food webs, and energy pyramids - Plants, animals, and fungi in their local ecosystem; local water sources
Social Studies	Selective Curriculum Links
2.3 Salmon Forest 2.6 Indigenous Connections 2.9 A Pulp Mill Role Play 2.11 Sharing a Limited Resource 4.2 Global Rivers Art 4.3 People's Relationship to the Environment	<ul style="list-style-type: none"> - The impact of the environment on cultural characteristics and ways of life in Indigenous societies - Cultural characteristics and ways of life of Indigenous people, including local Indigenous groups - How Indigenous societies, including local Indigenous groups, meet their needs and wants
Visual Arts	Selective Curriculum Links
1.1 Is Water Important? 1.4 Local Watershed 1.5 My Connections 1.6 Inspired by the Fraser 4.2 Global Rivers Art 4.3 People's Relationship to the Environment	<ul style="list-style-type: none"> - Explore identity, place, culture, and belonging through arts experiences - Explore relationships among cultures, societies, and the arts - Connect knowledge and skills from other subject areas in planning, creating, interpreting, and analyzing works of art - Express feelings, ideas, and experiences in aesthetic ways - Describe and respond to works of art and explore artists' intent - Visual art: line, shape, space, colour, form, pattern, contrast, emphasis.
Language Arts	Selective Curriculum Links
1.1 Is Water Important? 1.5 My Connections 2.3 Salmon Forest 2.5 Mountain Pine Beetle	<ul style="list-style-type: none"> - Explore a rich variety of texts, including story, to deepen learning and develop a broader understanding of self, family, community, and the world - Think critically about ideas and information to deepen, extend, and transform understanding - Support thinking using evidence, personal connections, and background knowledge

Recommended Activities For Grade 4

Based on the big ideas, curricular competencies, concepts and content of the new draft BC Curriculum

Science	Selective Curriculum Links
1.1 Is Water Important? 1.6 Inspired by the Fraser 2.1 Geography 2.2 Travel Brochure 2.3 Salmon Forest 2.4 Carbon Cycle 2.5 Mountain Pine Beetle 2.7 Living Along the Fraser	- 5 senses - Types of earth materials in their area
Social Studies	Selective Curriculum Links
2.6 Indigenous Connection 2.7 Living Along the Fraser 2.8 Sturgeon Survival Game 2.9 Pulp Mills Role Play 2.10 Global Trade Network 4.2 Global Rivers Art 4.3 People's Relationship with the Environment	- The history of their local community, and connections between their community and significant events, people, and developments - Construct an argument defending the significance of individuals/groups, places, events, and/or developments
Visual Arts	Selective Curriculum Links
1.1 Is Water Important? 1.4 Local Watershed 1.5 My Connections 1.6 Inspired by the Fraser 4.2 Global Rivers Art 4.3 People's Relationship to the Environment	- Exploring artistic works exposes us to diverse cultures, values, knowledge, and worldviews. - Explore identity, place, culture, and belonging through arts experiences - Connect knowledge and skills from other subject areas in planning, creating, interpreting, and analyzing works of art - Express feelings, ideas, and experiences in aesthetic ways - Describe and respond to works of art and explore artists' intent - Visual art: line, shape, space, colour, form, pattern, repetition, contrast, emphasis, rhythm.
Language Arts	Selective Curriculum Links
1.1 Is Water Important? 1.5 My Connections 1.7 What am I curious About?	- Engage actively as readers and listeners to construct meaning and develop thinking and comprehension - Think critically about ideas and information to deepen, extend, and transform understanding - Create a variety of texts to explore self, family, and community

