Running Water

Teacher's Guide

Inside education

ACKNOWLEDGEMENTS

Poster illustration and design by Brian Huffman

Running Water was produced by Inside Education to provide teachers with information and ready-to-use lessons on water in Alberta (Grades 7-11). The activities contained in this guide are linked to the Running Water poster.

Discover Inside Education's full suite of learning resources, teacher professional development programs, school and field programs, and youth education summits at **www.insideeducation.ca.**

Inside Education
info@insideeducation.ca
780.421.1497 (Edmonton)
403.263.7720 (Calgary)
1.888.421.1497 (Toll Free)

Our Mission
We are a charitable education society providing programs that enable Canadian teachers and students to understand the science, technology and issues related to our environment and natural resources.

Our Vision
We envision future generations of engaged stewards who think critically about our environment and natural resources, and their complex relationship with our economy and society.

Inside Education thanks these supporters for their generous contributions.

WELCOME

Welcome to the ***Inside Education Running Water*** poster educational resource. The poster and teacher's guide are filled with information and activities that can fit a variety of grades and classroom situations. Have fun exploring water with your class!

POSTER OVERVIEW

Showcasing science, technology, stewardship, innovation, and issues relating to watersheds, this poster and teacher's guide can enhance lessons and provide students with creative critical thinking opportunities.

MAJOR THEMES:

Watersheds
Water and Petroleum
Water and Environment
Water and Agriculture
Water and Stewardship

The **front** of the *Running Water* poster provides a representation of the semi-arid environment of southern Alberta. Many users of water are represented including: rural and urban municipalities; wildlife; and industries such as petroleum and agriculture.

The **back** of the poster explores many of the activities depicted on the front while making scientific, technological, societal and environmental connections.

TABLE OF CONTENTS

INTRODUCTION

Why an educational resource on water in Alberta's semi-arid south?

Water is essential for life. Not only is it important for physiological and biological reasons, water affects the physical landscape, economy, and culture of Alberta. With a high population and a large variety of water uses, it is important to have a greater understanding of water management in Alberta's semi-arid south.

This teaching resource was developed to support the Grade 8 Science unit Freshwater and Saltwater Systems as well as many other grade and subject levels. It will help students to appreciate the science and issues related to water by considering the following questions :

- What is a watershed?
- How does water affect the landscape?
- How is water being used in Alberta's semi-arid south?
- What needs are met by these activities?
- What are some of the concerns related to these uses of water?
- What is being done to conserve water and/or protect water quality in this region?
- Why is water management so important, and so complex?

SKIMMING THE SURFACE activity

Find the items listed below on the front of the Running Water poster, fill in the appropriate number and solve the puzzle!

1. # of bison x # of dams

   _____ x _____ = _____

2. # of logging trucks + # of golf courses

   _____ + _____ = _____

3. # of hawks + # of vehicle bridges – # of forest fires

   _____ + _____ - _____ = _____

4. # of pump jacks + # of centre pivot irrigation systems you can see

   _____ + _____ = _____

5. (# of hay bales - # of turkey vultures) ÷ # of grain elevators

   (_____ - _____) ÷ _____ = _____

6. # of waste water treatment facilities + # of derrick rigs

   _____ + _____ = _____

7. # of dams x # of storm drain outfalls

   _____ x _____ = _____

8. (# rail cars x # of storm drain outfalls) – (# of centre pivots + # of dams)

   (_____ x _____) - (_____ + _____) = _____

Using the key below, correlate your answers (on the right) with the letters (on the left). Unscramble your answers to find the solution to the statement that follows.

A = 3	G = 25	M = 2	S = 13	Y = 7
B = 40	H = 39	N = 17	T = 39	Z = 99
C = 15	I = 9	O = 74	U = 48	
D = 8	J = 50	P = 93	V = 66	
E = 6	K = 4	Q = 58	W = 82	
F = 22	L = 1	R = 21	X = 20	

The *Running Water* poster depicts a ____ ____ ____ ____ - ____ ____ ____ ____ environment.

SKIMMING THE SURFACE answer key

Find the items listed below on the front of the Running Water poster, fill in the appropriate number and solve the puzzle!

