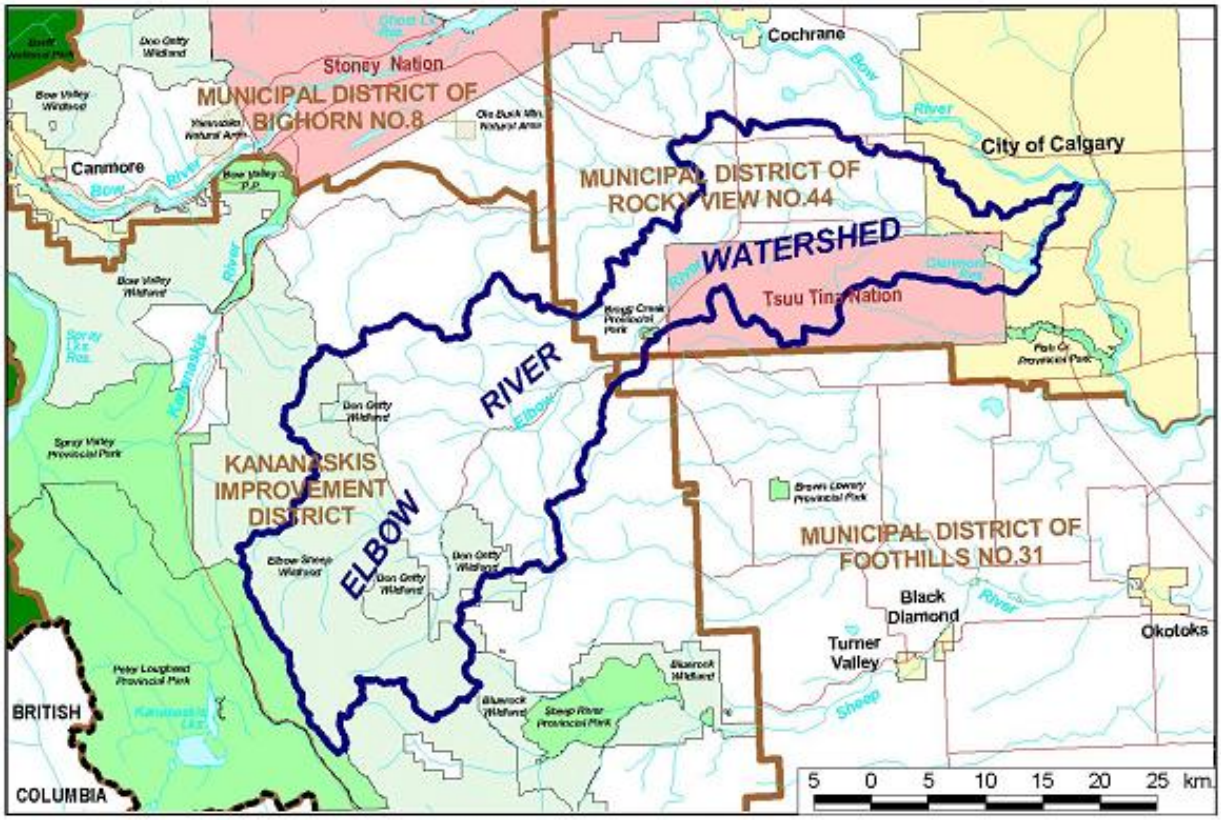
Freshwater Monitoring: A Case Study

An Educational Field Study for Grade 8 and 9 Students



Bow River Basin Council

Alberta Government

erwp

Acknowledgements

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This program is made possible through efforts of the following sponsors both past and present:

Freshwater Monitoring – A Case Study
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1.0 INTRODUCTION

1.1 PROGRAM AT A GLANCE

Curriculum Connections: Grade 8: Fresh and Salt Water Systems
Grade 9: Environmental Chemistry

Time Required: Preparatory Activities: approximately 5 classes (hours)
Field Study Activities: Full Day
Post-Program Activities: approximately 3-4 classes (hours)

Adult Recommendations: 1 Environmental Educator (program facilitator)
1 Teacher / Educator
1 Volunteer for each group of 5-6 students

Ideal Season: Spring (May and June)
Fall (September and October)

Location: The program is designed for the Elbow River Watershed; however, adaptations can be made for other watersheds in Alberta

1.2 PROGRAM OVERVIEW

Welcome to ***Freshwater Monitoring – A Case Study***, a field study designed for Grade 8 and 9 students.

This is a curriculum-connected full-day study of the Elbow River with multidisciplinary preparatory and post-activity support. The intent of this program is to provide a hands-on, engaging outdoor component, which adheres to the requirements of the Alberta Programs of Studies, including *Unit E: Freshwater and Saltwater Systems* for Grade 8s, and for Grade 9s, *Unit C: Environmental Chemistry*. This program is also written to achieve the mandate of the Alberta Tourism, Parks, and Recreation division, and also addresses the four program goals of preservation, outdoor recreation, heritage appreciation, and heritage tourism.

The preparatory activities are designed to prepare students for an off-site visit to the Elbow River. These activities focus on introducing students to the watershed monitoring area, related vocabulary, water testing procedures, and the expectations of safe and appropriate behaviour within a protected area. These activities also attempt to further students' ability to make predictions, and encourage them to develop a non-biased awareness of the various human impacts affecting the watershed.

The field study strongly incorporates the idea that the "rivers are an expression of our landscape." Students are challenged to predict and discover what is occurring not only in the river, but in the surrounding environment as well. Students will have the opportunity to monitor the Elbow River from the pristine waters of Elbow Falls in Kananaskis all the way to the city limits of Calgary. Traveling by bus, students will stop at key locations and test the water for various biotic and abiotic factors including dissolved oxygen levels, the presence of nitrates and phosphates, pH levels, turbidity, temperature, as well as the presence of invertebrate species. They will also have an opportunity to observe and discuss different types of both land uses and human activity occurring in the area.

Post program activities are intended to bring the program to a close for the students. Students will compile all the data collected during the field study and discuss reasons for any variations observed. Activities are prepared for students to explore the dynamics of water allocations and to discuss their personal role in water protection with the promotion of student action and stewardship.

2.0 PREPARATORY ACTIVITIES (*FOR STUDENTS*)

2.1 FIELD STUDY INTRODUCTION

Objectives:

- To introduce the concept of watersheds to students and to discuss where water is located in Alberta.
- To introduce the Elbow River watershed and the field study to students

Materials:

- "Mean Annual Discharge" visual
- "Where Alberta's Water Ends Up" visual
- Elbow river watershed activity and puzzle pieces
- Whiteboard and projector or SMART board

Time Required:

Approximately 45 minutes to an hour

Instructions:

1. **Class Review of Watersheds**

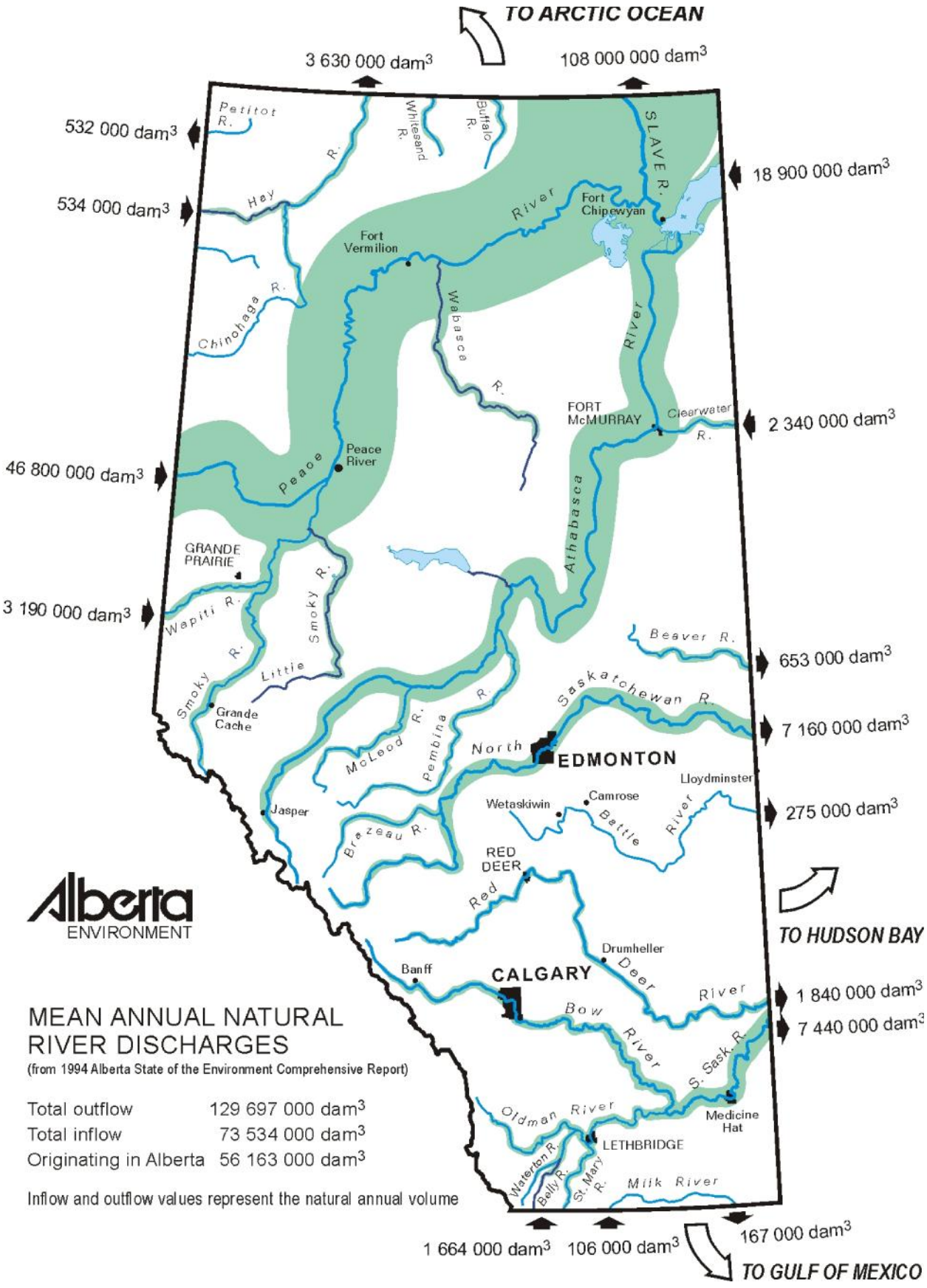
- "Water on the Brain"– As a class, brainstorm words associated with watersheds and write those on the board, then have the class devise a possible definition for a watershed.
    - One definition is: *A watershed is an area of land that drains into a body of water.*
    - Another definition is: "*The land catches water just like a big bowl or basin"*… which is why a watershed is often called a drainage basin.

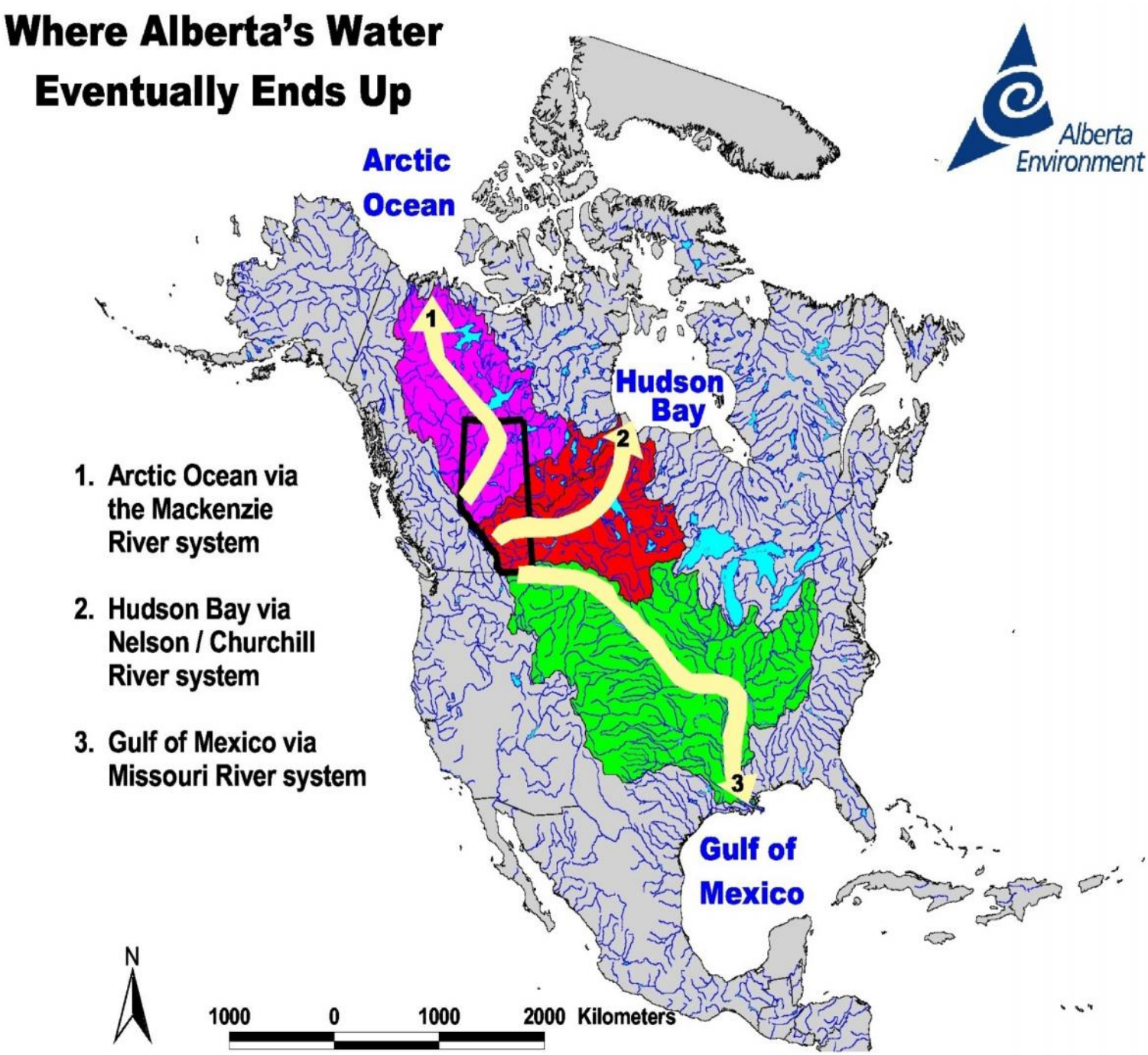
- The Watersheds in Alberta
    - Mount the "Mean Annual Discharge" visual onto a projector/SMART Board and discuss the major water arteries in Alberta. Compare where the majority of the water is in Alberta (60% is in the north) and where most of Alberta's population is (90% is within 100 km of the Canada / US border).
    - Discuss what implications this might have for water management and conservation.
    - Show the visual "Where Alberta's Water Ends Up" to further highlight where the river water in Alberta goes (water from the Elbow River ends up in Hudson's Bay).