Recommended Activities For Grade 5

**Based on the big ideas, curricular competencies, concepts and content
of the new draft BC Curriculum**

Science	Selective Curriculum Links
1.2 How Much Water? 1.3 Ecological Footprint 3.1 A Blood Test Metaphor 3.2 Water Quality Measures 3.3 Taking the Pulse of the Fraser	<ul style="list-style-type: none"> - Identify questions to answer or problems to solve through scientific inquiry - Processing and analyzing data and information - Observe, measure, and record data, using appropriate tools, including digital technologies - Identify patterns and connections in data - Compare data with predictions and develop explanations for results
Social Studies	Selective Curriculum Links
1.5 My Connection 2.2 Travel Brochure 2.6 Indigenous Connections 2.7 Sturgeon Survival Game 2.9 Pulp Mill Role Play 2.10 Global Trade Network 2.11 Sharing a Limited Resource 2.12 Groundwater 4.3 People's Relationship to the Environment	<ul style="list-style-type: none"> - Contrasting perspectives about land ownership and use, including issues of Indigenous title, jobs, and the environment - Canada's regions within the global economy - Explain different perspectives on a past or present event or issue, including how changing values, worldviews, and beliefs have influenced perspectives
Visual Arts	Selective Curriculum Links
1.1 Is Water Important? 1.4 Local Watershed 1.5 My Connections 1.6 Inspired by the Fraser 2.2 Travel Brochure 2.9 Pulp Mill Role Play 4.2 Global Rivers Art 4.3 People's Relationship to the Environment	<ul style="list-style-type: none"> - Explore connections to identity, place, culture, and belonging through creative expression - Explore a range of cultures and the relationships among cultures, societies, and the arts - Express feelings, ideas, and experiences through the arts - Describe and respond to works of art and explore artists' intent - Visual art: line, shape, space, texture, colour, form, tone, principles of design (pattern, repetition, balance, contrast, emphasis, rhythm, and unity/variety) - Drama: relationships, role, setting, and character
Language Arts	Selective Curriculum Links
1.1 Is Water Important? 2.2 Travel Brochure 2.5 Mountain Pine Beetle 2.9 Pulp Mills Role Play 2.12 Groundwater 5.1 Active Citizens	<ul style="list-style-type: none"> - Express ideas thoughts, feelings, and opinions through various forms of communication - Explore the ways language can be manipulated and used for specific purposes and audiences, including to evoke emotional responses - Evaluate the accuracy, reliability, and relevance of information

Recommended Activities For Grade 6

Based on the big ideas, curricular competencies, concepts and content
of the new draft BC Curriculum

Science	Selective Curriculum Links
1.2 How Much Water 1.3 Ecological Footprint 1.4 Local Watershed 2.4 Carbon Cycle 2.5 Mountain Pine Beetle 4.4 Global Rivers Data	<ul style="list-style-type: none"> - Processing and analyzing data and information - Cyclical changes in the environment - Observe, measure, and record data, using appropriate tools, including digital technologies - Identify patterns and connections in data - Compare data with predictions and develop explanations for results
Social Studies	Selective Curriculum Links
1.3 Ecological Footprint 1.5 My Connections 2.4 The Carbon Cycle 2.5 Mountain Pine Beetle 2.6 Indigenous Connections 2.8 Sturgeon Survival Game 4.2 Global Rivers Art 5.1 Becoming Active Citizens	<ul style="list-style-type: none"> - Human responses to particular challenges and opportunities of climates, landforms, and natural resources in past civilizations and cultures, including at least one Indigenous to the Americas - Representations of the world according to the religions, spiritual beliefs, myths, stories, knowledge, and languages of past civilizations and cultures
Visual Arts	Selective Curriculum Links
1.1 Is Water Important? 1.4 Local Watershed 1.5 My Connections 1.6 Inspired by the Fraser 2.2 Travel Brochure 2.9 Pulp Mill Role Play 4.2 Global Rivers Art 4.3 People's Relationship to the Environment	<ul style="list-style-type: none"> - Experiencing creative works of art develops empathy for others' perspectives and experiences - Explore relationships between identity, place, culture, society, and belonging through the arts - Reflect on works of art and the creative process to understand artists' motivations and meanings - Describe, interpret, and respond to works to explore artists' intent - Visual art: line, shape, space, texture, colour, form, tone, principles of design (pattern, repetition, balance, contrast, emphasis, rhythm, unity/variety, and harmony)
Language Arts	Selective Curriculum Links
1.5 My Connections 2.5 Mountain Pine Beetle 2.9 Pulp Mills Role Play 2.10 Global Trade Network 2.11 Sharing a Limited Resource 2.12 Groundwater 5.1 Active Citizens	<ul style="list-style-type: none"> - Apply a variety of reading and critical thinking strategies to increase comprehension and construct meaning - Experiment with point of view, voice, and tone to suit the purpose and audience in oral and written communication - Develop and defend an opinion or point of view with supporting evidence

Recommended Activities For Grade 7

Based on the big ideas, curricular competencies, concepts and content of the new draft BC Curriculum

