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Science 8:

Local Aquatic System Health

Indigenous Knowledge Lesson Plan

Local and Traditional Knowledge in Watershed Governance
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Science 8: Local Aquatic Fish Health

FRESHWATER AND SALTWATER SYSTEMS (SOCIAL AND ENVIRONMENTAL EMPHASIS)

Focusing Questions: How do water, land and climate interact? What are the characteristics of freshwater and saltwater systems, and how do they affect living things, including humans?

- Analyze human impacts on aquatic systems; and identify the roles of science and technology in addressing related questions, problems and issues
- Illustrate the role of scientific research in monitoring environments and supporting development of appropriate environmental technologies (e.g., describe a local example of aquatic monitoring, and describe how this research contributes to watershed management)

Skill Outcomes (focus on scientific inquiry)

Performing and Recording

Students will: Conduct investigations into the relationships between and among observations, and gather and record qualitative and quantitative data.

- Identify strengths and weaknesses of different methods of collecting and displaying data (e.g., identify strengths and weaknesses of technologies used to monitor and map changes in stream flow)

Scientific Inquiry

Students will be encouraged to:

- Seek and apply evidence when evaluating alternative approaches to investigations, problems and issues.

Purpose

Students will learn the significant relationship between humans and the ecosystems of which they are part, including the consequences of human activities on the environment. This lesson gives students the chance to get hands-on experience with western scientific approaches to understand aquatic ecosystem health.

Teacher Resources

- Operation Drinking Water Lesson Plans (Recommended: Lesson 1, 6) https://www.safewater.org/operation-water-pollution
- Operation Water Spirit (Recommended: Lesson 5) https://www.safewater.org/operation-water-spirit
- Mackenzie River Basin (location and introduction): http://www.trackingchange.ca/river-basins/mackenzie/

Cover Photo: Canoe on Sparrow Lake Sahtu Region
Photo Credit: Julien Schroder

- This lesson is based on research from Tracking Change: Local and Traditional Knowledge in Watershed Governance: http://www.trackingchange.ca/

Materials Needed

- Copies of Operation Water Pollution Overview handout (attached)
- Operation Water Pollution kit from SafeWater.org (monitors for TDS and pH) and additional materials to complete OWP Lesson 6
- Copies of Indigenous Knowledge handout
- Computers with PowerPoint and/or poster paper and markers for student presentations
- Optional: computer and projector to display WWF's interactive Watershed Reports map - https://watershedreports.wwf.ca/?_ga=2.85638169.1411731485.1593116753-1291091237.1593116753#ws-7/by/threat-overall/threat

INTRODUCTION

Aquatic ecosystems are impacted by human induced threats such as climate change, industrial development (oil and gas, mining), and hydroelectric dams. Understanding threats to the water is critical because people in the Mackenzie River Basin rely on it for food, drinking water, and travel. Indigenous Knowledge and observations of land users are important sources of information about these threats. Western science is also a useful way to investigate water quality. This lesson introduces students to different threats facing the Mackenzie River and types of scientific tests that can explain the health of the water. Students will get firsthand experience completing scientific monitoring to investigate levels of water pollution near their community.

Key questions for student inquiry:

- What types of threats face areas of the Mackenzie River? How can scientific monitoring be useful for making decisions about these threats?

LESSON PLAN PROPER

- **Location:** In classroom or computer lab / scientific testing should take place on the land/water, although it can take place in classroom
- **Length of activity:** 1 class period (part 1) / 1 day (part 2) / 1 class period (part 3)
- **Activating Strategies:**
  - *Introduction.* Briefly introduce that there are many human activities that impact water quality and fish health. For instance, pollution has serious consequences for people and the wildlife they rely on. This issue is particularly important in the north where people have a strong reliance on

and connection to the water and fish. For this reason, communities need to use different sources of information to make decisions about whether the water and fish are healthy. People who spend time on the river are a great source of knowledge about the health of the environment and should be a first point of contact when trying to understand the changes. Another useful source of information is monitoring changes through western scientific methods. Using both Indigenous Knowledge and western scientific processes can create a deeper understanding of changes to aquatic systems and ways to respond.

- *Individual Brainstorm.* Ask students what aquatic ecosystems are near their community. Why are these bodies of water important? Ask students what they have heard about the health of the fish and the water. Ask students to share their own experience in observing the health of the water and fish (e.g. What have you learned in science class that may help you know if the ecosystem is healthy? What have you learned about the health of water and fish through participating in cultural activities?).

- **Learning Experiences:**

  - *Class Activity.* Next, students will conduct a survey within their home community and on the land.