2. **Assemble Watershed Puzzle**

- Cut out the puzzle pieces and clues
- Give each group (approximately 5-6 students) a piece of the Elbow river puzzle and a clue slip

  Note: it's recommended that these groups are also used as the field study research teams. See activity 2.2
- Read the "Elbow River Map Building Clues" aloud to the class. Have the students assemble the puzzle on a blackboard or whiteboard (there are 6 pieces to the puzzle) and match each clue to the corresponding puzzle piece. These pieces can also be used as a watershed poster for your class.


TO ARCTIC OCEAN
3 630 000 dam3
108 000 000 dam3
532 000 dam3
534 000 dam3
18 900 000 dam3
46 800 000 dam3
3 190 000 dam3
2 340 000 dam3
653 000 dam3
7 160 000 dam3
275 000 dam3
1 840 000 dam3
7 440 000 dam3
167 000 dam3
1 664 000 dam3
106 000 dam3
TO HUDSON BAY
TO GULF OF MEXICO
Petitot R.
Whitesand R.
Buffalo R.
Hay R.
SLAVE R.
Fort Chipewyan
Fort Vermilion
River
Chinchaga R.
Wabasca R.
River
FORT McMURRAY
Clearwater R.
Peace River
Peace
GRANDE PRAIRIE
Athabasca
Wapiti R.
Smoky R.
Little Smoky R.
Beaver R.
Saskatchewan R.
Grande Cache
McLeod R.
Pembina R.
North EDMONTON
Lloydminster
Jasper
Wetaskiwin
Camrose
Battle River
Brazeau R.
RED DEER
Red Deer River
Drumheller
Banff
CALGARY
Bow River
S. Sask. R.
Medicine Hat
Oldman River
LETHBRIDGE
Waterton R.
Belly R.
St. Mary R.
Milk River
Alberta
ENVIRONMENT
MEAN ANNUAL NATURAL RIVER DISCHARGES
(from 1994 Alberta State of the Environment Comprehensive Report)
Total outflow 129 697 000 dam3
Total inflow 73 534 000 dam3
Originating in Alberta 56 163 000 dam3
Inflow and outflow values represent the natural annual volume


Where Alberta's Water Eventually Ends Up
Alberta Environment
Arctic Ocean
Hudson Bay
Gulf of Mexico
1. Arctic Ocean via the Mackenzie River system
2. Hudson Bay via Nelson / Churchill River system
3. Gulf of Mexico via Missouri River system
1
2
3
N
1000 0 1000 2000 Kilometers

Elbow River Map Building Clue Sheet

"This piece of the Elbow River Watershed shows the starting point of the water itself. The river's source, Elbow Lake, is located in Peter Lougheed Provincial Park, 2130m above sea level. Many hikers enjoy the summer scenery here."

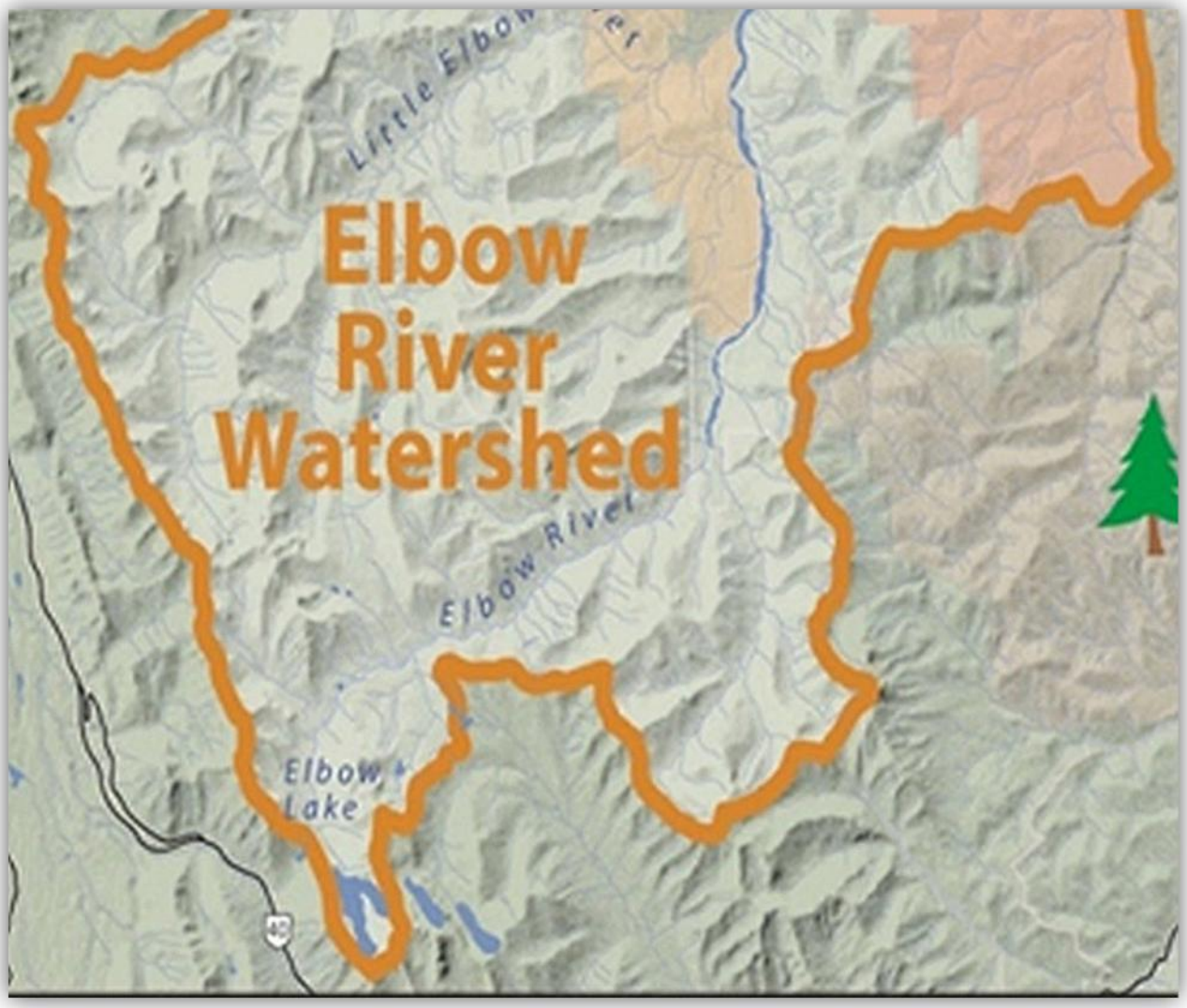
"This piece of the Elbow River shows parts of provincial forest lands known as the Sibbald area and the Elbow Valley area. Types of trees that commonly grow in this area include white spruce, lodgepole pine and trembling aspen. This is also part of the Spray Lakes Forest Management Agreement."

"Moose Mountain was named in 1949 and remains a popular hiking area. The Moose Mountain syncline is one of the largest natural gas reservoirs in North America. An extensive cave system lies within the southern portion of the mountain and atop the summit is a fire lookout tower."

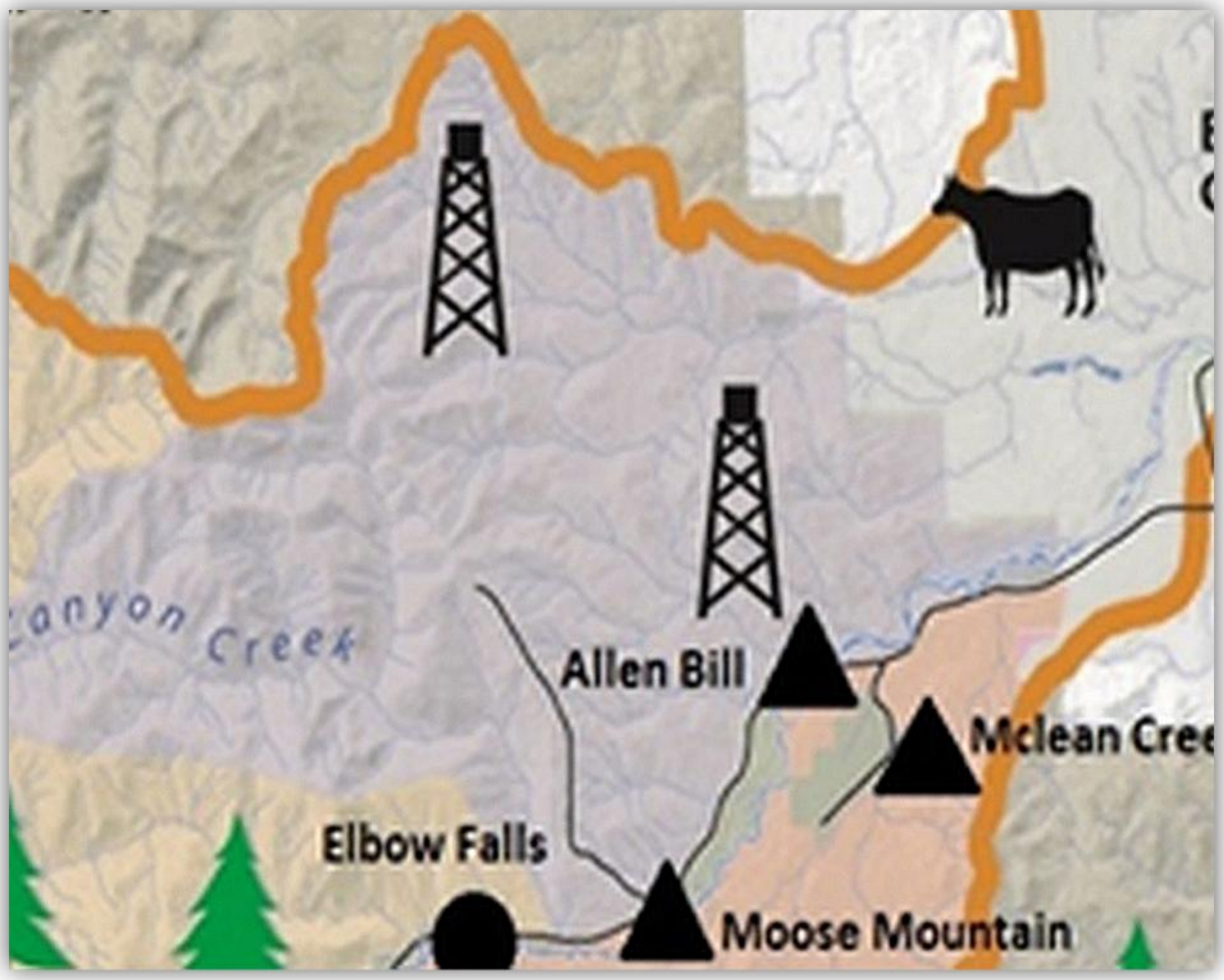
"Quads, motorbikes, and 4x4 trucks are recreational vehicles that are used by enthusiasts that frequent the McLean Creek Off-Highway Vehicle Zone of Kananaskis Country each summer. This forested area is comprised of numerous designated trails and bridges."

"Now heavily forested with spruce, pine, fir, and poplar, Bragg Creek was an open meadow (due to fire) prior to the first settlers' arrival around 1885. In 1894 the town was named after a rancher, Albert Warren Bragg, who was 17 at the time."

"This area of the Elbow River Watershed boasts 18 holes, hand-trimmed greens, straight-aways, doglegs, and fairways. Also, according to a 2004 civic census, the population of this urbanized area that surrounds the mouth of the Elbow River is nearly 1 million. This area marks the end of the Elbow River Watershed because the Elbow River drains into the Bow River."


Elbow
River
Watershed
Elbow River
Elbow
Lake


Canyon Creek
Elbo


anyon Creek
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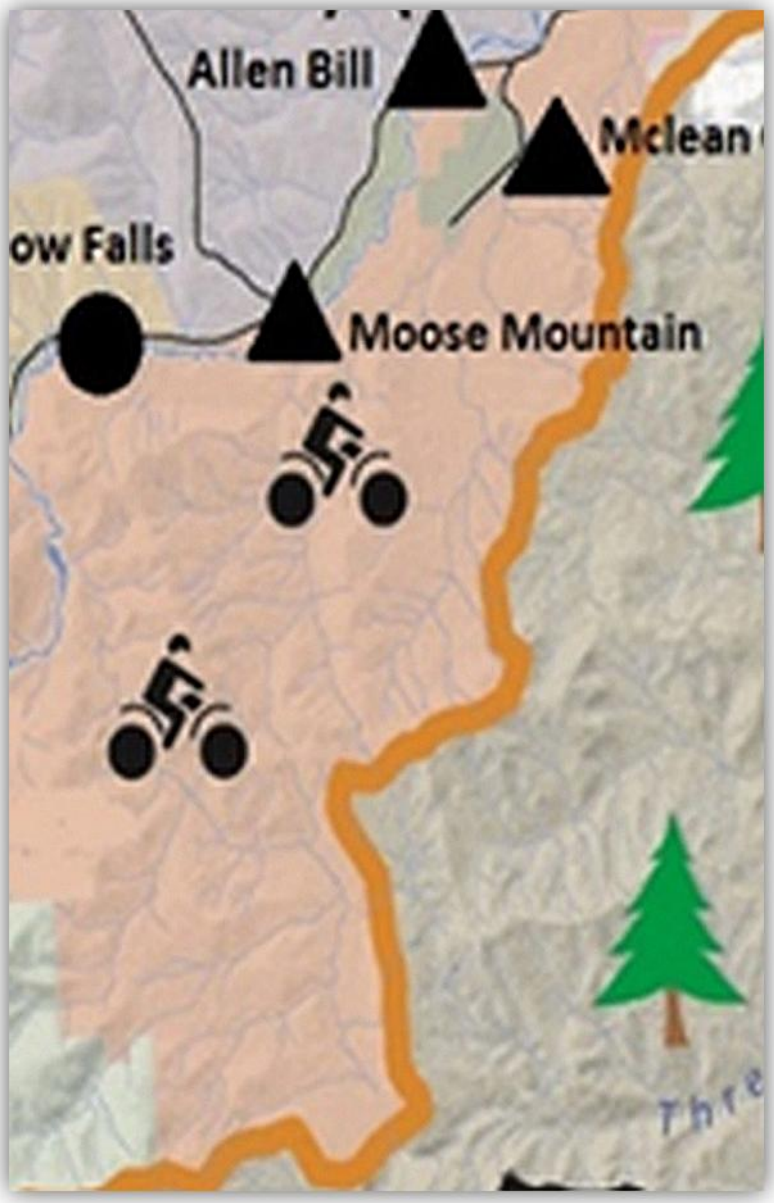
Mclean Cree
Elbow Falls
Moose Mountain