Science	Selective Curriculum Links
1.1 Is Water Important? 1.2 How Much Water? 1.3 Ecological Footprint 3.1 A Blood Test Metaphor 3.2 Water Quality Measures 3.3 Taking the Pulse of the Fraser 4.4 Global Rivers Data	<ul style="list-style-type: none"> - Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal interest - Make observations aimed at identifying their own questions about the natural world - Identify a question to answer or a problem to solve through scientific inquiry - Observe, measure, and record data, using equipment, with accuracy appropriate to the task
Social Studies	Selective Curriculum Links
2.6 Indigenous Connections 2.7 Living Along the Fraser 2.9 Pulp Mill Role Play 2.11 Sharing a Limited Resource 2.12 Groundwater 4.3 People's Relationship to the Environment 5.1 Active Citizens	<ul style="list-style-type: none"> - Interactions and exchanges of resources, ideas, and culture between different civilizations, including at least one Indigenous to the Americas - Rules, laws, and government across time and place - Determine the long- and short-term causes and the intended and unintended consequences of an event, decision, or development
Visual Arts	Selective Curriculum Links
1.1 Is Water Important? 1.4 Local Watershed 1.5 My Connections 1.6 Inspired by the Fraser 2.2 Travel Brochure 2.9 Pulp Mill Role Play 4.2 Global Rivers Art 4.3 People's Relationship to the Environment	<ul style="list-style-type: none"> - Explore relationships between identity, place, culture, society, and belonging through the arts - Interpret works of art using knowledge and skills from various subject areas - Describe, interpret, and respond to works of art - Visual art: line, shape, space, texture, colour, form, tone, principles of design (pattern, repetition, balance, contrast, emphasis, rhythm, unity/variety, and harmony) - Drama: relationships, role, setting, and character through space, action, mood, and vocalizations
Language Arts	Selective Curriculum Links
1.1 Is Water Important? 2.2 Travel Brochure 2.5 Mountain Pine Beetle 2.9 Pulp Mill Role Play 2.11 Sharing a Limited Resource 3.3 Taking the Pulse of the Fraser 5.1 Active Citizens	<ul style="list-style-type: none"> - Support thinking using relevant evidence, personal connections, and background knowledge - Explore and express ideas, opinions, and perspectives to communicate clearly through oral language - Create a variety of personal, informational, and imaginative texts according to purpose and audience

Recommended Activities For Grade 8

Based on the big ideas, curricular competencies, concepts and content of the new draft BC Curriculum

Science	Selective Curriculum Links
1.1 Is Water Important? 1.4 Local Watershed 3.1 A Blood Test Metaphor 3.2 Water Quality Measures 3.3 Taking the Pulse of the Fraser 4.3 People's Relationship with the Environment 4.4 Global Rivers Data 5.1 Active Citizens	<ul style="list-style-type: none"> - Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal interest - Make observations aimed at identifying their own questions about the natural world - Identify a question to answer or a problem to solve through scientific inquiry - Observe, measure, and record data, using equipment, including digital technologies, with accuracy - Construct and use a range of methods to represent patterns or relationships in data, including tables, graphs, - Seek patterns and connections in data from their own investigations and secondary sources
Social Studies	Selective Curriculum Links
1.2 How much Water 1.3 Ecological Footprint 1.5 My Connections 2.4 Carbon Cycle 2.5 Mountain Pine Beetle 2.6 Indigenous Connections 2.7 Living along the Fraser 2.10 Global Trade Network 2.11 Sharing a Limited Resource 2.12 Groundwater	<ul style="list-style-type: none"> - The relationship between humans and the physical environment - Social, political, and economic systems and structures, including those of at least one Indigenous society in the world
Visual Arts	Selective Curriculum Links
1.1 Is Water Important? 1.4 Local Watershed 1.5 My Connections 1.6 Inspired by the Fraser 2.2 Travel Brochure 2.9 Pulp Mill Role Play 4.2 Global Rivers Art 4.3 People's Relationship to the Environment	<ul style="list-style-type: none"> - The arts provide opportunities for individual and collective expression - Explore relationships between identity, place, culture, society, and belonging through arts activities and experiences - Interpret works of art using knowledge and skills from various subject areas - Take creative risks to express feelings, ideas, and experiences - Describe, interpret, and respond to works of art
Language Arts	Selective Curriculum Links
1.5 My Connections 2.2 Travel Brochure 2.5 Mountain Pine Beetle 2.7 Living Along the Fraser 2.9 Pulp Mill Role Play 2.11 Sharing a Limited Resource 2.12 Groundwater 3.2 Water Quality Measures	<ul style="list-style-type: none"> - Engage actively as readers and listeners to construct meaning, deepen thinking and comprehension, and promote inquiry - Analyze the accuracy, reliability, and relevance of information - Create a variety of texts to communicate ideas, create impact, and evoke emotion - Develop and defend a position with supporting evidence

Recommended Activities For Grade 9

Based on the big ideas, curricular competencies, concepts and content of the new draft BC Curriculum

