Unit 3
Relationships to Fresh Water

Overview

Introduction

First Peoples view water in a holistic sense, recognizing its unique qualities and roles in the world. Water is seen in cyclical forms that mirror the Western view of the water cycle, but also include a seasonal cycle.

First Peoples have a relationship with water that acknowledges water as a unique, living entity. Bodies of water often house spirits or have a matter of personage. The relationship is viewed as an understanding of reciprocity and care. In contemporary views, many First Nations have Waterkeepers who understand and protect this relationship.

This unit examines our relationships with water from a variety of approaches. Students consider how we respect and use water at a personal level, at the local level, and from the perspectives of First Peoples. They study what makes a healthy watershed, and have the opportunity to engage in field and lab activities that analyse water quality. Finally students examine contemporary issues of water use and water quality, particularly as they affect First Peoples.

Guiding Questions

- What is our relationship with water?
- How well do we use the freshwater resources in our region?
- How can water resources be understood from the perspective of Indigenous Knowledge and Indigenous Science?
- What are some critical issues around the ways we use water?

Relevant BC Learning Standards for Senior Secondary Science

Course	Key Content Standards	Key Curricular Competencies
Science 10	• Transformation of energy • Local and global impacts of energy transformations from technologies	Questioning and predicting: • Make observation aimed at identifying their own questions, including increasingly abstract ones, about the natural world. Planning and conducting: • Collaboratively and individually plan, select and use appropriate investigation methods, including field work and lab experiments, to collect reliable data. Processing and analyzing data and information: • Experience and interpret the local environment; • Apply First Peoples perspectives and knowledge, other ways of knowing and local knowledge as sources of information Evaluating: • Consider social, ethical, and environmental implications of the findings from their own and others' investigations Applying and innovating: • Contribute to finding solutions to problems at a local and/or global level through inquiry Communicating: • Express and reflect on a variety of experiences, perspectives, and worldviews thorough place.
Earth Sciences 11	• Water as a unique resource • First Peoples knowledge and perspectives of water resources and processes • Effects of climate change on water sources	
Environmental Science 11	• Abiotic characteristics – aquatic • First Peoples ways of knowing and doing • Resource stewardship • Restoration practices	
Environmental Science 12	• Water quality parameters and bioindicators • Availability and water use impacts • Land management • Personal choices and sustainable living	
Geology 12	• First Peoples knowledge of landforms over time • Groundwater and aquifers	

Resources

For further information on these resources, see the annotations in the Bibliography, beginning on page 273.

Suggested Resources

Maps

- Outline map of the local community
- Topographical map of a watershed in your local area

Print Resources

- Assembly of First Nations. Water Declaration. https://bit.ly/2H5rq4y
- Safe Drinking Water Foundation, First Nation Water Issues Case Studies, linked at https://tinyurl.com/fnesc77.
- Saltman, Jennifer. *First Nations water ceremony held for wildfire evacuees in Kamloops*. Vancouver Sun, 2017. https://bit.ly/2VZkHhK
- *The Streamkeepers Handbook, A Practical Guide to Stream and Wetland Care*. Salmonid Enhancement Program, Department of Fisheries and Oceans, 1995. The Pacific Streamkeepers Federation website. https://tinyurl.com/fnesc80.

Videos

- T'souke First Nation (2013 annual water blessing ceremony). Salish Sea Sentinel, 2013. 1:28 min. https://youtu.be/FbGEleRlYCc
- Watershed. video and article. BC Tomorrow website (www.bctomorrow.ca). https://tinyurl.com/fnesc58.

Websites

- BC Government. Snow Survey Data. https://bit.ly/2E7duEi.
- BC Government. BC guidelines for water quality. https://tinyurl.com/fnesc43.
- British Columbia. iMapBC application BC Government website, linked at https://tinyurl.com/fnesc28
- Fantasy Island watershed activity http://www.darylscience.com, direct link at https://tinyurl.com/fnesc16.
- Toporama, The Atlas of Canada. Nation Resources Canada. http://atlas.gc.ca/toporama/en/index.html.
- Waterworks: What is a watershed at sciencenorth.ca, link at https://tinyurl.com/fnesc17

Additional Resources

- Traditions and Science. Spring Culture Camp Grades 7-9 Guidebook. Old Crow Experiential Education Project. Vuntut Gwitchin Government. https://bit.ly/2U6PXdn
- Ts'elxwéyeqw Tribe. *Being Ts'elxwéyeqw: First Peoples' Voices and History from the Chilliwack-Fraser Valley, British Columbia*. David M. Schaepe, Ed. Harbour Publishing, 2017
- "I am the River, and the River is me: Legal personhood and emerging rights of nature." West Coast Environmental Law. https://tinyurl.com/fnesc15.

Blackline Masters

3-1 Respecting Water
3-2 Watershed Mapping Activity
3-3 Design Thinking Template
3-4 Case Study Framework Organizer
3-5 Consequence framework

Outline of Activities

3.1 Respecting Water
3.2 Local Water Systems
3.3 Healthy Watersheds
3.4 Water Sampling Investigation
3.5 The Quality of Fresh Water
3.6 Contemporary Water Issues

Suggested Activities

Note: There are more activities here than most teachers will incorporate into their units. It is not expected that you will use all of the activities, or follow the sequence as it is described. These activities are intended to be adapted to fit the needs of your students and classroom, as well as inspire ways that you can respectfully include relevant Indigenous knowledge and perspectives in your course.

Activity 3.1
Respecting Water

Students consider the relationship between humans and water, the significance of water to their own lives and the natural world, and the unique relationship that First Peoples have with water.

a. Ask students to think about their own relationship with water. You could begin by asking an open-ended question like "What is your relationship to water?" or "What are your connections with water?" Encourage a diversity of responses that reflect the many ways that we use water in our daily lives and on special occasions.
   - Students can brainstorm their responses to the question using a web or mind map, notes or diagrams.
   - After students have had time to respond, discuss the question as a whole class. Ask students to listen for the key ideas, and summarize them at the end of the discussion.
   - Ask students further questions about their relationship with water, such as:
     - Is water important to your identity? If so, how?
     - Do you take water for granted?
     - Could we show more respect for water? If so, how?

b. Find out what you and your students know about their local domestic water systems. Ask questions such as:
   - Where does the water in our taps come from?
   - Do your families pay for the water they use? If so, how expensive is it?
   - Is your drinking water treated in any way?
   - Where does our wastewater and sewage go? How is it treated?

c. The Interconnectedness of Water.
   - Discuss how water is interconnected with the natural world. Ask, Why is water crucial for life on Earth?
   - For more ideas and activities about the theme of Interconnectedness, see Unit 1, Interconnectedness, page 43.