1. # of bison x # of dams

   7 x 3 = 21

2. # of logging trucks + # of golf courses

   1 + 1 = 2

3. # of hawks + # of vehicle bridges – # of forest fires

   2 + 8 – 1 = 9

4. # of pump jacks + # of centre pivot irrigation systems you can see

   9 + 4 = 13

5. (# of hay bales - # of turkey vultures) ÷ # of grain elevators

   (17-1) ÷ 2 = 8

6. # of waste water treatment facilities + # of derrick rigs

   2 + 1 = 3

7. # of dams x # of storm drain outfalls

   3 x 2 = 6

8. (# rail cars x # of storm drain outfalls) – (# of centre pivots + # of dams)

   (8 x 2) – (4 + 3) = 9

Using the key below, correlate your answers (on the right) with the letters (on the left).
Unscramble your answers to find the solution to the statement that follows.

A = 3	G = 25	***M = 2***	***S = 13***	Y = 7
B = 40	H = 39	N = 17	T = 39	Z = 99
C = 15	***I = 9***	O = 74	U = 48	
D = 8	J = 50	P = 93	V = 66	
E = 6	K = 4	Q = 58	W = 82	
F = 22	L = 1	***R = 21***	X = 20	

The *Running Water* poster depicts a S E M I - A R I D environment.

QUICKEST EYES IN THE BUNCH activity

Divide the class into small groups and provide each group with a copy of the Running Water poster. Have each group come up with a sound or catchy word that relates to water, for example, "splash." This will be their team name and buzzer. Read the questions aloud and award points to the team with the correct answer. Teams indicate that they have the answer by buzzing in with their water word or sound.

Using the poster front find: (1 point questions)

1. A wetland
   (bottom left, centre, upper right, etc.)

2. An antelope
   (bottom centre)

3. A big horn sheep
   (top left, on cliff edge)

4. A wastewater treatment plant
   (top centre, near city: Weirville Sewage Treatment, upper right)

5. Someone testing water quality
   (three found along rivers; look for a blue and white truck)

6. Tree harvesting
   (cut-block, upper left corner)

7. A place where electricity is generated
   (hydroelectric power occurring at the three large dams)

8. Someone fishing
   (many examples of fishing are depicted)

9. A grain elevator
   (e.g. green elevator in the centre, near train track; small red elevator, top right)

Using the poster back: (2 point questions)

1. Name two functions of riparian areas.

   (Refer to the article "Water & Environment") Filter pollutants, slow run-off, prevent flooding, strengthen banks and shorelines, decrease erosion, absorb and store water, provide habitat

2. Define "aquifer."

   (Refer to the article "Watersheds") An underground layer of soil, gravel or porous rock that holds water and allows water to flow

QUICKEST EYES IN THE BUNCH activity

3. Name Alberta's seven major river basins.

   (Refer to the image "Alberta's Seven Major River Basins") Hay River Basin, Peace/Slave River Basin, Athabasca River Basin, Beaver River Basin, North Saskatchewan River Basin, South Saskatchewan River Basin, Milk River Basin

4. List one opportunity and one challenge of dams.

   (Refer to the article "Water and Agriculture")
   ***Opportunity** – supply more water downstream in summer, storage reservoirs for irrigation, supply and maintain consistent water supply for user, used for hydroelectric power generation, recreational uses, reduce flooding*

   ***Challenge** – sedimentation, natural fluctuations altered, land lost to reservoir, migration patterns of animals altered, require continued monitoring and maintenance*

5. Identify the three major characteristics of water quality.

   (Refer to the article "Watersheds'") Chemical, physical, biological

6. What is a watershed?

   (Refer to the article "Watersheds") An area of land that drains water into a body of water such as a stream, lake, river, wetland or ocean.

7. Name three ways we use water at home.

   (Refer to the article "Water & Stewardship") Drinking, washing, cooking, cleaning, watering lawns Additional answers are encouraged

Using the poster front and back find: (3 point questions)

1. An example of a ranching practice that would help to protect water quality.

   Answers may include:

   A ranch that has well maintained fences to keep cattle away from water bodies.
   A ranch with off-site watering systems that bring water to the cattle, away from water bodies.
   A ranch that minimizes grazing of sensitive areas during prime growing seasons.
   A ranch that rotates livestock to different pastures, providing 'rest time' for grazed areas to recover.

