

Nechako White Sturgeon Curriculum

Grades 4 – 7



A project sponsored by the
Nechako White Sturgeon Recovery Initiative

2014



**FOR QUESTIONS ON THIS RESOURCE OR
FOR ADDITIONAL INFORMATION,
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Nechako White Sturgeon Curriculum

The Nechako white sturgeon curriculum is a course that will allow teachers and students to learn about the Nechako white sturgeon, its endangered status, its habitat, and the impacts we have on their habitat and environment.

This Grade 4 to 7 curriculum program is provided by the Nechako White Sturgeon Recovery Initiative, a group of scientists, industry leaders, managers and citizens who work in collaboration to research, educate and conduct projects to restore the endangered Nechako white sturgeon population in the Nechako River.

This package provides the content for the curriculum. We ask feedback from participating teachers on the content, arrangement of material, and associated resources for this curriculum. Feedback forms are included in this package.

Please read **Background Reading for Teachers** to familiarize yourself with the story of the Nechako white sturgeon before being the curriculum.

INTENDED OUTCOMES OF THE CURRICULUM

- Promote the Nechako White Sturgeon

Students should walk away with a deep understanding and appreciation for the biology and ecology of the Nechako white sturgeon and how that relates to its status as endangered.

- Increase senses of community

Teaching students about the Nechako white sturgeon – our local prehistoric giant – will create a greater sense of community and ownership of the Nechako watershed and river, and promote its recovery over the next decades.

HOW TO USE THIS RESOURCE

This curriculum is to be used in conjunction with other science units, or as a stand alone unit for Grades 4–7. The content is specific to the Nechako Valley, therefore has added value when taught to students in School District 91.

There are **three Units** within this curriculum:

- Unit 1: Introduction to the Nechako white sturgeon and its environment
- Unit 2: Watersheds, Riparian Zones and Rivers
- Unit 3: The Nechako white sturgeon - our local prehistoric giant

Within each Unit are a number of **Lessons**. Each lesson includes:

- instructional objectives
- lesson activities with answer keys
- teaching strategies
- assessment strategies
- tips and notes
- suggested and provided materials

All audio-visual materials for the SMARTBoard are provided on the accompanying **thumb drive**. The thumb drive also contains this entire curriculum in PDF format for direct printing.

There are suggested **field trips**. Teachers can contact the Nechako White Sturgeon Recovery Initiative manager for help in locating a guest speaker for the field trips, however the material provided should allow teachers to self guide the field trips if no facilitator is available.

Teachers are encouraged to teach the Units in order 1-2-3, however Units 2 and 3 can be taught in reverse order.

ADDITIONAL RESOURCES

We encourage teachers to browse these sites for further information about Nechako White Sturgeon.

<http://www.nechakowhitesturgeon.org>

<http://www.uppercolumbiasturgeon.org>

<http://www.dfo-mpo.gc.ca>

<http://www.wildbc.org/publications-resources/waterstewardship/guide.pdf>

<http://www.deepspacesparkle.com>

<http://www.env.gov.bc.ca/wld/fishhabitats/sturgeon/index.html>

<http://www.youtube.com/watch?v=YhrEJUEi-ow> - YouTube video!

<http://www.newssociety.org>

PRESCRIBED LEARNING OUTCOMES

There are a number of Prescribed Learning Outcomes that apply to each of the Units in this curriculum. They are listed below:

Grade 4 (Life Science):

- Compare the structures and behaviours of local animals and plants in different habitats and communities.
- Analyse simple food chains.
- Determine how personal choices and actions have environmental consequences.

Grade 5 (Earth and Space Science):

- Describe potential environmental impacts by using BC's living and non-living resources

Grade 6 (Life Sciences):

- Analyse how different organisms adapt to their environment

Grade 7 (Life Sciences):

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

Parent letter

Dear Parents / Guardians,

Over the next few months, your child will be introduced to the Nechako white sturgeon. The Nechako white sturgeon is a genetically unique species of fish that lives in the Nechako River. It is classified as an endangered species and has environmental, social and cultural value in our area.

A number of lessons will be conducted in both the classroom and outdoors. These lessons present information about the life history of Nechako white sturgeon, the ecology of riparian areas, watersheds and river habitats, and the connection between Nechako white sturgeon and our community.

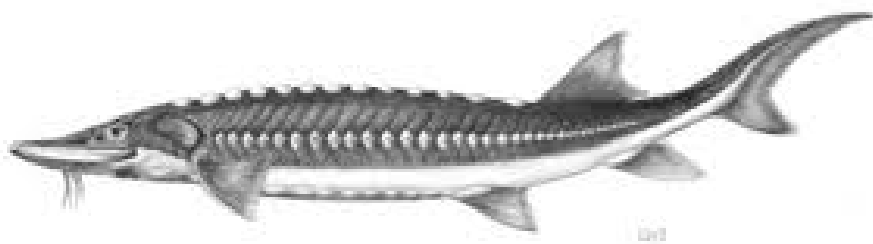
The lessons were researched and developed by local educators and scientists, and follow the BC Prescribed Learning Outcomes as part of the grade level curriculum. Feedback from teachers and students will help refine the lessons in future years.

We encourage you to ask your child about the Nechako white sturgeon, and join in on field trips if possible. The information being presented to students is for the whole family.

We thank you for your participation in this curriculum. If you have questions, please contact the Nechako White Sturgeon Recovery Initiative (nechakowhitesturgeon.org).

Background reading for teachers

The scientific name for the white sturgeon, *Acipenser transmontanus*, translates literally as 'sturgeon across the mountains'. This tremendous fish is only found in two major rivers west of the Rocky Mountains in Canada. Both of these rivers flow in British Columbia – the Fraser (which includes the Nechako watershed) and the Columbia systems. This mysterious creature is the largest freshwater fish in Canada, and has existed relatively unchanged for millions of years – surviving volcanic eruptions, ice ages and climatic upheavals. But the white sturgeon are now swimming in a current of change that is taking it to the very brink of extinction. It is ranked as Critically Imperiled by the British Columbia Conservation Data Centre and is an Endangered Species as ranked by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).



In the Nechako River, the white sturgeon population has dropped from what some scientists believe

was a minimum of 5000 fish to less than 350. The vast majority of those fish are more than 40 years old. In comparison, population estimates for the Columbia River white sturgeon are roughly 3,000. Like the Nechako population, almost all fish are greater than 40 years old, suggesting that sturgeon are either not reproducing successfully or that the young or juvenile are not surviving to adulthood. As sturgeon do not begin spawning until they are 15 to 40 years old, the lack of juvenile sturgeon in the Nechako and Upper Columbia means that an entire generation is already missing. The Fraser the population is much larger. For a comparison there are an estimated 4,500 white sturgeon in the mid-Fraser River, and 750,000 in the lower Fraser River.

In the lower Fraser River the white sturgeon reach 6m in length and over 800kg. Individuals reaching this size may be more than 100 years old! In the Nechako system where growth is slower, a large sturgeon generally reaches about 3m in length. The white sturgeon's long, streamlined body has no scales. Instead, it has bony plates, called scutes, arranged in five rows down its body. With a broad, flattened head, tiny eyes and shark-like tail, is well adapted for feeding on the bottom of rivers and lakes. Its toothless mouth is on the underside of its head, and extends out of its body in order to suck up food. White sturgeon also have whiskers, or barbels, located between the snout and the mouth, which help it find edible objects.

The spawning age of sturgeon is around 15 years for males, and more than 20 years for females – which is very late for fish. Once mature, females spawn more than once, but only every 3 to 6 years. Both sexes can spawn throughout their life. Sturgeon make up for their late and infrequent spawning by producing vast numbers of eggs, from about 700,000 in medium sized females to 3 or 4 million in the largest!

Preferred spawning sites have faster currents and rockier bottoms than feeding areas. Females and males spawn together in pairs or small groups where they release eggs and sperm into the fast flowing water. The small, brown eggs quickly sink and stick to the riverbed, where they are relatively safe from predators. Depending on water temperature, the eggs will hatch in 5 to 25 days, releasing larvae with yolk sacs attached, that look a bit like tadpoles. Larvae take about two weeks to develop into fry – miniature sturgeon complete with long snout and scutes. Nechako white sturgeon are believed to have a slow growth rate, due to the cooler water temperatures, shorter northern summers and differences in the types of foods available.

Adult white sturgeon live entirely on animal matter. As they search for food below them, they primarily use touch and taste, rather than eyesight, to find food. They do this by following an odour, or simply by drifting in a prime location and waiting for the food to come by. Young sturgeon may snack on larval insects, freshwater clams and snails, while older sturgeon feed primarily on fish, including live adult salmon and even smaller sturgeon.

The reasons for this species' dramatic decline are currently being studied on the Nechako, Upper Columbia and Kootenay systems. Contributing factors may include historical over-fishing, incidental catches and poaching, pollution and changes to the river landscape by human construction. Changes to the level and times of water flows, due to the reservoir in the Upper Nechako River, have had an impact on the sturgeon.

Through research conducted over the last decade, the Nechako white sturgeon are in a critical state of decline. Unless something is done, and done soon, the great creatures in the Nechako River will likely go extinct. In 2000 the Nechako White Sturgeon Recovery Initiative was created, and is ultimately responsible for identifying the reasons for white sturgeon decline, and for the design and implementation of habitat protection, restoration and management options. There is a recovery plan that will help restore white sturgeon population in the Nechako and Canada. This will take time to implement, but the long-term goal is to rebuild and maintain the population until the various causes of the decline can be determined and corrected.

For more information about the Nechako White Sturgeon Recovery Initiative, please visit, www.nechakowhitesturgeon.org.

UNIT 1

INTRODUCTION

NECHAKO WHITE STURGEON AND ITS ENVIRONMENT

Introduction to Unit 1

Subject(s): Science

Grade(s): Intermediate

Number of Lessons: 2 (can be split into 3 or 4 lessons depending on time)

Duration of Unit: 1 week

Rationale/Overview: The purpose of this unit is introduce the students to the Nechako white sturgeon, its status as endangered, and the Nechako watershed.

Background and Teacher Preparation Required: This is the introductory unit to this course. No prior knowledge about Nechako white sturgeon is necessary.

Cross-Curricular Connections: L.A., P.E. and/or D.P.A., Social Studies, Fine Arts

Extensions and Adaptations: This unit is supposed to be taught before either the Nechako watershed or the Nechako white sturgeon units.

Overview of Lessons

LESSON 1-1: INTRODUCTION TO THE NECHAKO WHITE STURGEON

Time of Lesson: 1 - 1.5 hours

Instruction Objectives: Student can participate in a discussion about the Nechako white sturgeon and explain what the endangered status means.

Strategies and Activities: Story about sturgeon, brainstorm about Nechako white sturgeon, define and discuss endangered status.

Materials:

- SMARTboard PowerPoint presentation: *Introduction to this Course*
- Handout: *Worksheets 1a & 1b - Nechako White Sturgeon Facts and Endangered Status*
- Book: *"The Tale of the Great White Fish"* by Maggie Devries
- SMARTboard Interactive Activity: *Unit 1 Definitions.notebook*

LESSON 1-2: INTRODUCTION TO THE NECHAKO WATERSHED

Time of Lesson: 1.5 hours

Instruction Objectives: Student can define the Nechako watershed and locate the Nechako watershed on a map, understand the parts of a watershed (rivers, land and riparian zone).

Strategies and Activities: Watershed activities outdoors, discussion about watersheds, mapping exercise.

Materials:

- Watershed observation activity: paper and pencils (outdoors)
- Watershed activity: paper and washable markers (outdoors)
- SMARTboard PowerPoint presentation: *Map of the Nechako Watershed*
- Classroom Map: map of the Nechako Watershed, coloured sticky dots
- Handout or Interactive: *Worksheet 1c - Crossword*. See CD for interactive version.
- SMARTboard Interactive Activity: *Unit 1 Definitions.notebook*

Lesson 1-1: Introduction to the Nechako White Sturgeon

Time of Lesson: 1 - 1.5 hours

Rationale: The purpose of this lesson is to provide the students with an overview of the Nechako white sturgeon and the challenges it currently faces. The goal is to have students be aware of local issues in order to connect to the Nechako watershed.

Instructional Objectives: Student can participate in a discussion about the Nechako white sturgeon and explain what the endangered status means.

Strategies and Activities: Story about sturgeon, brainstorm about Nechako white sturgeon, define and discuss endangered status.

Materials:

- Book: *"The Tale of the Great White Fish"* by Maggie Devries
- SMARTboard PowerPoint presentation: *Introduction to this Course*
- Handout: *Endangered Species*
- SMARTboard Interactive Activity: *Unit 1 Definitions.notebook*

Prerequisite Concepts and Skills: None.

Student Assessment:

- Observation and participation in class and small group activities.
- Completion of worksheets.
- 'Ticket out the Door' "What does endangered mean?" "How large is a Nechako white sturgeon" "How many sturgeon are in the river?" etc.

LESSON PLAN

Activity (5-10 minutes)

Have PowerPoint presentation *Introduction to this Course* on the SMARTboard with the opening slide showing.

Start a general conversation about what the students already know about the Nechako white sturgeon. Write on white board their key points.

Key Points

White sturgeon are the largest freshwater fish in Canada. Fraser River white sturgeon reach 6m in length, and Nechako River white sturgeon reach over 3 metres in length.

They live over 100 years.

Lived during the time of the dinosaurs.

Some may have participated in sturgeon releases in 2008 and 2009.

Activity (15-20 minutes)

Show *Introduction to this Course* PowerPoint presentation. Stop presentation where needed to continue conversation, or play through.

Ask

Why do we care so much about the Nechako white sturgeon?

What does endangered mean?

Endangered: Species in danger of becoming extinct.

Extinct: Species does not exist any longer.

Extirpated: A species no longer existing in a specific location, but exists elsewhere.

Activity (10 minutes)

On the white board work through a brainstorming exercise to come up with as many factors affecting the decline of the Nechako white sturgeon and then the ways we are working to recover the species.

Ask

What factors have caused the species to become endangered?

What is being done to help recover the species?

Factors include:

- overfishing
- introduction of exotic species
- dikes and drainage projects
- industrial and municipal pollution
- reduced or changes in food source for juvenile (young) sturgeon
- climate change influence food and water temperature
- hydroelectric dam building (Kenney Dam): block access to spawning sites, eliminate spring flooding, trap nutrients on which salmon depend, reduce downstream turbidity (so that juveniles are more visible)

Recovery includes:

- stop fishing
- live releasing of sturgeon caught in gill nets during the Food, Societal and Ceremonial fishery.
- endangered status
- research into their biology, reproduction, habitat needs etc.
- research into global warming
- building the Conservation Centre in Vanderhoof that will work as a hatchery to help improve juvenile survival in the river. Construction to be completed in spring 2014
- adding better substrate into the river
- education & awareness (River's Day, school presentations)

Activity (10-15 minutes)

Handout *Worksheets 1a & 1b*. Work through the worksheets as a class or in small groups. All the information for the worksheet should have been covered in the PowerPoint presentation and through class discussions.

Activity (5 minutes)

Unit 1 Definitions. Open up this SMARTboard activity and quickly review the definitions from this lesson.

Closure (10 minutes)

Read *Tale of a Great White Fish* by Maggie DeVries. This book has been provided to your school through this project. If your school does not have this book, please contact us!

Ask

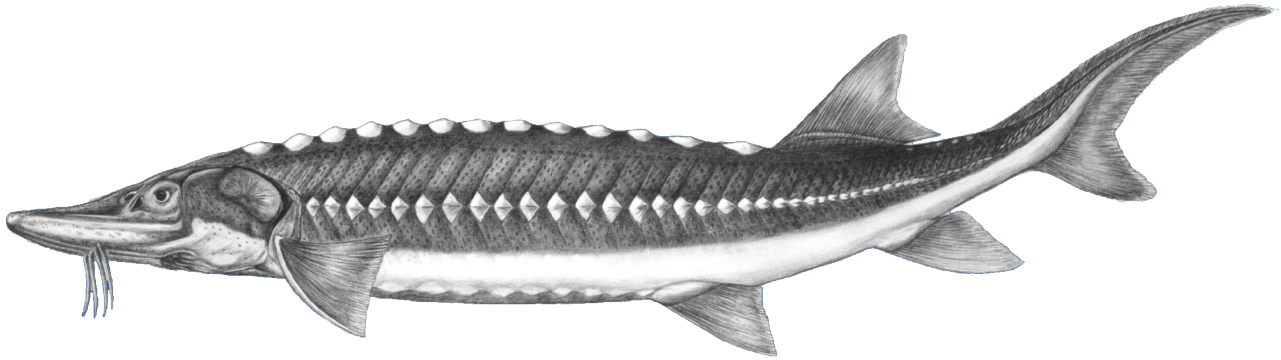
Reflect on what the decline of the Nechako white sturgeon means to you. If it was to become extinct, what have we lost?

Nechako White Sturgeon

Facts and Endangered Status

Fill in the facts below about the Nechako white sturgeon:

- The Nechako white sturgeon lives in the _____ River.
- Nechako white sturgeon are _____ distinct from Fraser River white sturgeon – meaning that Nechako white sturgeon do not spawn with other populations of white sturgeon.
- There are less than _____ adult Nechako white sturgeon left!
- _____ fish are needed to have a healthy population in the Nechako River.
- Female Nechako white sturgeon spawn when they reach _____ years old and males between _____ years old. There are not many _____ fish in the Nechako River.
- Nechako white sturgeon are at risk of becoming _____ in the next twenty years!



SARA - Endangered Species

Nechako white sturgeon are listed as an Endangered Species by the Species at Risk Act (SARA) of Canada. Endangered species are in danger of becoming extinct. What does extinct mean?

What does extirpated mean? _____

How is extinct different than extirpated? _____

There are special rules for species that are endangered.

- Can you keep Nechako white sturgeon if you catch one while fishing? _____
- Can you keep any part of the Nechako white sturgeon (e.g. a scute from its back)? _____
- If a Nechako white sturgeon dies, can you keep it or eat it? _____

What will happen to the Nechako white sturgeon if we catch and keep them?

There are other species that can be seen or live in our area that are species of special concern:

Bull trout • American white pelican • Long-billed curlew • Short eared owl • Western toad

Learn more about SARA by going to http://www.sararegistry.gc.ca/default_e.cfm.

(Material from the Learn to Fish program, Freshwater Fisheries Society of BC)

Nechako White Sturgeon

Reasons for Endangered Status

List 4 possible factors that impact Nechako white sturgeon and have contributed to them being classified as an endangered species:

Draw a picture of one of the things that is being done now to help recover the species.



Worksheet 1a & 1b Answer Key

Worksheet 1a - Facts & Endangered Status

Fill in the facts below about the Nechako white sturgeon:

- The Nechako white sturgeon lives in the **Nechako** River.
- Nechako white sturgeon are **genetically** distinct from Fraser River white sturgeon – meaning that Nechako white sturgeon do not spawn with other populations of white sturgeon.
- There are less than **350** Nechako white sturgeon left!
- **More** fish are needed to have a healthy population in the Nechako River.
- Female Nechako white sturgeon spawn when they reach **40** years old, and males when they are **teens-20s** years old. There are not many **juvenile or young** fish in the Nechako River.
- Nechako white sturgeon are at risk of becoming **extirpated** in the next twenty years!

What does extinct mean?

The species no longer exists, There are no animals of that kind alive on the planet.

How is extinct different than extirpated? **A species goes extinct in a certain area, or a unique population of a species goes extinct. This is the case for Nechako white sturgeon - they are genetically distinct from other white sturgeon, but if they go extinct there will still be other white sturgeon in the world. The genetic diversity will be lost.**

There are special rules for species that are endangered.

- Can you keep Nechako white sturgeon if you catch one while fishing? **No**
- Can you keep any part of the Nechako white sturgeon (e.g. a spine from its back)? **No**
- If a Nechako white sturgeon dies, can you eat it? **No**

What will happen to the Nechako white sturgeon if we catch and keep them?

The numbers will continue to decrease and increase the rate of extinction.