Science	Selective Curriculum Links
2.1 Geography 2.2 Travel Brochure 2.4 The Carbon Cycle 3.1 A Blood Test Metaphor 3.2 Water Quality Measures 3.3 Taking the Pulse of the Fraser 4.4 Global Rivers Data	<ul style="list-style-type: none"> - The interactions between the lithosphere, atmosphere, biosphere, and hydrosphere - The carbon cycle; forms of carbon - Make observations aimed at identifying their own questions, including increasingly abstract ones, about the natural world - Collaboratively and individually plan, select, and use appropriate investigation methods, including field work and lab experiments, to collect reliable data - Evaluate their methods and experimental conditions, including identifying sources of error or uncertainty
Social Studies	Selective Curriculum Links
1.3 Ecological Footprint 1.4 My Connections 2.2 Travel Brochure 2.4 The Carbon Cycle 2.6 Indigenous Connections 2.7 Living Along the Fraser 2.8 Sturgeon Survival Game 2.9 A Pulp Mill Role Play 2.10 Global Trade Network 2.11 Sharing a Limited Resource 2.12 Groundwater 4.2 Global Rivers Art 4.3 People's Relationship to the Environment	<ul style="list-style-type: none"> - The relationship between humans and the physical environment - The physical environment influences the nature of political, social, and cultural development.
Visual Arts	Selective Curriculum Links
1.4 Local Watershed 1.6 Inspired by the Fraser 2.2 Travel Brochure 4.2 Global Rivers Art 4.3 People's Relationship to the Environment	
Language Arts	Selective Curriculum Links
2.5 Mountain Pine Beetle 2.9 A Pulp Mill Role Play 2.11 Sharing a Limited Resource 2.12 Groundwater 3.2 Water Quality Measures 3.3 Taking the Pulse of the Fraser	<ul style="list-style-type: none"> - Examine ideas or information presented in a variety of texts to increase understanding - Analyzing the accuracy, reliability, and relevance of information - Create a variety of texts to communicate ideas, create impact, and evoke emotion - Develop and defend a position with supporting evidence

Appendix C: Assessment Rubrics (1 example/grade) Based on the new, draft BC curriculum

Kindergarten Visual Art – 1.6 Inspired by the River – Page 13

Students observe the Fraser River using picture frames and use the patterns they see outside as inspiration for a collaborative river mural.

- Big Ideas:
 - We create art to express who we are as individuals and community members.
 - The arts connect us to others through shared meaning
- Concept:
 - Visual art: line, shape, colour, principles of design (pattern, repetition)
- Curricular Competencies:
 - Exploring and creating
 - Explore artistic elements, processes, materials, tools, and techniques
 - Create artistic works collaboratively and as an individual using ideas inspired by imagination, inquiry, experimentation, and purposeful play
 - Reasoning and reflecting
 - Reflect on the creative process and make connections to other experiences
 - Communicating and documenting
 - Express feelings, ideas, stories, observations, and experiences through the arts
 - Experience, document, perform, and share creative works in a variety of ways

Assessment Rubric 1.6 – Inspired by the River – Kindergarten Visual Art			
	Approaching	Meeting	Exceeding
<i>Concepts and Content</i>	Student completes colouring their section of the river mural. They may show a limited to no use of pattern.	Student showcases understanding of warm/cool colours and patterns in their section of the river mural.	Student showcases understanding of warm/cool colours and patterns in their section of the river mural. They make an effective use of contrasting patterns in water and land.
<i>Exploring and Creating</i>	Student shows limited use of artistic material and technique.	Student showcases at least two (2) different techniques, such as making dots, cross-hatching, blending, and using negative space.	Student showcases more than two (3+) different techniques, such as making dots, cross-hatching, blending, and using negative space.
<i>Reflecting and Communicating</i>	Student can acknowledge having been to/near a body of water.	Student is able to verbally share their memories and experiences of being near the river, in relation to their artwork.	Student is able to verbally share their memories and experiences of being near the river, in relation to their artwork. They are able to answer or formulate questions for others to bring up more discussion on the topic.

Gr. 1 Science/LA – 2.5 Climate Change and Mountain Pine Beetle – Page 30

Read *The Life of Pine* (pg. 31). Work as a group to identify the main events in the story. Divide the class into groups with the same number of students as main events in the story. Each student creates a picture to illustrate one event in the story. Together each group creates a storyboard illustrating the main events in the story. Discuss the impact of climate on the pine beetle and how deforestation affects the Fraser River. Extend the learning by working together to create a similar story from the perspective of a pine beetle.