Allen Bill
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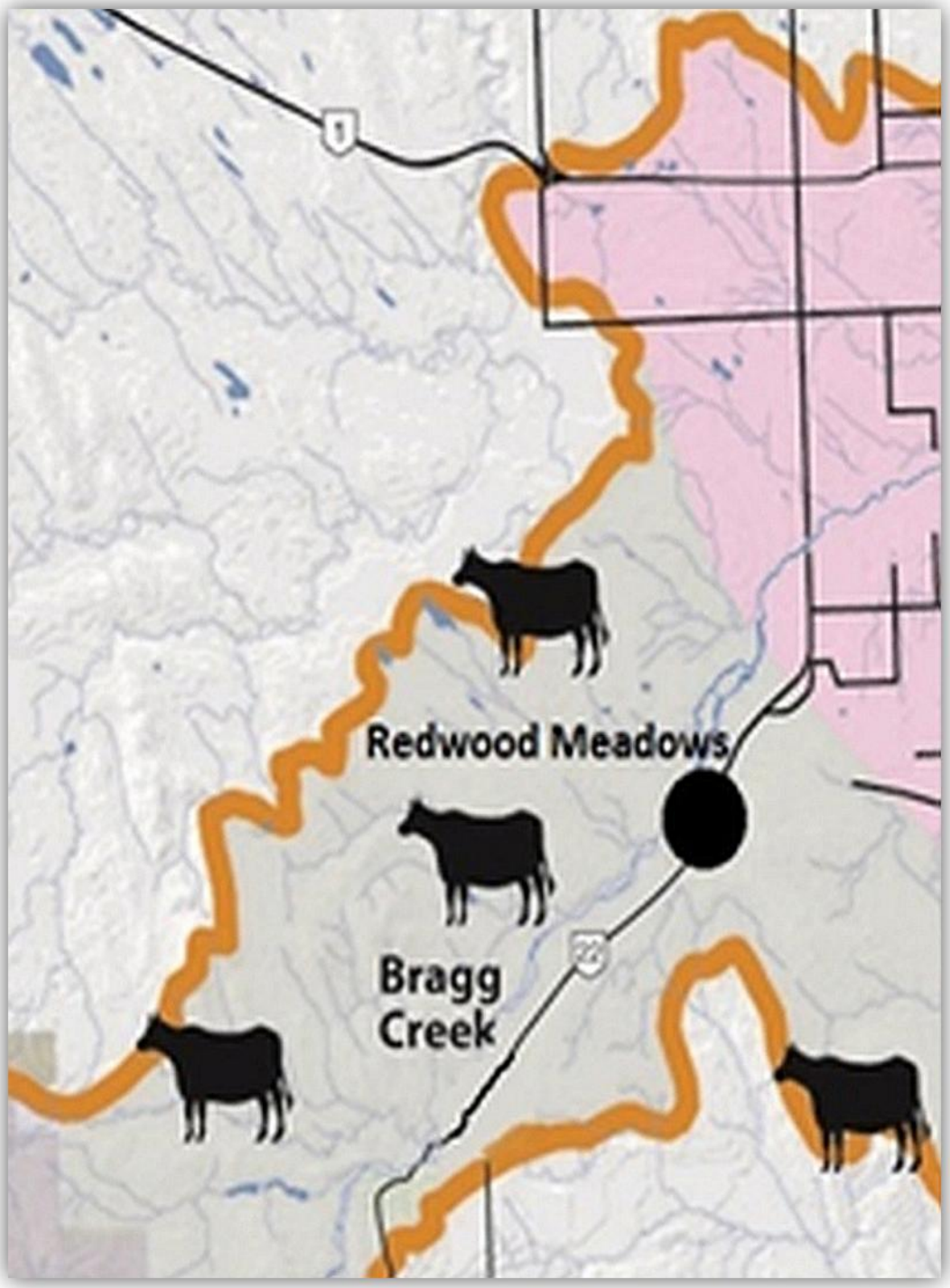
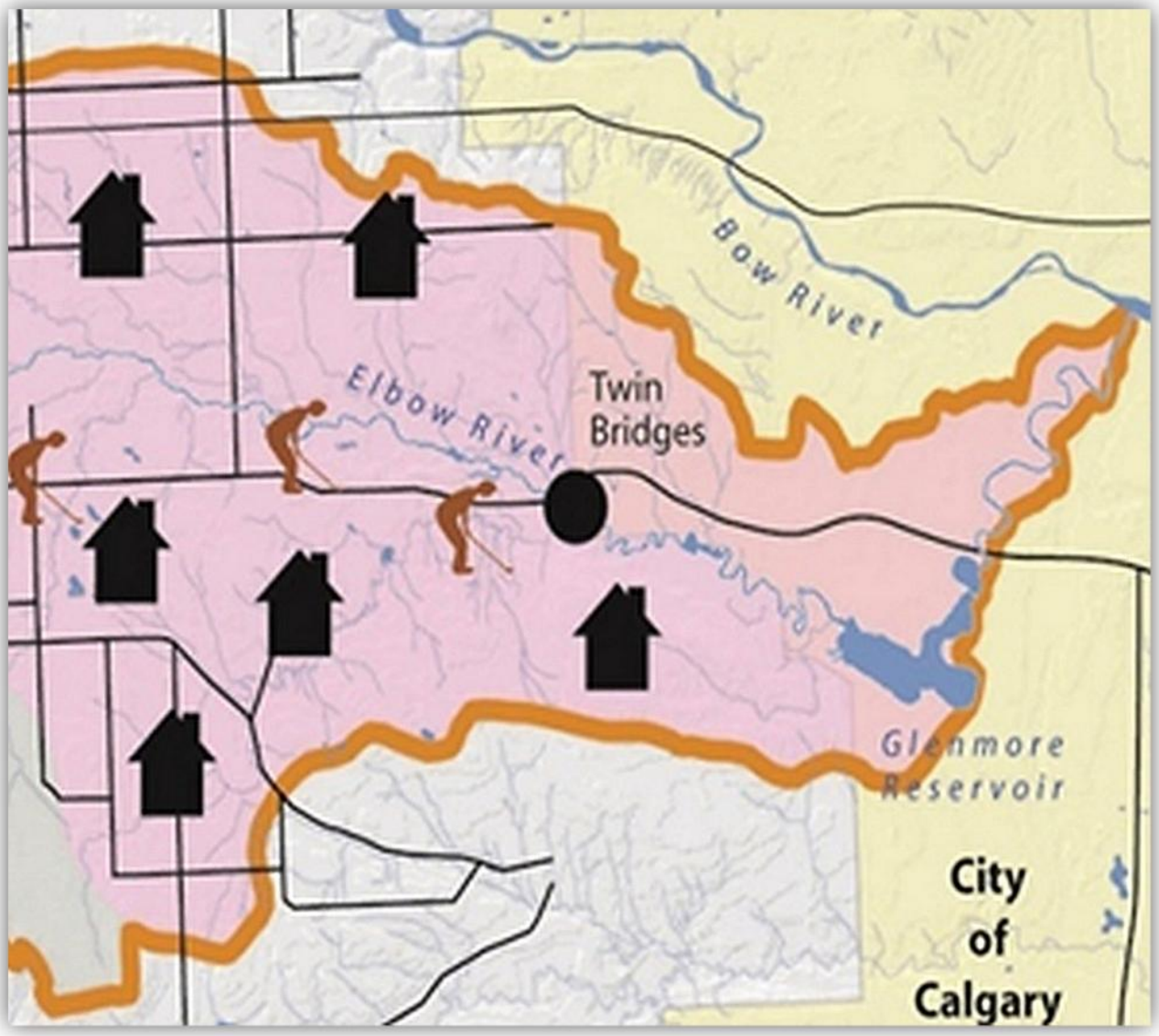
Moose Mountain


1
Redwood Meadows
Bragg
Creek
22


Bow River
Elbow River
Twin
Bridges
Glenmore
Reservoir
City
of
Calgary

KEY - TEACHER COPY

Elbow River Map Building Clues

1 - Headwaters
This piece of the Elbow River Watershed shows the starting point of the water itself. The river's source, Elbow Lake, is located in Peter Lougheed Provincial Park, 2130m above sea level. Many hikers enjoy the summer scenery here.

2 - Forestry
This piece of the Elbow River shows parts of provincial forest lands known as the Sibbald area and the Elbow Valley area. Types of trees that commonly grow in this area include white spruce, lodgepole pine and trembling aspen. This is also part of the Spray Lakes Forest Management Agreement.

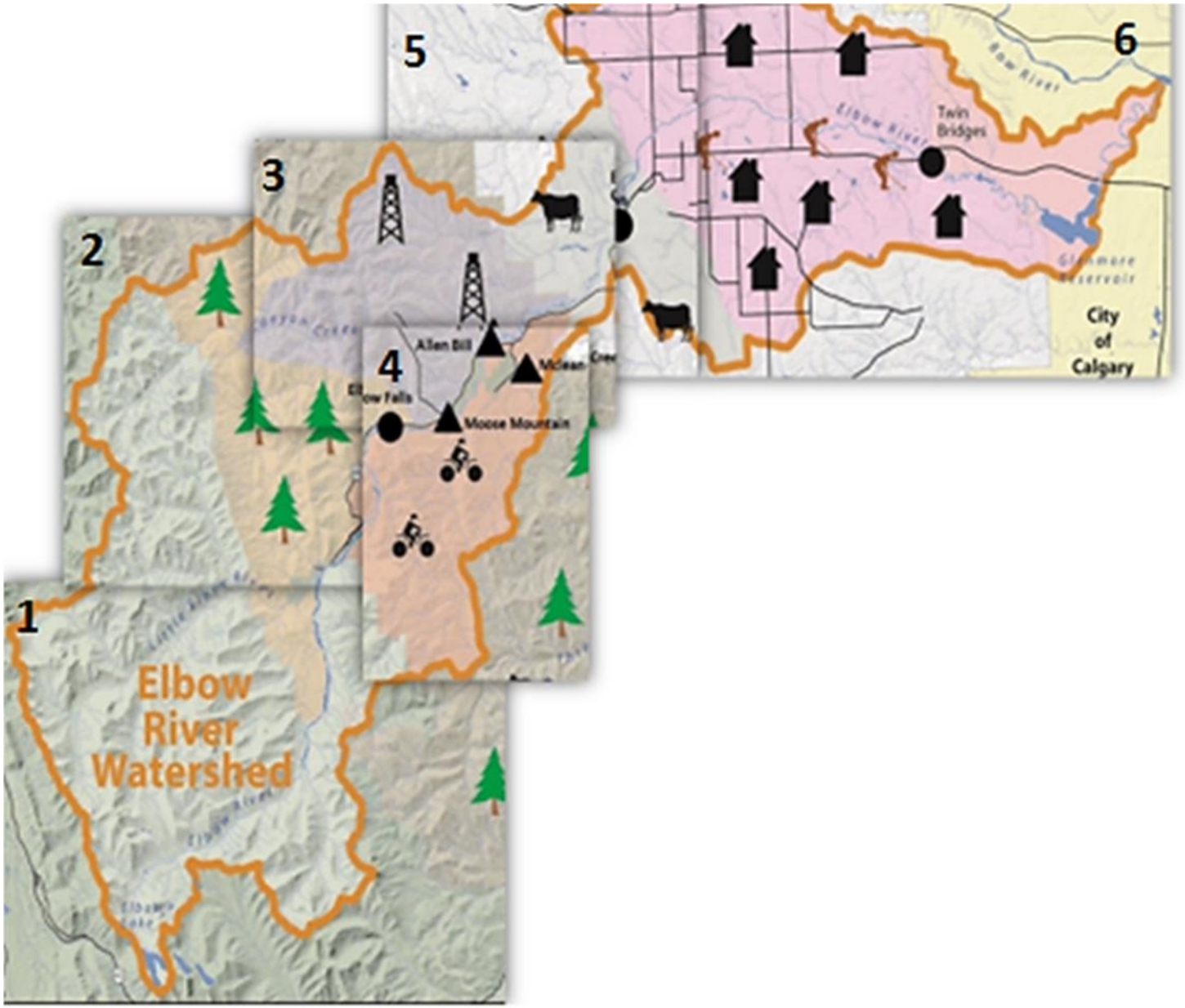
3- Oil and Gas
Moose Mountain was named in 1949 and remains a popular hiking area. The Moose Mountain syncline is one of the largest natural gas reservoirs in North America. An extensive cave system lies within the southern portion of the mountain and atop the summit is a fire lookout tower.

4 - Off-Highway Vehicles
Quads, motorbikes, and 4x4 trucks are recreational vehicles that are used by enthusiasts that frequent the McLean Creek Off-Highway Vehicle Zone of Kananaskis Country each summer. This forested area is comprised of numerous designated trails and bridges.

5 - Ranching / Agriculture
Now heavily forested with spruce, pine, fir, and poplar, Bragg Creek was an open meadow (due to fire) prior to the first settlers' arrival around 1885. In 1894 the town was named after a rancher, Albert Warren Bragg, who was 17 at the time.

6 - Recreation (Golfing) & Municipalities
This area of the Elbow River Watershed boasts 18 holes, hand-trimmed greens, straight-aways, doglegs, and fairways. Also, according to a 2004 civic census, the population of the urbanized area that surrounds the mouth of the Elbow River is nearly 1 million. This area marks the end of the Elbow River Watershed because the Elbow River drains into the Bow River.

KEY - MAP PUZZLE PIECES – TEACHER COPY



2.2 SCIENTIFIC TEAM RESEARCH CHALLENGE

Objective:

- To familiarize students with human activities and their potential impacts on the Elbow River watershed.

Materials:

- Scenario handouts
    1) Conservation
    2) Forestry
    3) Oil and gas
    4) Recreation – Off-Highway Vehicles
    5) Agriculture / Ranching
    6) Recreation - Golf courses
    7) Municipalities (extra scenario)
- Computer and Internet access

Time Required:

- Approximately 20 minutes for each group to read and discuss their scenarios
- 1 computer research class and time to collaborate their findings.