Worksheet 1b - Reasons for Endangered Status

List 4 possible factors that impact Nechako white sturgeon and have contributed to them being classified as an endangered species:

overfishing

introduction of exotic species

dikes and drainage projects

industrial and municipal pollution

reduced or changes in food source for juvenile sturgeon

climate change influence food and water

agriculture, removing water from the river

agriculture, pesticides and fertilizers seep into

groundwater or overland into river

landscape changes - Kenney Dam

shallower river due to dam

temperature

riverbank encroachment

block access to spawning sites from dam

dam eliminates spring flooding

dam traps nutrients

changes to turbidity and river chemistry from dam

Lesson 1-2: Introduction to the Nechako Watershed

Time of Lesson: 1.5 hours

Rationale: The purpose of this lesson is to introduce the Nechako watershed and for the students to develop a sense of place. People's empathy for special places strengthens their commitment to stewardship of our natural environment. Additionally, our local history is strongly tied to the Nechako River, as First Nations along with the first explorers and settlers used the Nechako River and the rivers within the watershed for survival. Constructing a sense of place has a key role in developing education and interpretation material about our natural and cultural environment.

Instructional Objectives: Students can define the Nechako watershed and locate the Nechako watershed on a map and understand the parts of a watershed (rivers, land and riparian zone). Students can explain how individuals and their actions can help conserve the Nechako watershed.

Strategies and Activities: Outside activity to grasp concept of a watershed, in class discussion.

Materials:

- Watershed observation activity: paper and pencils (outdoors)
- Watershed activity: paper, blue watersoluble markers, water bottles (outdoors)
- SMARTboard PowerPoint presentation: *Map of the Nechako Watershed*
- Classroom Map: map of the Nechako Watershed, coloured sticky dots, post-its, pins, markers etc.
- Handout or Interactive: *Worksheet 1c - Crossword*. See CD for interactive version.
- SMARTboard Interactive Activity: *Unit 1 Definitions.notebook*

Student Assessment:

- Observation and participation in class and small group activities.
- Ability to identify features and locations on a map that relate to watersheds.
- 'Ticket out the Door' "Name one factor that influences a watershed."

LESSON PLAN

Activity (15 minutes)

Collect materials for outdoor activity: paper (2 per student), blue water soluble markers, pencils, water bottle.

Tell your students that you will now practice the first part of the scientific method: **observation** by making detailed observations of their watershed. Part of being a good scientist is making **detailed observations** and **effectively communicating or describing your observations to another person**. Have the students take their paper and pencil with them and quietly line up to go outside and observe their watershed. This is an individual activity.

Take the class outside to the playing field, playground, forested area, or open area. The location of this activity is not important, other than the fact that students need to be able to see a distance away.

Have them form a circle and then turn to face outside of the circle, take three big steps and sit! They should be fairly evenly spaced with at least two metres between each student. Now they are to write/draw everything they observe for ~5 minutes in silence, no discussion. Note that you have not defined a watershed yet or discussed the topic with the students in detail. If some ask what they are supposed to observe, direct them to write/draw whatever they see before them (could be houses, buildings, play ground equipment, grass, trees, storm drain, cars, people, squirrels, ants etc.)

Have the class gather around and discuss the different observations they made of their watershed.

Ask

When rain falls on all of the things you just observed in your watershed, where does it go? *Lead a discussion toward water travelling downhill into rivers and waterways. All the things in their drawing are within a watershed.*

Transition to next activity.

Activity (10 minutes)

Divide into small groups. Tell the class they will be making model watersheds simply by crumpling up a piece of paper.

Pass out one blank sheet of paper and one blue water soluble marker to each group of three students.

One student crinkles the paper into a tight ball and then gently pulls the paper flat again without smoothing the paper entirely. The paper should look like a mountainous relief map.

The second student traces the **ridges** (high points) on the paper with the blue marker without going down into any of the valleys.

Ask

What will happen when the model watershed is “rained” on?
Specifically, ask them where will the water go?

Before spraying the model, tell the students you want them to observe the direction of water flow. A drop of water will roll down one side of a ridgeline into one watershed or roll down the other side and enter another watershed. The wet ink should show this pattern.

The third student “rains” on the piece of paper by gently squirting with the water bottle. Enough rain will run the blue marker down the “hills” into “river valleys”.

Ask

What happened to the blue marker? Where did it run? *Your discussion should lead them to the understanding that the high points or ridgelines on their model watershed define the boundaries of a watershed.*

What watershed are you in now? *Nechako Watershed*

Watershed (or Basin): The area of land where all of the water that is within it or drains into the same place – either a lake, marsh, stream, river or groundwater.

Sub Basin: A watershed within a watershed - a smaller river drainage.

Tributary: A river that flows into a main stem river or lake. It does not flow into the sea or ocean.

Return to classroom for next activity.

Activity (25 minutes)

Show *Map of the Nechako Watershed* PowerPoint presentation. Stop presentation at “Why are we learning about watersheds?”.

Ask

Why are we learning about watershed? *Because we live within it and our actions influence our water and other living things around us.*

What are some of the human uses of lands within a watershed?
Identify which have positive and negative impacts on water.

- | | |
|--|---|
| • farming and agriculture | fisheries |
| • forest harvesting | • recreational land activities (e.g. ski resorts) |
| • reservoirs, dams and waterworks | • recreational water activities (e.g. boating) |
| • sewage disposal | • fishing |
| • landfills | • transportation by water |
| • towns | • ditches and storm drains (water disposal) |
| • industrial sites | • tree planting |
| • roads | • restoration projects |
| • culverts | • recycling |
| • ports and harbours | |
| • First Nation food, social and cultural | |

Continue showing *Map of the Nechako Watershed* PowerPoint presentation.

Key Points

Stop at the slide “The Nechako Watershed” point out your community, Prince George where the Nechako flows into the Fraser River, the river’s path, the boundary of the watershed, any other interesting points for the students.

Flip to the next slide for facts about the Nechako watershed.

Facts about the Nechako River and Watershed

- Nechako means “big river” in the Carrier language.
- The Nechako river is 290 km in length (compare distance from Prince George to Burns Lake) and is a major tributary to the Fraser river.
- Nautley River is the largest tributary.

Flip to the next slide for a quick overview of Kenney Dam and the Reservoir.

Ask

Who knows the story about why Kenney Dam was built?

- Built in 1952 in the upper Nechako. It diverted westward, generating hydroelectric power before entering the **Kemano River**. The power is used for aluminium production and electricity for northern BC. As a result, the Nechako River is smaller and has a different hydrograph (*A hydrograph is a graph showing the rate of flow or discharge versus time past a specific point in a river. The rate of flow is typically expressed in cubic metres per second (cms or m³/s)* than it did historically. This may be a potential limitation for Nechako white sturgeon, as the river doesn't experience flushing of the system that likely cleaned the spawning grounds of sediment, and contains less water (a changed hydrograph). This topic will be discussed in more detail in a later lesson.

Continue showing Map of the Nechako Watershed PowerPoint presentation.

Ask

What is a tributary? *A tributary is a stream or river that flows into a main stem river or a lake. It does NOT flow directly into the sea or the ocean.*

Can you name some of the sub basins/tributaries of the Nechako watershed?

- Cheslatta River
- Nautley River
- Stuart River
- Chilako River
- Endako River
- Stoney creek
- Murray Creek
- Chilco Creek
- Clear Creek
- Sinkut River etc.

Activity (15 minutes)

Present the hardcopy map of the Nechako watershed to the class. Pin on the wall or place on a table and have student identify lakes, rivers and key features and locations on the map. Use sticky post-its, markers or labels.

Ask

What things can we do as individuals or as a community to improve the watershed environment for the Nechako white sturgeon?

Leave the map on the wall of the classroom for the duration of this course as a reference for later lessons.

Activity (10 minutes)

Hand out hardcopy or use interactive version on SMARTboard of *Worksheet 1c*. This activity can be take home or in class depending on the time.

Activity (5 minutes)

Unit 1 Definitions. Open up this SMARTboard activity and quickly review the definitions from this lesson.

Closure (10 minutes)

Review what the students learned about watersheds today and why watersheds are important.

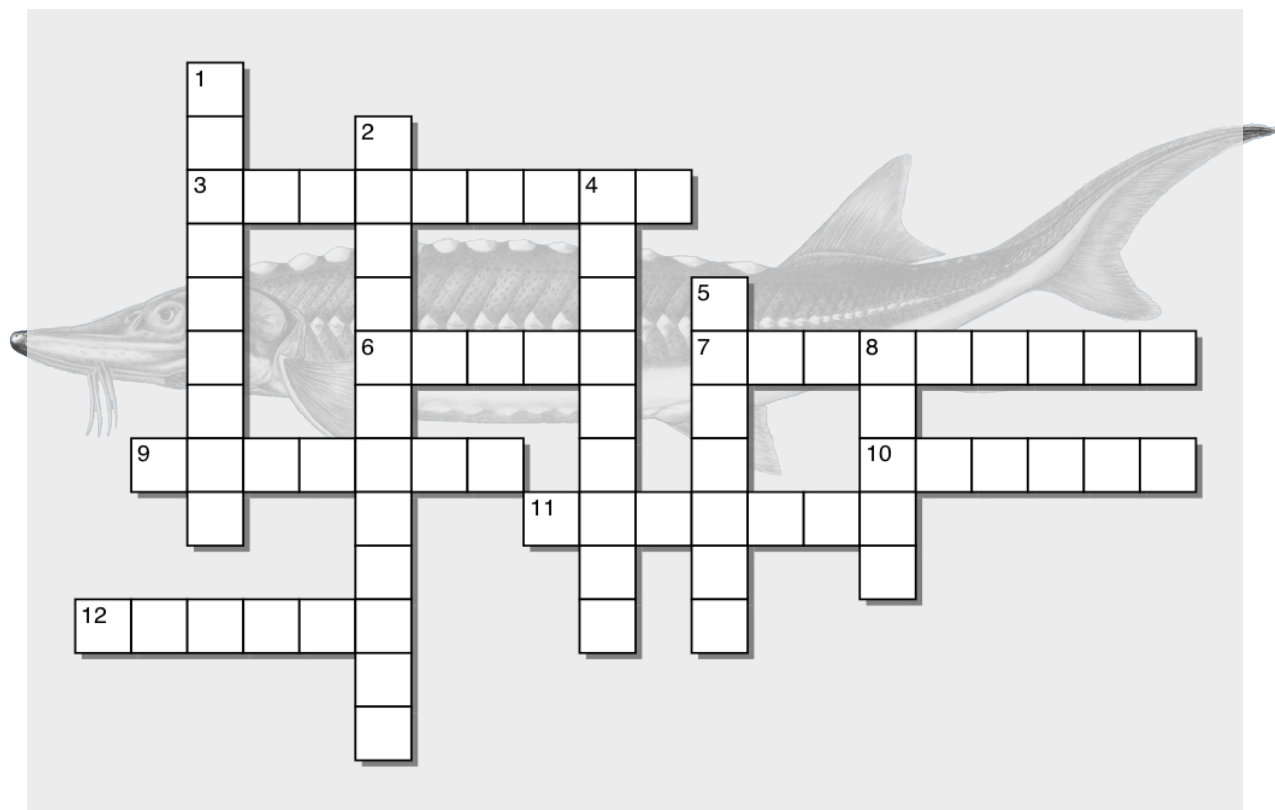
Ask

How does all the activity humans do within a watershed influence animals such as the Nechako white sturgeon?

What can we do differently to make things better for Nechako white sturgeon?

Nechako White Sturgeon

Crossword



Across

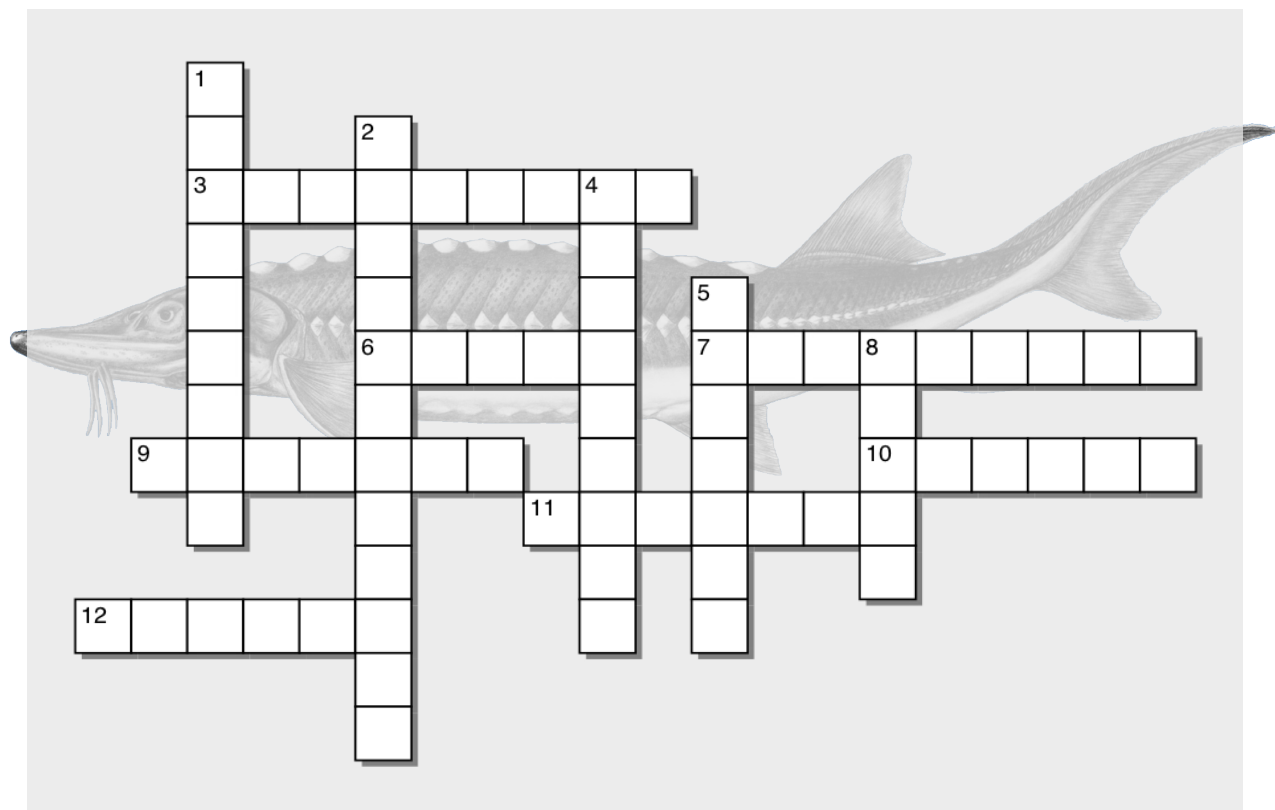
- 3) A river that flows into another river or lake.
- 6) The high point of a watershed.
- 7) A way that people educate others about important topics and issues.
- 9) Means 'big river' in Carrier.
- 10) The low point of a watershed.
- 11) Chemicals and other toxins _____ the Nechako River.
- 12) Water from the Nechako River is diverted west to generate power before entering the _____ River.

Down

- 1) The area of land where all of the water that is within it or drains into the same place.
- 2) Taking detailed _____ of our surroundings helps us learn and understand our environment better.
- 4) Kenney Dam creates a _____.
- 5) The largest sub basin of the Nechako watershed.
- 8) A channel that carries water downhill.

Nechako White Sturgeon

Crossword - ANSWER KEY



Across

3) A river that flows into another river or lake. [TRIBUTARY]

6) The high point of a watershed. [RIDGE]

7) A way that people educate others about important topics and issues. [AWARENESS]

9) Means 'big river' in Carrier. [NECHAKO]

10) The low point of a watershed. [VALLEY]

11) Chemicals and other toxins _____ the Nechako River. [POLLUTE]

12) Water from the Nechako River is diverted west to generate power before entering the _____ River. [KEMANO]

Down

1) The area of land where all of the water that is within it or drains into the same place. [WATERSHED]

2) Taking detailed _____ of our surroundings helps us learn and understand our environment better. [OBSERVATIONS]

4) Kenney Dam creates a _____. [RESERVOIR]

5) The largest sub basin of the Nechako watershed. [NAUTLEY]

8) A channel that carries water downhill. [RIVER]

UNIT 1 TEST

A number of test questions have been developed for this Unit. The questions include matching, definitions, multiple choice, True-False, and short answer in this document. Please feel free to customize the test for your class, considering the topics or materials you covered or focused on during the Unit.

You can find test questions for this Unit on the thumb drive that accompanies this curriculum:

- *Unit_1_Test.docx*

GRADE: _____ TEACHER: _____ SCHOOL: _____

Feedback Form for Unit 1

Please fill in the information below and return to the NWSRI. Please feel free to email any questions or comments to Lana Ciarniello at aklak@telus.net.

Background Information:

Is the information presented age appropriate and presented in an age appropriate manner? Yes or No

Was there enough information provided to conduct the lessons successfully?
Yes or No

If no, what additional information and/or resources would be useful?

Activities:

Were the activities engaging to the students? Yes or No

Was the timeline of the activities a good estimate?
Too Long ____ Too Short ____ Just Right ____

Any comments?

Worksheets:

Were the worksheets effective in teaching and/or reviewing the unit material?
Yes or No

Were the answer keys helpful? Yes or No

Additional Resources:

If used, were the resources suggested or provided for this unit useful? Yes or No

What else would you suggest be needed for this unit?

UNIT 2

WATERSHEDS, RIPARIAN ZONES AND RIVER HABITAT

Introduction to Unit 2

Number of Lessons: 6

Duration of Unit: 3 weeks

Rationale/Overview: The purpose of this unit is for the students to familiarize themselves with watersheds and a local riparian zone, the role this area plays in the overall health of the watershed, and how it influences river habitat. Understanding how the riparian zone influences water will lead to the students more thoroughly understanding the issues with the Nechako white sturgeon. The goal is that awareness about the watershed, riparian zone and river habitat will enhance students' understanding of consequences from human activities and how they can prevent negative outcomes.

Background and Teacher Preparation Required: This unit is meant to be taught after Unit 1 Introduction, but can also follow Unit 3 The Nechako White Sturgeon.

Cross-Curricular Connections: Language Arts, Physical Education and/or Daily Physical Activity, Social Studies, Fine Arts

Overview of Lessons

LESSON 2-1: WATERSHEDS

Time of Lesson: 1 hour

Instruction Objectives: Student can identify the Nechako watershed, and define the areas of a watershed and how they are linked together.

Strategies and Activities: Review from introduction to watersheds, activity sheets and watershed demonstration kit.

Materials:

- Handout: *Worksheet 2a - Watersheds*
- Demonstration: *Watershed Kit*
- Handout: *Worksheet 2b - The Nechako Watershed*
- SMARTboard Interactive Activities: *Watershed Definitions & Watershed Definitions-Matching*

LESSON 2-2: RIPARIAN ZONES

Time of Lesson: 1 hour

Instruction Objectives: Student understand what a riparian zone is, what makes a healthy riparian zone, and why it is important for watershed health.

Strategies and Activities: Discussion about riparian zones, PowerPoint presentation and art activity.

Materials:

- SMARTboard PowerPoint presentation: *Riparian Zones*
- Riparian art activity: drawing a riparian zone

LESSON 2-3: RIPARIAN ZONES AND BIODIVERSITY

Time of Lesson: 1.5 hours

Instruction Objectives: Student can define biodiversity and retell how organisms are linked in the ecosystem. Students can understand impacts by humans on riparian zone habitat.

Strategies and Activities: Discussion about biodiversity, explore concept of ecosystem. Create a cartoon style poster depicting organism interactions in an ecosystem.

Materials:

- SMARTboard PowerPoint presentation: *The Fallen Leaf*.
- Handout: *Worksheet 2c - The Fallen Leaf*.
- Activity: *Worksheet 2d - Ecosystem Cartoon*.

LESSON 2-4: NECHAKO WHITE STURGEON HABITAT AND HUMANS

Time of Lesson: 1.5 hours

Instruction Objectives: Students understand the basic habitat needs of Nechako white sturgeon. Students can identify human made impacts to riparian zones that impact biodiversity, river habitat, water quality and watershed health. Relate these impacts to Nechako white sturgeon.

Strategies and Activities: Read and discuss the poem *Sturgeon*, review sturgeon habitat needs and discuss impacts by humans on sturgeon habitat. Create a poem about Nechako white sturgeon.

Materials:

- Handout: *Worksheet 2e - Sturgeon Poem*. Go to <http://www.lornacrozier.ca> for more information about the poet.
- Handout: *Worksheet 2f - Habitat Requirements T-Chart*.
- SMARTboard Interactive Activity: *Habitat T-Chart*.
- Experiment: 2 glass jars, access to water tap, a sunny spot and a shady spot in the classroom, thermometer.
- Activity: Paper, pens, pencils to create poem.