Foundations
For background information about Interconnectedness, see page 15.

Blackline Master 3-1, page 103, *Respecting Water*

d. First Peoples Relationships with Water.
   - Students can read and discuss some quotes about the importance of water to First Peoples, found on Blackline Master 3-1, page 103, *Respecting Water*.
   - Learn some water-related words in the local First Nations language. If possible, work with First Nations language teachers in your school, district or First Nations community.
     - Water words could include: water (general term); clear water; spring or spring water; open water; lake, waterfall; water life; water spout; ocean; saltwater; to dip or draw water, to drink water, to hunt on the water, to come out of the water onto land.
     - Are there words about water that are difficult to translate into English?
   - You may want to introduce the Assembly of First Nations National Water Declaration at this point to introduce some ideas about First Peoples' relationship to water. (See Activity 3.6 below)

e. Explore the spiritual connections First Peoples have with water. Many First Peoples hold water ceremonies. The protocols differ for each community, and have a number of purposes. However they all demonstrate the interconnectedness with water, and the respect that First Peoples hold for water.
   - If possible, identify local examples of water ceremonies, or evidence of the interconnectedness of water in traditional stories.
   - The T'souke First Nations holds an annual water blessing ceremony on the ocean front. Students can watch a short video of the 2013 event. *In the water... a blessing*. T'souke First Nation. Salish Sea Sentinel, 2013. 1:28 min. https://youtu.be/FbGEleRlYCc
   - At Kamloops in 2017, following the disastrous wildfires that summer, Secwepemc people held a special water ceremony for the evacuees who were displaced from their homes. Students can read about the ceremony in the article *First Nations water ceremony held for wildfire evacuees in Kamloops*, Jennifer Saltman, Vancouver Sun, 2017. See https://bit.ly/2VZkHhK.

f. Legal Living Water. Students can investigate the topic of a body of water being declared a legal person.
   - Recall, or share with students, the quote at the bottom of Blackline Master 3-1 on page 103. It reports how New Zealand has given legal rights to the Whanganui River.
   - Discuss why a river might be given the legal status of a person. Ask how this reflects the Maori relationship with the river.
   - Students can research to find out how and why this law was passed. There are a variety of places on the internet to find information. One site to start with is a BC article on the West Coast Environmental Law site, "I am the River, and the River is me: Legal personhood and emerging rights of nature," online at https://tinyurl.com/fnesc15.

Activity 3.2
Local Water Systems

Students identify local freshwater features in their community or region.

Formative Assessment Strategy
Provide an outline map of the community and ask students to draw on rivers, streams and lakes they know.

a. How well do you know your local rivers and lakes? Discuss what streams, rivers, ponds and lakes occur around your community or region. Students can suggest water features they are familiar with, and discuss ways they may have experienced or interacted with them.
   - Ask questions such as:
     - What is the closest stream or river to our school?
     - What is the biggest river in our region? What body of water does it empty into?
   - Note that in urban areas many original streams have been buried or eliminated. Students may be interested to find out about lost streams, or projects where urban streams have been "daylighted" or opened up again.

Land-Based Activity
Water Walk

b. Water Walk. Take students outside to observe local water systems. There are a number of possible walks you could take.
   - If possible students could visit a nearby fresh water feature such as a lake, river or waterfall. Set a purpose that matches the feature and its significance to the local ecosystem and local First Nations communities.
   - Neighbourhood water walk. Take students around the neighbourhood to find evidence of water systems in the built environment. Ask students observe both natural water features (surface water, streams, puddles, ditches) and structures such as fire hydrants, storm drains, swimming pools, etc.)
   - How water friendly is our neighbourhood? In nature water soaks into the soil at a gradual rate. In many urban environments the ground is impermeable, increasing the amount of runoff. On your walk ask students to assess what happens to surface water in your neighbourhood. Is water allowed to percolate naturally into the soil, or is it the runoff directed to built infrastructures?

c. Give students an opportunity to locate water features on a map of the local area. There are a variety of approaches you could use, depending on the available resources.
   - Topographical maps. If available, students can use 1:50 000 topographical maps of your region.
   - Toporama, The Atlas of Canada. This interactive website by National Resources of Canada provides topographical maps of all of Canada. http://atlas.gc.ca/toporama
     - You can zoom in to as small a scale as 1:6000, and any scale larger than that. There are a variety of layers that can be toggled on and off. One useful layer is water flow, which adds arrows to show the direction of

water flow for rivers. Maps can be drawn on, and both distances and areas can be measured on the map.
- Google Earth. This app provides 3-D imagery of the landscape, which students can manipulate to zoom in or look at from different perspectives. Students can find their local community on the Google Earth app and identify rivers and lakes.

d. If the information is available and it is appropriate to share, students can learn the First Nations names of some local water features. The local Aboriginal Education department or First Nations community offices may be able to provide maps with some local place names.

e. How does topography affect freshwater systems? Discuss the connections between the freshwater features in your region and the topography. Include standing water features such as bogs or swamps.

f. Discuss the local water infrastructures that service your community.
- Students can find out where their drinking water comes from, and where waste water goes, and how it is treated.
- Visit a Water Treatment Facility. You may be able to have students visit a water treatment facility to see how water is treated before they drink it. This will likely be most appropriate for First Nations communities and other small communities where the treatment plant is accessible.

Activity 3.3.
Healthy Watersheds

Students build an understanding of what a watershed is, what makes a healthy watershed, and how human activity impacts watersheds.

A watershed is a region of land that is drained by one river system. Usually it falls between ridges of high land that direct the flow of water. A watershed includes both surface water (rivers, lakes, wetlands) and subsurface ground water.

Watersheds are significant for many reasons. They collect and channel precipitation from higher ground into water systems, and ultimately into the ocean. Whatever enters the watershed affects the water quality of the whole system. They also create ecosystems. For First Peoples, watersheds support are essential for maintaining healthy ecosystems where they harvest resources. In many First Nations communities, watersheds help define boundaries for a family, clan or community resource gathering activities.

a. Understanding Watersheds. Ask students if they can give a definition of a watershed. If students are likely to have encountered the term before, ask them to write a definition in their own words. If not, have students suggest ideas in a class discussion.