Part 1: Pre-Trip Introduction

Introduce students to local aquatic ecosystems and western scientific ways of monitoring and understanding the health of water and fish.

Explore the World Wildlife Fund's Watershed Reports map as a class. The website allows users to explore and learn about the main threats facing each sub basin of the Mackenzie River. Use the website to respond to the following questions:

- What are the main threats facing the Mackenzie River and other bodies of water near your community? Who is responsible? How do these threats impact the lives of people who depend on the river (e.g. food, livelihoods, navigation, etc.)?

Introduce the Operation Water Pollution Overview handout to give students context on the activity. Share the key questions for inquiry.

- Work as a class to answer the question, "what is water pollution?" Write "Water Pollution" on the board and ask each student to give a word or phrase related to the term. Discuss the connections between student responses and identify key forms of pollution in the local area. (View Lesson 1 from Operation Water Pollution teacher resource for more detail).

Part 2: Field Trip

Give students hands on experience with the "To Filter or Not to Filter" (Lesson 6) activity from Operation Water Pollution. This lesson plan (see teacher resources section for link) was originally designed for in-class use, but this activity should ideally take place on the land. The following are suggestions for how to modify the activity for a field trip format.

- Break students into small groups that each represent a different kind of community.

Hand out instructions, filter materials, and water samples to each group. Give students time to complete the activity (see OWP Lesson 6 for details) and present their experiments to the rest of the group. Use water from a local water source in lieu of any water samples that call for tap water from the school. Once the activity is complete, gather the group and go through the discussion questions that accompany OWP Lesson 6.

- Invite an Elder or land user to speak to join the students on the field trip. Ask the guest to share stories about the water, their observations about water pollution in the area, and to point out physical signs of water health so students can assess water quality themselves using Indigenous Knowledge.

Part 3: What about Indigenous Knowledge?

Introduce that the kinds of scientific monitoring we conducted in this lesson is one way of understanding water systems. Indigenous knowledge is a complementary way of understanding water. Sometimes Indigenous knowledge overlaps with scientific monitoring, and sometimes it is unique. Read through the "Indigenous Knowledge" handout together as a class.

- After reading the "Indigneous Knowledge" handout as a class have students compare the two types of knowledge, scientific and Indigenous knowledge, by filling out a Venn diagram. As they fill in the Venn diagram, have the students consider the following questions:
    - How does scientific testing help us understand the health of the water? What are the limitations of using these types of tests?
    - What can Indigenous knowledge tell us about water pollution that western science cannot? Why is it important to include land users when doing scientific tests?
    - What do scientific testing and Indigenous knowledge have in common?

CONCLUSION

- *Individual or group reflection:*
    - Ask students to reflect on the water pollution activity and group discussion about Indigenous knowledge. Provide reflection prompts such as, "Why is clean water important?" or "How can we tell if the water is healthy?"
    - [Option: Connect to English Language Arts] Ask students to write a concrete poem/shape poem (written in a way that the shape of the poem matches the topic of the poem) based on their reflection (see Operation Water Spirit Lesson 5 for more details). Alternatively, students may each write a paragraph or create an art piece to express their reactions to the learning activities.
- **Extension (land based):** Purchase HOBO monitor(s) to do water monitoring in greater scientific detail. An array of monitors are available to monitor water levels and water quality. View onsetcomp.com for available monitors and select the tools that are most relevant to your class' interest.

- **Extension:** Building off of the hands on water testing and group discussion, get students to think about "what's next?" Ask students to think about ways they could use the data they collected in this activity to make decisions about the health of the water. Ask students to brainstorm ways community members can respond to the threats facing the water in their area (e.g. share observations about water pollution and/or fish health on Facebook groups; present/write to local or national governments to advocate for safety measures; learn from Elders how to identify fish that are not safe to eat).
- **Extension:** Invite an Elder, harvester, or other land user to speak to the class about water pollution and threats of industrial activity to the water. The class could meet in the classroom or outside near a waterway. In advance of the visit, have students generate questions for the guest, building on this activity but in reference to their home community.
- **Extension:** Take a field trip to your local water treatment plant to learn about how your community gets clean water.

INDIGENOUS LANGUAGES - WORD BANK

Indigenous knowledge of the land is interwoven with language. The following are key terms in northern languages that are directly related to this lesson. Following the NWT's whole-school approach to language learning, we recommend bringing these terms into the science classroom, according to the language(s) spoken in your community. In this way, it is possible to provide students with a holistic understanding of the land, language, and culture in ways that support their own identities.