LESSON 2-5: RECOVERY AND REHABILITATION

Time of Lesson: 1.5 hours

Instruction Objectives: Students can identify restoration and rehabilitation projects in the Nechako Watershed specific to Nechako white sturgeon and overall watershed health.

Strategies and Activities: Definitions of recovery and rehabilitation. Review different types of project occurring for Nechako white sturgeon. Design a recovery/rehabilitation project.

Materials:

- PowerPoint presentation: *Recovery and Rehabilitation*.
- Handout: *Worksheet 2g - Recovery and Rehabilitation*.
- Activity: Restoration project - paper, markers, pencils and other craft material.

LESSON 2-6: RIPARIAN ZONES FIELD TRIP

Time of Lesson: 2 hours

Instruction Objectives: Student apply their classroom learning to the field.

Strategies and Activities: Students record observations and drawings of the riparian zone, do a species count and, if possible, a comparison between a mature and immature riparian zone.

Materials:

- Handout: *Worksheet 2c - Riparian Zones (if not completed in class in earlier lesson)*.
- Handout: *Worksheet 2h - Biodiversity Inventory*.
- Pencils, clipboards, paper, class camera
- Guest Speaker: please contact NWSRI for a list of possible guest speakers to accompany your class. Alternatively, if you know of any biologists please invite them to attend and lead the students through the material.

Lesson 2-1: Watersheds

Time of Lesson: 1 hour

Rationale: The purpose of this lesson is to introduce the Nechako watershed and for the students to develop a sense of place. People's empathy for special places strengthens their commitment to stewardship of our natural environment. Additionally, our local history is strongly tied to the Nechako River, as First Nations along with the first explorers and settlers used the Nechako River within the watershed for survival. Constructing a sense of place has a key role in developing education and interpretation material about our natural and cultural environment.

Instructional Objectives: Student can identify the Nechako watershed, and define the areas of a watershed and how they are linked together.

Strategies and Activities: Review from introduction to watersheds, activity sheet and watershed demonstration kit.

Materials:

- Handout: *Worksheet 2a - Watersheds*
- SMARTboard activity: *Watershed Definitions (.notebook file)*
- SMARTboard activity: *Watershed Definitions-Matching (.notebook file)*
- Demonstration: *Watershed Demonstration Kit*. It is recommended that teachers be familiar with the unit before presenting to the class. The Kit is available upon request. Please contact the Nechako White Sturgeon Recovery Initiative.
- Digital Image: *Nechako Watershed.jpg*

Student Assessment:

- Observation and participation in class and small group activities.
- Ability to identify features and locations on a map that relate to watersheds.
- Ability to relate our actions within the watershed as negative or positive toward watershed health.

LESSON PLAN

Introduction (5 minutes)

Introduce the new Unit and the rationale:

- To identify watersheds and riparian zones and relate to biodiversity, river habitat and Nechako white sturgeon.
- To gain a deeper awareness of the environment of the endangered Nechako white sturgeon and the many challenges the species currently faces.

Activity (5 minutes)

Quickly review what the class learned about watersheds in the introductory unit. Write their comments on the white board.

Key Points

splits up the landscape into areas where overland and percolating water comes to a common area (river or lake).

everything we do in the watershed impacts the overall health of the watershed.

the Nechako watershed is made up of over 30 sub basins or smaller watersheds that feed the river.

a watershed is made up of many parts (e.g. towns, riparian zones, lakes etc.)

humans, animals and plants all live together within a watershed.

Activity (10 minutes)

Hand out to the class *Worksheet 2a: Watersheds*.

Put on the SMARTboard: *Watershed Definitions* or SMARTboard: *Watershed Definitions-Matching*. Have the students fill in the definitions of the components of a watershed starting from the top of the watershed (ridge) to the bottom (mainstem river) working with the SMARTboard.

- Watershed: The area of land where all of the water that is within it or drains into the same place – either a lake, marsh, stream, river or groundwater.
- Riparian Zone: Land immediately adjacent a river or lake. The land of the riparian zone is influenced by the water table of the river or lake.
- Tributary: A river that flows into another river.
- Mainstem River: A river that flows into the ocean or the largest river in a watershed.
- Wetland: An area of saturated land that has water tolerant plants growing. Examples are swamps, ponds and bogs.
- Watershed Divide: The ridge that separates one watershed from another.
- Sub Basin: A watershed within a watershed.
- Precipitation: A form of water that falls from the sky. Can be rain, snow or hail.
- Overland Flow: Water that flows over the land or ground.
- Percolation: Water or liquids that filters through the soil below the surface of the ground. Underground flow.
- Groundwater: Water held underground in the soil or in the pores and crevices of rocks.

Ask

What are two potential paths for water that originates at the watershed ridge to get to a mainstem river? *Water can flow overland, through developed (agricultural lands, towns, industrial areas) or natural areas (forests). Water can percolate and flow underground through the soil.*

Have students colour in their hardcopy watershed diagrams.

Transition to next activity.

Activity (25 minutes)

Bring out the *Watershed Demonstration Kit*. Ask for student participation to help run the model. The model:

- shows how water flows through the soil (groundwater).
- shows how water picks up toxins and chemicals present on the surface of the ground and carries them through the soil to groundwater sources.
- shows the influence of wells on groundwater sources.

Ask

What does this model show us about how water moves through the watershed?

What actions do humans do within the watershed that influence the quality of water in our rivers and groundwater?

e.g. driving automobiles releases toxins and chemicals into the air (caught by precipitation) and onto the ground (overland flow after rain) and get taken into the rivers.

e.g. pesticides or fertilizers on fields percolate into the ground or get carried via overland flow into our rivers.

Transition to next activity.

Activity (15 minutes)

On the SMARTboard (digital file *Nechako Watershed.jpg*) or on the hardcopy map on the wall, show the map of the Nechako watershed. Ask the class the following questions, pointing out or marking their answers on the map.

Ask

Where is our community on the map?

Where is somewhere special you went this summer?

Do you have family or a friend from a different community? Where do they live?

Considering what we just learned about how water flows over and through a watershed, ask students to consider positive and negative actions in the watershed.

Ask

Which of your actions in these places negatively or positively impacted the watershed? *Answers will vary, examples include:*

long distance driving = negative

fished from shore instead of a boat = positive

biked to school today = positive

littered plastic food wrapper in the trail along the river = negative

Hand out *Worksheet 2b: The Nechako Watershed*. Have students expand on the class discussion and mark their own maps. This worksheet could be sent home or completed as a review at the beginning of the next lesson.

Closure (5 minutes)

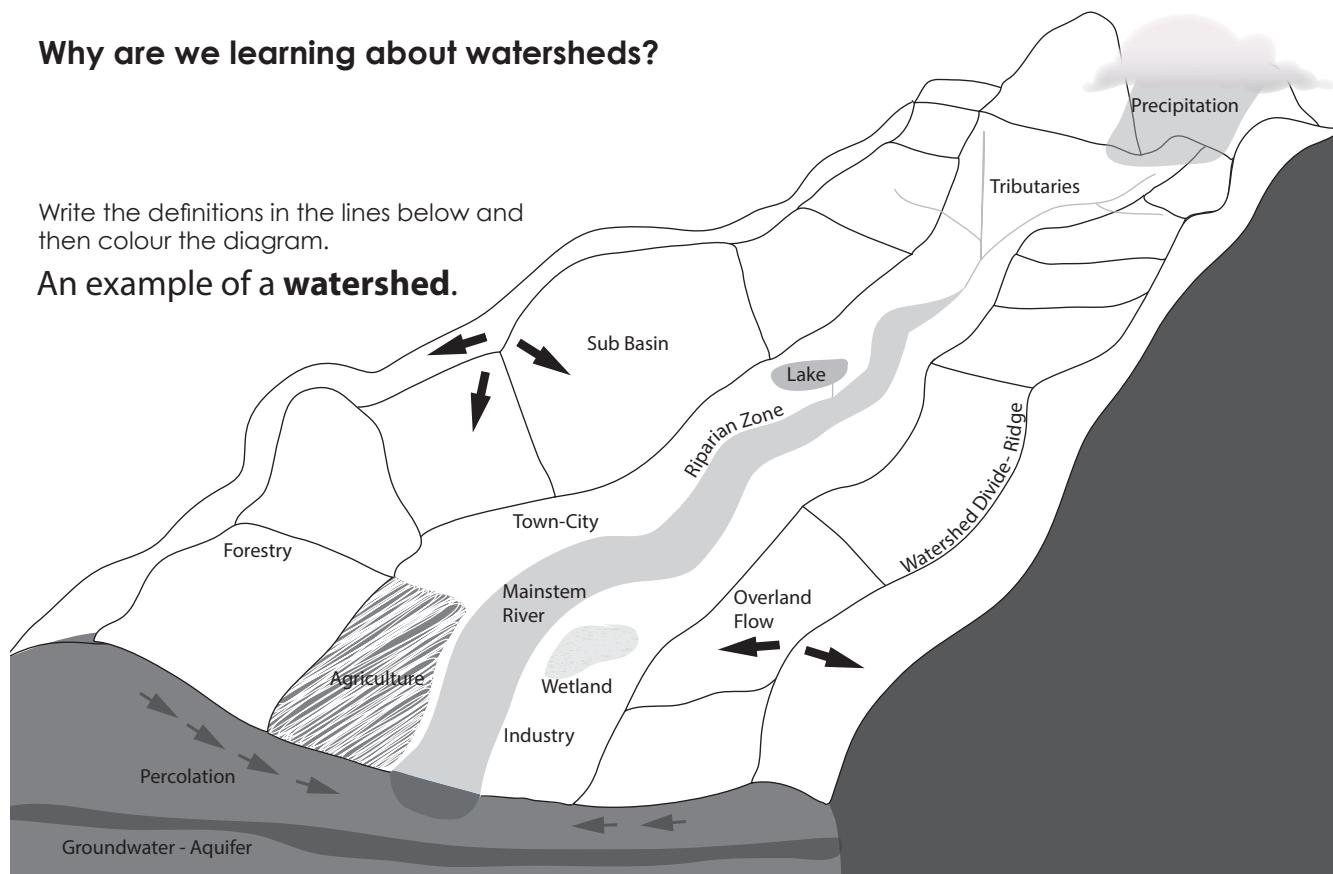
Ask students to make note of their actions for the rest of the day and what those actions mean to the watershed.

Watersheds

Why are we learning about watersheds?

Write the definitions in the lines below and then colour the diagram.

An example of a **watershed**.



Definitions

Watershed: _____

Riparian Zone: _____

Tributary: _____

Mainstem River: _____

Wetland: _____

Watershed Divide: _____

Sub Basin: _____

Precipitation: _____

Overland Flow: _____

Percolation: _____

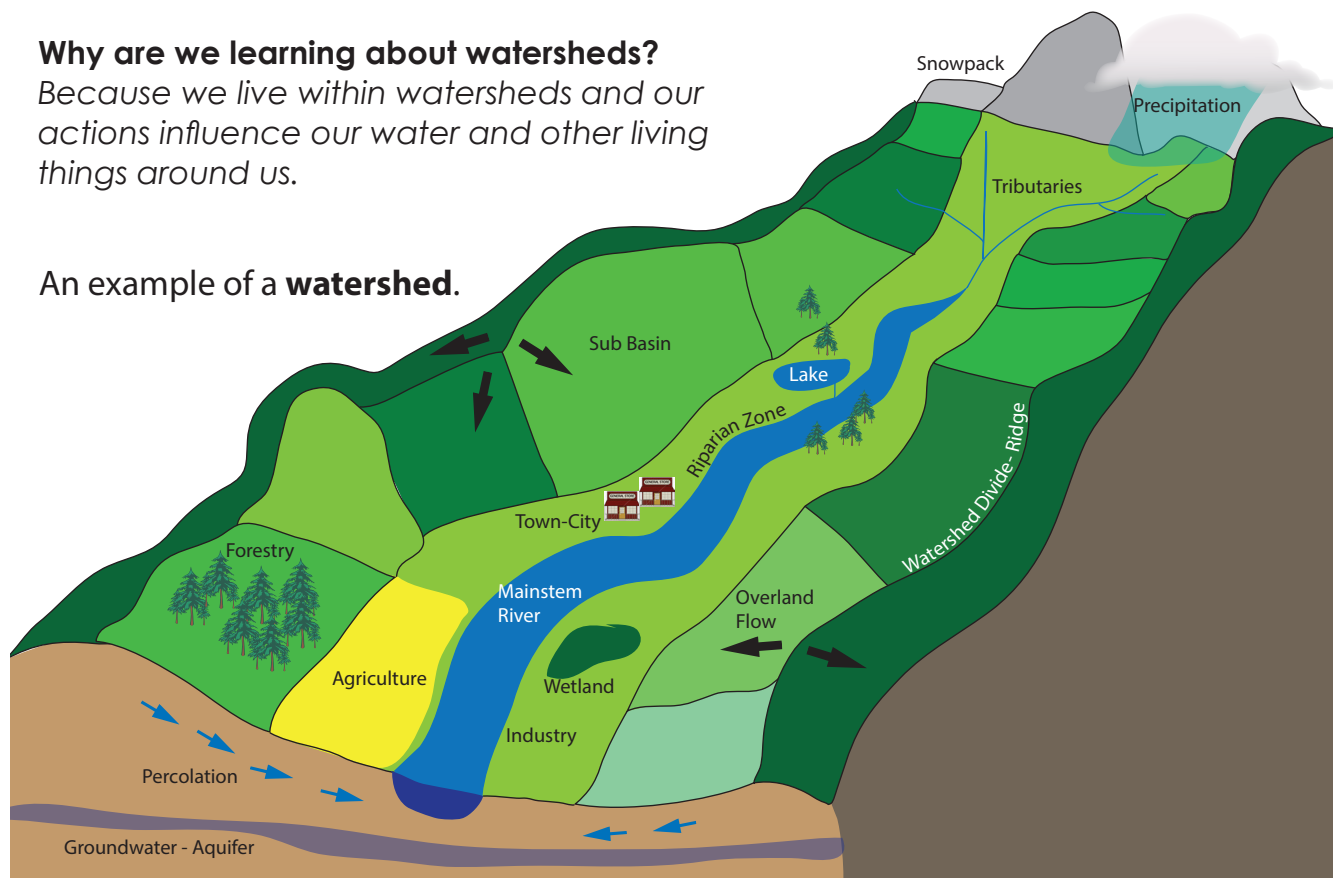
Groundwater: _____

Watersheds - Answer Key

Why are we learning about watersheds?

Because we live within watersheds and our actions influence our water and other living things around us.

An example of a watershed.



Definitions

Watershed: The area of land where all of the water that is within it or drains into the same place – either a lake, marsh, stream, river or groundwater.

Riparian Zone: Land immediately adjacent a river or lake. The land of the riparian zone is influenced by the water table of the river or lake.

Tributary: A river that flows into another river.

Mainstem River: A river that flows into the ocean or the largest river in a watershed.

Wetland: An area of saturated land that has water tolerant plants growing. Examples are swamps, ponds and bogs.

Watershed Divide: The ridge that separates one watershed from another.

Sub Basin: A watershed within a watershed.

Precipitation: A form of water that falls from the sky. Can be rain, snow or hail.

Overland Flow: Water that flows over the land or ground.

Percolation: Water or liquids that filters through the soil below the surface of the ground. Underground flow.

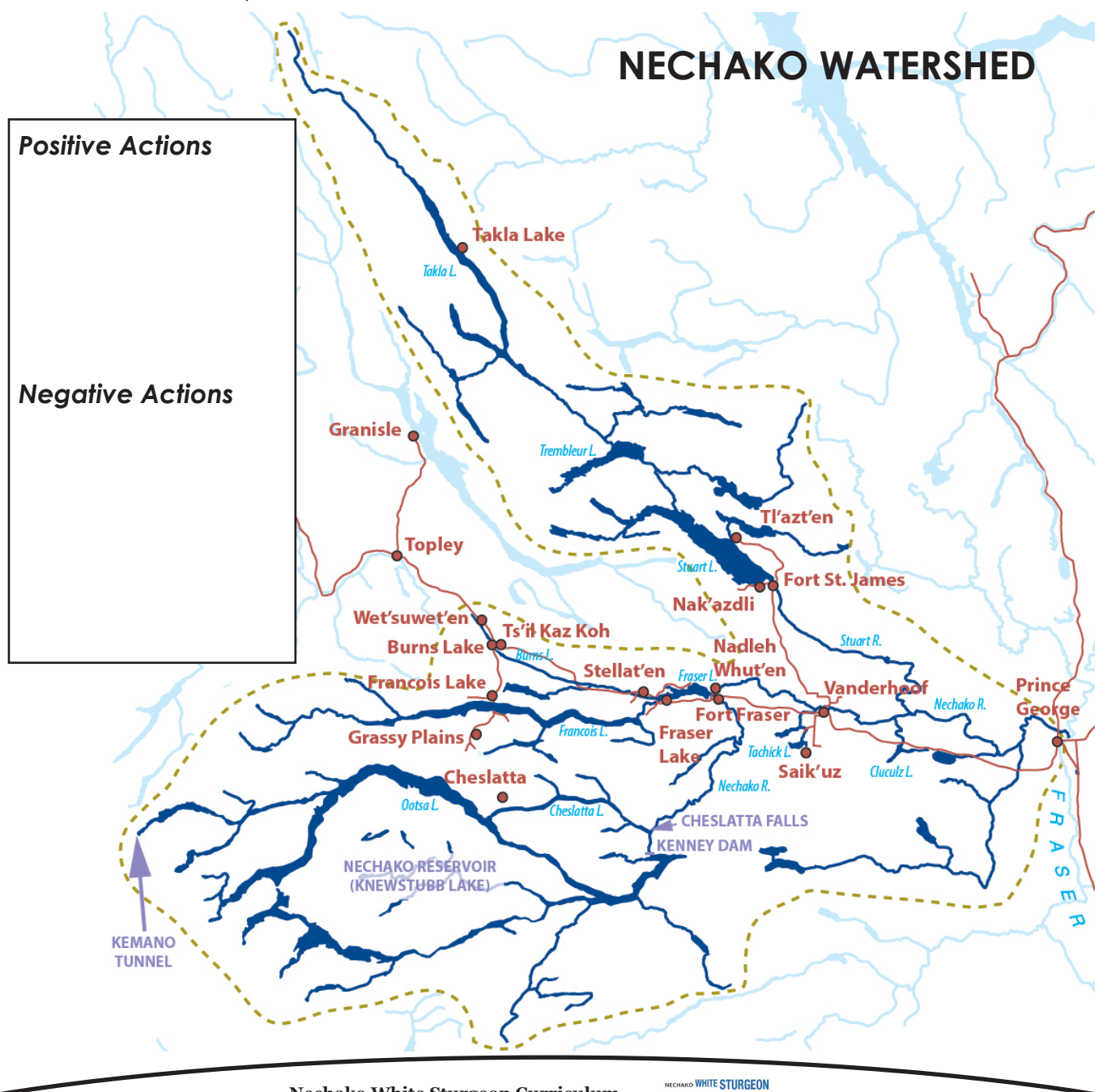
Groundwater: Water held underground in the soil or in the pores and crevices of rocks.

The Nechako Watershed

We live within the **Nechako watershed**. The Nechako watershed is made up of over 30 smaller river systems (sub basins). The Nechako River watershed is part of the larger Fraser River watershed. Nechako white sturgeon live within the waters of the Nechako watershed. On the map below, mark the following locations:

- where you are right now
- where you live
- two places you have visited
- the landfill for your community
- the place you shop for groceries
- where your parents work

Everything we do on the landscape has an impact on the watershed our water and the animals - e.g. Nechako white sturgeon - and humans that live within it. List three positive and three negative actions that occur (by you or others) in the places you marked on the map.



Lesson 2-2: Riparian Zones

Time of Lesson: 1 hour

Rationale: The purpose of this lesson is to define what a riparian zone is and link its importance for fish and other animals, humans, and the ecosystem in general.

Instructional Objectives: Student can define what a riparian zone is and list the reasons why riparian zones are important. Students can list negative and positive impacts to riparian zones.

Strategies and Activities: Brainstorming on what a riparian zone is and use handouts and PowerPoint presentations to present concepts.

Materials:

- SMARTboard PowerPoint presentation: *Riparian Zones*
- Handout: *Worksheet 2c - Riparian Areas*
- Handout: *Map of the Nechako Watershed*
- Paper and markers

Student Assessment:

- Observation and participation in class and small group activities.
- Ability to identify where a riparian zone is on a landscape.
- Understanding of the features and importance of riparian zones.