Formative Assessment Strategy
Assess students' prior knowledge about watersheds through their responses and discussion.

b. How big is a watershed? Explain that large watersheds can contain smaller watersheds. For example, the Fraser River watershed drains almost 25% of British Columbia. It is made up of several other major watersheds, such as the Nechako, Thompson and Lillooet watersheds. These in turn are made up of smaller watersheds.
   - Ask students to determine what larger watersheds their community or region is part of. Suggest they consider what is the largest river the local waters flow into before entering the ocean.

c. What is a healthy watershed? Students can view a video or read an article about watersheds in British Columbia.
   - The video "Watershed" and accompanying article which covers the same content can be found at the BC Tomorrow website (www.bctomorrow.ca). The watershed page is linked at https://tinyurl.com/fnesc58.
   - The information includes features of a watershed, why watersheds are important, and how human activity can affect watersheds.
   - Before viewing the video, ask students to look for reasons why watersheds are important.
   - After viewing, students can work in groups to list the many ways that watershed are important. They can refer back to the video and the text.
   - Then groups can summarize the impacts of human activity on watersheds.
   - Students can use Blackline Master 2-2, page 80, *Combination Notes* to review and summarize what they have learned about watersheds.

Watershed video, BC Tomorrow. website. https://tinyurl.com/fnesc58

Blackline Master 2-2, page 80, *Combination Notes*

d. Significance of Watersheds for First Nations communities
   - Students can suggest some reasons why healthy watersheds are important for First Nations communities. (For example, they are necessary for clean water, healthy ecosystems where they harvest resources; in many parts of the province they are essential for healthy salmon populations.)
   - For many BC First Nations watersheds are key to their governance systems, as watersheds are used to define their territories.
     - For an example of how watershed are used to define territories, students can refer to the Gitxsan Nation website. It has a map of Gitxsan territory that shows the lands for each Wilp or House Group.
     - The map is linked at https://bit.ly/2PXhJpR. This map shows the entire territories of the Gitxsan, and the individual territories of the Wilp or House Group.
     - Students can zoom in on the map to see the individual territories of all the Gitxsan House Groups. They are indicated by territory name and the chief's name. Students can identify the watershed or part of a watershed that make up the territory of a particular House Group.

Blackline Master 3-2, page 104, *Understanding Watersheds*

e. Mapping watersheds

- To investigate the basics of watersheds, you can use Blackline Master 3-2, page 104, *Understanding Watersheds*. First, ask students to indicate the direction of the water flowing through the rivers and streams shown on the map.
- Next ask students to notice the dotted line marked "Saddle." Ask what this line represents. (E.g. the ridge between a group of hills or mountains.) Discuss the directions that the rivers on each side of this line will flow. (Above the line will flow north; below the line will flow south.)
- Ask, if rain or snow was to fall on the north side of the hill tops, where would the water eventually drain into a lake? Where would rain have to fall to drain into the large river?
- Have students identify the second saddle running north-south. They can draw a dotted line on the map to show the line of this ridge. Discuss where the rainfall would flow on either side of this ridge.
- Ask students to imagine that someone at the location labelled on the map (starburst symbol) spilled some toxic chemicals. Ask them to indicate which rivers downstream of the spill would be affected by the spill.
- Ask students to indicate the main watershed shown on this map. They could shade in the area that includes the watershed. (Students should shade all the land between the two saddles that drains into the main river.)
- Have students look back at the maps used in Activity 3.2c to identify the watershed that your school is in.
  - Have students draw a sketch map showing your local watershed, and the neighbouring watersheds.

f. Snow Packs in Watersheds. In large watersheds, a great deal of water is stored over winter in the snowpack at higher elevations. The amount of snow, and the rate at which it melts in the spring, can have a significant impact the landscapes lower in the watershed. This can result in drought, if there was low snowfall, or in flooding, if a large pack melts quickly.

- Students can investigate the amounts of accumulated snow in a region near you and determine if the snowpack is considered to be normal or not.
  - Students can use the BC Government Snow Survey Data interactive website to find your local snow pack data station. It is found at the link https://bit.ly/2E7duEi.
- Once they have identified the closest data station, explore the data and determine how much snow is held in the snowpack. Compare this to another station elsewhere in the province. Compare this year to previous years.
- What are the effects and consequence of more than or less than regular amounts of snow accumulation? Ask students to think about repercussions in all four seasons.

- Ask students to identify flooding zones in the local watershed for the upcoming spring, given what they know about watersheds and snowpack distribution.

g. Watersheds and water cycles

- Have students build a model depicting their knowledge of, and interaction with, the water cycle considering the flow of energy. Include how the dispersal of a pollutant would affect the system.
  - Fantasy Island watershed activity at http://www.darylscience.com, direct link at https://tinyurl.com/fnesc16.
  - Waterworks: What is a watershed at sciencenorth.ca, linked at https://tinyurl.com/fnesc17

Activity 3.4
Water Sampling Investigation

This activity gives suggestions for students to collect water quality data from a local stream, lake or wetland. It can be used in a variety of ways, depending on the desired purpose and outcomes.

The purpose you set for the sampling will dictate the types of tests students will undertake, and the materials you will need. See the Materials Checklist, page 97 for a list of suggested field supplies.

To organize the field trip, use Blackline Master 3-3, page 105, *Water Sampling Investigation*. You can go over the tests to be conducted, and students can fill in the appropriate boxes.


Blackline Master 3-3, page 105, *Water Sampling Investigation*

a. Setting the purpose for the investigation

- Decide on why students will collect the water sampling data. This will help determine which of the tests they will carry out. Some possible purposes are:
  - Salmon habitat assessment
  - Biodiversity of an ecosystem
  - Water quality for drinking
  - Is it safe for swimming?
- You may want to have students participate in a national project to test local water quality. See the Water Rangers program, https://waterrangers.ca.
- You will find a number of ideas for stream and wetland studies in *The Streamkeepers Handbook*. (DFO 1995). https://tinyurl.com/fnesc80.

b. Preparations

- Discuss the purpose of the water sampling activity with the students.
  - Ask students to suggest what types of tests they might do on the water body for the purpose and outcomes they want.