Instructions:

1. Assign Groups

Give each scientific group one of the above scenarios to read. (Using the same groups from activity 2.1 is recommended.) Each group will become field experts on a particular land use (i.e. the group with the oil and gas scenario will become experts on how oil and gas affects the Elbow River watershed).

2. Online Research

Groups research their given topic using the internet resources provided for each scenario. After concluding their research, students should prepare answers for the two focus questions listed with their scenario.

3. Explore Findings

- Discuss findings of human impacts on the watershed.
- Have students prepare for a land-use debate during the field study.

Headwaters (Conservation) Research Group

Attention all students. Dark days are approaching for the Elbow River watershed. The sustainability and purity of Calgary's water source is in peril. Pollutants from point and non-point sources are slowly penetrating our waterways by recreational, agricultural and municipal activities alike. Though lacking confirmation, our sources suggest that human industries might be secretly tapping and stealing from this revered water basin. This is the final year of the international decade of freshwater. The time to act is now. Preservation of the watershed is needs your help.

Your mission as members of SAPS, Students for Aquatic Preservation Society, is to determine what or who is threatening our watershed. Should these threats be tolerated, reduced, or terminated? Who is a friend of the SAPS group and who is a foe?

Remember to uphold our mandate as an independent, non-profit organization whose goal is to raise awareness of the importance of a pure watershed, to highlight what threatens the Elbow River Watershed and to confront these invaders by promoting preservation and conservation projects. Good luck SAPS members, and may your showers be short.

FOCUSING QUESTIONS

1. *What are some of the potential impacts of pollutants and human development on the Elbow River watershed?*
2. *What measures have been taken, or could be taken, to reduce these possible impacts on the Elbow River?*

Conservation Society RESOURCE SITES

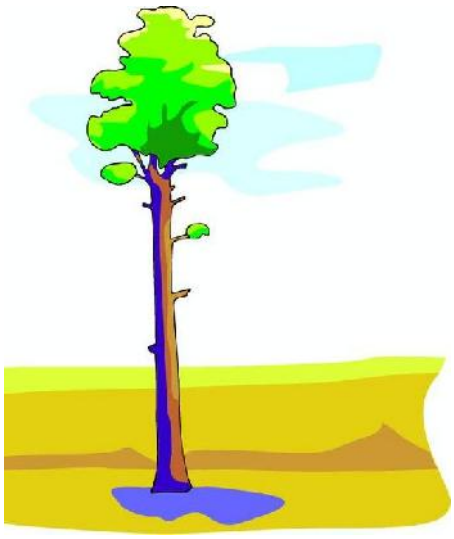
Elbow River Watershed Partnership Past & Current Projects
http://www.erwp.org/index.php/events-and-projects/projects/past
http://www.erwp.org/index.php/events-and-projects/projects/current

Alberta Environment
http://esrd.alberta.ca/

Trout Unlimited
www.tucanada.org

Parks Foundation Calgary
http://www.parksfdn.com/project.html

Forestry Research Group



Your older brother is finally going to get his new car because he found a good (high paying!) job working for a local sawmill. And to make things even better…he's moving out so you get his old (and much bigger) room! He will be working with his crew, harvesting trees in the Elbow Valley and Sibbald areas of Kananaskis Country. Wait a second—isn't Kananaskis Country a protected area? Forestry isn't allowed in Alberta Parks…right? Forestry and environmental protection didn't mix…or do they?

From your science classes at school, you know that tree roots act like anchors holding dirt and sediment in place. You read about fishermen complaining because forestry occurring near the riverbanks increase erosion, which affects fish spawning areas. Eroded sediment carried into the water makes the river too turbid for fish and the dirt is sometimes mixed with toxic chemicals that pollute the water. Your brother must be mistaken about where he's working. Is he really moving out? Maybe he's a big fat liar!

You decide to investigate whether or not the sawmill actually harvests in Kananaskis Country and use what you find for your upcoming science project.

FOCUSING QUESTIONS

1. *What are some potential impacts of forestry on the Elbow River watershed?*
2. *What measures have been taken, or could be taken, to reduce these potential impacts on the Elbow River?*

Forestry REASEARCH SITES

Logging and Sawmilling Journal –
http://www.forestnet.com/archives/april_00/family.htm

Cochrane Times
"Hundreds Protest Deforestation (2012)"
http://www.cochranetimes.com/2012/08/08/hundreds-protest-deforestation

Alberta Sustainable Resources: Forestry
http://esrd.alberta.ca/lands-forests/default.aspx

Oil and Gas Research Group

It's that time of year again…for a family vacation! Your mom, dad, grandpa, you, your annoying brother, and the family dog all pile into the van for a road trip across Alberta, starting with a visit to the Drumheller Royal Tyrell Museum of Paleontology. You journey for hours across a prairie dotted with farmhouses and oil wells. As you near the badlands in your overheating chariot with the windows down, a distinct foul odor begins to fill the van. Rotten eggs—oh, disgusting! Fingers fly to accuse the culprit but no one notices the passing scene of three tall flaming stacks on a natural gas drill site in the field. Who was the real stinker?

At the museum, you come across a display about fossil fuels and notice this excerpt:

> *Sour gas is a product of fossil fuels. This natural gas contains hydrogen sulphide and is toxic to animals and humans in high concentrations. Sour gas has a distinctive rotten egg smell. Approximately one third of Alberta's natural gas production is sour. The gas is disposed of by burning on site, which is assumed to turn the gas into harmless carbon dioxide that enters waterways from the atmosphere.*

You must have counted dozens of gas flare stacks on the drive. Does oil and gas mean hazardous waste? Gas operations need roads, ground water, and big pipelines that can affect the environment and the river. What controls are in place to dispose of waste safely, or are there poisons finding their way into our water systems? Better roll up those windows!

FOCUSING QUESTIONS

1. *What are some of the potential impacts of oil and gas on the Elbow River watershed?*
2. *What measures have been taken, or could be taken, to reduce these potential impacts on the Elbow River?*

Oil and Gas RESEARCH SITES

Elbow River Watershed Partnership Past & Current Projects
"ie. Moose Mountain Dialogue"
http://www.erwp.org/index.php/events-and-projects/projects/past

Alberta Energy Regulator
"Sour Gas"
"Flaring and Venting"
http://www.aer.ca/rules-and-regulations/by-topic

Recreational Research Group

Your friend's dad is finally taking you and your friend to McLean Creek in an OHV (off-highway vehicle). You're going to go quading!

You enter the park by plowing down a super steep hill. You grip your seat with amazement as the quad powers down the muddy slope, ripping up the dirt and grass underneath. During one adrenaline filled moment, the ATV got stuck and you had to winch your way out. When the quad was finally dislodged, the tire tracks were nearly a foot deep in the mud – wow! There was a bridge a couple metres down from where you crossed, but why would anyone want to "stay on the trail?" You're off-roading after all, and besides, there were already tracks from other trucks that had crossed the stream before you got there!

After an hour of roaring engines ripping through the wilderness, one lost muffler and two more creek crossings, it's time to break for lunch. You sit by the muddy stream while your friend and his dad snap twigs to build a fire for hotdog roasting. It feels strange to be so deep in the wilderness, and not having seen any animals. You start to wonder if quads and dirt bikes have any negative effects on the environment, the animals, and the watershed. That couldn't be…could it? I mean come on, all you've left behind are some tracks in the creek—and a muffler!

FOCUSING QUESTIONS

1. *What are some potential impacts of recreational OHV (Off Highway Vehicle) use on the Elbow River watershed?*
2. *What measures have been taken, or could be taken, to reduce these possible impacts on the Elbow River?*

Recreation RESEARCH SITES

Public Land use and Motorized Vehicles
http://esrd.alberta.ca/recreation-public-use/recreation-on-public-land/motorized.aspx

All-Terrain Vehicles, Fish Habitat, and You
http://www.dfo-mpo.gc.ca/Library/333554.pdf

Elbow River Watershed Partnership Projects
"Alberta Community Development"
"McLean Creek Tour"
http://www.erwp.org/index.php/events-and-projects/projects/past

Agricultural Research Group

You are off for a float trip down the Elbow River with your class. As you splash each other haphazardly with your paddles, you can't imagine a better way to escape the usual routine of the classroom. Downstream, in the distance, you see that you are coming up on a herd of animals. Are they elk?!? No, just some roaming cattle down for a drink. You yell "M-O-O-O" as you float by, only to get an ear flick in response. The trip continues as the sun creeps high overhead and makes the crystalline river shimmer. A little while later, your class passes yet another herd of cattle. You watch as their hooves slide down the bank, causing brown trails of mud to go swirling downstream. And then you see it. A cow lifts its tail, and does its business right into the water. "Ewwwww! Gross!" All splashing stops for the rest of the trip.

Your float trip concludes in Bragg Creek's local coffee shop for cinnamon buns. As you sit with your pastry, you come across an article posted by the *Elbow River Watershed Partnership*. Someone has highlighted information on fecal coliforms in water; apparently they are a problem for Bragg Creek residents. The article reads:

> *"Fecal coliforms are found in the intestinal tract of warm blooded animals and are a useful indicator of water contamination from sewage or manure. E-coli is one species of fecal coliform".*

E-coli - isn't that some form of bacteria that makes you sick? Wait a minute, the article is saying that the same water you paddled in is used for drinking water! This can't be happening. There are tons of agriculture sites upstream from Calgary. You start to wonder what other kinds of "stuff" from farms are finding their way into the watershed. You decide to swear off drinking ANY water (Cola tastes better anyway, right?) until you can get to the bottom of this mystery.

FOCUSING QUESTIONS

1. *What are some potential impacts of ranching and crop farms on the Elbow River watershed?*
2. *What measures have been taken, or could be taken, to reduce these possible impacts on the Elbow River?*

Agriculture RESEARCH SITES

Elbow River Watershed Partnership Projects
"Cattle Setback program" and "Farmers of the Elbow River Watershed"
http://www.erwp.org/index.php/events-and-projects/projects/past

Agriculture and Agrifood Canada: Robocow animation (Search for "Robocow")
http://www.agr.gc.ca/

Cows and Fish
www.cowsandfish.org

Golf Course Research Group

It's a hot, windless day. You are perfectly happy to lounge about the golf course picnic table with your Slurpee and stare up into the blue sky. A magpie flies overhead with a large white object in its beak. Is it an egg? A marshmallow? Or…the magpie drops its cargo just centimetres from your head, and a golf ball comes screaming downward, bouncing off the picnic table as it rolls into the rough! The disappointed bird collects the ball and continues its flight. The bird must think the golf ball is an egg that will crack by dropping it…and nearly did so on your head! But why would a magpie look for eggs around here?

Then you remember the wetlands your uncle constructed throughout the golf course. Sometimes he pays you to collect golf balls lost in those water holes so that he can sell them. You've only ever seen a couple of nests there. Besides, aren't golf courses full of fertilizers and pesticides that poison wildlife? Wait a sec, you've seen how much fertilizer is used to keep the grass green around here. Could those chemicals be getting into the water holes that you trudge through in search of golf balls? You decide that your health is at risk and it's time to consult the turf manager (your uncle) about the matter.

You find your uncle trimming the brightly coloured green and demand that he explain whether or not your legs are going to melt off the next time you enter that wetland. Laughing and still distracted by his task, your uncle spouts off something about constructed wetlands, cattail filters and buffer zones. Huh? He then sits up and very seriously explains that fertilizers contain nutrients called phosphates and nitrates that are necessary to keep lawns healthy. These nutrients when in excess can cause an increase in the growth of terrestrial or aquatic plants. He goes on to list a wide variety of fertilizers used including organic fertilizers like manure. Even after the confusing explanation, you somehow don't feel so good. The only thing left to do is investigate for yourself. What kinds of fertilizers are being used on golf courses and are they leeching into the water? Why did you uncle mention cattails and why did he build those wetlands anyway? You grab your phone…better have the poison control center on speed dial, just in case!

FOCUSING QUESTIONS

1. *What are some potential impacts of golf courses on the Elbow River watershed?*
2. *What measures have been taken, or could be taken, to reduce these possible impacts on the Elbow River?*

Golf Course RESEARCH SITES

Elbow River Watershed Partnership Projects
"Glencoe Golf and Country Club"
"Farmers with Elbow River Watershed"
http://www.erwp.org/index.php/events-and-projects/projects/past

Glencoe Golf and Country Club – Environmental Commitments
http://www.glencoegolf.org/Membership/Course/Environment.aspx

Municipality and Water Treatment Research Group

Oh no, your little toddler sister is at it again! She has grabbed a handful of your collector's edition army figurines and has run into the bathroom. You hear a flush and some excited giggles as you race in after her, only to watch in horror as yet another Admiral Jones spirals down the drain. Have you ever wondered where tap water comes from or where toilet water goes? You're about to go on a school field trip to your city's water treatment plant, and your teacher gives you a research assignment about water treatment methods done before returning water to a watershed. Maybe by finding more about water treatment, you can track down the final destination of your lost collection.

Wastewater leaving houses needs to be cleaned before being returned to the river and this is called sewage treatment. Depending on where you live, wastewater is treated in a variety of ways. You start to wonder how effective water treatment facilities are and just how they differ. Are they able to make the water 100% clean? It's time to research the final resting location of poor Admiral Jones.

FOCUSING QUESTIONS

1. *What are some potential impacts of the presence of municipalities on the Elbow River watershed?*
2. *What measures have been taken, or could be taken, to reduce these possible impacts on the Elbow River?*

Municipality RESEARCH SITES

City of Calgary Water Use – Education Programs
"River to the Tap"
"Tap to the River"
http://www.calgary.ca/UEP/Water/Pages/Youth-education/Youth-Education.aspx

Elbow River Watershed Partnership –
"Farmers with Elbow River Watershed"
http://www.erwp.org/index.php/events-and-projects/projects/past

United States Environmental Protection Agency -
"Water activities"
http://www.epa.gov/students/index.html

2.3 SCIENTIFIC ROLES

Objective:

- To familiarize students with the group structure and students' roles during the field study.