LESSON PLAN

Review (5 minutes)

Review the definition of a riparian zone from the last lesson and where a riparian zone is within a watershed. Provide Handout Worksheet 2c - *Riparian Areas* as a review of what a riparian zone is. You can refer to this worksheet throughout the lesson.

Key Points

Riparian zone is the land immediately adjacent a lake or river. The soil in a riparian zone is influenced from the water of the lake or river and is composed of moist to saturated soils.

Riparian zones follow along the entire length of any creek or river in a watershed, or surround lakes and wetlands. The width of a riparian zone depends on the size of the river or lake (wider for larger rivers, narrower for creeks).

Water-loving plant species live within riparian zones.

Activity (25 minutes)

Display on the SMARTboard the PowerPoint presentation *Riparian Zones*. Flip through the first four slides that show images.

Ask

What do all these photographs show? *The riparian zone of different rivers of different sizes.*

Continue with the slideshow. Stop where necessary to discuss. There are several slides that have a lot of information on them that outlines why riparian zones are important.

- Riparian zones are important because they connect the water with the land, and host a wide range of plant and animal life.
- They keep water cool and clean. Along the edge of the water where it is shallow, trees and vegetation provide shade and moderate the water temperature during warmer weather. This prevents algae growth.
- They connect different ecosystems, transport/circulate nutrients, and allow wildlife to travel between different habitats.

The slideshow continues and presents several concepts of ecosystems and connections between plants, animals and water within the riparian zone.

Plants play a huge part in the riparian zone.

- adapted to wet conditions and can tolerate periodic flooding
- moderate the temperature in the water
- roots and plants provide stability and strength
- leaves, twigs, and needles provide nutrients to aquatic invertebrates, which in turn nourish fish
- large trees that have fallen into water, help slow down the energy of flowing water, protect stream banks, and create pools and hiding places for fish

Animals benefit from a healthy riparian zone because:

- birds and mammals help to disperse the seeds of shrubs and trees
- invertebrates, molluscs (slugs and snails), and worms help to break down plant and animal matter, making it more readily available as nutrients to other organisms
- salmon fulfill a unique role by connecting the ocean, freshwater, and the land during the course of their life cycle (which begins and ends in stream corridors)
- complex predator-prey relationships that help maintaining a healthy balance among species
- habitat for a huge array of animals (80% of wildlife depend on this area in whole or in part)

Humans benefit from riparian zones because:

- cleaner water
- improved watershed health - good for us too!
- fertile and productive for agriculture
- reduce energy during floods
- good often flat locations to build towns, industry and transportation routes
- store and trap sediments and contaminants
- scenic areas to live, walk or recreate.

Activity (25 minutes)

Distribute craft supplies including paper and markers. Have the students illustrate a healthy riparian zone. Have them be detailed in the:

- varying height of plants and number of different type of plants (water loving)
- as many animal species as they can think would live in a riparian zone
- different aquatic species and organisms in the water (fish, invertebrates, detritus (rotting plant matter)).

Display art work in classroom or in hallway outside classroom. If time permits, have classroom discussion on each person's work, or split into smaller groups and have students share their work with each other.

Closure (5 minutes)

Review what makes a riparian zone healthy.

Riparian Areas

The **riparian zone** is the area of land adjacent to streams, rivers, lakes and wetlands, where the vegetation and soils are strongly influenced by the presence of water.

Riparian areas are important for plants, animals, humans, water quality and overall watershed health. Riparian zones connect the land with water.

A healthy riparian zone:

Has a diversity of plants to the banks of the water that provide shade to the water

Has a diversity of animals living within it

Is as least as wide as the tall trees in the riparian zone

A healthy riparian zone will:

Reduce energy during floods

Provide habitat for animals (birds, mammals, insects, fish, reptiles, invertebrates)

Store nutrients and contaminants

Provide structure and stability to river banks

Filter and reduce energy of overland flow

Regulate water temperature

Provide corridors for animals to travel

Be an area of increased biodiversity

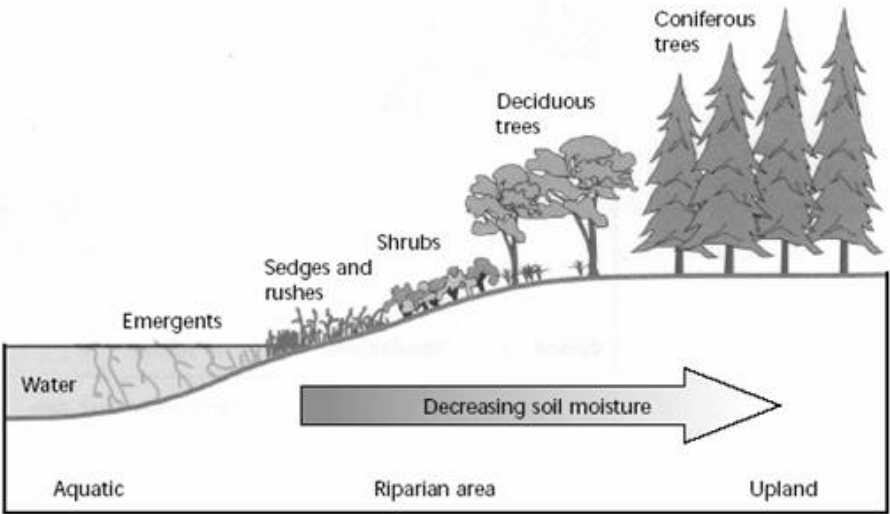


FIGURE 1 Illustration of the moisture gradient in a typical riparian ecosystem (from Stevens et al. 1995:2).

Impacts of Land Use in Riparian Zones

People have long relied on riparian zones for the abundant food, water, and material resources they supply. Riparian areas are often flat making it easier to build roads, farms, and towns in them. Therefore, many riparian areas have been built on for different **land uses** (e.g. agriculture).

Land use and development in riparian zones comes at a price! Impacts from development of riparian areas include:

- contamination and pollution of water
- loss of vegetation and biodiversity
- increased erosion of river banks leading to altered river habitat
- increased water temperature
- ability for invasive species to grow

Below list 3 different land uses that occur along the Nechako River. Tick if they are beneficial (positive) or detrimental (negative) to riparian health.

Land Use Practices	Positive	Negative
	☐	☐
	☐	☐
	☐	☐

Lesson 2-3: Riparian Zones and Biodiversity

Time of Lesson: 1.5 hours

Instruction Objectives: Student can define biodiversity and retell how organisms are linked in the ecosystem. Students can make the link between sturgeon and riparian zone health.

Strategies and Activities: Discussion about biodiversity, explore concept of ecosystem, create a poem of the importance of biodiversity in a riparian zone.

Materials:

- SMARTboard PowerPoint presentation: *The Fallen Leaf*.
- Handout: *Worksheet 2d - The Fallen Leaf*.
- Activity: *Worksheet 2e - Ecosystem Cartoon*.

Student Assessment:

- Observation and participation in class and small group activities.
- Ability to identify how organisms, ecosystems and biodiversity link together.
- Understanding of how humans influence the riparian zone ecosystem.

LESSON PLAN

Introduction (20 minutes)

Discuss the definitions of organism, ecosystem and biodiversity.

Organism: Individual animal, plant, or single-celled life form.

Ecosystem: A biological community of interacting organisms and their physical environment.

Biodiversity: The variety of life in the world or in a particular habitat or ecosystem.

Key Points

Different places on the earth have different numbers and variety of organisms. Each organism plays a part in the functioning of the ecosystem. Biodiversity is the count of how many organisms and the different types of organisms live within an ecosystem.

In general, the higher the biodiversity, the healthier the ecosystem.

The organism may be as small as a leaf, or as large as a sturgeon - they all have their important role in keeping the ecosystem functioning.

If one organism is removed (through extirpation or extinction) then the ecosystem either fails (other organisms can not succeed/survive or invasive organisms enter the ecosystem), or the organisms within the ecosystem have to adapt.

Activity (30 minutes)

Display on the SMARTboard the PowerPoint presentation *A Fallen Leaf* (the presentation includes a short animation that shows the connection between different organisms within the riparian zone).

Key Points

The variety of organisms in the riparian zone each add to the success or health of the riparian zone.

A healthy riparian zone includes all the links between organisms.

Either before or after the animation is shown, give students the Handout *Worksheet 2c: The Fallen Leaf*. Allow students to fill in the answers as the animation is shown, pause at the appropriate times, or use the Handout as a review after the animation is complete.

Begin the presentation and pause where discussion is needed.

At the end of the PowerPoint presentation, review the cycle and consider where humans fit into the cycle of the leaf. Brainstorm with the students what impacts on biodiversity humans have, particularly in the riparian zone.

Ask

Where do humans fit in the cycle and how do we influence the ecosystem in the riparian area? *Humans have an impact at almost every step. Below are some examples:*

- *humans cut down trees in the riparian zone - remove leaves from the forest and material to feed microorganisms*
- *this also reduces the amount of trees that fall into the water that create habitat for fish and invertebrates*
- *humans put chemicals onto the ground and into the water - poor conditions for invertebrates to live*
- *humans capture fish - less food for larger fish as well as land predators like bear*
- *Ask the students for positive human impacts in a riparian zone*

Transition to next activity.

Activity (30 minutes)

Split the class into small groups or as individuals and take out pens and paper. Have the students create a 4 scene cartoon about organism interactions in a riparian zone. The cartoon can show a different example of a cycle like the *Fallen Leaf*, or it can be about one part of the cycle (e.g. fish eating invertebrates). Be creative!

Review (10 minutes)

Ask

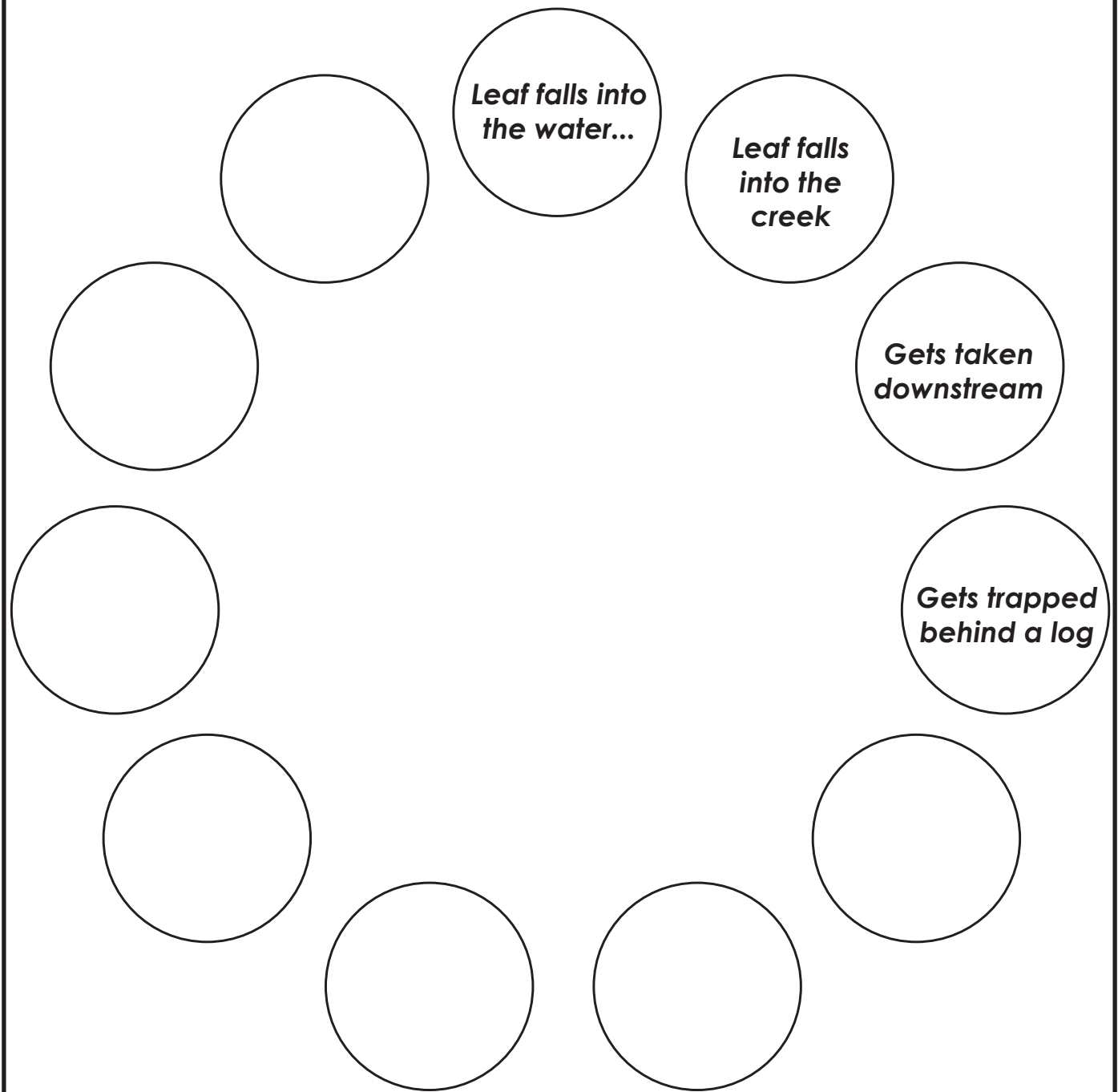
Considering all we have learned so far, why do we find higher biodiversity within the riparian zone? *Connection between land and water, lush vegetation due to presence of water, many areas for shelter for different organisms, abundance of food and water.*

The Fallen Leaf

A leaf falls from a tree in the riparian zone. What happens?

Fill in the circles with the next steps in the life cycle of the leaf and ecosystem. When you are done, illustrate the story in the centre of the circle.

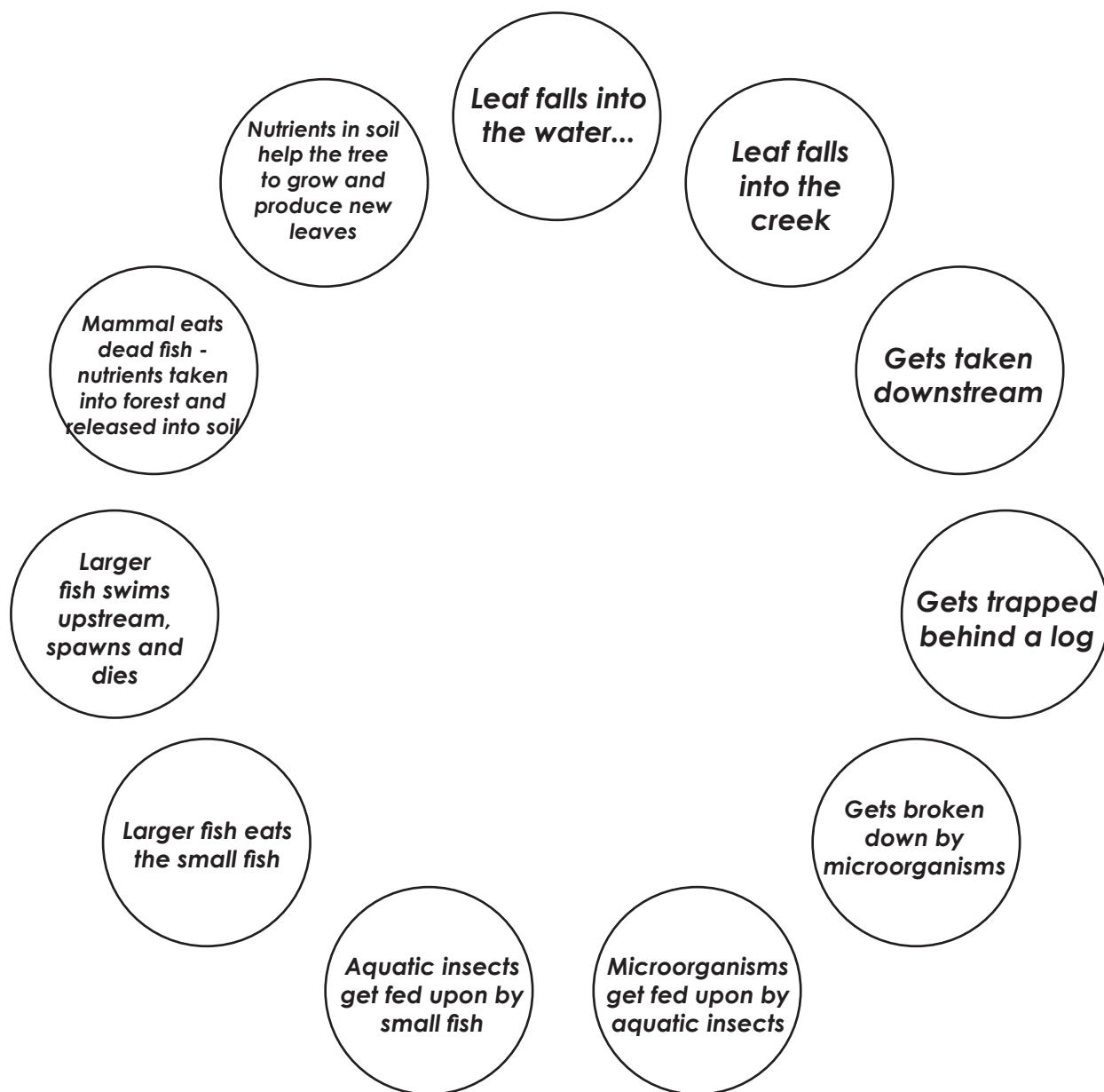
BONUS: Where would humans be put into this cycle? How do humans influence this cycle?



The Fallen Leaf - Answer Key

A leaf falls from a tree in the riparian zone. What happens?

Fill in the circles with the next steps in the life cycle of the leaf and ecosystem. When you are done, illustrate the story in the centre of the circle.



Ecosystem Cartoon

Create your own ecosystem cartoon, showing organisms interacting (in funny ways) in a cycle like the *Fallen Leaf*. Or pick a part of the cycle and have some fun illustrating what is happening. Your cartoon can be set in a healthy or unhealthy riparian zone - up to you.

Be creative and have fun!

Lesson 2-4: Nechako White Sturgeon Habitat and Humans

Time of Lesson: 1.5 hours

Instruction Objectives: Students understand the basic habitat needs of Nechako white sturgeon. Students can identify human made impacts to riparian zones that impact biodiversity, river habitat, water quality and watershed health. Relate these impacts to Nechako white sturgeon.

Strategies and Activities: Read and discuss the poem *Sturgeon*, review sturgeon habitat needs and discuss impacts by humans on sturgeon habitat. Create a poem about Nechako white sturgeon.

Materials:

- Handout: *Worksheet 2e - Sturgeon Poem*. Go to <http://www.lornacrozier.ca> for more information about the poet.
- Handout: *Worksheet 2f - Habitat Requirements T-Chart*.
- SMARTboard Interactive Activity: *Habitat T-Chart*
- Experiment: 2 glass jars, access to water tap, a sunny spot and a shady spot in the classroom, thermometer.
- Activity: Paper, pens, pencils to create poem.

Student Assessment:

- Observation and participation in class and small group activities.
- Ability to identify basic habitat needs of Nechako white sturgeon.
- Understanding of how humans influence sturgeon habitat specifically in the Nechako Watershed.

LESSON PLAN

Experiment (5 minutes)

Conduct an in-class experiment. Fill two jars up with water. Place one in the sun and one in the shade. Leave the jars for at least 30 minutes. The jars will be discussed later in the lesson.

Ask

What do you think this experiment is testing for? *Test how having no shade can increase the water temperature.*

What do you predict will be the outcome? *Sunny jar will be warmer.*

Introduction (20 minutes)

Discuss the habitat requirements of Nechako white sturgeon. This topic will be covered in more detail in Unit 3, however a basic understanding is needed here to help relate sturgeon population health to river habitat, riparian zone ecosystem, watershed health and human influences.

On the white board, brainstorm the habitat requirements of Nechako white sturgeon.

Ask

What are the habitat requirements of sturgeon - or in other words, what types of areas or conditions do Nechako white sturgeon need in the river to survive? Consider the different life stages.