- Big Ideas:
 - Living things have features and behaviours that help them survive
- Concept:
 - Structural features of living things in the local environment
 - Behavioural adaptations of animals in their area
- Curricular Competencies (Science):
 - Demonstrate curiosity and a sense of wonder about the world (Questioning)
 - Identify simple patterns and connections (Processing and Analyzing)
 - Consider some consequences of their actions on the environment (Evaluating)
- Curricular Competencies (LA):
 - Use language in playful ways to develop style, voice, artistry, and point of view

Assessment Rubric 2.5 – Climate Change and Mountain Pine Beetle – Grade 1 Science			
	Approaching	Meeting	Exceeding
<i>Concepts and Content</i>	Student shows understanding that mountain pine beetles cause harm to pine trees.	Student is able to explain how the mountain pine beetle causes damage to pine trees.	Student is able to explain how the mountain pine beetle causes damage to pine trees by identifying features of the tree including bark and pitch.
<i>Processing and Analyzing</i>	Student is able to understand that weather affects the mountain pine beetle.	Student is able to explain why there are more mountain pine beetles now than in the past (milder winters).	Student can demonstrate the correlation between the mountain pine beetle, milder winters, deforestation, and how this affects other animals in the forest.
<i>Evaluating</i>	Student is not yet able to identify an action they can make which could slow climate change.	Student is able to identify one action they can make which could slow climate change.	Student is able to identify several actions they can make which could slow climate change.

Gr. 2 Science – 2.1 Geography – Page 18

Students research the different geographic features of one region of the Fraser River basin, identifying geographic features, climate, common plant and animal species, major cities and industries, and natural resources. Students create a skit, promotional video, poster, or three dimensional model to communicate their findings. Discuss how the living and non-living features of each region would affect the Fraser River.

- Big Ideas:
 - Wind and water change the shape of the land
- Concepts:
 - Major landforms in their area
 - Erosion and deposition by wind and water in their area
- Curricular Competencies:
 - Identify simple patterns and connections (Processing and analyzing data and information)
 - Consider some consequences of their actions on the environment (Evaluating)
 - Communicate observations and ideas using oral or written language, drawing, or role play (Communicating)

Assessment Rubric 2.1 – Geography – Grade 2 Science			
	Approaching	Meeting	Exceeding
<i>Concepts and Content</i>	Student is able to describe the landforms in one region of the Fraser River.	Student is able to identify the landforms in one region and how the region has been shaped by wind and water.	Student can identify the landforms in one area of the Fraser River, show how the Fraser River impacts erosion and deposition in the area.
<i>Processing Information</i>	Student is able to find connections between the river and landforms by identifying one way that the river affects the land.	Student is able to find connections between the river and landforms by addressing 2-3 interactions between the river and the land.	Student is able to discuss the impact of landforms, erosion and deposition one or more of the common plants and animals in the region.
<i>Evaluating + Communicating</i>	Student communicate 1-2 features of the geographic region using one of the following methods to communicate their learning (map, video, skit, 3D model, large mural, etc...).	Student communicate 3-4 features of the geographic region using one of the following methods to communicate their learning (map, video, skit, 3D model, large mural, etc...).	Student communicate 5+ features of the geographic region using one of the following methods to communicate their learning (map, video, skit, 3D model, large mural, etc...).

Gr. 3 Science – 2.3 The Salmon Forest – Page 24

Students learn that salmon play a vital role in providing nutrients to plants and animals living in riparian zones of salmon-bearing streams. Students create poster that demonstrates how nutrients move through the food cycle using the following levels of the food chain: plants, fungi, decomposer, scavenger, and consumer. Students consider what would happen if salmon stopped spawning in the Fraser River basin.

- Big Ideas:
 - Living things and their environment are interdependent
 - Matter and energy flow through ecosystems
- Concepts:
 - Plants, animals, and fungi in their local ecosystem
 - Food chains, food webs, and energy pyramids
 - Water is a vital resource that cycles through the environment
- Curricular Competencies:
 - Make predictions based on prior knowledge
 - Identify some simple implications of their and others' actions on the environment
 - Represent and communicate ideas and findings in a variety of ways such as diagrams and simple reports, using digital technologies as appropriate

Assessment Rubric 2.3 – The Salmon Forest – Making a Poster – Grade 3 Science			
	Approaching	Meeting	Exceeding
<i>Concepts and Content</i>	Student is able to identify one way in which nutrients move in the food chain.	Student is able to identify some (2-3) ways in which nutrients move in the food chain. They can label the poster with some (1-3) levels of the food chain.	Student is able to identify many (4+) ways in which nutrients move in the food chain. They can appropriately label the poster with most (4-5) levels of the food chain.
<i>Questioning + Predicting</i>	Student is able to identify one implication that could be caused by the disappearance of salmon.	Student is able to identify some (2-3) implications that could be caused by the disappearance of salmon.	Student is able to identify many (4+) implications that could be caused by the disappearance of salmon. Student can also identify human impacts that would contribute to the disappearance of salmon.
<i>Representing + Communicating</i>	Student's poster depicts some animals. There is a limited use of diagrams and digital technology (word processing).	Student's poster clearly depicts the food chain. Student uses diagrams and appropriate digital technology to support the ideas.	Student's poster clearly depicts the food chain and the role of water as a resource in the environment. There is an effective use of digital technology to support the ideas.