Materials:

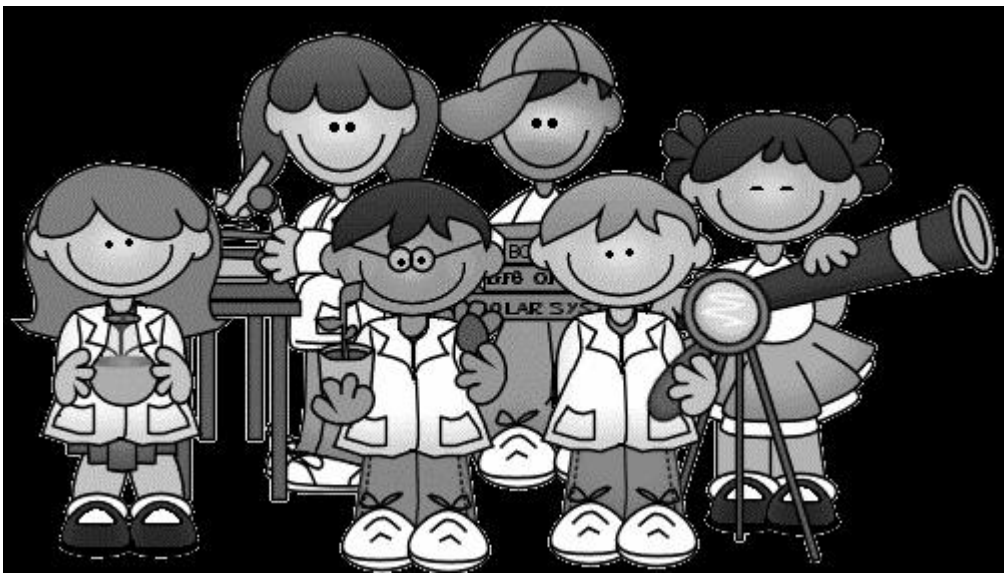
- Scientific team roles (visual)

Time Required:

- 20 minutes

Instructions:

- Divide students into 5 or 6 scientific research groups with approximately 5 or 6 students in each group (this may have already been done with previous activities)
- Assign or have student's pick a *scientific role* (see below) to ensure they know their responsibilities.



Scientific Team Roles:

Recorder (1 person):

- **Records all data** found by testers onto a chart.
- Also assists with identifying invertebrates
- **Sketches** the sampling sites (Elbow Falls, Redwood Meadows, and Twin Bridges)

Phosphate/Nitrate Test and Turbidity Test (2 people):

- Responsible for **Phosphate** or **Nitrate** test (each group will only be assigned one of the two)
- Also responsible for **Turbidity** test during the 10 minute wait period for the previous test
- Responsible for interpreting the results of these tests

PH, Temperature, Dissolved Oxygen (1 person):

- Responsible for **PH, Temperature** and **Dissolved Oxygen** tests
- Responsible for interpreting the results of these tests

Invertebrate Collector (1 or 2 people):

- Collects **Invertebrates** using net and bucket (must wear rubber boots, which are supplied)
- Assists recorder in identifying invertebrates.
- Properly **returns invertebrates** to river by gently pouring the contents of the bucket back into the river.

Once a group member has completed his/her role they must work together with other group members to complete any outstanding tests and reflect on the land use impacts up river from the sampling site.

All students are responsible for RIVER SAFETY and EQUIPMENT CARE

2.4 PREDICTIONS AND WATER TESTING

Objective:

- To encourage students to anticipate what results they will encounter during the field study.
- To introduce students to water testing methods and what test results indicate.

Materials:

- What do the tests mean? (visual)
- Predictions handout
- Kananaskis Education Freshwater Field Study Equipment video
    - https://www.youtube.com/watch?v=U5fK7nbRwAE

Time Required:

- 1 class period to watch video and conduct water samples
- 1 class period to make predictions

Instructions:

1. Discuss the tests

- Using the visual "What do the tests mean?" discuss all the water tests the students will be conducting on the field study day. It's critical for the students to be familiar with what it is they're looking for, and why.

2. Watch the video

- Play the Kananaskis Education Freshwater Field Study Equipment video (approximately 13 minutes) for the students in order to familiarize them with some of the equipment they'll be using during the field study.

    NOTE: While most of the information provided in the video is up-to-date, the nitrate/phosphate equipment has been changed. However, the test procedure used for both the nitrate/phosphate equipment in the video and the current equipment remains similar.

3. Predictions handout

- Divide students into (their scientific research) groups and predict what changes in water quality might occur during the Elbow River field study.
- Students should consider the impact of the land use they are studying to assist in their predictions (i.e. forestry, oil & gas, etc.) as they follow the course of the river.

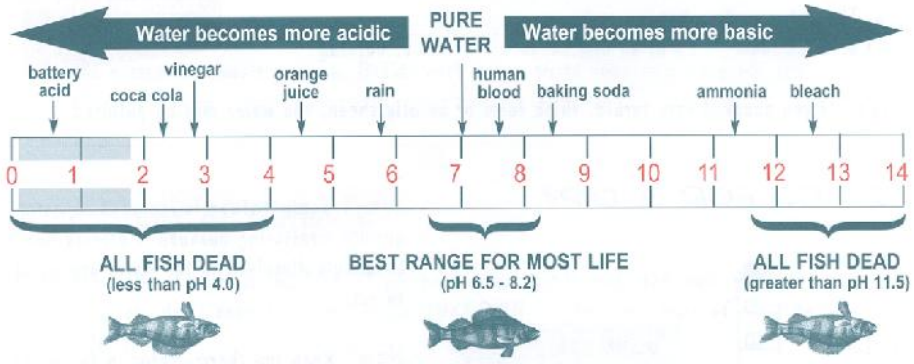
4. Discuss predictions

Ask students some of the following questions:

- *Is there a general consensus on the predictions for the Elbow River Field Study?*
- *Do predictions always have to be right?*
- *Brainstorm possible factors that may influence variations in predictions vs. results. Some possibilities may include: faulty equipment, improper use of equipment, unknown polluting sources, a rainy day, a sunny day, day of the week, etc.*

What do the Water Tests Mean?

pH



Source: Water Watchdogs (Saskatchewan River Basin)

Temperature	Temperature is monitored because it affects how chemicals dissolve in the water and affects the amount of dissolved oxygen in the water. An increase in temperature indicates there is heat coming from: • An input source (e.g. effluent from a factory) • Loss of the riparian area (trees) surrounding the river, which means the sun is heating up the water more than it would with trees around it.
Turbidity	Increased turbidity or lack of clarity means there is a large amount of sediment in the water. An increase in turbidity results in: • Decreased fish egg survival. • Predators that rely on their eyes to hunt are ineffective. • Chemicals can attach to dirt and be dissolved in the river. • "A fish in turbid water is like a human in a smoke-filled room."
Dissolved Oxygen	• High oxygen content = many invertebrates • Low oxygen (eutrophication) = a dying ecosystem • As temperature decreases, dissolved oxygen increases.
Nitrates	• Nitrates (which are nutrients) occur naturally in small amounts from decomposition in the atmosphere. • Other sources come from pesticides, fertilizers, and manure. • Excess nitrates can cause too much plant and algae to grow in the water, which reduces oxygen and could cause death in some aquatic animals.
Phosphates	• Phosphates (also nutrients) occur naturally in small amounts from soils and rock that leach into the water. • Phosphates are also from detergents occurring in some soap, pesticides which are toxic to invertebrates, and fertilizers.
Invertebrates	• Invertebrates are environmental indicators (something that tells you whether the environment is healthy). • The presence of those invertebrates, which are only able to live in pristine conditions, indicates a high water quality. Examples of these invertebrates include: stonefly, mayfly, and caddisfly larvae. • Examples of invertebrates that can tolerate low oxygen levels and high nutrient levels are: blackfly larvae, leech, bristleworm

Fill in the chart below with the results you **predict** you will find on the Elbow River.

WATER PREDICTIONS HANDOUT
FOR THE ELBOW RIVER FIELD TRIP

		HEADWATERS Elbow Falls	MID-RIVER Redwood Meadows	TOUR END Calgary City Limits
TEST DATA	pH			
	Temperature (^{0} C)			
	Turbidity (cm)			
	Dissolved Oxygen (mg/L)			
	Nitrates (mg/L)			
	Phosphates (mg/L)			
	Invertebrates ❑ Mark **X** in the boxes of the insects you think will be present	❑ Mayflies ❑ Stoneflies ❑ Diptera ❑ Leeches ❑ Caddisflies Other:	❑ Mayflies ❑ Stoneflies ❑ Diptera ❑ Leeches ❑ Caddisflies Other:	❑ Mayflies ❑ Stoneflies ❑ Diptera ❑ Leeches ❑ Caddisflies Other:

What test(s) do you think will be most influenced by the activity that is your group's expert area and why?

_____

_____

2.5 VOCABULARY

Objective:

- To introduce students to the vocabulary used throughout the field study.

Time Required:

- Varies

Instructions:

- There is a significant amount of vocabulary involved in this field study. This list can be made into a matching exercise, used as a handout, developed into bingo cards and made into a story, etc. or kept as a resource for your instruction.

Vocabulary with Definitions:

Aquifer: An underwater reserve of water.

Biological Indicator: A living organism whose state is indicative of conditions in a particular environment.

Dissolved Oxygen: The oxygen freely available in water, vital to fish and other aquatic life.

Erosion: The displacement of solids (soil, mud, or rock) by wind, water, or ice. Erosion is an important natural process, but it may be increased through human activities.

Fertilizer: A substance (either a chemical mixture or manure) used to make soil more fertile or productive.

Ground Water: Water that filters down through soil and fills spaces in the ground.

Herbicide: A chemical used to control "weeds" or unwanted plants.

Headwaters: The headwaters are often small streams, which create a larger river. It may also be glacial, which means that the melting of ice from glaciers is the water source.

Non-Point Source: A source of pollution in which pollutants are diffuse (widely distributed) and originate from no specific location.

Macro invertebrates: An organism visible to the unaided eye and lacking a backbone.

Nitrates: A naturally occurring nutrient resulting from decomposition in the atmosphere. It is also found in pesticides, fertilizers, and manure.

Outflow: Something that flows out, such as a sewage treatment plant.

OHV / ATV: Off-Highway Vehicle / All-Terrain Vehicle used for 4-wheel driving usually on rugged paths, referred to as "off-roading."

pH: A scale that measures the acidity or alkalinity of a substance.

Phosphates: A naturally occurring nutrient resulting from the leaching of soils and rock Phosphates are also from detergents occurring in some soap and fertilizers.

Pollutant: Any material, or form of energy that will cause harm to a living organism.

Point Source: A specific location where pollution originates.

Pesticide: A chemical used to control "pests", often insects.

Runoff: The portion of precipitation (also melted snow) that flows over the surface of the land and ultimately reaches streams.

Sediment: Often referred to as "suspended particles", such as silt, in the water.

Tributary: A stream, which feeds a larger stream or river.

Turbidity: The cloudiness or haziness in the water, caused by suspended particles (sediment), much like smoke in the air.

Wastewater: Waste liquids or matter (often called sewage) which is carried off by sewers to wastewater treatment facilities, held in holding tanks, or spread on septic fields.

Watershed: Area of land that drains into a body of water.

Water monitoring: The regular observation and testing of a water supply.

Water Cycle: The process in which nearly all water on Earth moves continuously between the oceans, land, and atmosphere.

Water quality: The characteristics of a water resource that make it suitable or unsuitable for various uses.

Water Table: The level beneath which porous rocks are saturated with water in the ground.

Water treatment: The purification of a supply of water.

2.6 CLASS DISCUSSION ABOUT THE FIELD STUDY

Objective:

- To conduct a class discussion focusing on the specifics of the actual field study day

Time Required:

- 30 minutes

Instructions:

Discuss the following checklist of items in class prior to the field study day:

1. **Behavioral expectations on the field study and important park rules**.
   The intent of parks and protected areas is to protect and preserve the natural environment. Have the class make a list of behaviours on the field study that would show respect for living things and a commitment to their care. An initial list could include:
   - Leaving nests, rotting logs and ant hills alone and intact. These are homes for small animals.
   - Staying on the trails.
   - Litter should be placed in a garbage can or in your pocket.
   - Walking carefully, watching each step to avoid crushing small plants and trees.
   - Cutting, defacing, picking, or removal of any plant, fossil, rock, or other park material is prohibited.
   - Observing wildlife from afar without disturbance (or feeding). This includes decomposable food such as orange peels and other commonly disposed of items such as sunflower seed shells.
   - Brainstorm others with the class…with emphasis on 'why' this rule is in place.

2. **Parks and protected areas have four main program objectives.**
   Initiate a conversation with the students regarding how these objectives could be balanced:
   - **Preservation**: to preserve in perpetuity a network of parks and protected areas that represent the diversity of the province's natural heritage, as well as related cultural heritage
   - **Heritage Appreciation**: to provide opportunities to explore, understand and appreciate the natural heritage of Alberta, as well as to enhance public awareness and our relationship to it
   - **Outdoor Recreation**: to provide a variety of outdoor recreation opportunities dependent on natural landscapes, as well as related facilities and services.
   - **Heritage Tourism**: to encourage residents and visitors to the province in order to discover and enjoy Alberta's natural heritage through a variety of outdoor recreation and nature-based tourism opportunities, facilities, and accommodation services.

3. **Litter-free lunch concept**
   Using reusable containers and cloth bags during lunch can significantly reduce litter. (ie. Why an orange peel, while biodegradable, is still considered litter that should be packed or properly disposed of. ("If it didn't grow there, it can't stay there.")
4. **Water safety**:
   The following chart identifies some potential hazards to consider around water and the discussion that could take place on how to minimize these hazards:

Potential Hazards	Minimizing Hazards
Slippery Rocks	Step carefully Avoid algae-covered rocks
Falling into river	Be with a partner when by the bank Watch footing and water level depth
Getting wet and cold	Bring proper wet boots Bring extra clothes or hand towel
Getting lost	Always stay with a partner and by the group
Sunburn	Wear sunglasses, sunscreen and a hat
Broken Glass	Always wear shoes and be watchful Notify teacher if glass is found Pick up and keep your garbage with you Avoid bringing glass containers in your lunch
Discussing other hazards…	

NOTE: The above hazards can be added to school board forms.

5. **Appropriate clothing**
   Students should be appropriately dressed for the season and the activities of the day. Students should wear several layers of clothing, including a water resistant layer and a hat or hood. Boots provide more protection than sandals or canvas runners. Rubber boots will be provided for the stream study. If it's warm and sunny, students should have sunscreen, hats, and insect repellent (if sensitive to bites).

2.7 OPTIONAL PREPATORY ACTIVITY (SAMPLE)

INDUSTRY EVIDENCE & MITIGATION

Time: 15 minutes

Concepts:

- Identifying evidence of industry and discovering ways in which various industries can mitigate their effect on the ecosystem

Materials:

- The cards needed for this activity can be found below. The cards will need to be printed off and cut prior to the activity. (They can also be printed in color and/or laminated.)