Eggs

- Clean, rocky substrate in turbulent river habitats (eggs stick to rocks)
- Temperatures of 14 – 18 degrees Celcius for optimum incubation
- POOR HABITAT: extreme water temperatures, abrupt temperature changes, contaminants, shallow water, low velocity, sediment accumulation silt, sandy river bottom

Larvae

- Require clean, rocky substrate in turbulent river habitats (for hiding and eating)
- POOR HABITAT: extreme water temperatures, abrupt temperature changes, contaminants, shallow water, low velocity, silt, increased water clarity, reduced food availability

Juveniles/Sub-adults/Mature adult population

- Deep pools, slow back eddies (to hide and rest)
- Lakes in the winter months (sometimes)
- Fast flowing areas below rapids (good place to get food)
- Prefer deep and faster flowing areas to spawn

Transition to next activity.

Activity (30 minutes)

Pass out the Handout *Worksheet 2e - Sturgeon Poem*. Read the poem out loud to the class. Stop to provide definitions of words or explain ideas. Have the students write comments or draw images of what they understand about the poem on the Handout. Allow for a classroom discussion.

Ask

What does this poem tell us about Nechako white sturgeon habitat? *Inhabits deep, cool water. In lakes. They live and eat at the bottom of the river or lake.*

What else does this poem tell us? *Human catch and eat sturgeon. Humans don't fully understand the sturgeon and our actions have an impact on their overall survival.*

Transition to next activity.

Experiment (15 minutes)

Recover the jars and record the water temperature from each jar. Write these on the white board and discuss the results. The results should show that the sunny jar was warmer. As previously discussed, eggs and young sturgeon and salmon do not prefer warm water temperatures. Salmon are a food source for sturgeon. If water temperature is too high, salmon survival is low and there is less food for sturgeon.

Ask

What factors cause water temperature in a river to rise? *Reduced riparian zone/vegetation that shades the river and water. Shallower water from dam activity or a naturally dry season.*

Are these factors natural or human made? *Both but mostly human made.*

Relate the discussion back to Nechako white sturgeon and the Nechako River.

This experiment is just one example of how humans can have an impact on riparian ecosystem health and river habitat, particularly for sturgeon and other fish that they eat. Hand out *Worksheet 2f - Habitat Requirements T-Chart*. Use the SMARTboard Interactive Activity: *Habitat T-Chart* on the SMARTboard if desired.

Ask

List other human impacts to sturgeon habitat and their food sources (salmon and invertebrates) that are specific to the Nechako Watershed.

Often culverts under roads (paved and gravel roads) are not installed properly and they block access for smaller fish (food source) to their spawning areas, thereby reducing the amount of small fish to feed upon.

Kenney Dam reduces the overall amount of water and depth of the river. This can be harmful for spawning, eggs and juvenile fish in particular.

Logging and agricultural practices tend to reduce the amount of riparian vegetation available along rivers, which can affect water temperature, food source and bank stability (additional sediment from erosion of stream banks can cover gravel beds needed for eggs and small sturgeon).

Transition to next activity.

Activity (20 minutes)

Have students work individually or in groups to create an original poem about the Nechako white sturgeon. Use the poem *Sturgeon* as an example, however the students' poem can be as simple as two or three lines. The poem should include details about sturgeon habitat and what factors impact their habitat and survival.

If time permits, have the students illustrate their poems and either present orally to the class or post on the wall for other classes to read.

Sturgeon Poem

Read the poem *Sturgeon*. This is a free verse poem with ideas that flow like ripples in a river. Remember when you read to follow the punctuation marks so the meaning is clear. Use the space beside the poem to write or draw what you understand about the poem. What is happening to the sturgeon in the poem? Where does the sturgeon spend its time within the river? Does the poet tell a happy or sad story in this poem?

Sturgeon

By Lorna Crozier
(from *Inventing the Hawk*)

Bottom feeders, the sturgeon move
their long snouts through the darkest part
of water, unchanged, Antediluvian
they are older than the oldest man,
older than any spirits of the air
Grandmother, grandfather, fish,
surely they are holy, worshipped
by the shamans when our world
was full of wonder. Too huge to hold
in the mind, they may be
what we have called Ogopogo, Loch Ness
fabulous, long-necked monsters
of the lakes, solitary, shy of man...
They are a heavy, bony fish
with thick sucking lips. They are
edible, their eggs consumed as caviar
black translucent pearls
the female lays after twenty years
without a mate.
Though they move
where light cannot reach them
as we move each night in dream,
unchanged, we pull them from
the bottoms of lake or river or sea
without awe or mercy,
thrust them into the sun
their old toothless mouths large as caves
their stunned eyes holding at the last
instant of their ancient lives
a human face.

Habitat Requirements T-Chart

Fill in the following chart with what you have learned about sturgeon habitat needs and how humans impact them (negatively and positively) in the Nechako Watershed.

<i>Nechako white sturgeon habitat requirements</i>	<i>Human Impacts in the Nechako Watershed</i>

Lesson 2-5: Recovery and Rehabilitation

Time of Lesson: 1.5 hours

Instruction Objectives: Students can identify restoration and rehabilitation projects in the Nechako Watershed specific to Nechako white sturgeon and overall watershed health.

Strategies and Activities: Definitions of recovery and rehabilitation. Review different types of project occurring for Nechako white sturgeon. Design a recovery/rehabilitation project.

Materials:

- PowerPoint presentation: *Recovery and Rehabilitation*.
- Handout: *Worksheet 2g - Recovery and Rehabilitation*.
- Activity: Restoration project - paper, markers, pencils and other craft material.
- Take home Handout: *Home Tips for Healthy Streams*

Student Assessment:

- Observation and participation in class and small group activities.
- Ability to define terms in lesson.
- Ability to identify areas along the river that need rehabilitation and why.

Review (10 minutes)

Review habitat requirements of Nechako white sturgeon and impacts from humans on these habitats from previous lesson.

Activity (20 minutes)

Bring up the PowerPoint presentation *Recovery and Rehabilitation* on the SMARTboard. The beginning of the slideshow is review from the first introductory lesson (Unit 1 Lesson 1-1). Flip through these slides and review information.

Stop at the 'First Definitions' slide and go through these two important definitions.

Recovery: a return to a normal state of health (of the population). Currently the population is so low that it needs help in recovering to a healthy level (over 2,500 animals). The population should also be self-sustaining in that it does not require the help of humans to sustain it through a hatchery program.

Rehabilitation: return to its former condition. Currently the shape, riparian zone and water in the Nechako River are very different than they were 20, 50, 100 years ago. Rehabilitation of areas along the river banks (e.g. planting trees) helps return the habitat to its previous condition. You can also use the word 'restoration'.

The remaining slides show some of the work being done by the NWSRI. The list is not complete. Please visit www.nechakowhitesturgeon.org for an up-to-date list of Current Projects. This section of the slideshow is intended to give examples of recovery and rehabilitation projects that can occur to help Nechako white sturgeon. It is not intended that the students understand the science or methodology of any of these projects.

Key Points

Research has to occur at all levels, from eggs to adult fish (food and growth), habitat (where they spawn, rest, eat), to water quality (what conditions are best). Often research leads to new questions and more research.

Public awareness is a huge part of recovery and rehabilitation.

Transition to next activity.

Activity (45 minutes)

Based on the information covered in this lesson and what the students have learned about human impacts to sturgeon habitat, have the students create a recovery or rehabilitation project/plan for Nechako white sturgeon.

Working individually or in small groups, use *Worksheet 2g - Recovery and Rehabilitation* as a starting point.

The project can be for any part of the sturgeon life cycle, a specific location on the Nechako River, it can include further research, etc. The projects should include:

- The goal of the project.
- Location of the project.
- Time line for completion of the project.
- Materials needed.

Be creative! Use craft materials etc. Encourage the plan to be colourful and clear on what they are planning and why.

Review (15 minutes)

At the end of the lesson, post the plans on the wall for the class to see.

Ask

What were some of the challenges you faced creating a recovery/rehabilitation plan?

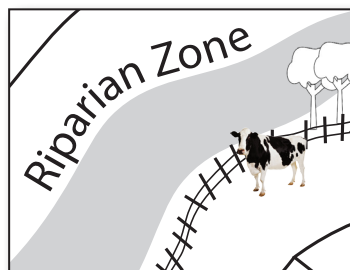
As the students leave, provide each student with the *Home Tips for Healthy Streams* pamphlet to take home to discuss with their parents.

Recovery and Rehabilitation

Because we know more about the importance of riparian areas to the health of watersheds, some riparian zones that have been damaged due to bad land use practices get **rehabilitated** (returned to original condition) through work done by volunteer groups, businesses and governments.

Example of rehabilitation project include:

- putting up fences along streams in agricultural lands so that farm animals can not walk in and damage the riparian zone
- putting rocks or log on stream banks that have been damaged



ACTIVITY: Open a magazine, book or go out to a local creek or lake and draw a cross-section of the riparian zone in the space below. Be specific - take note of the number and height of plants, evidence of animals, evidence of human impacts, type of stream banks etc. Circle the areas that are unhealthy in red and the areas that are healthy in green. On a separate piece of paper, describe a rehabilitation project that would improve the habitat within or along a river and how that would affect Nechako white sturgeon.

Lesson 2-6: Riparian Zones Field Trip

Time of Lesson: 2 hours (this time will vary depending on travel time and number of students attending)

Instruction Objectives: Student apply their classroom learning to the field.

Strategies and Activities: Students record observations and drawings of the riparian zone, do a species count and, if possible, a comparison between a mature and immature riparian zone.

Materials:

- Handout: *Worksheet 2c - Riparian Zones (if not completed in class in earlier lesson).*
- Handout: *Worksheet 2h - Biodiversity Inventory.*
- Movie: *Murray Creek Restoration Project* at www.newssociety.org
- Pencils, clipboards, paper, class camera.
- Guest Speaker: please contact NWSRI for a list of possible guest speakers to accompany your class. Alternatively, if you know of any biologists please invite them to attend and lead the students through the material.
- A bus for transport if necessary.

Student Assessment:

- Participation in field trip.
- Ability to identify components of the riparian zone and measure biodiversity.
- Ability to identify areas along the riparian zone that may need rehabilitation and why.

Field Trip (1-1.5 hours)

After arriving at the field trip site, review safety issues as well as respecting the river, river banks and the environment.

Key Points

Do not remove anything from the site!

Take caution when walking along the riparian zone, do not intentionally destroy vegetation or in-stream structures like logs.

Do not throw rocks into the water - this disturbs fish and can harm eggs and young fish.

Do not leave garbage at the site.

Have students break into groups of 10-15 students. Potential activities per group include:

- walk and observation of the riparian zone (*Worksheet 2c - Riparian Zones optional*)
- talk about fish and fish habitat and link to Nechako white sturgeon (by biologist)
- conduct biodiversity inventory (*Worksheet 2h - Biodiversity Inventory*)

It is recommended that the biodiversity inventory continue during the entire field trip. This allows the students to more accurately record all the different plants and animals they see.

Optional Activity

Assign each group with a camera to visually record different aspects of the riparian zone and river habitat. In a journal or piece of paper, record with each photograph: what the pictures show (e.g. healthy riparian zone, fish, bird track, etc.); why they took that photo; and where it was along the site (e.g. looking upstream or downstream, river right or river left, top, middle or bottom part of site).

Back in the classroom, have each group organize their photographs into a slideshow. Have them present their slideshow on the SMARTboard to the class and describe what they saw and learned during the field trip.

The location of the field trip is up to the teacher. If the teacher knows of an easily accessible stretch of creek, please contact the NWSRI so they can add it to this list. Below are suggested field trip locations that provide good opportunities for students to learn about the riparian zone, fish habitat, links to Nechako white sturgeon, and rehabilitation projects.

Field Trip Option 1: Murray Creek, Vanderhoof

The Murray Creek Demonstration Site is a rehabilitated section of the upper section of Murray Creek. Murray Creek flows from the Blue Mountain hills through agricultural and residential lands to the Nechako River. It empties into the north side of the Nechako River just upstream of the Burrard Street bridge, right at the Migratory Bird Sanctuary and the only known sturgeon spawning site.

The Murray Creek Rehabilitation Project is a long standing local restoration project to improve the habitat along and within Murray Creek to enhance a long lost sport fishery of rainbow trout, to educate ranchers and farmers on best practices along creeks, to improve water quality in support of downstream populations of Nechako white sturgeon and chinook salmon, and to provide hands-on experience to students.

The Demonstration Site is located on private land, but is accessible for school groups. There is plenty of room for busses to access the site and turn around, and the walking for students and educators is easy-moderate. There is a large billboard at the site that explains all the work that has been done at this site, as well as a brochure. The brochure is available online at www.newssociety.com, and on the accompanying CD.

Learning objectives on this field trip can include:

- visual understanding of the riparian zone.
- able to see examples of rehabilitation within a riparian zone and creek.
- link upstream areas and how they can affect downstream resources (e.g. sturgeon do not live in Murray Creek, but the quality of the water in Murray Creek can affect sturgeon).
- potential to see fish and other animals in their natural habitat.
- good location to conduct *Worksheet 2h - Biodiversity Inventory*.

Watch the short movie: *Murray Creek Restoration Project* at www.newssociety.org for a great overview of this project. Murray Creek is located about a 10 minute drive from downtown Vanderhoof. For directions please contact NWSRI.

Field Trip Option 2: Stoney Creek, Vanderhoof

Stoney Creek runs from Nulki Lake, over a series of falls into agricultural land, and then through residential Vanderhoof. It flows into the south side of the Nechako river at the Migratory Bird Sanctuary and then into the only known sturgeon spawning site.

Stoney Creek was part of the traditional fishery for Saik'uz First Nation. Chinook salmon and coho salmon spawn in this river.

There is a walking trail and bridge over Stoney Creek that is a easy walk and is in sight of the Nechako River. Stoney Creek provides a good example of a stream that

has direct impacts to the Nechako River. There are interpretive signs along the trail that speak to the positive and negative aspects of this river. The lower reach (along the trail) has been altered due to human impacts and the riparian zone is greatly impacted.

Learning objectives on this field trip can include:

- visual understanding of the riparian zone.
- obvious impacts from land use practices on the riparian zone and river habitat.
- linkage between improving habitat for salmon to allow greater food source for sturgeon.
- potential to see fish and other animals in their natural habitat, particularly from the walking bridge.
- interpretive signs add information about other aspects of the riparian zone.
- good location to conduct *Worksheet 2h - Biodiversity Inventory*.

Stoney Creek is located in Vanderhoof at the west end of Douglas Street. There is a bridge over the creek, with good access for busses. It is also walking distance from schools in downtown Vanderhoof.

Field Trip Option 3: Stellaquo River, Fraser Lake

The Stellaquo River is an important sockeye salmon spawning river. In the fall there are thousands of sockeye in the river for students to see. The river is very clear and access to the river at the gravel pit site* is possible for busses.

The Stellaquo River offers a good opportunity for students to see a relatively natural riparian zone. There is a trail along the river for students to explore the riparian zone.

The Stellaquo River feeds into Fraser Lake that Nechako white sturgeon have been known to use at different times of the year.

Learning objectives on this field trip can include:

- visual understanding of the riparian zone.
- link upstream areas and they can affect downstream resources.
- potential to see fish and other animals in their natural habitat.
- good location to conduct *Worksheet 2h - Biodiversity Inventory*.

*The Stellaquo River is located just west of Fraser Lake off of Francois Lake Road. For directions to the gravel pit site, please contact NWSRI.

Biodiversity Inventory

Biodiversity is the variety of life in the world or in a particular habitat or ecosystem. *The healthier the riparian zone, the greater the biodiversity.*

Conduct a biodiversity inventory (counting plants and animals) of a riparian zone. First, describe your riparian zone. Next write the names, draw a picture or use tally marks for each of the species you find in your site (evidence of an animal counts too, e.g. animals tracks). When you are done, what does your data tell you? Do you think this site is healthy or unhealthy? *OPTIONAL: Compare the biodiversity of an altered vs. unaltered or rehabilitated riparian zone to see if there is a difference in the number of species between the two habitats.*

Description of Riparian Zone	Biodiversity Inventory
Name of River: Tributary to what river?	Plants
What kind of riparian zone? ☐ Altered ☐ Rehabilitated ☐ Mature	Mammals
Length of inventory site: _____ m Date of inventory: _____	Fish, Reptiles and Amphibians
Do you think this is a healthy riparian zone? ☐ Yes ☐ No WHY or WHY NOT? _____ _____ _____ _____	Birds Invertebrates

UNIT 2 TEST

A number of test questions have been developed for this Unit. The questions include matching, labelling, True-False, and short answer in this document. Please feel free to customize the test for your class, considering the topics or materials you covered or focused on during the Unit.

You can find test questions for this Unit on the thumb drive that accompanies this curriculum:

- *Unit_2_Test.docx*

GRADE: _____ TEACHER: _____ SCHOOL: _____

Feedback Form for Unit 2

Please fill in the information below and return to the NWSRI. Please feel free to email any questions or comments to Lana Ciarniello at aklak@telus.net.

Background Information:

Is the information presented age appropriate and presented in an age appropriate manner? Yes or No

Was there enough information provided to conduct the lessons successfully?
Yes or No

If no, what additional information and/or resources would be useful?

Activities:

Were the activities engaging to the students? Yes or No

Was the timeline of the activities a good estimate?
Too Long ____ Too Short ____ Just Right ____

Any comments?

Worksheets:

Were the worksheets effective in teaching and/or reviewing the unit material?
Yes or No

Were the answer keys helpful? Yes or No

Additional Resources:

If used, were the resources suggested or provided for this unit useful? Yes or No

What else would you suggest be needed for this unit?

UNIT 3

THE NECHAKO WHITE STURGEON

OUR LOCAL PREHISTORIC GIANT

Introduction to Unit 3

Number of Lessons: 6

Duration of Unit: 3 weeks

Rationale/Overview: The purpose of this unit is for the students to identify and gain a deeper awareness of the endangered Nechako white sturgeon and the many challenges the species currently faces. Students need to become aware of local issues in order to connect to the Nechako watershed.

Background and Teacher Preparation Required: It would be beneficial if the students have already learned about the Nechako River (Unit 1 Introduction and/or Unit 2 Watershed, Riparian Zones and River Habitat).

Additionally, at any point in the Unit, teachers are encouraged to show all or parts of YouTube Video: *Every Sturgeon Counts*. This video provides a great introduction about the importance of Nechako white sturgeon, particularly for First Nations, but also on the anatomy and safe handling procedures for sturgeon.

The teacher touches base with local expert(s), such as Cory Williamson or Brian Frenkel of the Nechako White Sturgeon Recovery Initiative (www.nechakowhitesturgeon.org).

Unit Project: Teachers are encouraged to have students complete a Unit Project. This project is additional to the curriculum, and can be done outside classroom time. Teachers are welcome to provide class time to work on this project. The project provides an opportunity for students to be creative and use all their learning to create a skit about the day in the life of a Nechako white sturgeon. See Handout.

Cross-Curricular Connections: Math, Fine Arts, Language Arts, Social Studies, P.E.

Resources: Bulletin board for art projects; art materials/dress-up clothes; Nature Guide of the Nechako Valley; PowerPoint Presentations; model of a sturgeon; Sturgeon life cycle poster; computers; science journals, SMARTboard, whiteboard, markers, maps of the Nechako, Fraser, Columbia and Sacramento watersheds; guests/local experts; outdoor clothing; cameras/phones; websites:

<http://www.uppercolumbiasturgeon.org>

<http://www.dfo-mpo.gc.ca>

<http://www.wildbc.org/publications-resources/waterstewardship/guide.pdf>

<http://www.deepspacesparkle.com>

<http://www.env.gov.bc.ca/wld/fishhabitats/sturgeon/index.html>

<http://www.youtube.com/watch?v=YhrEJUEi-ow> - YouTube video!

Brochure: 2010 Reducing By-Catch Brochure.pdf (available on thumb drive)

Overview of Lessons

LESSON 3-1: NECHAKO WHITE STURGEON ANATOMY - FORM & FUNCTION

Time of Lesson: 1 hour

Instruction Objectives: Student can identify 5-10 external parts of the sturgeon.
Introduce Unit Project: *My Nechako white sturgeon*.

Strategies and Activities: Life size replica of the Nechako white sturgeon with worksheet, and display model. Introduce Unit Project and discuss.