- You may want to practice collecting the water quality data in the safety of the classroom first to familiarize the students with the equipment and testing apparatus. If you know someone with an aquarium you can ask them for some of their aquarium water to get some real results.
- You could have students create maps to and from the proposed collection site.
- Students can use internet mapping resources to outline the exact data collection locations at the stream, lake or wetland.
- If time permits, you may want to visit your data collection site with your students before you start collecting data. This might help them prepare themselves for their data collection time, such as wearing the appropriate clothing and footwear or leaving some backpack items in their locker.
- You can put students into groups that are responsible for specific types of data.
- Warn students about possible dangers in stream areas from pollution and garbage that can collect from people irresponsibly disposing of garbage and waste. Also make sure they are aware that these areas are slippery and falls can occur and to wear proper footwear.

c. Water Sampling

These are some of the principle parameters that can be collected and tested. Which ones students will use will depend on the purpose of sampling activity.

Physical measurements
Temperature: air and water
Water depth
Stream Flow Rate

Chemical measurements
pH
Nitrate
Nitrite
Ammonia
Dissolved Oxygen

Observational measurements
Turbidity test
Invertebrate identification
Streamside Plant Identification

Water Sampling Investigation
Field Materials Checklist

- ❒ Blackline Master 3-3 "Data Recording Sheet"
- ❒ Buckets (great for carrying your supplies)
- ❒ 2 meter stick (marked off in 1/10 meter)
- ❒ Thermometers (Celsius)
- ❒ Clipboards
- ❒ Pencils (pen ink can smear when wet)
- ❒ Aquarium Water Testing Kit (either API or Tetra brands can be bought at PetSmart or Walmart). The freshwater testing kit you get must test for pH, nitrate, nitrite, ammonia
- ❒ Salifert O2 Test kit (These are available at some aquarium stores or online in Canada for $20)
- ❒ Stopwatch
- ❒ Calculator
- ❒ 1 to 2 foot wood stakes (tie bright flags or paint the tops of the stake a bright color)
- ❒ hammer (to drive the stakes into the stream bank)
- ❒ float for flow test. This could be a bottle filled with water (if you are certain it will be retrieved) or something biodegradable that is brightly colored that floats (e.g orange, radish
- ❒ plastic collection containers with sealable, secure lids (can be old butter containers etc….)
- ❒ small garden hand shovel
- ❒ camera
- ❒ standard ruler
- ❒ compass
- ❒ drawing paper
- ❒ invertebrate key in plastic page protector (sample linked at https://tinyurl.com/fnesc72)
- ❒ clear plastic sealable bottle that is 250ml-1000ml size (for turbidity test)
- ❒ turbidity color chart in plastic page protector

Activity 3.5
The Quality of Fresh Water

This activity can be done in conjunction with Activity 3.4, Water Sampling Investigation.

a. Have students brainstorm different ways that one or more local freshwater sources in your region, such as a lake, river or wetlands, is used.
- Ask students to classify the uses into human or animal uses.
- They can further classify the human uses. Ask, which are uses for local residents, and which are uses that extend beyond our region? Be sure students consider commercial, industrial, agricultural and recreational uses in addition to municipal. Human activities include:
  - Intense agriculture, which can introduce large amounts of nitrogen containing fertilizer into water systems,
  - Industrial factories, which can introduce numerous toxic contaminants through effluent discharge,
  - Urban development, which can cause stress on aquifers due to high water consumption needs of the local populations
  - Energy production, damming rivers to build hydroelectric generators can displace many of the species living in the area and completely change the location of the watershed.
- Discuss how these different uses impact the access to water, or affect its quality.

Lab Activity
Testing for Water Quality

b. Students can engage in water sampling of local water sources. You can use both natural sources such as a local lake or stream, or a domestic supply of water such as the school water system, home, a local mall or a community centre.
- Use the directions in Activity 3.4, selecting the tests that are appropriate for the materials you have. Typical water quality tests include:
  - alkalinity
  - ammonia
  - arsenic
  - colour
  - copper
  - iron
  - manganese
  - nitrate
  - pH
  - sulphate
  - total chlorine
  - total hardness.
- Water testing kits can be ordered from the Safe Drinking Water

Foundation, https://www.safewater.org. There are opportunities for schools to be sponsored to receive the kits free, or they can be purchased.

c. How safe is your water?
- Students can refer to the BC guidelines for drinking water quality guidelines at the BC government site. Select the Drinking Water Sources guidelines linked at https://tinyurl.com/fnesc43.
- Students can compare their data with the guidelines to assess how well their water samples match the guidelines.
- Have students reflect on what they would do in a water quality issue in their community where the water was declared unsafe to use. Ask, Have you ever had this occur?

d. Students can use a Design Thinking activity to explore solutions for water quality issues. (Design Thinking is a framework for problem solving used in many sectors. See e.g. https://www.ideou.com/pages/design-thinking.)
- Pose this problem scenario:

  How can a water system be regulated, monitored, purified or recycled so that people can have access to quality drinking water?

- Pair students up and have them go through the Design Thinking Template together. The template is found on Blackline Master 3-5, page 111. (2 pages). This activity may take a significant amount of time. Be sure to plan for a natural break according to your school schedule.
- Have students create a solution to the problem and present their idea. Students should include and consider both ecological and environmental impacts to their decision and how it reflects the Indigenous concepts of balance and accommodation, recognizing that all voices of those affected and all possible solutions should be included.
- Have students present their solutions to each other in a gallery walk.
- Students choose their three preferred solutions giving reasons for their choice. Students should be able to give constructive criticism on how to further improve the idea. If possible, share these ideas and solutions outside the class to obtain an authentic audience.
- Ask students to reflect on how the quality of a water source impacts the environment and people who use it. Ask questions such as:
  - How does water quality of a water source affect the body systems of those people affected?
  - How does it affect the ecosystem?
  - What links are present that would amplify the problem? (e.g. food webs, watersheds)
- As an extension, have students determine who in their community would have the power to implement these solutions. Then discuss how can these student solutions can be presented to those with the power to develop their ideas into reality?

Peer Assessment Strategy
Have students offer constructive criticism to improve the design of others, being sure to look at scientific knowledge and quality procedures.

Formative Assessment Strategy
Use these student reflections to assess their understanding of the impact of water quality on ecosystems and people.

e. Ask questions such as the following:
- What is happening about water safety that bothers you? Write details and examples.
- Who is involved in this problem? Name as many people or organizations as possible.
- How could this be different? What are alternatives?
- What else do you want to know about this issue?