2. A place where evaporation might occur *(any plants on the poster)*

3. The headwaters *(the small streams, starting at the glaciers, top right)*

FOLLOW THE FLOW

Time: 60 minutes

Curriculum Connections:

- Grade 7 *Science Interactions and Ecosystems*
- Grade 8 Science *Freshwater and Saltwater Systems*
- Grade 9 *Science Environmental Chemistry*
- Grade 7-9 *Environmental Outdoor Education*
- Science 14 *Investigating Matter and Energy in the Environment*
- Science 20 *Changes in Living Systems*

Objectives:

- Students will investigate the various uses of water in Alberta.
- Students will explore some of the technologies associated with water and look at the impact that these technologies have on water quality and quantity.
- Students will look at some of the impacts humans have on aquatic systems and how to reduce the impact.

Materials:

- *Running Water* posters
- Sticky notes (one pad per group)
- "Follow the Flow" handout - one copy per student

Background Information:

Refer to the sections on the back of the *Running Water* poster entitled:

- Watersheds
- Water & Environment
- Water and Agriculture

Procedure:

1. Divide students into groups and provide each group with a copy of the poster, a pad of sticky notes and copies of the "Follow the Flow" handout. For individual work, a smaller copy of the poster can be printed off using the poster PDF on the website.

2. Students will work through the "Follow the Flow" handout identifying the uses of water and the impacts that various activities have on a watershed.

3. Some answers will be written on the handout while others will be written on sticky paper and attached to the front of the poster. When using the sticky paper, have students write the corresponding question number and a brief description on the sticky paper.

Extension:

Have students investigate the river that they rely on for their own water needs.

- What biotic and abiotic elements affect the flow and distribution of water?
- What are the various industrial, agricultural, domestic and recreational activities that affect this river?

FOLLOW THE FLOW handout

Name: _____

Date: _____

Instructions:

Using the *Running Water* poster, answer the questions below. Some of the questions require a written answer on the sheet, while others require labeling items on the poster using sticky paper. Start at the headwaters of the river (in the mountains) and follow the main river through the poster. Include any bodies of water that are not directly connected to the river but are still part of the watershed.

1. Using sticky paper, label the bodies of water that you spot on your travels down the river. Identify each water body (e.g., wetland, stream, reservoir) and state whether it is part of a natural or managed system.

2. Using your sticky paper, label at least five structures that affect the natural flow of water in the watershed. In the space provided, identify the function of each structure.

_____

_____

_____

_____

_____

_____

_____

3. How would the landscape differ without a managed system of water? Without this managed system, how would the many activities on the poster be affected? (e.g.industrial, agricultural, domestic and recreational)

_____

_____

_____

_____

_____

_____

_____

4. Describe the effect of biotic and abiotic elements on the flow and distribution of water in the poster.

Element	***Biotic or Abiotic***	***Effect***
e.g. Highway	Abiotic	Highways can act as barriers and affect the natural flow of water.

5. Using your sticky paper, label any evidence of glacial action that you can find on the poster. Name as many of the landforms as possible.

6. Using your sticky paper, label at least four natural resources that are being developed on the poster.

7. Label one activity occurring in the watershed where quantity may be a concern. Explain how it is a concern below.

_____

_____

_____

8. Label one activity occurring in the watershed where quality may be a concern. Explain how it is a concern below.

_____

_____

_____

9. Label three examples that show the water quality is being protected on the poster. Briefly describe below how they protect the water quality.

_____

_____

_____

FOLLOW THE FLOW answer key

The following answer key provides possible answers to the student worksheet. However, student answers may vary and discussion is encouraged.