Materials:

- SMARTboard PowerPoint presentation: *NWS External Anatomy*
- Handout: *Worksheet 3a - Nechako White Sturgeon External Anatomy*
- Handout: *Worksheet 3b - Venn diagram: Sturgeon versus Sockeye Salmon*
- Display: *Life-size Nechako White Sturgeon* replica available from NWSRI
- YouTube Video: *Every Sturgeon Counts - Part 5*
(<http://www.youtube.com/watch?v=YhrEJUEi-ow>)
- Handout: *Unit Project - My Nechako white sturgeon*

LESSON 3-2: LIFE CYCLE

Time of Lesson: 1 - 1.5 hours

Instruction Objectives: Students can illustrate the life cycle of the Nechako white sturgeon.

Strategies and Activities: Brainstorm about what students know about the life cycle of the Nechako white sturgeon. Use the 'Every Sturgeon Counts' video to inform students about real-life interactions with sturgeon. Use art activity and student lead discussion to promote understanding of each life cycle stage. Encourage work on Unit Project.

Materials:

- SMARTboard PowerPoint Presentation: *NWS Life Cycle*
- Handout: *Worksheet 3c - Nechako White Sturgeon Life Cycle*.
- YouTube Video: *Every Sturgeon Counts - Part 1*
(<http://www.youtube.com/watch?v=YhrEJUEi-ow>)
- Class Activity: Art supplies including large paper, markers, scissors, cut-outs etc.

LESSON 3-3: STURGEON HABITAT

Time of Lesson: 1 hour

Instruction Objectives: Students can explain the habitat requirements of Nechako white sturgeon.

Strategies and Activities: Discuss habitat requirements of the Nechako white sturgeon. Allow work on Unit Project.

Materials:

- SMARTboard PowerPoint presentation: *NWS Habitat and Food*
- Handout: *Worksheet 3d - Habitat & Food*.
- Handout or Interactive: *Worksheet 3e - Wordsearch Review*

LESSON 3-4: STURGEON DECLINE

Time of Lesson: 1.5 hour

Instruction Objectives: Students can reflect on how the environment of the Nechako white sturgeon has changed over the past 100 years, and how that has affected the survival of the species.

Strategies and Activities: Discuss how the habitat in the Nechako River for the sturgeon has changed over time, from 10,000 years ago to 100 years ago to now. Brainstorm on the meanings of 'adaptation' and 'survival' and relate to human experiences, re-examine the life cycle and link life cycle, habitat and survival together. Review restoration projects currently occurring for Nechako white sturgeon. Allow work on Unit Project.

Materials:

- YouTube Video: *Every Sturgeon Counts - Part 4*
(<http://www.youtube.com/watch?v=YhrEJUEi-ow>)
- SMARTboard PowerPoint presentation: *NWS Decline*
- Website: www.nechakowhitesturgeon.org for a list of current restoration projects.

LESSON 3-5: GUEST SPEAKERS AND FIELD TRIP

Time of Lesson: 1.5 hours

Instruction Objectives: Students can demonstrate an overall understanding of Nechako white sturgeon life history and habitat needs and how these relate to overall survival of the species. Students participate in field trip and/or host guest speakers in classroom. Students can identify First Nations traditions in relation to the Nechako River and the Nechako white sturgeon.

Strategies and Activities: Have local experts attend class to speak in regards to the Nechako white sturgeon (local biologist and First Nations guest speaker), and/or go to Nechako White Sturgeon Conservation Centre for a tour. Discussion about the value the Nechako white sturgeon holds for the students and what it would mean to them if it became extinct. Allow work on Unit Project.

Materials:

- Guest Speaker: Local First Nation speaker (contact NWSRI for contact details or contact local First Nation Band Office directly).
- YouTube Video: *Every Sturgeon Counts - Part 2* (<http://www.youtube.com/watch?v=YhrEJUEi-ow>)
- Field Trip: Nechako White Sturgeon Recovery Centre in Vanderhoof. Contact the Centre or the Nechako White Sturgeon Recovery Initiative for details and to book the tour. Extend the tour to a walk along the Nechako River to view the spawning site (just upstream of Burrard Avenue).
- If unable to get to the Recovery Centre, invite Guest Speaker to the classroom: Local biologist and/or White Sturgeon Recovery Centre coordinator (contact NWSRI for contact details or Contact the Centre or the Nechako White Sturgeon Recovery Initiative directly).

FUTURE CONSIDERATIONS: Sturgeon release event (fall 2014 and beyond).

LESSON 3-6: PRESENTATIONS

Time of Lesson: 1.5-2 hours

Instruction Objectives: Students conduct oral presentations of Unit Project to class.

Strategies and Activities: Students present their Unit Project to the class.

Materials:

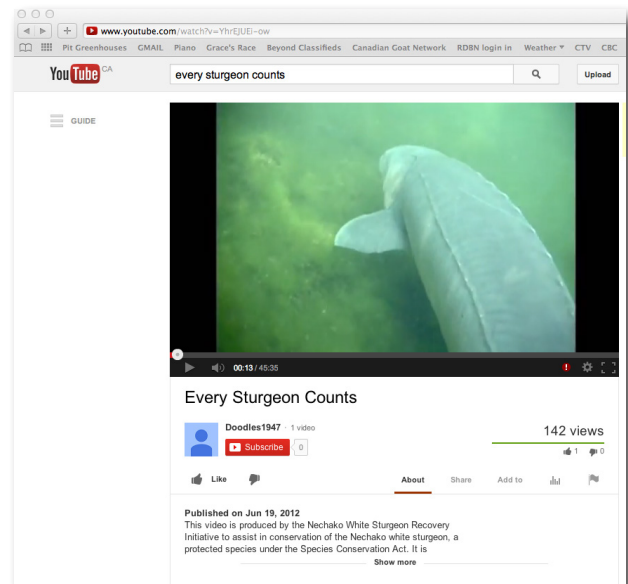
- Projector, SMARTboard, whiteboard, etc. as needed for presentations.

Every Sturgeon Counts

Found at: <http://www.youtube.com/watch?v=YhrEJUEi-ow>

This video was put together by the Nechako White Sturgeon Recovery Initiative and the Carrier Sekani Tribal Council. The objective of this project is to: 'assure that fisher families have the necessary tools in their fishing boats to allow for the successful release of live sturgeon caught in a gill net.'

Cora McIntosh of Saik'uz First Nation, narrates this informative video on the importance of Nechako white sturgeon to the Nechako River, First Nations and to the history of our area. The video is a very good addition to this curriculum and should be shown in part or its entirety during the course of this curriculum. Lesson suggestions are given below.



Total length of the video is 45:35 minutes. It is broken down into several sections.

- **Defining the Problem, Recruitment Failure:** 00:00 to 04:10
A quick and clear overview of the plight of the Nechako white sturgeon. Useful to be viewed in Unit 1 Lesson 1-1 Introduction, or Unit 3 Lesson 3-2 Life Cycle.
- **Salmon, Sturgeon and First Nations** 4:10 to 16:40
This section focuses on local First Nation culture and history with the Nechako River, salmon, Stuart Lake, and Nechako white sturgeon. A good addition to Unit 1 Lessons 1-1 and 1-2; Unit 3 Lesson 3-5.
- **About the Sturgeon Release Kit and Program:** 16:40 to 21:25
Details about this program operated by the NWSRI.
- **Procedure for Releasing Sturgeon Safely:** 21:26 to 31:20
Recommended to show this section during Unit 3 Lesson 3-4 Sturgeon Decline. This section highlights the impact humans can have on sturgeon as well as showing students how to reduce the risk of injury or death of the animal if it is caught in a net. Also demonstrates a practical use of science and research that leads to conservation of a species.
- **Sturgeon Anatomy:** 32:57 to 34:10
Overview of sturgeon anatomy using a live sturgeon in the river. Fits nicely with Unit 3 Lesson 3.1 External Anatomy.
- **Patching a Gill Net:** 34:13 to 43:17
A detailed lesson on repairing nets.
- **Closing Remarks about being Stewards of the Sturgeon:** 43:18

Unit Project:

A day in the life of my Nechako white sturgeon



As individuals or in small groups, write and act out a **skit about a typical day in the life of a Nechako white sturgeon** - your Nechako white sturgeon. Use what you have learned throughout this unit, as well as other units about sturgeon to create your skit.

The skit **must** include:

1. the name and general description of your sturgeon (include an image that can be a real photo or an image you create).
2. where your sturgeon lives (be specific).
3. at minimum three things that happen to your sturgeon, or that your sturgeon does in his/her day.
4. your script (e.g. a journal entry) handwritten on paper that you hand in to your teacher. Your script has to include everything you are going to do in your skit.

Other Requirements:

- It should be no longer than 3 minutes long.
- You can use graphics, the SMARTboard, props etc.
- You are allowed to do further research on Nechako white sturgeon for more information, but you must show where you found your information if you learned it outside the classroom.

Things to consider:

- are there any issues or concerns for your sturgeon?
- is your sturgeon from now, long ago or the future?
- use your imagination!!! It can be a fantasy, but it has to include real elements that you learned in class, e.g. things happening to sturgeon today in the Nechako River.

BE CREATIVE AND SPECIFIC!!! HAVE FUN!!!

This project is due: _____



Unit Project:

A day in the life of **my Nechako white sturgeon**

Select either individuals or in small groups for this project. Students can work in or outside classroom time for this project.

The skit **must** include:

1. the name and general description of your sturgeon (include an image that can be a real photo or an image your create).
2. where your sturgeon lives (be specific).
3. at minimum three things that happen to your sturgeon, or that your sturgeon does in his/her day.
4. your script (e.g. a journal entry) handwritten on paper that you hand in to your teacher. Your script has to include everything you are going to do in your skit.

Other Requirements:

- In addition to the requirements already included, add your own requirements as suitable for your classroom and class population.

Encourage students to:

- be creative - think outside the box
- seek outside information - particularly from First Nation family or community members
- set their story in another time period or do a comparison between the past and now, or now and the future
- if the student is shy, encourage an exceptional written product and the use of graphics and the SMARTboard to do the talking for the oral component

HAVE FUN!!!

Lesson 3-1: Nechako White Sturgeon External Anatomy - Form & Function

Time of Lesson: 1 hour

Rationale: The purpose of this lesson is to describe the external anatomy of the Nechako white sturgeon and relate its form with how it lives in its environment (function). This lesson introduces the Unit Project, which will allow students to summarize all they have learned about the Nechako white sturgeon.

Instructional Objectives: Student can identify 5-10 external parts of the sturgeon. Introduce Unit Project: *My Nechako white sturgeon*.

Strategies and Activities: Life size replica of the Nechako white sturgeon with worksheet, life cycle poster, art project. Present Unit Project and discuss.

Materials:

- SMARTboard PowerPoint presentation: *External Anatomy of Nechako White Sturgeon*
- Handout: *Worksheet 3a - NWS External Anatomy* (double-sided)
- Display: *Life-size Nechako White Sturgeon* replica available from NWSRI
- YouTube Video: *Every Sturgeon Counts - Part 5* (<http://www.youtube.com/watch?v=YhrEJUEi-ow>)
- Handout: *Unit Project - My Nechako white sturgeon*

Student Assessment:

- Observation and participation in class and small group activities.
- Ability to identify the external parts of the sturgeon and relate those to function.
- Completion of Handouts.

LESSON PLAN

Introduction (5 minutes)

Introduce the new Unit and the rationale:

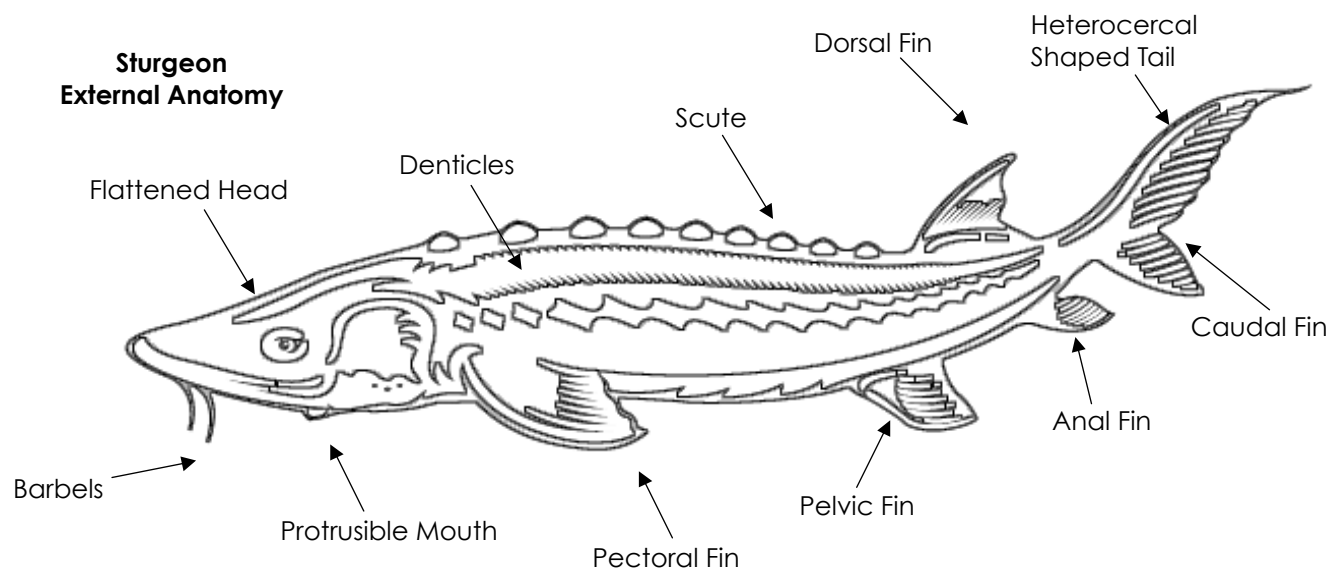
- To identify the shape and life cycle of the Nechako white sturgeon and relate this information to how and where it lives and what it needs to survive.
- To gain a deeper awareness of the endangered Nechako white sturgeon and the many challenges the species currently faces.

Activity (5 minutes)

Introduce the Unit Project: *My Nechako white sturgeon* and provide Handout. Answer any questions about the project. Give a clear timeline for the project.

Activity (10 minutes)

Show the plush display model of the Nechako white sturgeon. Have students gather round, touch it and name as many parts of the sturgeon that they know already.



Activity (10 minutes)

On SMARTboard bring up YouTube Video: *Every Sturgeon Counts* (<http://www.youtube.com/watch?v=YhrEJUEi-ow>). Scroll to Part 5 at the 32 minute and 57 second mark. Watch the roughly 2 minute video on sturgeon external anatomy.

Activity (20 minutes)

Have PowerPoint presentation *NWS External Anatomy* on the SMARTboard. By looking at an animal, we can learn a lot about how it lives by the shape of its body. Start a short discussion about **Form & Function**. Write on white board the students' comments.

Key Points

Every animal (and plant) has a shape that is made up of a number of body parts. Each body part has a FORM or SHAPE. The form (e.g. shape of the head) of the body or body part determines how the animal will move, eat, mate, protect itself etc. This is the FUNCTION.

Form influences function and function influences form.

Over a very long, long time form-function can change depending on changes in the environment. If the change in the environment is 'sudden', the animal may go extinct.

Go through *NWS External Anatomy* on the SMARTboard. Stop where necessary to discuss the content. Handout *Worksheet 3-1a External Anatomy* prior to or after working through the slideshow.

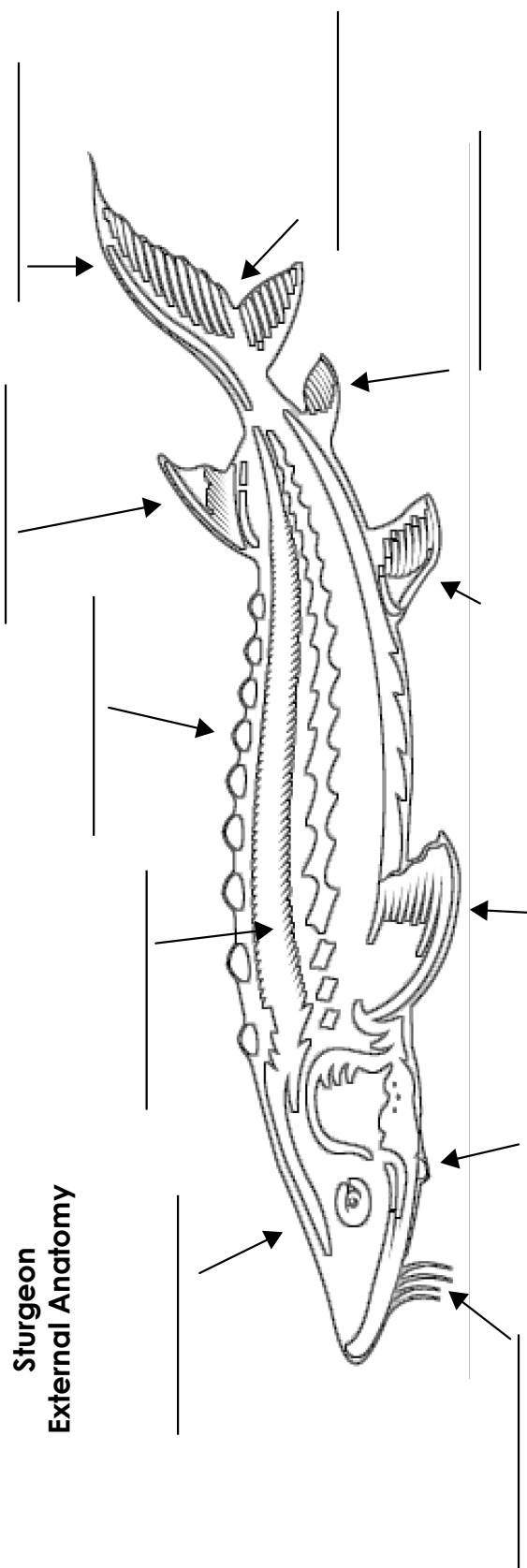
Ask

What does the body form of the Nechako white sturgeon tell us about how it moves, eats, and protects itself?

Form	Function
Flattened Head	Shaped for bottom feeding.
Protrusible Mouth - comes out of the body.	Mouth comes out of body and suctions food off the river bottom.
Barbels - 4 located under the head ahead of the mouth.	Sensory. Used to smell for food. Useful in murky or dark water.
Dorsal Fin - fin on the back of the sturgeon.	Used for stabilizing and preventing rolling.
Caudal Fin - heterocercal , meaning that the top is longer than the bottom.	Used for propulsion.
Anal Fin - located near the anus.	Used for stabilization
Pelvic Fin - located ahead of the anal fin.	Used for stopping and turning and movement up and down the water column
Pectoral Fin - fins closest to the head.	Used for stabilization and downward movement.
Denticles - type of small toothlike plate - no scales on a sturgeon.	Used for protection against other fish. Smooth in one direction (head to tail), rough in the opposite.
Scute - large sharp scales. There are five rows of scutes on the body of a sturgeon.	Used for protection. Sharper in juvenile sturgeon because they are smaller and have more chance of predation. Easy to cut your hand on a scute.

Sturgeon do not have bones, but a **cartilaginous skeleton**.

Does the sturgeon have a bony or cartilage skeleton?



Nechako White Sturgeon External Anatomy

Fill in the boxes with the body FORM and its FUNCTION.

FORM	FUNCTION

Lesson 3-2: Nechako White Sturgeon Life Cycle

Time of Lesson: 1.5 hours

Rationale: The purpose of this lesson is to introduce the life cycle of the Nechako white sturgeon to further develop the students' understanding of the Nechako white sturgeon. Understanding the life cycle of a species helps foster a greater respect for all sizes of animal as well as time of year, as well as make the connection between animal, habitat and season.

Instructional Objectives: Students can illustrate the life cycle of the Nechako white sturgeon.

Strategies and Activities: Brainstorm about what students know about the life cycle of the Nechako white sturgeon. Use the 'Every Sturgeon Counts' video to inform students about real-life interactions with sturgeon. Use art activity and student lead discussion to promote understanding of each life cycle stage. Encourage work on Unit Project.

Materials:

- SMARTboard PowerPoint Presentation: *NWS Life Cycle*
- Handout: *Worksheet 3b - Nechako White Sturgeon Life Cycle (2 page Handout)*.
- Handout: *Worksheet 3c - Venn diagram: Sturgeon versus Sockeye Salmon*
- YouTube Video: *Every Sturgeon Counts - Part 1*
(<http://www.youtube.com/watch?v=YhrEJUEi-ow>)
- Class Activity: Art supplies including large paper, markers, tape etc.