> *To use any of the Northern Indigenous languages fluently means that the speaker observes and interacts with their environment. They are relational languages. The connection between the speaker, their actions and the environment speaks to a worldview where relationships are important – relationships with self, others, the land and one's spirituality* - Our Languages, 2020, p. 5

We encourage collaboration with language teachers where available to support student learning. A few ideas to bring northern languages into science classrooms include:

- Creating classroom displays that highlight terms from this list using diagrams, photographs, artwork, and/or definitions.
- As a teacher, using these words in conjunction with or in place of English words throughout the lesson (and others) where possible.
- Encouraging students to incorporate these terms into written and oral components of this lesson (and others).
- Discussing with students how the precision of some of these words is linked with Indigenous knowledge of the land.
- Incorporating terms into a game/activity/lab assignment to make language learning fun.

Source: https://www.ece.gov.nt.ca/sites/ece/files/resources/our_languages_curriculum_2020_low_res.pdf

TRADITIONAL WORDS					
English	**Tsaat'ine tthadeh/ Dene (Beaver or xe'ghont'e)**	**Sahtúǫt'ıne/ Dene (Slavey or Kaguntu)**	**Nēhiyawēwin/ Cree**	**Dinjii Zhu' Ginjik/ Gwich'in**	**Inuvialuktun/ Inuvialuit**
Drinking Water	Tu tsedǫ	Tu tse'tsehi	minihk-wayâpoy	Chuu Tr'idinii	Imiq
Water levels	Tu dende'ǫ	Nde'ǫ gotsi tu	tânimây-kohk nîpîy	Chuu nijin nyaa'àih	Imaq naqittuq - (low)
Good tasting	Tu łuko	Tu theka'	wîkasin nîpîy	Gwiinzii vig-waandaih	Mam-maqtuq imaq
Dirty water	Tu tsene'	Tu dzǫ t'ehi	wîpahtan nîpîy	Chuu vee	Imaq mama-ittuq
Bad tasting water	Tu dehtsį	Tu nezų'ile	Ispakowan nîpîy	Chuu tr'aakaii	Imaq mama-ittuq
Bad smelling water	Tu woteh dehtsį	Duye' tu de'tsį	Wicekan nîpîy	Chuu nididzin	Imaq mama-ittuq
Water that is muddy from industrial activity	Tu dek'odłeh wolį atse'lehi tsi'	Tu gócłeh gųnli woli atselihi tsi	wîpahtan nîpîy oschi atos-kewnihk	Gwitr'it k'iighè' chuu dhiveh	Imaq salu-maittuq
Water that is naturally muddy	Tu xade' mbet'a wotleh'	Tu gócłeh gųnli adsi'gotsi	asiskîwiwin nîpîy	Chuu vee	Maqayak

Water that is healthy	Tu mbe uujǫ ghe'tse'da	Tu beta nezų ts'ena	kanâtastêw nîpîy	Chuu diiyeenjit nizih	Imaq surraituq
Water that might make you sick	Tu edu mbe ujoǫ ghet'tse'da	Tu beta dedihi ati'	kahâh-kosînkôn nîpîy	Chuu k'iighè' duuleh tr'iłts'ik	Imaq anniarun
Water I would never drink	Eyi tu la edu ghǫ'don esi	Tu edu tsetsehi'ile ǫt'e	nîpîy môywîhkât kaminih-kwan	Aii chuu duuyeh shinih	Imignaiq-tuq
Town water from the tap (water truck)	Tu wo'dłutthe tsi tu	Tu me'ch'ine tsi' tu	ôcenas oschi nîpîy	Kaiik'it gwizhìt chuu diits'an tr'ahtsih	Imaq imiraurvik
Cleaning up the water	Tu ǫte k'ii anda't- 'se'glehi	Tu nezų anda-godeh	nânapâcita nîpîy	Chuu srìtr'ilih	Saluma-yuq imaq
Water testing	Tu ke't'sede'ihi	Tu de'tse' nde'o'ii	nîpîy kocihi-wewin, kocihta nîpîy	Chuu tr'inah'inh	Imaq taku-naqtuq

Keywords: pollution, scientific monitoring, water quality

Themes: western science, community, traditional knowledge

Student Handout: Operation Water Pollution Overview

WHAT IS OPERATION WATER POLLUTION?

Operation Water Pollution (OWP) is a program from the Safe Drinking Water Foundation. OWP enables students to learn about water pollution (how it is caused, how it is cleaned up, how to prevent it, and what students can do about the problem). Our class is participating in this program so we can get firsthand experience investigating water quality in our community!

Most sources of water are not suitable to drink without treatment. If this water is consumed without treatment or inadequate treatment, people can develop illnesses. This is a major concern in rural areas of both developing and developed countries (like Canada!). In fact, the World Health Organization estimates that every year 5 million people die from a water-borne disease.