Objective:

- The objective of the game is for students to recognize and identify evidence of industrial and recreational land use throughout Alberta (oil & gas, forestry, OHV, recreation, and agriculture). Make sure the cards with the labeled industries are handed out, along with an even distribution of the other industry photos

How to Play:

- Distribute the cards amongst the students; tell them to look at the card and hold it against their chest so no one else can see it. The participants will go around showing each other their cards and trying to match themselves to the industry they belong to.
- For example, if a student holding the 'Oil & Gas' card comes across a student with a picture of a flare stack, they would pair up and try to find more evidence of their industry. If a student with the 'Forestry' card comes across the flare stack picture, they will pass each other and continue trying to find evidence of their industry.
- The game is complete when all the participants have formed five distinct groups. Get each group to read what industry they have and the evidence of that industry. Correct any students that may be in the wrong place and talk about the effect the evidence is having on an aquatic ecosystem.
- Ask each group to come up with two ways their industry could minimize their impact on the environment as well as discuss about what ideas they came up with.

OIL & GAS


DEPTH OF COVER OVER PIPELINE MAY VARY
RIGHT-OF-WAY
30 metre
(100 foot)
safety zone
30 metre
(100 foot)
safety zone

OFF-HIGHWAY VEHICLE

RECREATION

FORESTRY

AGRICULTURE


Agribition
2012

3.0 PREPARATORY ACTIVITIES (*FOR TEACHERS*)

3.1 CHECKLIST FOR FIELD STUDY DAY

Logistical Notes:

- Confirm departure and pick up times and dates for transportation. Some bus companies may also be reluctant to travel into the Elbow valley area (Highway 66).
- Sample itinerary (this will be adjusted based on your school's schedule, bussing, and available time). Five hours is the approximate time required to run an optimal program.

Grade 8

8:45 a.m.– depart from school	→	*9:30 a.m.– arrive at Elbow Valley Visitor Centre*
9:45 a.m.– arrive at Elbow Falls	→	*11:00 a.m.– depart Elbow Falls*
11:05 a.m. – arrive at Boat Launch	→	*11:35 a.m.– depart Boat Launch*
11:40 a.m.– arrive at Allen Bill	→	*12:10 p.m.–depart Allen Bill*
12:20 p.m.-arrive at McLean Creek	→	*12:50 p.m - depart McLean Creek*
1:10 p.m.– arrive at Red Wood Meadows	→	*2:00 p.m. –depart for school*

Grade 9

8:45 a.m.– depart from school	→	*9:30 a.m.– arrive at Elbow Valley Visitor Centre*
9:45 a.m.– arrive at Elbow Falls	→	*11:00 a.m.– depart Elbow Falls*
11:05 a.m. – arrive at Boat Launch	→	*11:35 a.m.– depart Boat Launch*
11:45 p.m.-arrive at McLean Creek	→	*12:15p.m - depart McLean Creek*
12:35 p.m.– arrive at Red Wood Meadows	→	*1:10 p.m. – depart Red Wood Meadows*
1:30 arrive at Twin Bridges	→	*2:15 p.m. – depart for school*

- Schedule the field study day with the Kananaskis Environmental Educator. Have a cheque prepared for field trip and deliver it to your parks programmer on the day of the trip.

- This program runs more efficiently if there is at least one adult with each group of students (average is 5-6 groups) while conducting tests on the river. *Any volunteers will also require the following information:*
  - All activities planned and the schedule for the day
  - A map and/or directions (if they are driving their own vehicle and planning to meet you there)
  - Health concerns, discipline issues, and expectations for students.

- Ensure all students are dressed appropriately; check the weather prior to your field study http://www.theweathernetwork.com. Remember, rain gear for all students is essential.

- Discussion with class (previous section) prior to the trip to review park rules, litter-free lunch, and behavioural expectations.

- Please see sample permission forms below

Photocopies required for the field study

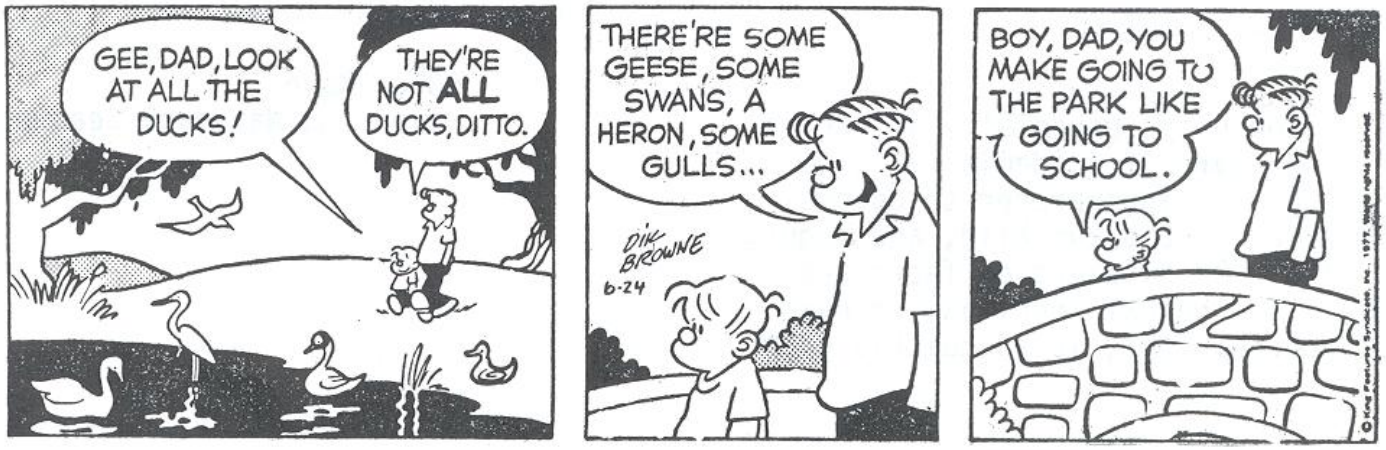
- Field study data sheets (one for each group)
- Evaluation forms
    - Teacher evaluation of program
    - Student evaluation of field trip
    - Group work evaluation

Additional items to bring on the field study:

- Class list and list of students with health/allergy concerns.
- First Aid kit.
- Spare clothing for students.

3.2 PARENT/GUARDIAN PERMISSION FORM (SAMPLE)

The following pages contain sample parent permission forms with specific information of the field study for your students and their parents. Feel free to change or add any information required, or use as is.



Date: _____

Freshwater Systems: A Case Study
Grade 8 Science Field Trip to the Elbow River Watershed

Dear Parents / Guardians:

As part of this year's science unit on *Freshwater and Saltwater Systems*, we are currently planning a class field trip to the Elbow valley. The students will be monitoring the water quality of the Elbow River using scientific testing equipment. This one-day field experience begins near the headwaters of the Elbow River within Kananaskis Country. The students will then follow the course of the Elbow River, testing the water quality at various locations, and analyzing how it may change as it enters the city of Calgary.

Field Study Date: _____

Field Study Location: _____

Departure time from School: _____

Arrival time back at School: _____

Cost: _____

The cost of this program includes transportation, service provided (Kananaskis Country Environmental Education staff), field study equipment, and program development expenses. Please contact the teacher in charge of the field trip if there are any concerns about the cost of this field study.
Please make cheques payable to: _____

Volunteers are required. The students will be organized into groups of approximately 5 students. Each group will have a parent volunteer to assist and facilitate student efforts in completing the field study activities. The environmental education staff and the teacher will provide all field study instruction. There is no cost for volunteers. If you are interested in participating as a volunteer, please complete the lower portion of this sheet.

Complete and return the lower portion of this form on or before: _____

I _____ give permission for _____ to
(parent /.guardian) (student name)

attend the field study on _____ at _____
(date) (location)

_____ Yes, I am interested in volunteering for the field study

_____ No, I am not able to volunteer on the field study

_____
Signature

Date: _____

Freshwater Systems: A Case Study
Grade 9 Science Field Trip to the Elbow River Watershed

Dear Parents / Guardians:

As part of this year's science unit on *Environmental Chemistry*, we are currently planning a class field trip to the Elbow valley. The students will be monitoring the water quality of the Elbow River using scientific testing equipment. This one-day field experience begins near the headwaters of the Elbow River within Kananaskis Country. The students will then follow the course of the Elbow River, testing the water quality at various locations, and analyzing how it may change as it enters the city of Calgary.

Field Study Date: _____

Field Study Location: _____

Departure time from School: _____

Arrival time back at School: _____

Cost: _____

The cost of this program includes transportation, service provided (Kananaskis Country Environmental Education staff), field study equipment, and program development expenses. Please contact the teacher in charge of the field trip if there are any concerns about the cost of this field study.
Please make cheques payable to: _____

Volunteers are required. The students will be organized into groups of approximately 5 students. Each group will have a parent volunteer to assist and facilitate student efforts in completing the field study activities. The environmental education staff and the teacher will provide all field study instruction. There is no cost for volunteers. If you are interested in participating as a volunteer, please complete the lower portion of this sheet.

Complete and return the lower portion of this form on or before: _____

I _____ give permission for _____ to
(parent /.guardian) (student name)

attend the field study on _____ at _____
(date) (location)

_____ Yes, I am interested in volunteering for the field study

_____ No, I am not able to volunteer on the field study

_____
Signature

4.0 FIELD STUDY DATA SHEET

Fresh Water Monitoring:
A Case Study of the Elbow River

Grade 8 & 9

Data Sheet

4.1 FIELD STUDY ITINERARY

(Including locations, discussion topics, and activities. May be subject to change)

Stop #1: Elbow Falls

- What is a watershed?
- Discuss the protection of the headwaters and the role of Parks and Protected Areas
- Discuss significance of tests
- Conduct water samplings tests
- Sketch the field study site
- Conduct invertebrate sampling
- Recap findings

Stop #2: Elbow River Boat Launch

- Introduction to Oil & Gas impacts on water
- Introduction to Forestry impacts on water
- Introduction to Agricultural impacts on water
- Discuss mitigation efforts and/or activity in relation to these land uses

Stop #3: Allen Bill (Grade 8)

- Discussion of rip-rap, floods and its impact on aquatic life (fish)
- Introduction of non-native species into an ecosystem and its impact on native species
- Swim Fish Swim activity

Stop #4 Mclean Creek

- Discuss and observe off highway vehicle use and potential impact on the ecosystem
- Discuss mitigation efforts
- Initiate land use debate OR Take a Stand activity OR turbidity activity
- Washroom break (lunches to be eaten during travel time)

Stop #3 Redwood Meadows

- Discuss municipal and/or recreational impact on the watershed
- Conduct water sampling tests
- Sketch the field study site
- Conduct invertebrate sampling

Stop #4 Twin Bridges – Calgary City Limits (Grade 9)

- Discuss recreational impacts on the watershed
- Introduce idea of accumulative effects
- Conduct water sampling tests
- Sketch the field study site
- Conduct invertebrate sampling

Final Activity

- Wrap up with comparisons of group predictions and results
- Activity to instill a sense of stewardship towards water and protected areas (time permitting)

4.2 FRESHWATER SYSTEMS: A CASE STUDY FIELD STUDY DATA SHEET

Group members: _____ _____

_____ _____

_____ _____

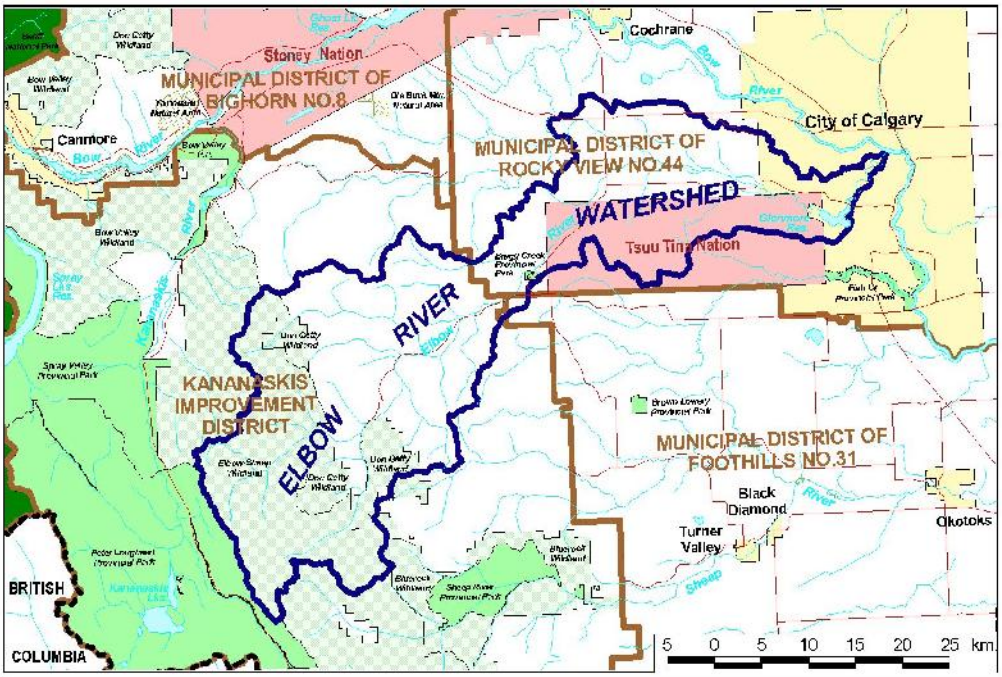
Information

Date: _____ **Time**: _____

Weather: _____

Important Student Reminders:

- Fill out all the required data at each sampling location.
- A group member must complete a sketch at each sampling site.
- As a group, discuss the land use impacts upstream from the sampling and the observation section of your data sheet.
- **Use care and attention when handling all sampling equipment – your school will be charged for any lost or broken items!**
- Enjoy the day outdoors!



Student Task Reminder

Scientific Team Roles:

Recorder (1 person):

- **Records all data** found by testers onto a chart.
- Also assists with identifying invertebrates
- **Sketches** the sampling sites (Elbow Falls, Redwood Meadows, and Twin Bridges)

Phosphate/Nitrate Test and Turbidity Test (2 people):

- Responsible for **Phosphate** or **Nitrate** test (each group will only be assigned one of the two)
- Also responsible for **Turbidity** test during the 10 minute wait period for the previous test
- Responsible for interpreting the results of these tests

PH, Temperature, Dissolved Oxygen (1 person):

- Responsible for **PH, Temperature** and **Dissolved Oxygen** tests
- Responsible for interpreting the results of these tests

Invertebrate Collector (1 or 2 people):

- Collects **Invertebrates** using net and bucket (must wear rubber boots, which are supplied)
- Assists recorder in identifying invertebrates.
- Properly **returns invertebrates** to river by gently pouring the contents of the bucket back into the river.

Once a group member has completed his/her role they must work together with other group members to complete any outstanding tests and reflect on the land use impacts up river from the sampling site.