Student Assessment:

- Observation and participation in class and small group activities.
- Ability to identify the stages of the life cycle.
- Participation and quality of work in class activity.
- 'Ticket out the Door' "Tell me one stage of the life cycle of the Nechako white sturgeon."

LESSON PLAN

Activity (5 minutes)

Brainstorm about what the students already know about the life cycle of fish in general or specifically the Nechako white sturgeon.

Activity (10 minutes)

Call up the YouTube Video: *Every Sturgeon Counts* (<http://www.youtube.com/watch?v=YhrEJUEi-ow>) on the SMARTboard. Watch Part 1 (00:00 to 04:10). This video provides a simple and clear introduction to the life history of the Nechako white sturgeon as well as the issues it faces for continued survival.

Key Points

Nechako white sturgeon are endangered, there are less than 350 animals in the river.

The factors leading to the observed **recruitment failure** (the number of young surviving to adulthood and reproducing) is not completely understood. Research and education continue.

Activity (25 minutes)

Handout *Worksheet 3b - Nechako White Sturgeon Life Cycle*. Draw attention to the life cycle diagram and point out the 5 main stages - Adult, Spawning, Eggs, Larvae and Juvenile. Have students follow along as they watch the PowerPoint presentation. Show *Nechako White Sturgeon Life Cycle* PowerPoint presentation.

Ask

What life cycle stage is causing recruitment failure and the decline of the species? *The egg to juvenile stage. Very few young sturgeon currently in the river.*

Life cycle facts

Because sturgeon are so long lived they reach maturity at a much later age than most species. **Female reach maturity at 40 years of age, males reach maturity in their 20-25 years old.**

Mature sturgeon spawn between **May to July** when the water temperature is between **14-18°C**.

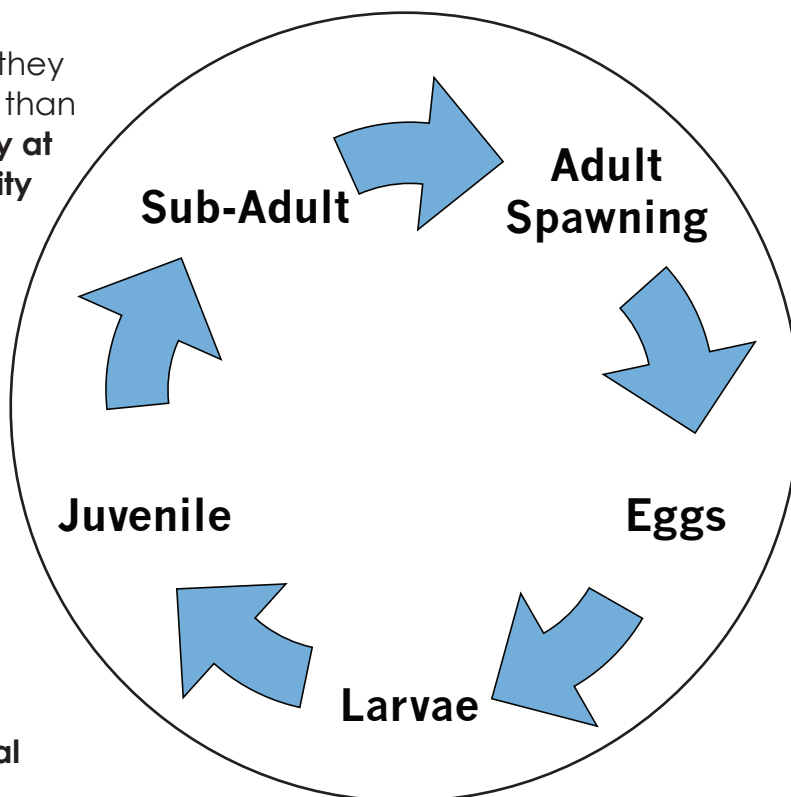
High-quality spawning habitat needs the following conditions:

- substrate – **clean stones-gravel to large rocks**, not sand
- water velocity – **swift flowing water**
- depth – **deep water**

A single female can produce **several million eggs**. They **spawn every 3 to 6 yrs**. **Whether a female spawns depends on having an adequate spawning site, and the proper water temperature**. If conditions are unfavourable she will **reabsorb** her eggs and miss spawning that year.

Female sturgeon **broadcast (releases) their eggs into water**, one or more male sturgeon then fertilize the eggs. In the Nechako River, only one known spawning site has been identified - in proximity to the bridge in Vanderhoof.

Once fertilized **eggs sink to the bottom and adhere to plants and rocks**. If too much sand is in the gravel, the eggs can not adhere and they drift downstream. Also, they get covered with sand and can not 'breathe' so they choke and die.



Eggs hatch between 7 and 10 days (cooler temperatures cause them to hatch later) into **tadpole like larvae**. The larvae hide in the gravel and live off their **yolk sac for the first 12 days** and then start to feed on **aquatic insects and zooplankton**.

After **20 days larvae develop into juveniles and emerge to find habitat in the river**. They resemble their parents with a full set of scutes, and fins.

White sturgeon are vulnerable throughout their egg and larvae stage. In areas of poor habitat they are **susceptible to predation, and lack of food**. **Less than 0.1 percent of juveniles survive past their first year**.

Lack of young sturgeon surviving to reproductive again = recruitment failure.

Activity (20 minutes)

Gather craft supplies including large paper, markers and tape. Have students split into groups of 2 or 3. Each group selects a life cycle stage and illustrates their paper with words and images of key points from that life cycle stage (note, more than one group will have each life cycle stage). After 10 minutes have the groups tape their papers around the room, in the order of the life cycle. Have the students cycle around the room to view each other's work, or the teacher can walk around and read out each group's responses and have a class discussion considering the following questions:

Ask

How important is habitat and river conditions to sturgeon spawning and egg development?

How much impact do predators have on sturgeon survival?

What things do we do along the Nechako River and in the watershed that may impact sturgeon spawning conditions?

Activity (15 minutes)

If the class has covered the salmon life cycle recently and/or is familiar with the salmon life cycle, Handout *Worksheet 3-1c Venn Diagram: Sturgeon vs. Sockeye Salmon*. Have the class work in small groups or as a class to complete the Venn Diagram. See the answer key of the worksheet for hints.

Key Points

Nechako white sturgeon have a very different life cycle and spawning behaviour than salmon.

Sturgeon and salmon both require clean gravel and swift water for successful spawning.

OPTIONAL CONTENT: Aging Sturgeon

Offer this information to students if time permits and/or interest from the class.

How to age a sturgeon: Because a sturgeon does not have scales, scientists use a small piece of the **sturgeon's pectoral fin to determine their age**. The rays are finger like pieces of bone which give a fin its strength. Like the rings of a tree, **layers are added to a ray each year**. These layers can then be counted to provide the sturgeons' age. Like a tree the space between the layers show how fast the sturgeon is growing.

Procedure for collecting fin sample for aging: To provide consistency, sampling of the fin ray is always done in the same place and in the same way. A small section of the left pectoral fin ray is cut using a hacksaw blade. Once this is done a scalpel is used to completely remove the sample from the rest of the fin. Finally, using a jeweller's saw the sample is cut into 4 to 6 cross sections. Cross sections are then mounted onto slides, which can be viewed under a microscope.

Closure (5 minutes)

Review the five stages of the sturgeon life cycle.

Ask how the information learned today can add to their Unit Project.

Nechako White Sturgeon Life Cycle

SUB-ADULT

What defines a sub-adult? _____

 _____.

ADULTS & SPAWNING

Female Nechako white sturgeon spawn at _____ years old. Males at _____ years old.
 Sturgeon spawn when river conditions are just right!
 Time of year: _____
 Water temperature: _____
 Substrate: _____
 Water Speed: _____ Depth: _____

JUVENILE

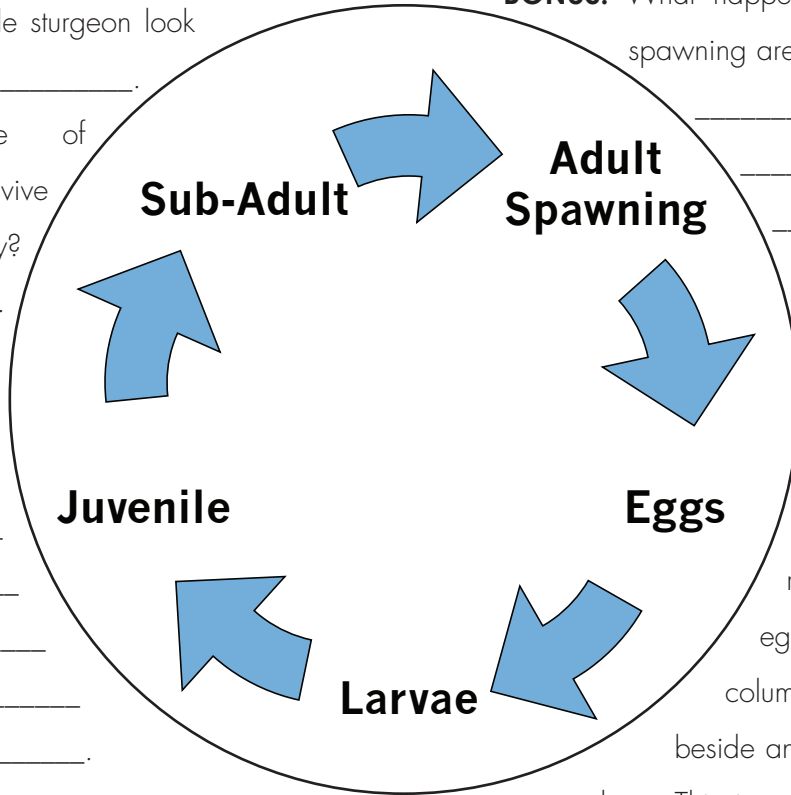
Juvenile sturgeon look like _____.
 What percentage of juvenile sturgeon survive past their first birthday?
 _____.

BONUS: Name four potential predators that feed on juvenile sturgeon. _____

 _____.

BONUS: What happens if the conditions for spawning are **not** adequate? _____

 _____.



EGGS

Female white sturgeon release _____ eggs into the water column and the male swims beside and release milt to fertilize them. This is called _____ spawning. The eggs then _____
 _____ on the river bottom.

Eggs hatch within _____ days.

BONUS: What water condition causes the eggs to take longer to hatch? _____
 _____.

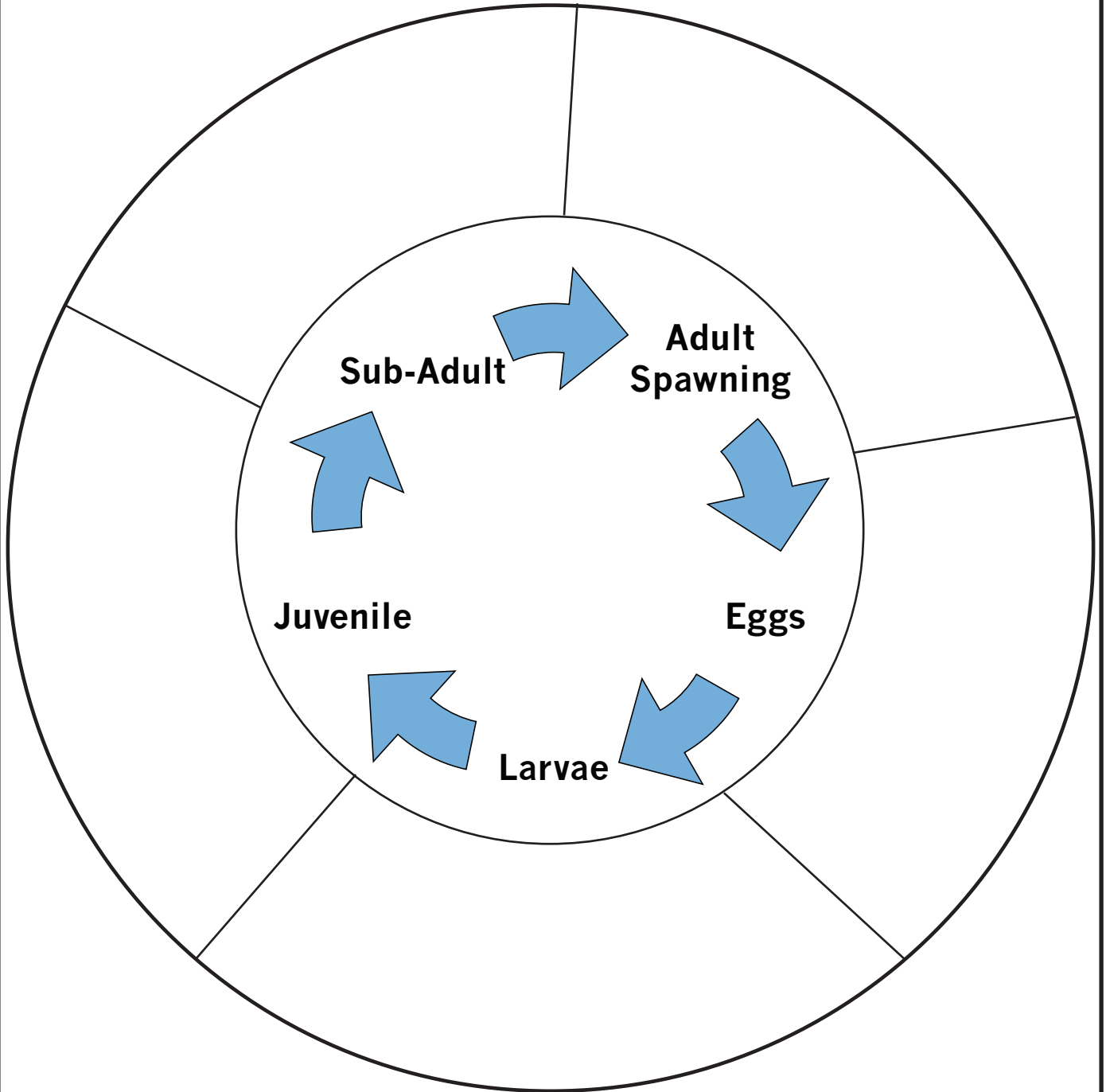
LARVAE

larvae look like _____. They get their food from their _____ for the first _____ days. After that they eat _____
 _____. After another _____ days they are called juveniles.

BONUS: Where do you think larval sturgeon are found in the river? _____.

Nechako White Sturgeon Life Cycle

Draw a picture of a Nechako white sturgeon at each life cycle stage: Adult-Spawning, Eggs, Larvae, Juvenile and Sub-Adult. BONUS: At each life cycle stage include what habitat is needed by Nechako white sturgeon.



Nechako White Sturgeon Life Cycle - Answer Key

ADULTS & SPAWNING Female Nechako white sturgeon spawn at **40** years old. Males between **teens to 20s** years old. **BONUS:** Why? **Because they are a long lived species.** Sturgeon spawn when river conditions are just right!

Time of year: **May-July** Water temperature: **14°-18°C** Substrate: **Clean gravel to rocks, no sand (if too much fine substrate the eggs do not survive)** Water Speed: **fast** Depth: **deep**

BONUS: What happens if the conditions for spawning are **not** adequate? **The female resorbs the eggs and waits from 4-5 years later to spawn.**

EGGS Female white sturgeon release **million** eggs into the water column and the male swims beside and release milt to fertilize them. This is called **broadcast** spawning. **The eggs then sink to the bottom and adhere to rocks and plants** on the river bottom.

Eggs hatch within **7-10** days. **BONUS:** What water condition causes the eggs to take longer to hatch? **Colder water temperatures.**

LARVAE Larvae look like **tadpoles**. They get their food from their **yolk sac** for the first **12** days. After that they eat **aquatic insects and zooplankton (microscopic invertebrates in the water column)**. After another **20 days** they are called juveniles. **BONUS:** Where do you think larval sturgeon are found in the river? **In the gravel and vegetation. Hidden from predators.**

JUVENILE Juvenile sturgeon look like **adult sturgeon with their scutes and fins etc..** What percentage of juvenile sturgeon survive past their first birthday? **0.1 percent = 1000 per million eggs.**

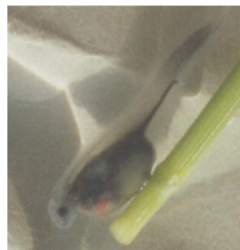
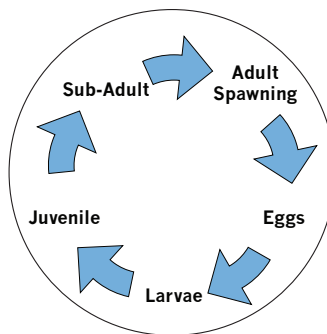
BONUS: Name four potential predators that feed on juvenile sturgeon. **salmon, trout, mergansers, kingfisher birds, gulls, osprey, other fish, larger sturgeon, otters, etc.**

SUB-ADULT What defines a sub-adult? **Greater than 1 metre in length but NOT reproductive.**

deep river water, Stuart, Fraser or Takla lakes



back eddies, gravel and vegetative cover



clean gravel, aquatic vegetation



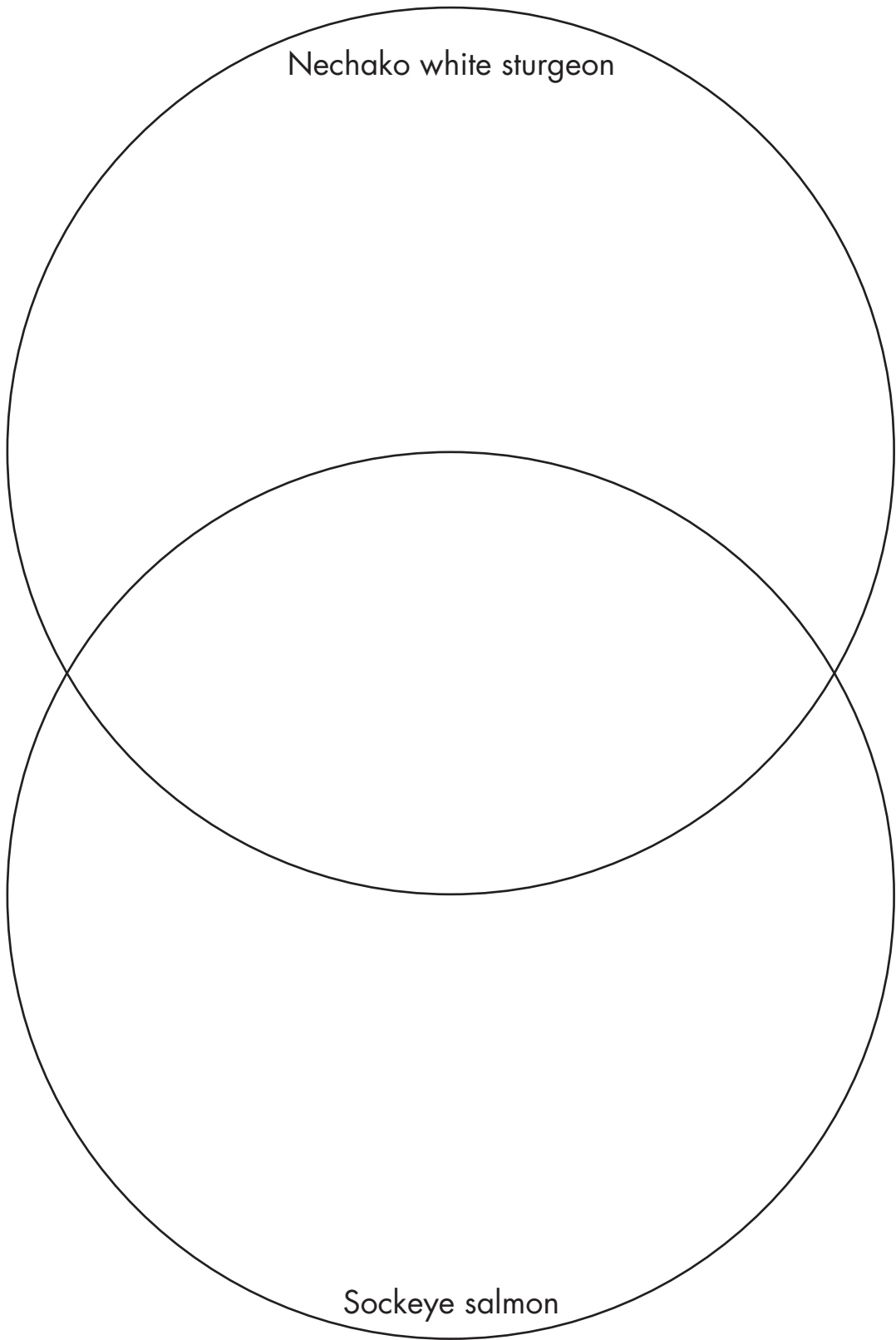
clean gravel, swift moving water, deep water, water 14-18°C



clean gravel, aquatic vegetation. This image is an example of an egg that is smothered by fine sand substrate and dies.