Gr. 4 Socials + Art (Drama) – 2.9 Pulp Mill Role Play – Page 48

Students organize a town-hall meeting to discuss the application for a new pulp mill in their community. Students construct arguments for different interest groups and role-play to communicate these arguments (townsfolk, mill owners, environmental group, neighbouring business, Indigenous groups, and agriculturalists). As a class, decide whether the development application will be approved.

- Big Ideas (Socials)
 - Economic interdependence can lead to co-operation, competition, and conflict between societies
- Concepts (Socials):
 - The history of their local community, and connections between their community and significant events, people, and developments
- Curricular Competencies (Socials):
 - Construct an argument defending the significance of individuals/groups, places, events, and/or developments (significance)
 - Determine multiple causes and consequences of an event, decision, or development (cause and consequence)
 - Explain different perspectives on past or present people, places, issues, and events (perspective)
 - Evaluate whether an event, decision, or action was fair from a particular perspective (ethical judgment)
- Concepts (Art - Drama):
 - Relationships, role, setting, vocalizations

Assessment Rubric 2.9 – Industry and the Environment (a Pulp Mill Role play) – Grade 4 Socials			
	Approaching	Meeting	Exceeding
<i>Concepts and Content</i>	Student shows understanding of what point source pollution is. Student can identify at least one economic and environmental advantage or disadvantage of building a pulp mill.	Student understands what point source pollution is. Student can identify some (2-4) economic and environmental pros and cons of building a pulp mill.	Student can name several sites of local point source pollution. Student can identify many (5+) economic and environmental pros and cons of building a pulp mill.
<i>Significance + Consequence</i>	Student is able to take a stance by identifying at least one advantage or disadvantage of building a pulp mill.	Student is able to construct an argument by identifying several (2-4) pros and/or cons of building a pulp mill related to the role of their choice.	Student is able to construct an argument by identifying many (5+) pros and cons of building a pulp mill. The argument not only reflects the role of their choice but also other roles in this scenario. Student may use this insight to convince other groups.
<i>Perspective + Ethical Judgment</i>	Student is able to take a stance on whether or not they support the building of a pulp mill.	Student is able to evaluate the final decision and identify its fairness from the perspective of the role they have chosen.	Student is able to evaluate the final decision and identify its fairness not only from one perspective but also from a few others.
<i>Drama</i>	During the role play, student shows active participation.	During the role play, student uses an appropriate tone of voice and body movement to convey their message.	During the role play, student uses an effective tone of voice, tenor, register and body language, depending on what roles they portray and who they address.

Gr. 5 Socials – 2.10 The Fraser River is Part of a Global Trade Network – Page 50

Students investigate the journey of paper products from the forest to their classroom, finding connections between BC's natural resources, the Fraser River basin, the use of the Fraser River for transportation and trade, and Canada's role in the global economy. Students choose another food or electronic gadget to research and create a poster to illustrating how this item ended up at a store in their neighbourhood.

- Big Ideas:
 - The development of natural resources has shaped the economy of different regions of Canada
- Concepts:
 - Canada's regions within the global economy
- Curricular Competencies:
 - Use Social Studies inquiry processes¹
 - Ask questions, gather, interpret and analyze ideas, and communicate findings and decisions
 - Ask questions and corroborate inferences about the content and origins of different sources (evidence)

Assessment Rubric 2.10 The Fraser River is part of a Global Trade Network – Grade 5 Socials			
	Approaching	Meeting	Exceeding
<i>Concepts and Content</i>	Student is able to identify one raw material or manufactured good that is exported from and imported to British Columbia on the Fraser River. Student can identify one step in the manufacturing process.	Student is able to name some (2-3) raw materials or manufactured goods that are exported from and imported to British Columbia on the Fraser River. Student can identify 2-3 steps in the manufacturing process of their chosen item.	Student is able to name many (3-5+) raw materials or manufactured goods that are exported from and imported to British Columbia on the Fraser River. Student can present a thorough description of the journey of their chosen item.
<i>Social Studies Inquiry Process</i>	While discussing our dependence on global trade, student uses one inquiry process ¹ .	While discussing our dependence on global trade, student uses (2-3) inquiry processes ¹ .	While discussing our dependence on global trade, student uses (4-5) inquiry processes ¹ .
<i>Using Evidence</i>	Based on a raw material of choice, student can identify one type of transportation, processing facility or occupation that have shaped the economy of BC.	Based on a raw material of choice, student can identify several (2-4) types of transportation, processing facilities and/or occupations that have shaped the economy of BC.	Based on a raw material of choice, student can identify many (5+) types of transportation, processing facilities and/or occupations that have shaped the economy of BC.