1. Using sticky paper, label the bodies of water that you spot on your travels down the river. Identify each water body (e.g., wetland, stream, reservoir...) and state whether it is part of a natural or managed system.
   Canal (Managed), Stream/Tributary (Natural), Reservoir (Managed), River (Natural), Dugout (Managed) Lake (Natural), Off-Stream Reservoir (Managed), Wetland/Marsh (Natural)

2. Using your sticky paper, label at least five structures that affect the natural flow of water in the watershed. In the space provided, identify the function of each structure.
   - *Dams- hold back water allowing for a continuous supply*
   - *Weirs- divert water and control flow*
   - *Canal system- provides a supply of water to areas that would otherwise not have it*
   - *Hydroelectric facility- provide a renewable source of electricity*
   - *Bridges- help to provide efficient transportation routes*
   - *Stormwater drains- help to drain communities to prevent flooding and water damage*

3. How would the landscape differ without a managed system of water? Without this managed system, how would the many activities on the poster be affected? (e.g. industrial, agricultural, domestic and recreational)
   - *Without the reservoirs and canals, many agricultural products could not be grown on the landscape.*
   - *Many rural communities rely on agriculture for their livelihood, without water this is not possible.*
   - *Many rural communities would be without a reliable water supply for domestic use.*
   - *Oil industry activities that rely heavily on water may not be possible.*
   - *Some recreational activities, such as swimming, boating and fishing would not be as prevalent without a managed system to maintain lake/reservoir levels.*
   - *Wastewater from homes would not be treated.*

4. Describe the effect of biotic and abiotic elements on the flow and distribution of water in the poster.

Element	***Biotic or Abiotic***	***Effect***
Trees and Shrubs in riparian area	*Biotic*	*Help prevent erosion that would change the course of the river and affect the quality of the water.*
Human alteration	*Biotic*	*Humans alter the flow and distribution of water to meet their needs.*
Animals	*Biotic*	*Cattle can damage riparian areas and potentially contaminate water supplies.*
Structures	*Abiotic*	*Bridges, dams etc. alter the natural flow of water.*
Rocks and sediments	*Abiotic*	*Can greatly influence the flow of water and affect water levels.*

5. Using your sticky paper, label any evidence of glacial action that you can find on the poster. Name as many of the landforms as possible.
   Glacier, River, Stream, Moraine, Prairie Potholes, Wetlands

6. Using your sticky paper, label at least four natural resources that are being developed on the poster.
   - *Oil (pumpjacks found throughout, oil derrick on bottom right)*
   - *Natural gas from coal (silver sheds on bottom left portion of poster)*
   - *Forestry (near foothill region)*
   - *Agriculture (throughout) - Cattle (free range and confined feeding operation), Crops/Irrigation farming*
   - *Fishing (in off-stream reservoir, right)*

7. Label one activity occurring in the watershed where quantity may be a concern. Explain how it is a concern below.
   - *Urban development*
     Potential loss of wetlands
     Can disrupt the flow of water
     Creates an increased demand for water
   - *Agriculture*
     Irrigation uses a large amount of water
   - *Transportation*
     Roads can affect the flow of surface and ground water system
     Bridge crossings must be properly designed to allow proper flow
   - *Oil extraction*
     Water is often used to increase oil reservoir pressure and is removed from the active hydrologic cycle
   - *Reduced water flow due to dams*

8. Label one activity occurring in the watershed where quality may be a concern. Explain how it is a concern below.
   - *Urban development*
     Potential loss of wetlands
     Greater amounts of wastewater produced
   - *Agriculture*
     Excessive fertilizing
     Ranching- cattle can damage riparian areas; care should be taken to ensure water supplies are not contaminated
     Confined feeding operations must properly handle waste
     Erosion from farmlands can be a concern
   - *Recreation*
     Cleared riparian areas for water access
     Motorboats can release pollutants if not properly maintained
   - *Transportation*
     Various fluids can leak from automobiles
     Bridge crossings must be properly designed to decrease risk of sedimentation
   - *Natural gas extraction from coal seams*
     Any water produced from coal seams must be disposed of properly
     Steps must be taken to ensure groundwater aquifers are protected
   - *Sedimentation of water bodies is a concern related to:*
     Construction sites
     Forestry activities- road building and stream crossings
   - *Stormwater*

9. Label three examples that show that water quality is being protected on the poster. Briefly describe how they protect the water quality below.
   - *Water quality is being protected on some of the farms with large riparian areas around water bodies.*
   - *Riparian areas on ranches are fenced off to restrict cattle access.*
   - *There are solar powered water stations for cattle, away from water bodies.*
   - *Water is being treated at the treatment facility before being released back into the waterway.*
   - *There are images of individuals in the poster who are monitoring water quality.*