Blackline Master 3-5, page 113, *Consequence Framework*

f. Have students discuss as a small group, using Blackline Master 3-5, page 113, *Consequence Framework* with the sentence stem:

What would be the consequences if the water was completely safe to drink…
- For example, people wouldn't need to spend money on bottled water.
- See how far down a chain of events students can go. (For example, people would save money. People would drink tap water)

Formative Assessment Strategies
Have students submit their responses to Blackline Master 3-5, Consequence Framework, to assess their understanding of the importance of water quality

Activity 3.6
Contemporary Water Issues

a. Whose Water Is It? This activity will help students consider their relationships to water from source to tap.
- Fill a glass or beaker of water from the tap in front of the students.
- Set the glass down on a counter or table and ask, "Whose water is this?"
- Let the students propose their thoughts on water ownership.
- Refer to the water in the pipes that lead to the tap and ask the same question, "Whose water is this"?
- Refer to a local stream or reservoir and ask the same question "Whose water is this"?

b. As we know, water is essential to life. We also know that Canada has 1/5 of the world's freshwater supply. Yet we are also one of the highest "water wasters." At the same time, we know that too many First Nations communities do not have quality fresh water for their daily needs.
- Discuss the issue of poor water quality that is a constant issue in some First Nations communities in Canada.
- Have students watch a 2015 CBC news report, "Unable to drink local water for 16 years." Found online at https://bit.ly/2QYE9rl (Note, contains allegations of racism)
  - Students can also read the associated news article, "Bad water: 'Third World' conditions on First Nations in Canada" at https://bit.ly/2MgtKX4.

c. Assembly of First Nations Water Declaration. Give students an opportunity to study the Assembly of First Nations (AFN) document, National Water Declaration.
   - Present to the students the AFN National Water Declaration document and discuss how this document reflects First Nations relationships to water. Understanding that this document was written as a response to the numerous issues surrounding First Nations relationship to water, such as:
     - Degradation of water supply outside of traditional territory
     - Water as the life-blood of the earth
     - Water as a spiritual entity

Assembly of First Nations National Water Declaration. https://bit.ly/2H5rq4y

d. Compare the AFN Water Declaration with water rights in the BC Provincial Water Licensing and Rights provisions, found at the BC Government website, https://bit.ly/2XnAEPI
   - How should conflicts about water rights between the AFN and the BC Provincial Government be resolved? For example Site C Hydroelectric Dam and pipeline construction.

e. Bottled water. Ask students if they know of any issues around bottled water. Discuss the pros and cons of using bottled water.
   - Students can research the safety and sustainability of bottled water. They can find out about places in BC where large companies are permitted to bottle water from an aquifer to sell.
   - Ask students to consider the question, Should water even be a commodity from an Indigenous perspective?
   - Have students submit their thoughts on whether water should be sold as a commodity if viewing water from a First Peoples perspective in short paragraph form.

f. Water Issues Case Study. Have students investigate a current issue around water and consider it in light of the AFN Water Declaration.
   - Discuss possible topics such as issues of water use a quality in First Nations communities, bottled water pipeline development, water or sewage treatment, impacts of climate change.
   - For additional case study examples, see a unit developed by the Safe Drinking Water Foundation, First Nation Water Issues Case Studies, linked at https://tinyurl.com/fnesc77.
   - This case study can be done individually, in pairs or in small groups. Use the following as a guiding question throughout the case study: "If we operate according to the AFN Water Declaration how would we respond to this issue?"
   - Students can work to gather their resources. Where necessary you may need to provide the students with some resources on their topic.

Blackline Master 3-6, page 114, *Case Study Framework Organizer*

- Students can use Blackline Master 3-6, page 114, *Case Study Framework Organizer* to help guide their research. It lays out five criteria for the project:
  - Ability to see the issue from a First Peoples' perspective
  - First Peoples concerns are addressed in terms of the issue
  - AFN National Water Declaration document is referenced
  - First Peoples relationships to water are described in the context of the issue
  - How well does the final presentation reflect your understanding of the issue?
- Students prepare a final output that summarizes the issue and includes the criteria set out in the Case Study Framework Organizer.
- Students can present orally to teachers, as a presentation to the class, in written form or in another manner chosen by the students.

Blackline Master 3-1

Honouring Water

Water is the most life sustaining gift on Mother Earth and is the interconnection among all living beings. Water sustains us, flows between us, within us, and replenishes us.

Water is the blood of Mother Earth and, as such, cleanses not only herself, but all living things.

Water comes in many forms and all are needed for the health of Mother Earth and for our health.

The sacred water element teaches us that we can have great strength to transform even the tallest mountain while being soft, pliable, and flexible.
Water gives us the spiritual teaching that we too flow into the Great Ocean at the end of our life journey. Water shapes the land and gives us the great gifts of the rivers, lakes, ice, and oceans. Water is the home of many living things that contribute to the health and well-being of everything not in the water.

Assembly of First Nations
https://www.afn.ca/honoring-water/

When you respect water, that water will respect you back. If you don't respect water, that water will take you – that's when you drown."

Leo Pard, Blackfoot Spiritual Elder, Piikani Nation
https://www.sacredrelationship.ca/why-water/