All students are responsible for RIVER SAFETY and EQUIPMENT CARE

WATER TESTS ON THE ELBOW RIVER

TEST DATA

	HEADWATERS Elbow Falls	MID-RIVER Red Wood Meadows	STUDY END Twin Bridges
pH			
Temperature (^{0} C)			
Turbidity (cm)			
Dissolved Oxygen (mg/L)			
Nitrates (mg/L)			
Phosphates (mg/L)			
Invertebrates ❑ Mark **X** in the boxes of the larvae that are present **List any additional 'species' not listed in the space provided**	❑ Mayflies ❑ Stoneflies ❑ Diptera (true flies) ❑ Leeches ❑ Caddisflies	❑ Mayflies ❑ Stoneflies ❑ Diptera (true flies) ❑ Leeches ❑ Caddisflies	❑ Mayflies ❑ Stoneflies ❑ Diptera (true flies) ❑ Leeches ❑ Caddisflies

Site #1: Elbow Falls Study Site

Study Site Sketch:

List any land use impacts upstream from this test site:

Other observations:

Site #2: Red Wood Meadows Study Site

Study Site Sketch:

List any land use impacts upstream from this test site:

Other observations:

Site #3: Twin Bridges – Calgary City Limits

Study Site Sketch:

List any land use impacts upstream from this test site:

Other observations:

5.0 POST FIELD STUDY ACTIVITIES

5.1 CONSOLIDATING THE DATA / PREDICTIONS VS. RESULTS

Objective:

- To make use of the data collected during the field study (consolidating, tabulating means and medians, etc.).
- To compare the predictions made with the observed and recorded results.

Materials:

- Consolidation chart (as visual)

Time Required:

- 45 minutes (or more)

Instructions:

- Compile data from all groups onto the consolidation chart.
- Create averages of all data, review consistencies and differences in measurements.
- Discuss why there is variation in scientific data (ie.) scientific error, testing anomalies
- Direct each group to discuss the differences between their pre-field study predictions and the actual results, or together as a class. What are the possible reasons for the differences?

  Examples

  - Time of day, week, or year
  - Changes in water quality due to procedures by industry, municipalities, and recreation
  - Sampling error (how would you determine if this was the case?)
    - Alberta Environment measurements
    - Repeating the tests (using the entire class's data compared to one group)
  - Compare class data to that of a single group

CONSOLIDATED TEST RESULTS FROM THE ELBOW RIVER FIELD STUDY

TEST DATA

		HEADWATERS Elbow Falls	MID-RIVER Redwood Meadows	STUDY END Calgary City Limits
pH	Group 1			
	Group 2			
	Group 3			
	Group 4			
	Group 5			
	Group 6			
SITE AVERAGE				
Temperature	Group 1			
	Group 2			
	Group 3			
	Group 4			
	Group 5			
	Group 6			
SITE AVERAGE				
Turbidity	Group 1			
	Group 2			
	Group 3			
	Group 4			
	Group 5			
	Group 6			
SITE AVERAGE				
Dissolved Oxygen	Group 1			
	Group 2			
	Group 3			
	Group 4			
	Group 5			
	Group 6			

CONSOLIDATED TEST RESULTS
FROM THE ELBOW RIVER FIELD STUDY

		HEADWATERS Elbow Falls	MID-RIVER Redwood Meadows	STUDY END Calgary City Limits
GROUP AVERAGE				
Nitrates	Group 1			
	Group 2			
	Group 3			
	Group 4			
	Group 5			
	Group 6			
SITE AVERAGE				
Phosphates	Group 1			
	Group 2			
	Group 3			
	Group 4			
	Group 5			
	Group 6			
SITE AVERAGE				
Invertebrates **Add up all the invertebrates found in each group to get the total number of invertebrates.**		Mayflies _____ Stoneflies _____ Diptera _____ Leeches _____ Caddisflies ____ Others:	Mayflies _____ Stoneflies _____ Diptera _____ Leeches _____ Caddisflies ____ Others:	Mayflies _____ Stoneflies _____ Diptera _____ Leeches _____ Caddisflies ____ Others:

5.2 DATA COMPARISON

Objective:

- To compare the student's consolidated data with that collected by Alberta Environment, collected for water quality monitoring purposes.

Materials:

- Data Comparison – Quick Facts Chart (display on smart board or projector)
- Water quality test table (visual)

Time Required:

- 30 minutes

Instructions:

- Collect all the data from the students and compile it into one large chart. As a class discuss

❑ Discuss what are the expected trends and why they are expected? (with accompanying data table)

- View the water quality table and compare the students' results. How did they differ? What are some factors which may contribute to the differences? Examples: seasonal runoff, variation in equipment, etc.
- *Other discussion topics:* Is data collected over the course of one day meaningful? Why was there a reduction in the amount of phosphates? Why did the turbidity increase? Why did nitrate levels increase?

DATA COMPARISON – QUICK FACTS CHART

	Trends Expected	Why Trends Expected	Possible Explanation for why Trends not found
Nitrates	-Low amounts but slightly increasing downstream -Less than 0.09mg/l	- More nutrients are naturally added to river by soil, animal matter - Increasing human impacts (sewage)	-Long term data would be more accurate to show trends -Location of water testing sites may not be perfectly reflective of river water quality -Weather affecting data (ex: rain, drought) -Especially turbulent/slow stretch of the river -Scientific error: -is the equipment properly calibrated? -is everyone following instructions? -continuity in the person sampling- why is that important? -Seasonal variations (ex: Spring runoff) - The interface between groundwater (aquifer) and the river -Simply a snapshot of the river at the particular time that the water was sampled. -A specific event could be affecting test result- further research could be necessary
Phosphates	-Low amounts of but slightly increasing downstream -Less than 0.09mg/l	- More nutrients are naturally added to river by soil, animal matter - Increasing human impacts (sewage, soaps)	
pH	-Constantly between 7.5-8.5 Basic/ Alkaline	- The dominant rock type in eastern Rockies is limestone -Dissolved limestone causes the water to be naturally basic	
Temperature	-Above 0°C -Warming downstream	-River widens, more surface area, farther from glaciers—all cause warmer water	
Dissolved Oxygen	-Above 9.00mg/l decreasing downstream	-Water is less turbulent -More animals/ vegetation downstream has greater oxygen demand	
Invertebrates	-Increasing in size -Increasing in diversity	-More nutrients= more food -More food allows for bigger animals and more variance in species	
Turbidity	-Increasing turbidity (increasing cloudiness)	-More sediment naturally caused by wider, more vegetated stream banks -Unnaturally caused by ATV's, highway runoff, parking lots, forestry, un-natural erosion	

WATER TESTS ON THE ELBOW RIVER

Alberta Environment May, 2002

	HEADWATERS Cobble Flats (West of Elbow Falls)	MID-RIVER Bragg Creek	TWIN BRIDGES City of Calgary
pH	7.7	7.79	8.05
Temperature (^{0} C)	4.7	4.6	5.2
Turbidity (NTU)	1.3	2.9	5.0
Dissolved Oxygen (mg/L)	10.5	10.84	9.59
Nitrates (mg/L)	0.12	0.2	0.52
Phosphates (mg/L)	0.003	0.021	0.003

5.3 WATER QUOTES

Objective:

- To stimulate a conversation about the variety of demands and perspectives on fresh water.

Materials:

- Water Quotes sheets cut into individual pieces for students

Time Required:

- 15-45 minutes (or as conversation warrants)

Instructions:

- Cut and copy the following Water Quotes sheets. Distribute quotes randomly to all students.
- If desired, students can be allowed to trade cards with each other until they find the quote they most connect with and wish to share with the class.
- Have students read their quotes aloud. You may wish to have them discuss what the quotes mean to them personally or reflect on how the quotes relate to their field study. Additional suggestions include a reflective paragraph, poem, or other literary work.

Water Quotes

"To put your hands in the river is to feel the chords that bind the earth together." - Barry Lopez, author
"Boundaries don't protect rivers, people do." - Brad Arrowsmith, landowner
"Water is a more important resource to the people of Alberta than oil and gas." - Peter Lougheed, 2004
"Who hears the rippling of rivers will not utterly despair of anything." - Henry David Thoreau, mid 1800's
"Good stewardship is all about leaving the resource for future generations." Edith Wearmouth, rancher, 2004
"Water is the property of the public." - William Pearce, Federal Department of the Interior, 1890s
"Whiskey's for drinking; water is for fighting over." - Mark Twain, 1884
"First in time, first in right." - Alberta Water Act
"60% of the freshwater in Canada drains north; however 90% of the population lives within a few hundred kilometers of the southern border." - Oliver Brandes and Keith Furuson, *Flushing the Future?*
"Comprising less than 1% of the global population, Canadians possess 20% of the world's freshwater resources." - Oliver Brandes and Keith Furuson, *Flushing the Future?*
"Canadians use at least twice as much water per person as citizens in many other industrialized countries." - Oliver Brandes and Keith Furuson, *Flushing the Future?*

"I don't know when I've seen such rhythmical curves of riverbanks and coulees, and slowly lifting hills." - CW Jeffreys, artist
"In the end our society will be defined not only by what we create but by what we refuse to destroy." - John Sawhill, Nature Conservancy
"I learned everything from a close and direct observation of nature." - David Pugh, 1984
"The world would not be the same without water." - Marie Reis
"Of all the water on the Earth, 97% is saltwater. Of the 3% left, 2% is frozen in ice caps. That leaves less than 1% available for human consumption. Of this 1%, approximately .2% is still potable." - State of the Earth Report
"More than 20% of the world population does not have access to safe drinking water." - State of the Earth Report
"Throughout the history of literature, the guy who poisons the well has been the worst of all villains..." - Author unknown
"Thousands have lived without love, not one without water." - W.H. Auden
"The noblest of the elements is water." - Pindar, 476 B.C.
"If there is magic on this planet, it is contained in water." - Loran Eisley (Anthropologist), The Immense Journey, 1957

"When the well is dry, we learn the value of water." - Benjamin Franklin
"Eventually, all things merge into one, and a river runs through it. The river was cut by the world's great flood and runs over rocks from the basement of time. On some of the rocks are timeless raindrops. Under the rocks are the words, and some of the words are theirs. I am haunted by waters." - Norman Maclean, A River Runs Through It.
"When you drink the water, remember the spring." - Chinese Proverb
"Water is the one substance from which the earth can conceal nothing; it sucks out its innermost secrets and brings them to our very lips." - Jean Giraudoux
"The noblest of the elements is water." - Pindar, 476 B.C.
"All the water that will ever be is right now." - National Geographic, October 1993
"Stones are hollowed out by the constant dropping of water." - Ovid
"The people are like water and the ruler a boat. Water can support a boat or overturn it." - William Shakespeare
"Only a fool tests the depth of the water with both feet." - African Proverb
"It takes 90 litres of water to run the dishwasher." - *Troubled Water*
"A typical bath uses more than 180 litres of water." - *Troubled Water*

"If you leave the tap on when you brush your teeth, 18 to 25 litres of water will go down the drain." - *Troubled Water*
"A 10 – minute shower uses 45 litres of water." - *Troubled Water*
"A single toilet flush uses 15 to 30 litres of water." - *Troubled Water*
"We are witnessing something unprecedented: Water no longer flows downhill. It flows towards money." - Robert F. Kennedy Jr.
"A billion people worldwide do not have any water within a 15-minute walk of their homes." - *Troubled Water*
"Without water we would die within 3 days." - *Troubled Water*
"If the wars of this century were fought over OIL…the wars of the next century will be fought over WATER." - Ismail Serageldin, World Bank vice president
"Every 8 seconds a child dies from contaminated water." - *Troubled Water*
"Water that has been begged for does not quench the thirst." - *Ugandan Proverb*
"Nothing on earth is so weak and yielding as water, but for breaking down the firm and strong, it has no equal." - Tao-Tsze
"A leaky faucet that loses a drop per second loses 16 bathtubs full a month, and 10,000 litres a year." - *Troubled Water*

"The sewer is the conscience of the city." - Victor Hugo
"25 million people die each year from contaminated water. That's about equivalent to the entire population of Canada." - *Troubled Water*
"Water is the only drink for a wise man." - Henry David Thoreau
"It struck me…that all you had to do is take the water out of the ground and then sell it for more than the price of wine, milk, or for that matter, oil." - Perrier (bottle water company) executive
"It takes 50 glasses of water to produce 1 glass of orange juice." - *Troubled Water*
"The cycle of life is intricately tied up with the cycle of water." - Jacques Cousteau
"We're all downstream." - Marq De Villiers
"In the Sahara, more people die from drowning in flash floods than from lack of water." - *Troubled Water*
"In Stgomta Sweden they hold an annual "Pee Outside Day" where nobody flushes a toilet. They save a 50% of the water the town would typically use in a day." - *Troubled Water*
"The average American home uses 1,300 litres of water a day. The average African family uses 22 litres of water a day." - *Troubled Water*
"Water is the blue soul of the planet." - Pedro Arrojo Agudo

5.4 WHAT IS WATER ALLOCATION?

Objective:
- To provide an opportunity for students to observe and discuss the dilemma of water allocation.

Materials:
- Photocopies of land use cards (see below)
- Plastic cups for each student (mark where a full, half, and a quarter cup is with a permanent marker)
- 1 litre water container (water bottle, Ziploc container, etc). One for each group of 4 students (approximately 7-8 containers total)

Time Required:
- 30 minutes

Instructions:
- Divide the class into groups of four
- Photocopy the cards below to have as many sets as there are groups (ie. 8 groups…8 sets of cards)
- Distribute the land use cards so each group has a set and have students each take one land use card

Instructions:
- Divide the class into groups of four
- Photocopy the cards below to have as many sets as there are groups (ie. 8 groups…8 sets of cards)
- Distribute the land use cards so each group has a set and have students each take one land use card
- Fill the 1 litre water containers with water and distribute one to each group

- *Round 1*: Instruct the students to allocate the water they have in front of them into the plastic cups, which represents the water they are allowed to use.
    - *Discussion*: Once complete go around the room to hear how and why they distributed the water as they did. Have the students carefully pour the water back into the 1 litre container.
- *Round 2*: Ask the students if there are any land uses missing in this demonstration (ie. recreation such as golf courses, conservation such as fish habitat, etc.) Instruct the students that they need to distribute the water again except this time they need to leave half the water in the river.
    - *Discussion*: Ask the students if the allocation was more difficult this time? Was there some negotiating that took place? What are some other ideas the students have about water allocation?

Forestry – *You own a pulp and paper mill*

Full Cup = Your pulp mill is running at full capacity and you're a wealthy business person. You employ a lot of people and have high profits but you're creating a lot of unsafe wastewater.