WANDERING THROUGH THE WATERSHED

Time: 1 class + presentation time (minimum)

Curriculum Connection:

- Grade 7 *Science Interactions and Ecosystems*
- Grade 8 *Science Freshwater and Saltwater Systems*

Objectives:

- Students will be creative in telling a story about the journey that one molecule of water takes as it travels through the watershed.
- Students will develop a further understanding of a watershed and the hydrologic cycle.
- Students will consider some of the influences that they have on water.

Materials:

- *Running Water* poster
- Craft materials may be required (paper, colouring pencils, scissors, etc.)

Background Information:

Students can refer to the "Watersheds" section on the back of the poster.

Procedure:

1. After introducing the concepts of a watershed and the hydrologic cycle, have students develop a story illustrating the travels of one molecule of water. Using the poster as a guide, students will brainstorm the variety of situations a water molecule could experience. Students will present this story to the class. Encourage students to be creative in this presentation, and in the adventures that the main character has.
2. Students, working alone or in small groups, can make use of their personal talents and present this story in a variety of creative ways. For example:
   - Art (e.g. a cartoon, or diagram)
   - Music (a song)
   - Multimedia (e.g. a slide show)
   - Drama (a play)
   - Writing (a poem, or a story)
3. The story of each molecule's adventure must include at least:
   - Three stages of the hydrologic cycle
   - Three instances where animals or humans use the water molecule
   - Three instances where the quality of that water is affected

Time: 60 minutes

Curriculum Connection:

- Grade 8 *Science Freshwater and Saltwater Systems*

Objectives:

- Students will develop an understanding of water allocation.
- Students will be introduced to the various water users in Alberta.
- Students will be challenged to develop strategies for water allocation.

Materials:

- *Running Water* posters
- Large beaker with half-full mark
- 5 smaller beakers

Background Information:

Refer to the "Watersheds", "Water and Agriculture" and "Water & Stewardship" sections on the back of the poster.

Procedure:

Introductory Activity

1. Fill a large beaker with water and make a half-way water level mark. The water in the beaker is to represent a river.
2. Ask for five student volunteers to represent users of the river. Assign each of the five volunteers to be one of the following water users – Municipal, Agriculture, Petroleum, Environment and Recreation.
3. Have the five users stand in a row at the front of the class and provide a smaller beaker to each of them.
4. Explain to the students that they all rely on the river for water. You are going to walk down the user line and pour water into each of the small beakers. The users will have to tell you how much of the water they think they need. The one rule is that they will need to leave some water for the other users in the line.
5. Once the water has been allocated to each of the users, explain that the half-full line on the large beaker represents the amount of water that must remain in the river when it flows out of Alberta into Saskatchewan (i.e. apportionment, or trans-boundary agreements).

Group Activity

1. Divide the class into small groups. Using the *Running Water* poster, students should take 5 minutes to brainstorm all of the water users in the watershed.
2. With the users that students were able to identify, have each group develop a water allocation strategy to decide what allocation, or share, of the available surface water each user should be entitled to. Have groups determine a per cent value for each user. The values should add up to 100%.
3. Have students present their allocations to the class with justifications as to why they assigned the values they did.
4. Discuss the difficulties students had trying to decide where the water should go.
5. Look up *Government of Alberta - Environment and Parks* water allocations. Are there any similarities to the students' allocations? Are there any statistics that seem surprising? What users are listed here that students did not have on their own lists?

Extension:

Have the students imagine that Alberta's south is experiencing drought-like conditions with very little spring snowmelt and low amounts of precipitation. Have the students develop a fair way to distribute the water. They should consider the social, environmental, and economic needs of the province.

Following this, discuss Alberta's First in Time, First in Right principal. In Alberta, the most senior licenses (i.e. earliest licenses) have rights to the water, and in Alberta's south these licenses can belong to irrigation farmers. However, in times of drought Albertans have worked together to share water.