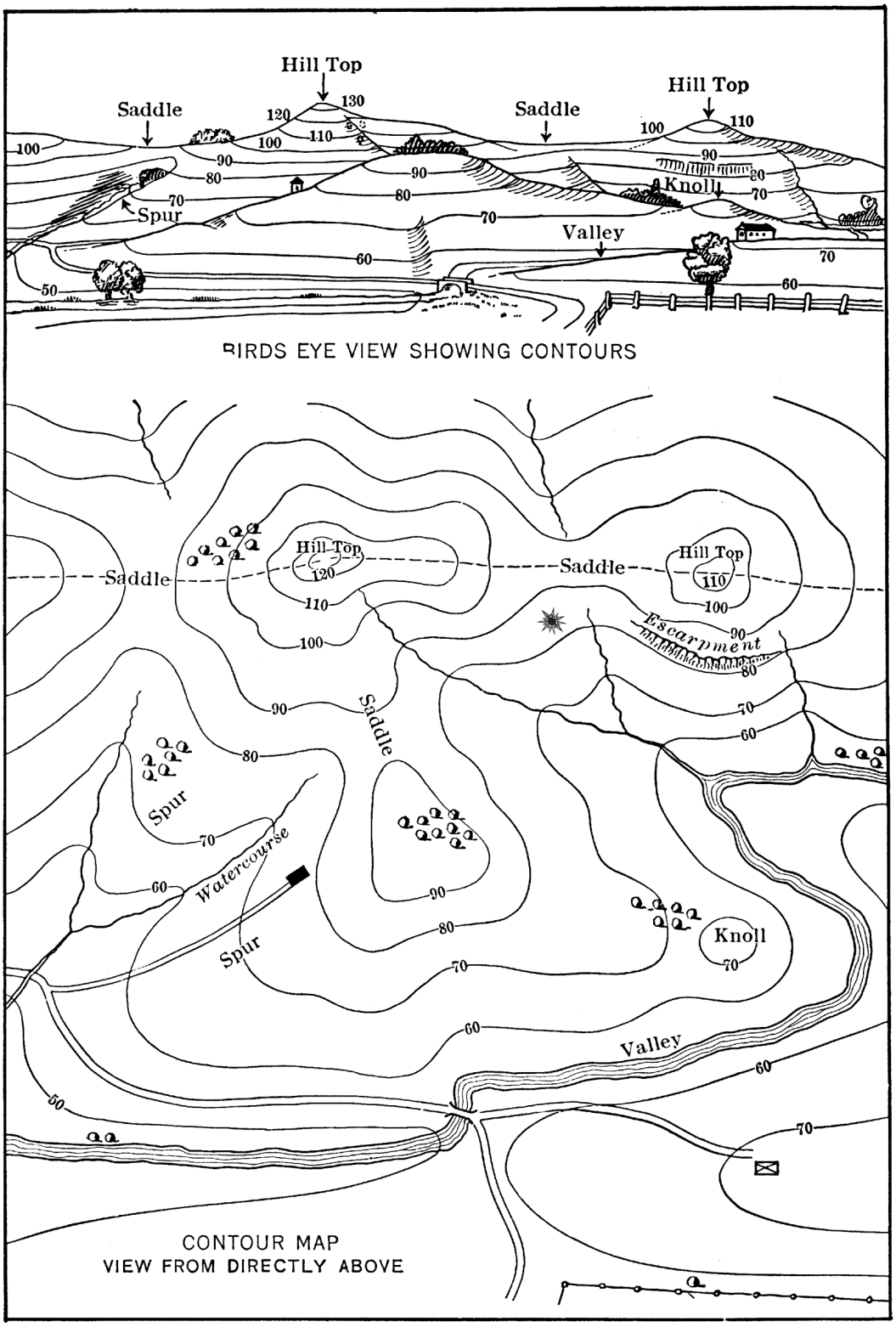
When First Nations lose access to a sacred or traditional water source, they also lose access to the beings and spirits that inhabit that water source. This loss ripples out. Stories, songs, dances, and even Indigenous words related to or based in that water source are also lost. The foundational elements of Indigenous legal traditions and knowledge systems are therefore at risk.

Danika Billie Littlechild
Transformation and re-formation: First Nations and water in Canada. https://dspace.library.uvic.ca/handle/1828/5826

On March 20th, 2017, the New Zealand government enacted legislation recognizing the Whanganui River as a legal person, holding rights and responsibilities equivalent to a person. ... The Whanganui River legislation enshrines that pre-existing relationship [with Maori people of the river].

Blackline Master 3-2

Understanding Watersheds



Blackline Master 3-3

Water Sampling Investigation

Physical Measurements

❒ 1. Temperature
- Use regular lab thermometers to measure both air and water temperatures.
- Measure the water temperature in the same place and the same level where you will be taking the dissolved oxygen water sample.
- For the water temperature, put the tip of the thermometer a few centimetres below the surface.
- Wait one to two minutes before reading the temperature. Make sure you read it while it is still in the water.

❒ 2. Water Depth
- Use a two meter stick to measure the depth of the stream in four different spots in your sampling area.
- Record the four trials.
- Calculate the average depth.

❒ 3. Stream Flow Rate

a. Mark out a section of the stream to test
- Put a marker such as a flagged stake at the start point on a straight section of the stream.
- Measure a distance of 10m to 15m along the bank. Record the distance between stakes.
- Put another marker at the end point.

b. Estimate the area of the stream's cross-section
- From the start point, measure the distance across the stream from one side to the other (width).
- Take depth measurements straight across the waterway to the other side.
- Measure the depth of the stream at regular intervals using the 2 meter measuring stick.
- Add up all of the depths and divide by the number of measurements to get the Average Depth (depth).
- For a more accurate estimate you can repeat this process half way between the start and end, and at the end point.
- Calculate the area of the stream cross section using the formula A = w x d (Area equals total width times average depth).

c. Run the time trials
- Release a float in the middle of the stream at the start point and start the timer. Use either a retrievable float or a biodegradable object such as a radish or orange.
- Stop timing when it reaches the end point.

- Repeat the time trial two more times.

d. Calculate the average velocity
- Calculate the velocity of each trial using the formula V=d/t (velocity equals distance travelled divided by travel time (units of m^2)
- Calculate and record the average velocity.

e. Stream Flow Rate
- Calculate the stream flow rate using the formula Q = A x V. (Flow Rate (m^3/s) = Total Average Cross Section (m^2) x Surface Velocity (m/s)
- Since stream beds vary from rocky and rough to smooth, you have to "correct" the surface velocity to reflect the velocity on the bottom of the stream. The more rocky the bottom the lower the correction number. Choose which of these situations apply to the stream.

Type of Stream	Velocity Correction Factor
Regular channel with smooth sides	0.85
Deep slow, moving stream	0.75
A small stream with a smooth bed	0.65
A quick, turbulent stream	0.45
A very shallow, rocky stream	0.25

Flow Rate "Q" Calculation:

- The final corrected stream flow rate is Flow Rate (m^3/s) = Total Average Cross Section (m^2) x Surface Velocity (m/s) x Correction factor

Chemical Tests

❒ 4. pH
- Collect a water sample in the water sample bottle. Put 5 mL of the sample into a test tube.
- Use the pH indicator from your water testing kit to measure the pH of the sample. Follow the directions for the kit to test and identify the pH.
- Record the pH on your data sheet.