Half Cup = Your company is running at 75% capacity and this is biting into your profits. You are currently working on a new system of processing which will reduce the amount of water you need, but this requires more of your profits.

Quarter Cup = You are just covering operating costs, you have installed new water and waste-saving technology which costs a lot of money. In order to pay for this expense you had to lay off staff and get a huge bank loan.

Empty Cup = Your plant must shut down.

Oil and Gas – *You own an oil and gas company and specialize in exploration, drilling, and deep well oil extraction, which means pumping water into wells to retrieve the oil.*

Full Cup = You are continually exploring and drilling new sites daily. You use all allocated water for deep well extraction in order to keep your profits high.

Half Cup = You are drilling some new wells but because you have less water allocation you are exploring alternate methods of extracting (such as salt water or foam products). This research is cutting into some of your profits.

Quarter Cup = You are continuing to explore and drill but are just covering operating costs. You have stopped deep well extraction because you don't have enough water. You are slowly increasing your use of alterative products as they become more affordable.

Empty Cup = You are considering filing for bankruptcy.

Agriculture – *You own a cattle ranch around the town site of Bragg Creek which is on the Elbow River.*

Full Cup = You have over 250 head of cattle which have free access to the river. Your calving rates are very high, you're producing AAA quality beef, and your business is highly successful.

Half Cup= Your herd is reduced to 200 head due to a reduction in water supply. Your herd is healthy but the calving rates are slightly lower. You have fenced some of the access to the river and pump a water supply to most of your cattle.

Quarter Cup = Your herd is down to 150. Fences control all cattle access to the river. You have to supplement your income with another part-time job.

Empty Cup = You've converted your pasture to native grass and built a straw bale home. You're considering marketing your property for tourism and becoming a vegetarian.

Municipality – *You are the mayor of a city with over one million people*

Full Cup = Your city has not installed water meters and therefore residents can use as much water as they like. The city is gorgeous, it attracts millions of tourists every year and gardens are flourishing everywhere.

Half Cup = Your city has installed water meters at every residence. This has increased the taxes for residents which has made voters unhappy.

Quarter Cup = In addition to meters there is a water limit placed on all residents. Cost of water has increased and is becoming a financial problem for some families. Lawn watering is prohibited during hot spells. Only native plants are allowed in city parks.

Empty Cup = The city is in drought-like conditions. There is barely enough water to meet basic needs, residents are moving away and the polls suggest you won't be re-elected.

5.5 DID YOU KNOW? (STEWARSHIP ACTIVITIES)

Objective:

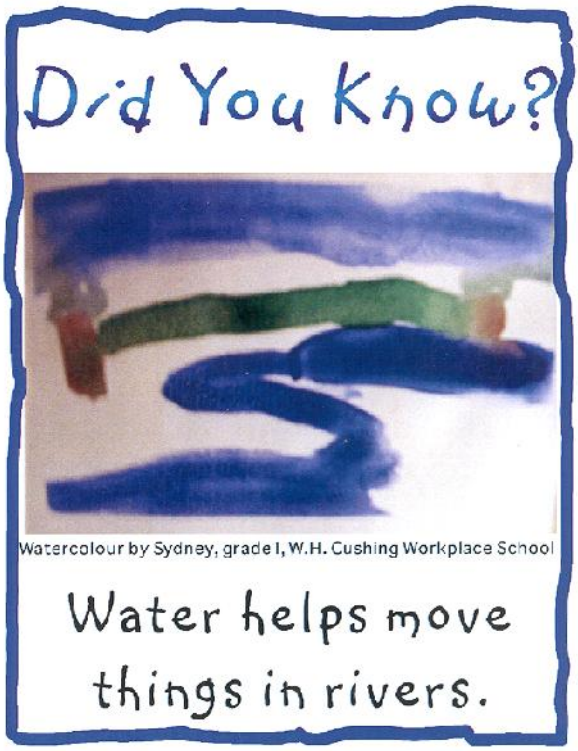
- To provide an opportunity for the students to share what they have learned about water and water-related issues with others.
- To provide students the opportunity to "do their part" in improving the health of water and watersheds.

Time Required:

- Variable

Instructions:

- There are many ways students can become involved to improve the health of our watersheds. Taking action will give students an opportunity to apply some of the information they learned about watersheds, parks and protected areas, and communities.
- Listed below are a few ideas for projects the class may implement.
  - **"Did you know"** campaign. Students initiate a poster project detailing information they learned during the water unit. These could be posted at your school, at a community centre, or at the Elbow River Watershed Partnership meetings. Call an ERWP coordinator to find out how.
  - Alberta Water Quality Awareness Day (www.awqa.ca). Register your class for AWQA day, send in your results for the province-wide monitoring program, and potentially win free water testing kits for your class!
  - Yellow Fish Road (www.yellowfishroad.org). Trout Unlimited Canada has a great storm drain painting program and teacher's resources.
  - Elbow River Watershed Partnership (www.erwp.org) has river cleanup days, tree planting projects, and other community events. Contact the partnership for inspiration on initiating your own project.
  - Adopt a local stream or river. Plant native vegetation or construct an interpretive sign.
  - Class debate. Some debate topics include: "Is our drinking water protected well?" "How should Alberta's water be managed for the future?" "What is the role of parks and protected areas with water?"
  - View the teacher's resources (section 7.0) and design an action activity suitable for your class.



6.0 PROGRAM EVALUATIONS

6.1 PROGRAM EVALUATION - TEACHER

*Thank you for participating in the **Freshwater Systems: a Case Study** program. Your feedback is greatly appreciated and will help to improve future programs. Please use the back of the evaluation form if you require more space.*

In-Class Presentation	***not at all***		***neutral***		***yes***
1. Did the presentation help to prepare the students for the field study day?	1	2	3	4	5
2. Did you find the presentation materials and activities valuable?	1	2	3	4	5
3. Was the presentation conducted at an appropriate time and duration?	1	2	3	4	5
4. Was the presentation delivery/technique effective?	1	2	3	4	5

Any additional comments about the in-class presentation? _____

_____

Which **preparatory activities** did you complete with your class?

- ❑ Program Introduction (watershed discussion, map construction, and field trip description)
- ❑ Scientific Team Research Challenge
- ❑ Water sampling tests
- ❑ Predictions handout
- ❑ Class discussion about the field study
- ❑ Did you use any **additional preparatory activities**? If so, please describe

_____

Field Study	***not at all***		***neutral***		***yes***
5. Was the field study location appropriate?	1	2	3	4	5
6. Was the program delivery/technique effective?	1	2	3	4	5
7. Was the duration of the program appropriate?	1	2	3	4	5
8. Were the activities educational and engaging for the students?	1	2	3	4	5
9. Was the program a valuable experience relative to the cost ratio?	1	2	3	4	5

Any additional comments about the field study? _____

_____

Which **post-program activities** did you complete with your class?

- ❑ Water quotes
- ❑ Did you know – share the information exercises
- ❑ What does the data mean
- ❑ Did you use any **additional post-program activities**? If so, please describe _____

_____

Did you find the additional resources and contacts valuable? **YES** **NO**

Please list any additional resources and/or contacts you feel may benefit the program_____

_____

Send completed evaluation forms to Kananaskis Country Environmental Education (403) 678-5505

6.2 FIELD STUDY EVALUATION - STUDENT

During the Water Field Study, **I learned** the following:

_____

_____

_____

I now have the following **new questions** about water and watersheds:

_____

_____

_____

I did **not understand** this part of the field trip and/or water unit:

_____

_____

_____

Assess the following:

	not at all		*neutral*		*yes*
1. Did you find the scientific data collection useful for your study?	1	2	3	4	5
2. Was invertebrate collecting and identifying a valuable experience?	1	2	3	4	5
3. Overall, did you learn more about water and water related issues?	1	2	3	4	5
4. Will you help to educate others about water and water issues?	1	2	3	4	5

Any additional comments about the water field study or your water unit? _____

_____

_____

6.3 GROUP WORK EVALUATION - STUDENT

Self-Evaluation of your group work:

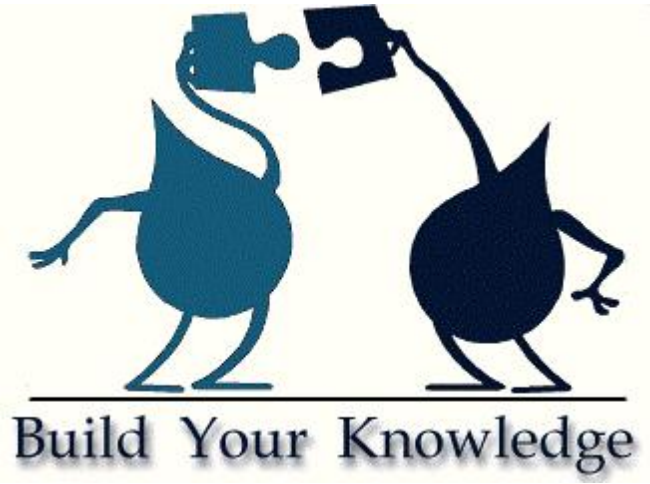
Each group member has a responsibility to the water field study and their group to do the following:

1. cooperate with other members of the group
2. contribute ideas and information
3. listen to the environmental educator and your teacher when they are providing information
4. complete your research test, taking care of the equipment, and following instructions thoroughly
5. participate with enthusiasm

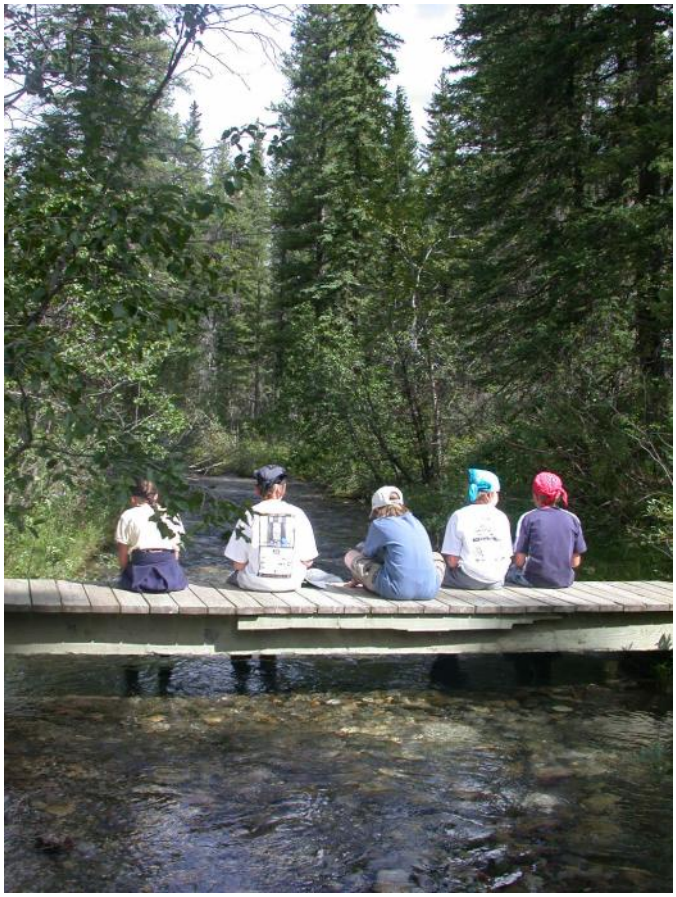
Rate your **personal performance** in the following areas. Be as honest as possible!

Rate your performance from 1 to 5 (1 being *never* and 5 being *always*) as it relates to the water field study:

	never		***sometimes***		***always***
1. Kept focused and on task	1	2	3	4	5
2. Listened well when the instructors were speaking	1	2	3	4	5
3. Participated with enthusiasm	1	2	3	4	5
4. Treated the research equipment with care	1	2	3	4	5
5. Did my best scientific work	1	2	3	4	5
6. Asked thoughtful questions	1	2	3	4	5



7.0 TEACHER'S RESOURCES



7.1 RESOURCE LIST

- Kananaskis Country Environmental Education
  - Field trip bookings, information, and educational resources
  - 403-678-5500 Ext. 284
  - www.kananaskis-country.ca

- Elbow River Watershed Partnership
  - Resources, data, technical information, and stewardship possibilities
  - www.erwp.org

- Alberta Parks and Protected Areas
  - Information about the parks and protected areas system
  - www.AlbertaParks.ca

- Trout Unlimited Canada
  - Yellow Fish Road Program – paint storm drains with fish!
  - www.yellowfishroad.org

- Riverwatch
  - Rafting field trips for students on various rivers in Alberta.
  - http://www.riverwatch.ab.ca/

- South Saskatchewan River Basin
  - Water Watchdog program and resources
  - www.saskriverbasin.ca/

- Alberta Watersheds
  - Watershed Maps and information on watersheds. Highlights Alberta Watershed Awareness Day
  - http://www.waterforlife.gov.ab.ca

- Cows and Fish: Alberta Riparian Habitat Management Society
  - Great information about riparian areas and about water stewardship and protection.
  - www.cowsandfish.org

- Ducks Unlimited
  - Teacher's resources, wetland connections
  - www.ducks.ca/

- What's happening to Alberta's water?
  - Information, maps, climate change research, connected with the University of Alberta
  - http://www.ualberta.ca/~ersc/water/

- Alberta Environment (water web page)
  - Research, technical findings, resources, data, policies, manuals, and more

  http://esrd.alberta.ca/

- Fisheries and Oceans Canada**:**
  - http://www.dfo-mpo.gc.ca/index.htm

- Agriculture and Agrifood Canada (search for "Robocow")
  - http://www.agr.gc.ca/eng/home/?id=1395690825741

- United States Environmental Protection Agency for students
  - http://www.epa.gov/students/index.html

- International Year of Freshwater 2003: "Water for Life" decade
  - http://www.wateryear2003.org/

- Parks Foundation Calgary
  - http://www.parksfdn.com/

- City of Calgary Water use Education programs
  - http://www.calgary.ca/UEP/Water/Pages/Youth-education/Youth-Education.aspx

- Glencoe Golf and Country Club
  - http://glencoegolf.org/

- Tsuu T'ina Nation and Ecotourism
  - http://www.tsuutina.ca/

- Living by Water
  - Landowner projects to protect water
  - http://www.livingbywater.ca/

- SEEDS – Alberta Centennial Water Challenge
  - Water challenge
  - www.seedsfoundation.ca

- Bow River Basin Council
  - www.brbc.ab.ca

- Stream of Dreams
  - Water education through community art
  - http://www.streamofdreams.org/

- Canada's Aquatic Environment
  - Provides a wealth of information on Canada's lakes, rivers, wetlands, and oceans; aquatic research in Canada; and human interactions on aquatic environments
  - http://www.aquatic.uoguelph.ca