Gr. 6 Language and Visual Arts – 2.6 Indigenous Connections – Page 34

Indigenous people have lived along the Fraser River since time immemorial. Although there are many different groups, languages, and cultures, the people share important links to the Fraser River as a source of life, food, transportation, and spirituality. Watch *Hiqw' Stó:lō*, a 12-minute film recounting the Musqueam and Stó:lō oral histories of how salmon came to the Fraser River.

Gr. 6 Language Arts

- Big Ideas: Engaging in inquiry, making meaning, and connecting with our own and others' experiences through stories and texts deepens our understanding of self, identity, and others
- Curricular competencies:
 - Read, view, and listen to a variety of text types and genres, including those of Indigenous origin
 - Consider multiple perspectives, voices, values, beliefs, and bias in texts from a variety of cultures, including Indigenous ones
 - Understand how literary elements, devices, and language features enhance meaning
 - Explore and express ideas, opinions, and perspectives to communicate clearly through oral language

Gr 6 Visual Arts

- Big Ideas: Experiencing creative works of art develops empathy for others' perspectives and experiences
- Curricular Competencies:
 - Explore relationships between identity, place, culture, society, and belonging through the arts
 - Demonstrate an understanding and appreciation of personal, social, cultural, and historical contexts in relation to the arts
 - Symbols and metaphors to explore ideas and perspectives

Assessment Rubric			
	Approaching	Meeting	Exceeding
<i>Curricular Competencies</i>	Student is able to recall and verbalize a few details about the film.	Students is able to recall and verbalize several elements of the film.	Student is able to recall and verbalize most elements of the film.
	Student can identify 2-3 similarities and differences between the salmon stories.	Student can describe the two stories and can identify how animals were given human qualities.	Student can orally review the two stories and describe how the stories express Indigenous voices, values and perspectives.
	Student can express 1-2 ways that the film demonstrates that salmon is important to Larry and Sonny.	Student can identify several ways that Larry and Sonny communicated their values and beliefs about the environment.	Student can identify ways that Larry and Sonny communicated their values and beliefs about the environment and express why salmon origin stories might be present in First Nations communities along the Fraser River.

Gr. 7 Science – 3.3 Taking the Pulse of the Fraser – Page 65

Students follow each step of the scientific method as they observe the Fraser, collect a water sample, and test the sample's pH, turbidity, and temperature to find out whether these measures fall within the acceptable levels for salmon.

- Big Ideas: Matter can be classified as pure substances and mixtures
- Concepts: Mixtures and substances, chemical changes
- Curricular Competencies:
 - Questioning and predicting
 - Make observations aimed at identifying their own questions about the natural world
 - Identify a question to answer or a problem to solve through scientific inquiry
 - Make predictions about what the findings of their inquiry will be
 - Planning and conducting
 - In fair tests, measure and control variables
 - Observe, measure, and record data, using equipment, including digital technologies, with accuracy appropriate to the task
 - Processing and analyzing data and information
 - Construct and use a range of methods to represent patterns or relationships in data, including tables, graphs, key, scale models, and digital technologies as appropriate
 - Use scientific understandings to identify relationships and draw conclusions
 - Evaluating: Demonstrate an awareness of assumptions and identify information given and bias in their own work and secondary sources

Assessment Rubric 3.3 – Taking the Pulse of the Fraser – Grade 7 Science			
	Approaching	Meeting	Exceeding
<i>Questioning and Predicting</i>	Student records 1-2 observations about the Fraser but does not yet connect these observations with their own questions about the natural world.	Student makes 2-3 observations about the Fraser and connects these observations with questions they have about the river.	Student makes 4-6 observations about the Fraser and connects these observations with questions they have about the water quality of the Fraser River.
<i>Planning and Conducting</i>	Student correctly tests one measure of the water quality of the Fraser River (temperature, pH, or turbidity).	Student correctly tests two measures of the water quality of the Fraser River (temperature, pH, or turbidity) and can identify potential sources of error/bias.	Student correctly tests all three measures of the water quality of the Fraser River (temperature, pH, or turbidity), can identify sources of error/bias, and can discuss the environmental and ethical appropriateness of the methods.
<i>Processing, Analyzing and Evaluating</i>	Student partially completes the tables provided for recording their data.	Student completes all tables provided for recording their data.	In addition to completing all tables provided, student develops their own methods of data analysis and display, using such tools as, but not limited to, graphs, key, scale models.