❒ 5. Dissolved Oxygen
- Collect a new sample of water. Put 5 mL of the water into a test tube.
- Follow the instructions of the Dissolved Oxygen test kit to add the necessary test solutions, making sure you wait for the times indicated.
- Observe the colour changes and interpret them according to the test kit instructions.

❒ 6. Nitrates
- Collect a new sample of water. Put 5 mL of the water into a test tube.
- Follow the instructions of the nitrate test kit to add the necessary test solutions, making sure you wait for the times indicated.

- The measurements are in parts per million (ppm). You can follow your test kits instructions to measuring.

❒ 7. Nitrites
- Collect a new sample of water. Put 5 mL of the water into a test tube.
- Follow the directions on the nitrites test kit.

❒ 8. Ammonia
- Collect a new sample of water. Put 5 mL of the water into a test tube.
- Follow the directions on the ammonia test kit

❒ 9. Phosphates
- Collect a new sample of water. Put 5 mL of the water into a test tube.
- Follow the directions on the ammonia test kit

❒ 10. Coliform
- Follow directions of the test kit.

❒ 11. Turbidity Test
- Use the turbidity test as directed by your teacher.
- You can compare your turbidity sample with the sample chart in this link: https://sciencefirstpeoples.weebly.com/salmon.htm

❒ 12. Invertebrate Identification
- Gently disturb some of the rocks in the pools to find some of the larger invertebrates.
- Take pictures of them, making sure to record the time and date. Make sure to leave the area as pristine as possible.

❒ 11. Plant Identification
- Identify the plant species in and around your water quality sampling site.
- Plants can be identified using the "E-Flora" Website at https://tinyurl.com/fnesc67

Blackline Master 3-3

Stream Study Data Recording Sheet

Recorder Names _____

Stream Name _____

Location _____

GPS Coordinates _____

Collection Date _____

General Conditions

Time of Data Collection _____ am/pm

Days Since Last Data Collection _____

Weather Conditions (describe the weather as you see it…ie clear, cloudy, rainy, snowy)

_____

_____

_____

Physical Measurements

Current Air Temperature _____ Co

Current Water Temperature _____ Co

Depth of Water (multiple trials across the stream)

Trial 1 _____ (m) Trial 2 _____ (m) Trial 3 _____ (m) Trial 4 _____ (m)

Average Depth _____ (m)

Distance across water _____ (m) Average Cross Section _____ (m2)

Total Average Cross Section _____ (m2)

Stream Surface Velocity (try this 3 times)

Distance in meters between the 2 flagged stakes _____ meters

Time it takes for the float to drift between the 2 flagged stakes

Trial 1 _____ seconds Trial 2 _____ seconds Trial 3 _____ seconds

Velocity (m/s) =

Trial 1 _____ m/s Trial 2 _____ m/s Trial 3 _____ m/s

Velocity Average _____ m/s

Stream Study Data Recording Sheet page 2

Chemical Measurements

pH _____ (1 – 14) Nitrite Test _____ 0 – 5 ppm (mg/L)

Nitrate Test _____ 0 – 160 ppm (mg/L) Ammonia Test _____ 0 – 8.0 ppm (mg/L)

Dissolved Oxygen _____ 2 – 14 ppm (mg/L)

Observational Measurements

Water Turbidity _____ 10 – 250 (NTU)

Invertebrate & Plant Identification

(these might be identified at a later time from pictures)
Record the date and time of each picture taken

Photo 1 Date/Time _____ Identification _____

Photo 2 Date/Time _____ Identification _____

Photo 3 Date/Time _____ Identification _____

Photo 4 Date/Time _____ Identification _____

Photo 5 Date/Time _____ Identification _____

Photo 6 Date/Time _____ Identification _____

Photo 7 Date/Time _____ Identification _____

Photo 8 Date/Time _____ Identification _____

Photo 9 Date/Time _____ Identification _____

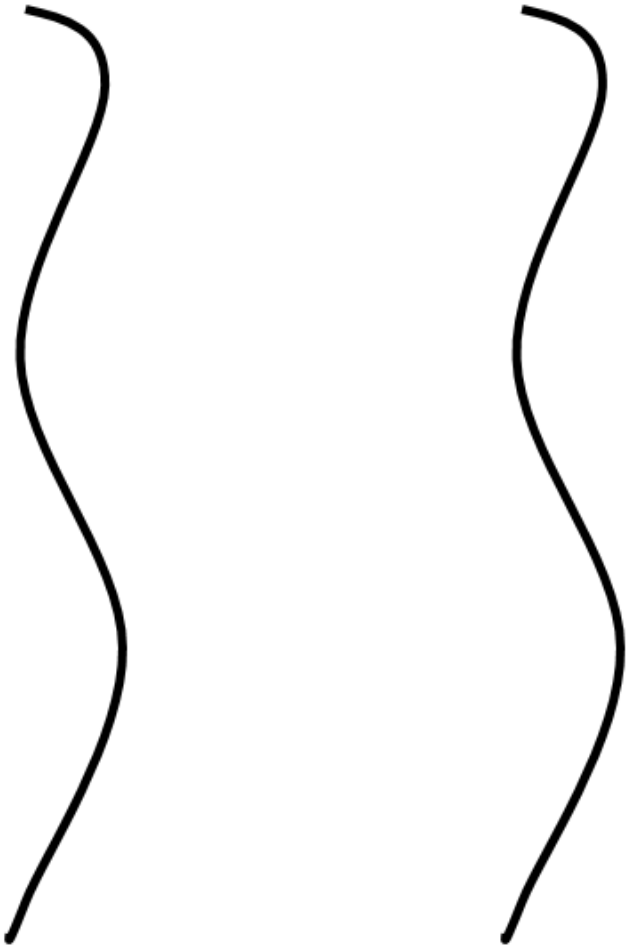
Streamside Plant Identification

Draw an aerial sketch of where the plants occur in relation to the stream on the next page.