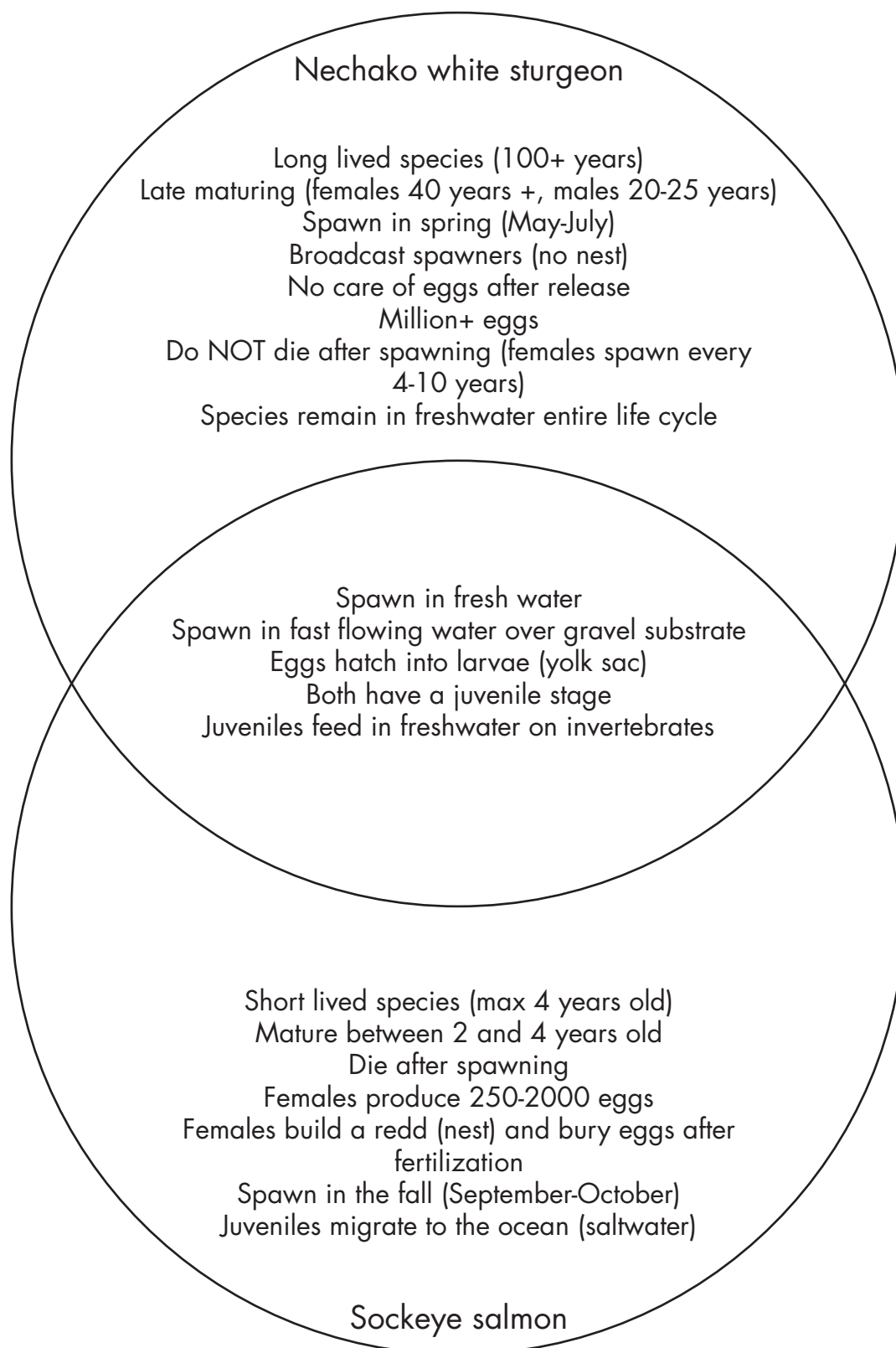
Venn Diagram: Sturgeon Vs. Sockeye Salmon

Fill in the circles of the Venn Diagram to determine SIMILARITIES and DIFFERENCES between the life cycles of the Nechako white sturgeon and sockeye salmon.



Venn Diagram: Sturgeon Vs. Sockeye Salmon - Answer Key

Fill in the circles of the Venn Diagram to determine SIMILARITIES and DIFFERENCES between the life cycles of the Nechako white sturgeon and sockeye salmon.



Lesson 3-3: Sturgeon Habitat

Time of Lesson: 1 hour

Instruction Objectives: Students can explain the habitat requirements of Nechako white sturgeon.

Strategies and Activities: Discuss habitat and food requirements of the Nechako white sturgeon. Allow work on Unit Project.

Materials:

- SMARTboard PowerPoint presentation: *NWS Habitat and Food*
- Handout: *Worksheet 3d - Habitat & Food T-Chart*.
- Handout or Interactive: *Worksheet 3e - Wordsearch Review*

Student Assessment:

- Observation and participation in class and small group activities.
- Ability to name habitat and food needs of Nechako white sturgeon.
- Ability to define terms from Unit.

Activity (30 minutes)

During the life cycle lesson, students learned about some of the habitat requirements for Nechako white sturgeon. Review the life cycle as a class.

On the SMARTboard put up the PowerPoint presentation *Habitat and Food*. Using *Worksheet 3d - Habitat & Food T-Chart* go through the habitat requirements for each life cycle stage and include their food needs (see Answer Key for information).

Key Points

Have the students call out their ideas of what sturgeon eat at each life stage before advancing the slide.

Activity (15 minutes)

Allow students time to review all they have learned to date.

Bring up on the SMARTboard the interactive *Wordsearch Review* (Double-click the *index.html* file in the 'Wordsearch Review Interactive' folder. Allow the page to open in a browser like Explorer, Safari, Firefox etc. To solve the puzzle, click, hold and drag over the letters of the word you are solving. Ask for hints if necessary). Hand out the hardcopy versions of the wordsearch *Worksheet 3e - Wordsearch Review* so the students can finish on their own, or work along with the class.

As the students find the words, ask for definitions for each word.

Activity (15 minutes)

Allow students to work on their Unit Project.

Habitat & Food T-Chart

Fill in the following chart with what you have learned about sturgeon habitat and food requirements at each life stage.

	<i>Nechako white sturgeon habitat requirements</i>	<i>Nechako white sturgeon food requirements</i>
<i>Egg</i>		
<i>Larval</i>		
<i>Juvenile</i>		
<i>Adults</i>		

Habitat & Food T-Chart - Answers

Fill in the following chart with what you have learned about sturgeon habitat and food requirements at each life stage.

	<i>Nechako white sturgeon habitat requirements</i>	<i>Nechako white sturgeon food requirements</i>
<i>Egg</i>	<i>clean gravel and rock substrate fast flowing water water temperature between 14-18°C relatively deep</i>	<i>None! They are developing within the egg.</i>
<i>Larval</i>	<i>clean gravel and rock substrate fast flowing water</i>	<i>for the first 12 days or so they feed from their yolk sac. after the yolk sac is gone, they feed on macro-invertebrates (organisms that are large enough to be seen with the naked eye and have an exoskeleton)</i>
<i>Juvenile</i>	<i>deep areas in the river slow back eddies fast flowing sections (areas for finding food and spawning) lakes cool areas of the river</i>	<i>feed primarily on benthic (bottom) invertebrates and fish invertebrates include: amphipods, isopods, mysids, clams, snails fish include: sculpins and other juvenile fish and fish eggs</i>
<i>Adults</i>	<i>deep areas in the river slow back eddies fast flowing sections (areas for finding food and spawning) lakes cool areas of the river</i>	<i>large fish including salmon (the large salmon runs in the Nechako River are thought to be highly important annual food sources for sturgeon)</i>

Wordsearch - Review!

Now that you know everything about Nechako white sturgeon, try and find some important terms you learned in the box below.

R	V	P	R	E	H	A	B	I	L	I	T	A	T	I	O	N	K	F	E
J	R	K	V	N	T	A	W	A	R	E	N	E	S	S	H	C	B	Q	N
B	D	I	B	I	E	X	Z	T	R	D	E	S	A	L	M	O	N	J	D
W	H	S	Y	A	W	C	N	B	E	R	X	I	A	G	H	D	G	U	A
A	A	F	I	D	R	P	H	W	O	G	T	N	F	O	Y	E	B	V	N
V	T	I	B	L	K	B	S	A	A	V	I	V	P	S	M	E	S	E	G
G	C	S	D	W	T	L	E	M	K	H	N	E	H	Z	C	P	X	N	E
F	H	H	Z	M	K	A	T	L	Q	O	C	R	X	H	U	U	U	I	R
G	E	E	S	Q	R	R	F	P	W	Q	T	T	A	L	D	R	T	L	E
Y	R	R	P	U	D	V	P	Z	A	S	O	E	J	J	R	E	O	E	D
I	Y	Y	A	J	A	A	T	C	T	T	H	B	E	T	E	C	Q	F	T
G	A	G	W	H	K	E	Y	U	E	U	A	R	Y	U	C	R	O	J	O
L	A	O	N	F	M	C	Z	X	R	R	B	A	O	R	O	U	T	O	G
T	R	I	B	U	T	A	R	Y	S	G	I	T	L	B	V	I	P	C	R
W	S	U	U	X	T	C	E	B	H	E	T	E	K	I	E	T	P	Q	A
N	R	I	V	E	R	B	B	B	E	O	A	Y	S	D	R	M	J	X	V
M	S	A	M	E	I	O	T	P	D	N	T	Q	A	I	Y	E	B	E	E
P	R	E	D	A	T	O	R	D	H	K	T	J	C	T	K	N	L	D	L
N	C	S	U	R	V	I	V	A	L	W	U	T	L	Y	C	T	S	L	U
O	G	C	O	O	L	V	F	H	L	S	L	D	A	M	E	U	C	M	U

AWARENESS	SALMON	DAM	REHABILITATION
RIVER	YOLKSAC	FISHERY	PREDATOR
EXTINCT	NECHAKO	RECRUITMENT	ENDANGERED
SILT	BARBEL	TRIBUTARY	HABITAT
HATCHERY	RECOVERY	SURVIVAL	WATERSHED
INVERTEBRATE	SCUTE	JUVENILE	STURGEON
SPAWN	COOL	LARVAE	
TURBIDITY	GRAVEL	DEEP	

Lesson 3-4: Sturgeon Decline

Time of Lesson: 1.5 hour

Instruction Objectives: Students can reflect on how the environment of the Nechako white sturgeon has changed over the past 100 years, and how that has affected the survival of the species.

Strategies and Activities: Discuss how the habitat in the Nechako River for the sturgeon has changed over time, from 10,000 years ago to 100 years ago to now. Brainstorm on the meanings of 'adaptation' and 'survival' and relate to human experiences, re-examine the life cycle and link life cycle, habitat and survival together. Review restoration projects currently occurring for Nechako white sturgeon. Allow work on Unit Project.

Materials:

- YouTube Video: *Every Sturgeon Counts - Part 4*
(<http://www.youtube.com/watch?v=YhrEJUEi-ow>)
- SMARTboard PowerPoint presentation: *NWS Decline*
- Website: www.nechakowhitesturgeon.org for a list of current restoration projects.

Student Assessment:

- Observation and participation in class discussion and activities.
- Ability to identify at least two restoration projects for Nechako white sturgeon.
- Participation in Speed Quiz.

Activity (20 minutes)

Bring up on the SMARTboard YouTube Video: *Every Sturgeon Counts - Part 4* (<http://www.youtube.com/watch?v=YhrEJUEi-ow>). Scroll to 21:26 and watch this section of the video: **Procedure for Releasing Sturgeon Safely** (21:26 to 31:20).

Key Points

This video highlights the impact humans can have on sturgeon.

There are safe ways to reduce the risk of injury or death of the animal if it is caught in a net.

The people in the video use science and research as a practical means that lead to conservation of a species.

Activity (40 minutes)

Bring up on the SMARTboard the PowerPoint presentation: *NWS Decline*. This presentation reviews the factors that affect sturgeon survival and reintroduces the term recruitment failure.

Key Points

The low survival rate of young sturgeon is the leading reason why the species is endangered and at risk of becoming extinct in the next twenty years.

Altered habitat, human impacts, pollution, and climate change are all factors that impact young sturgeon survival.

These factors affect their ability to hide from predators, affect their food source, and affect their general habitat.

Ask

What factor or factors do you think are the ones that are most responsible for the recruitment failure?

Is the population recoverable - can we save it from extinction?

Introduce the term 'adaptation'.

Adaptation: a change by which an organism or species becomes better suited to its environment.

Many species over time are able to adapt to changes in their environment, so they are able to survive over the long term. Nechako white sturgeon are adapted for a particular habitat and river condition (habitat and food). However, the habitat of the Nechako white sturgeon has changed dramatically over the past 100 years.

Continue with the slideshow to view a quick overview of the work the NWSRI is doing to help protect and recover the Nechako white sturgeon population. Begin a class discussion about this work. Visit www.nechakowhitesturgeon.org for an up-to-date project list.

Ask

Of the projects you just saw, which ones do you think are the most important for helping Nechako white sturgeon? Why?

What can **we** do to help the Nechako white sturgeon?

Activity (20 minutes)

Allow students to work on their Unit Project.

Closure (10 minutes)

Play Speed Quiz. Split the class into two groups. Have one student from each group go in turn and compete to see who can answer the following questions correctly (the first to put up their hand gets to answer first).

What does endangered mean? *at risk of going extinct*

How large is a Nechako white sturgeon? *3 m long*

How many sturgeon are in the river? *350 or less*

What food do juvenile sturgeon eat? *macro invertebrates*

What is the fin on the back of a sturgeon called? *dorsal*

Sturgeon do not have scales, they have ____? *scutes*

Name one tributary to the Nechako River. *Murray Creek, Stoney Creek, Nautley, Stewart*

At what ages does a female sturgeon start spawning? *40 years old*

Sturgeon spawn in deep turbid water over clean _____? *gravel or rocks*

Where is the only known spawning site for Nechako white sturgeon?
in Vanderhoof, upstream of the Burrard Ave bridge, in the Nechako Migratory Bird Sanctuary

What is the main food source for adult sturgeon? *salmon*

The shape of their tail - heterocercal - helps the sturgeon stay where in the water column? *at the bottom*

What life stage comes after the egg hatches? *larval, larvae*

What is the area adjacent a river called? *riparian zone*

What is the word to describe how an animal changes over time to changes in their environment? *adaptation*

Lesson 3-5: Guest Speakers and Field Trip

Time of Lesson: 1.5 hours

Instruction Objectives: Students can demonstrate an overall understanding of Nechako white sturgeon life history and habitat needs and how these relate to overall survival of the species. Students participate in field trip and/or host guest speakers in classroom. Students can identify First Nations traditions in relation to the Nechako River and the Nechako white sturgeon.

Strategies and Activities: Have local experts attend class to speak in regards to the Nechako white sturgeon (local biologist and First Nations guest speaker), and/or go to Nechako White Sturgeon Conservation Centre for a tour. Discussion about the value the Nechako white sturgeon holds for the students and what it would mean to them if it became extinct. Allow work on Unit Project.

Materials:

- Field Trip: Nechako White Sturgeon Recovery Centre in Vanderhoof. Contact the Centre or the Nechako White Sturgeon Recovery Initiative for details and to book the tour. Extend the tour to a walk along the Nechako River to view the spawning site (just upstream of the bridge).
- Guest Speaker: First Nation speaker (contact NWSRI for contact details or contact local First Nation Band Office directly).
- YouTube Video: *Every Sturgeon Counts - Part 2*
(<http://www.youtube.com/watch?v=YhrEJUEi-ow>)
- If unable to get to the Recovery Centre, invite local biologist and/or White Sturgeon Recovery Centre coordinator (contact NWSRI for contact details or Contact the Centre or the Nechako White Sturgeon Recovery Initiative directly) to the classroom.

FUTURE CONSIDERATIONS: Sturgeon release event (fall 2014 and beyond).

Student Assessment:

- Observation and participation in class discussion and field trip.

Preparation (15 minutes)

Have students prepare 5-10 questions as a class for the guest speaker. Assign students to ask these questions.

During the field trip and/or class guest speaker have the students take notes. Encourage students to include what they learn in their Unit Project.

Field Trip to the Sturgeon Facility in Vanderhoof (1-1.5 hours)

The Nechako White Sturgeon Recovery Centre is located in Vanderhoof. It is where the Nechako white sturgeon hatchery program occurs.

Before heading into the Recovery Centre, be sure to review the rules of conduct:

- no touching unless instructed by the facilitator
- ask questions with hands up
- walk do not run
- stay with your group, do not wander away from the group

Optional Activity

After the tour, walk down to the Nechako River and follow the walking path under the bridge and upstream until you reach a sign that states "Sturgeon Spawning Habitat". This is the location where sturgeon have been recorded spawning. Start a discussion.

Ask

Describe what this site looks like. Does it look like good sturgeon spawning habitat? *Fast flowing, murky, gravel substrate, deep in sections.*

What potential human impacts put this site at risk of pollution, disturbance or alteration? *Boating, boat engines, pollution from roads and bridge, run-off from residential and farm land etc.*

Class Guest Speaker (1 hour)

Have ready on the SMARTboard the YouTube Video: *Every Sturgeon Counts - Part 2* (<http://www.youtube.com/watch?v=YhrEJUEi-ow>): **Salmon, Sturgeon and First Nations** 4:10 to 16:40. This section of the video focuses on local First Nation culture and history with the Nechako River, salmon, Stuart Lake, and Nechako white sturgeon. Play this to augment the guest speaker if need by.

Invite a local First Nation speaker into the classroom to speak about the importance and traditions around sturgeon and First Nations (contact NWSRI for contact details or your local First Nation Band office directly). Have them speak about the salmon fishery and the by-catch of sturgeon.

As well, encourage the guest speaker to talk about the relationship between First Nation traditions and the plants and animals found within the riparian zone (hunting, fishing, medicinal plants, trapping etc.).

Lesson 3-6: Presentations

Time of Lesson: 1.5-2 hours

Instruction Objectives: Students conduct oral presentations of Unit Project to class.

Strategies and Activities: Students present their Unit Project to the class.

Materials:

- Projector, SMARTboard, whiteboard, etc. as needed for presentations.

Student Assessment:

- Quality of presentation in regards to aesthetics, information presented, flow of the story, etc.
- Ability to present project effectively to the class (oral presentation skills).
- Observed knowledge of subject topic, and ability to answer questions from the class.

Activity (1.5-2 hours)

Have students present their Unit Project one at a time. Allow 5 minutes total for the presentation, including set-up and take down, as well as questions.

This is the students' opportunity to show the teacher and class what they have learned about Nechako white sturgeon.

Depending on the number of students in the class, the presentation may take two days.

UNIT 3 TEST

A number of test questions have been developed for this Unit. The questions include matching, labelling, True-False, and short answer in this document. Please feel free to customize the test for your class, considering the topics or materials you covered or focused on during the Unit.

You can find test questions for this Unit on the thumb drive that accompanies this curriculum:

- *Unit_3_Test.docx*

GRADE: _____ TEACHER: _____ SCHOOL: _____

Feedback Form for Unit 3

Please fill in the information below and return to the NWSRI. Please feel free to email any questions or comments to Lana Ciarniello at aklak@telus.net.

Background Information:

Is the information presented age appropriate and presented in an age appropriate manner? Yes or No

Was there enough information provided to conduct the lessons successfully?
Yes or No

If no, what additional information and/or resources would be useful?

Activities:

Were the activities engaging to the students? Yes or No

Was the timeline of the activities a good estimate?
Too Long ____ Too Short ____ Just Right ____

Any comments?

Worksheets:

Were the worksheets effective in teaching and/or reviewing the unit material?
Yes or No

Were the answer keys helpful? Yes or No

Additional Resources:

If used, were the resources suggested or provided for this unit useful? Yes or No

What else would you suggest be needed for this unit?