It is important that young people learn about water quality issues because they are the leaders of tomorrow: youth will become teachers, health officials, engineers, politicians, and scientists. By getting hands-on experience researching real-life water quality issues, students will be better informed about the water challenges facing rural and Indigenous communities.

SDWF
Safe Drinking
Water Foundation

"TO FILTER OR NOT TO FILTER?"

Working as a class and in small groups we will:

1. Brainstorm "what is water pollution?" and think of examples of water pollution in our community
2. Build water filters to clean up polluted water, identify different pollutants, and consider the challenges of doing this in real life
3. Discuss Indigenous perspectives of water and how Indigenous Knowledge is useful when caring for the water

Safe Drinking Water Foundation Logo and Water Filters
Photo Credit: Safe Drinking Water Foundation https://www.safewater.org/

Student Handout: Indigenous Knowledge

Indigenous knowledge is knowledge developed over long periods of time (hundreds or thousands of years) through direct contact with the land. It connects knowledge of the land with people's everyday lives. People note changes in the land over time that affect their communities. These people then use that knowledge to make daily decisions related to harvest and stable access to food.

WHAT IS INDIGENOUS KNOWLEDGE?

Indigenous knowledge can involve things we usually think of as "science," like measuring, counting, and monitoring various things. On the river, this could include measuring water levels, numbers of fish, length of fish, and changing size of algae blooms. It can also involve things we may not think of as "science," like memories of how the river has changed (or stayed the same) over generations, or local knowledge of which fishing areas contain unhealthy fish. People keep and pass on this knowledge because it is relevant to their lives and wellbeing.

HOW IS INDIGENOUS KNOWLEDGE COLLECTED & SHARED?

Oral histories are an important aspect of the knowledge held by Indigenous communities about the Mackenzie River Basin. Oral histories are histories that are not written down. Instead, they are passed on out loud from generation to generation. Elders and active harvesters are an important part of oral history. They are experts about environmental changes. Their past experiences, observations and perceptions represent important "data" that exists about the regions, places, and resources that matter most to communities. Some types of oral histories include:

- Biographical oral histories - tell stories about people
- Place based oral histories - tell stories about land
- Issue oriented oral histories - tell stories about issues

LOCAL AND TRADITIONAL KNOWLEDGE INDICATORS	
Qualitative Indicators (things we can describe)	**Quantitative Indicators (things we can count)**
• Risk perception (e.g. how comfortable we feel drinking water from a certain place or travelling over the ice) • Quality of the habitat conditions • Water quality (e.g. colour, algae blooms) • Texture and colour of fish flesh • Taste of water	• Number of fish in a catch • Length and weight of fish • Thickness of fat around organs (e.g. ducks, fish) • Water levels

HOW IS INDIGENOUS KNOWLEDGE CONNECTED TO THE LAND?

A lot of knowledge about both social and ecological change is linked to specific places. Elders and active harvesters have knowledge about places that matter to them, including areas around traditional fish camps, travel routes, spiritual sites, sites for healing, and more. There is also knowledge that is place-related because of hazards or problems (e.g. an area affected by mining, a permafrost slump, an abandoned mine, etc.). There are different ways to document stories about places.

Ways to learn Indigenous knowledge of the land:

- Create a video recording or taking places of important places
- Researching Indigenous place names. Place-names: names originate from the words of the First Nations, Métis, or Inuit
- Interviewing Elders or land users
- Taking photos of places over time to compare year to year
- Combining interviews with Elders and land used to develop an understanding of the quality and quantity of water
- Gathering young people and Elders together to share knowledge

Some examples of how Indigenous knowledge has been used in research and studies includes:

- *Community Based Monitoring* - Programs that take into account local needs and values about how resources are managed (such as water and waterways), allows local people the chance to give feedback, share critiques and suggestions, and make recommendations based on their experiences with changes and impacts in their environment. (Example: Misikew Cree First Nation Community Based Monitoring Program).
- *Traditional Knowledge Camps* - Along with an Elder, youth learn the traditional way of living off the land (i.e. learn to forage for berries and traditional medicine, and how to fish and hunt wildlife), travel historic trails, and visit old campsites; and learn about scientific research and collect water samples. (Example: Nacho Nayak Dun First Nation Traditional Knowledge Camp in the Peel Watershed Region)
- *Mapping Change* - People travel traditional routes and portages in order to map changes to the region, such as high and low water levels. Sometimes, these bring youth and Elders together. Past trips have gone from Eda Cho Kue to Fort Reliance in 2016 Trip and from Lutsel K'e to Fort Reliance in 2017.