Add the following features where they occur in your sampling location
Log
Riffles
Rapids
Overhanging bank or cutback
Rocks along a shoreline
Garbage or Refuse

Stream Study Data Recording Sheet page 3

Streamside Plant Identification
(Draw an aerial sketch of where the plants occur in relation to the stream)
Write the names of the species in the place(s) where they occur



Add the following features where they occur in your sampling location

Log 

Riffles 

Rapids VVVVVVV

Overhanging bank or cutback along a shoreline 

Rocks 

Garbage or Refuse 

Blackline Master 3-5

Design Thinking Template

1. Interview Notes (Empathy)	2. Detailed Interviews (Empathy)
3. Defining the Issue Goals and Wishes Insights	8. Reflection

Blackline Master 3-4 page 2

Design Thinking Template

4. Sketch 5 Ideas (Ideate)

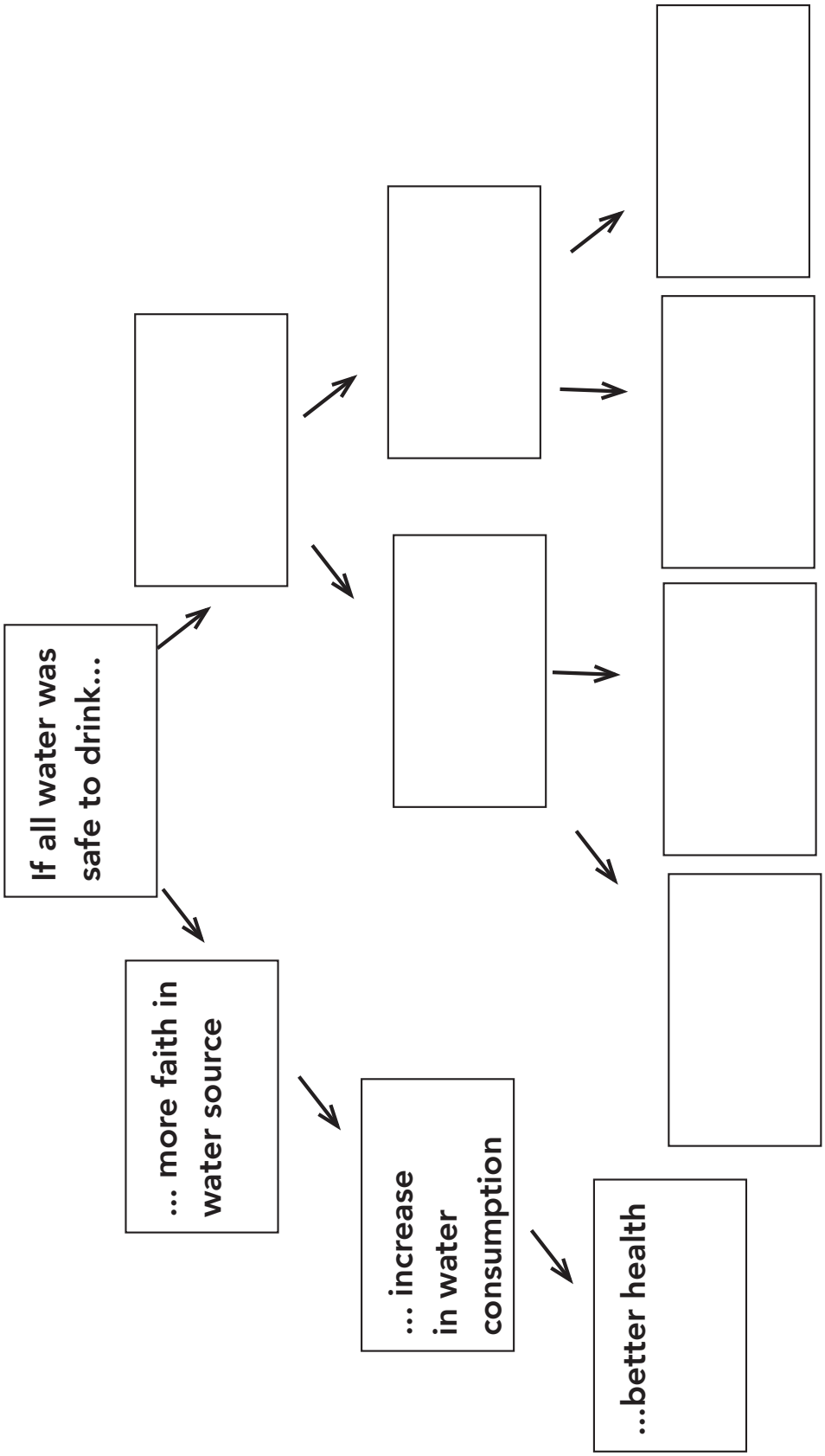
5. Gain Feedback from Your Partners (Ideate)

6. Redesign Your Idea Based on Feedback (Ideate/Prototype)

7. Sketch Your Group's Idea (Ideate/Prototype)

Blackline Master 3-5

Consequence Framework



Blackline Master 3-6

Case Study Framework Organizer

As you look into an issue presented by your teacher, consider the following aspects of the issue and record your thoughts.

- Ability to see the issue from a First Peoples' perspective
- First Peoples concerns are addressed in terms of the issue
- AFN National Water Declaration document is referenced
- First Peoples relationships to water are described in the context of the issue
- How well does the final presentation reflect your understanding of the issue?

Prepare a final output that summarizes the issue and includes the parameters set out in the grading rubric below.

You can present orally to your teacher, make a presentation to the class, in written form or in another format agreed on by you and your teacher.

	4	3	2	1
Ability to see the issue from a First Peoples perspective	All aspects of the issue were discussed using First Peoples viewpoints	Most aspects of the issue were discussed using First Peoples viewpoints	Few aspects of the issue were discussed using First Peoples viewpoints	No attempt was made to view the issue through First Peoples perspectives
First Peoples concerns are addressed in terms of the issue	All possible concerns are addressed in terms of the issue.	Multiple concerns are addressed in terms of the issue.	One concern is addressed in terms of the issue.	No First Peoples concerns are addressed in terms of the issue.
AFN National Water Declaration document is referenced	AFN National Water Declaration document is referenced where appropriate	AFN National Water Declaration document is referenced, in some cases inappropriately.	AFN National Water Declaration document is referenced inappropriately	No reference to AFN National Water Declaration document
First Peoples relationships to water are described in the context of the issue	First Peoples relationship to water is interwoven throughout the discussion	First Peoples relationship to water is part of the discussion	First Peoples relationship to water is briefly referenced	First Peoples relationship to water is not present in the response to the issue.
To what extent does the final presentation reflect your understanding of the issue?	The final presentation clearly reflects the students research and clearly shows understanding	The final presentation at times reflects the students research and understanding is generally shown	The final presentation rarely reflects the student research and rarely is understanding shown	The final presentation does not reflect the student research and understanding is not shown.