Gr. 8 Socials – 2.7 Living Along the Fraser – Page 37

Students research a community along the Fraser River and create a poster or summary about the community's interactions with the Fraser. Students should consider Indigenous communities, non-Indigenous settlers, waterfront usage, local industry, tourism, and sewage/outflow.

- Big ideas:
 - Intercultural contact and conflict lead to multiple complex experiences and perspectives
- Concepts:
 - The relationship between humans and the physical environment
 - Relationships between expansion, exploration, and colonization
- Curricular Competencies:
 - Continuity and change
 - Determine key historical turning points that led to progress and decline for different groups
 - Test and/or develop different geographic models and theories
 - Cause and consequence
 - Determine and assess the long- and short-term causes and the intended and unintended consequences of an event, decision, or development
- Activity:
 - Research a community found along the Fraser river
 - Create a poster or summary about the community's interaction with the Fraser river

Assessment Rubric 2.7 – Living Along the Fraser – Grade 8 Socials			
	Approaching	Meeting	Exceeding
<i>Concepts and Content</i>	Student creates a poster or summary that shows 1-2 ways that a community affects or is influenced by the Fraser River.	Student creates a poster or summary that shows 3-5 ways that a community affects or is influenced by the Fraser River.	Student creates a poster or summary that shows 6+ ways that a community affects or is influenced by the Fraser River.
<i>Continuity and Change</i>	Student is not yet able to explain how/why this community has been shaped by being located on the Fraser River.	Student is able to explain at least two ways in which the community has been shaped by the Fraser River. Student identifies the relationship between people and the physical environment.	Student is able to explain more than two ways in which the community has been shaped by the Fraser River. Student identifies relationships and intercultural conflicts (if applicable) between Indigenous communities, settler groups, and industries.
<i>Cause and Consequences</i>	Student is not yet able to provide a prediction for short-term or long-term ecological consequences of residential settlements, industries, tourism and recreation on the Fraser.	Student is able to predict short-term or long-term ecological consequences of residential settlements, industries, tourism and recreation on the Fraser, using at least one piece of evidence.	Student is able to predict both short-term and long-term ecological consequences of residential settlements, industries, tourism and recreation on the Fraser, using 2+ pieces of evidence.

Gr. 9 Science – 2.4 The Carbon Cycle – Page 27

Students investigate how the Fraser River contribute to the movement of carbon from land to ocean by creating a storyline for carbon as it moves through the environment.

- Big Ideas:
 - An element's properties are related to the arrangement and energy of its electrons and to its atomic size
- Concepts:
 - The carbon cycle
 - Forms of carbon
- Curricular Competencies:
 - Questioning and predicting
 - Formulate multiple hypotheses and predict multiple outcomes
 - Processing and analyzing data and information
 - Seek and analyze patterns, trends, and connections in data, including describing relationships between variables and identifying inconsistencies
 - Use knowledge of scientific concepts to draw conclusions that are consistent with evidence
 - Evaluating
 - Evaluate the validity of and limitations of a model or analogy in relation to the phenomenon modelled
 - Consider social, ethical, and environmental implications of the findings from their own and others' investigations
 - Critically analyze the validity of information in secondary sources and evaluate the approaches used to solve problems
 - Communicating
 - Formulate physical or mental theoretical models to describe a phenomenon
 - Communicate scientific ideas, 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

Assessment Rubric 2.4 – The Carbon Cycle – Grade 9 Science			
	Approaching	Meeting	Exceeding
<i>Concepts and Content</i>	Student shows understanding of carbon as one of the chemical elements.	Student shows understanding of how carbon atoms cycle through the ecosystem in living and non-living things.	Student shows understanding of how carbon atoms cycle through the ecosystem in living and non-living things. Student is also able to describe the properties of carbon in various molecular forms, regarding the arrangements, energy of the electrons, and atomic sizes.
<i>Questioning and Predicting</i>	Student is not able to fully explain the reasoning for the order in which to put the pieces.	Student is able to put the pieces in the order that they think fits best. Student is able to explain their choices.	Student understands that there are multiple possibilities for how carbon can cycle through an ecosystem, and any order will work so long as they explain the reasoning behind their choices.
<i>Evaluating</i>	Student is not yet able to describe the causes and consequences of the increase in greenhouse gases in the atmosphere.	Student is able to describe the causes and consequences of the increase in greenhouse gases in the atmosphere.	Student is able to describe the causes and consequences of the increase in greenhouse gases in the atmosphere. Student also provides ways in which they can help reduce the emission of greenhouse gases.