Time: 60 minutes in class / 1 week (at home)

Curriculum Connection:

- Grade 8 *Science Freshwater and Saltwater Systems*

Objectives:

- Students will record their personal water use for one week and compare it to the national average.
- Students will evaluate their water use and find ways to reduce this amount.
- Students will become aware of issues surrounding their personal water use.

Materials:

Running Water poster

"Water Watch - Personal Water Use" handout - one copy per student

"Water Watch - Personal Water Use, Low Flow" handout - one copy per student

1 litre container filled with water

Background Information:

Refer to the section on the back of the *Running Water* poster entitled "Water & Stewardship."

Procedure:

1. Hold up a one-litre container and ask students to guess how many containers of water they would use in one day. Have the students write their estimates down to refer to later.
2. Print off the worksheet entitled "Water Watch - Personal Water Use". Distribute one copy per student. Have students calculate their daily and weekly water use by filling out this sheet over the period of one week. A value should be placed in each box indicating the number of times they do each activity and, when necessary, the length of time that the water runs. For example:
   - a toilet is flushed seven times per day.
   - water runs for 1 minute each of the 12 times that hands are washed. Suggest to students that they include the entire household in this activity to increase the accuracy of household values.
   Note: You may consider doing daily checks to ensure that students are participating in the activity.
3. Total up all of the water used in one week and then calculate the average daily use. Compare this to the average use in a Canadian home —251 L *(source: Environment Canada - 2011 figure).*
4. Conduct a discussion on water use. Were students surprised with the amount of water they used in and around the home? Brainstorm a list of ways to conserve water while still meeting needs (i.e. cooking, proper cleaning, etc.)
5. Provide each student with a copy of the handout, "Water Watch - Personal Water Use, Low Flow". Have students recalculate their water use using the low-flow values. Compare these values with the original values.

Extension:

- Compare the average daily use with other countries. Refer to the following website for this information: www.ec.gc.ca/eau-water
  Discuss reasons why Canadians use more water than most other countries.
- Most people in the world do not have the same access to water that we enjoy. Allot each student a certain amount of water (for example, 40 L/day) and have students determine how they would use that water.
- Ask students to bring in empty 4 L milk containers. Line these containers up along a wall, piling them one on top of another. Collect enough to equal the amount of water that an average household uses in a day (you will need 63 containers). This is a powerful way for students to conceptualize their water use. Be sure to recycle containers afterward.
- If you have access to a lot of snow, have students gather enough snow to melt the equivalent of one toilet flush (6 L). Students will be amazed with the amount of snow required.

WATER WATCH handout

Personal Water Use

Activity	*Sun*	*Mon*	*Tues*	*Wed*	*Thurs*	*Fri*	*Sat*	*Total number of times or minutes*	*Water Used (L)*	*Total*
Bathroom										
Toilet									15-20 L	
Shower									20 L/min	
Bath									20 L/min	
Washing									5.0 L/min	
Brushing Teeth									5.0 L/min	
Kitchen										
Washing Food									7.0 L/min	
Cooking Food									7.0 L/min	
Cleaning									7.0 L/min	
Dishwasher									40 L	
Drinking									7.0 L/min	
Other										
Cleaning House									7.0 L/min	
Washing Clothes									225 L	
Washing Car									35 L/min	
Watering Lawn									35 L/min	
Other									7.0 L/min	
TOTAL										

Daily Average: _____

Personal Water Use - Low Flow Values

Activity	*Sun*	*Mon*	*Tues*	*Wed*	*Thurs*	*Fri*	*Sat*	*Total number of times or minutes*	*Water Used (L)*	*Total*
Bathroom										
Toilet									6 L	
Shower									7 L/min	
Bath									9.5 L/min	
Washing									4.0 L/min	
Brushing Teeth									4.0 L/min	
Kitchen										
Washing Food									4.0 L/min	
Cooking Food									4.0 L/min	
Cleaning									4.0 L/min	
Dishwasher									21 L	
Drinking									4.0 L/min	
Other										
Cleaning House									4.0 L/min	
Washing Clothes									95 L	
Washing Car									23 L/min	
Watering Lawn									23 L/min	
Other										
TOTAL										

Daily Average: _____

TOWN HALL MEETING

Time: three class periods

Curriculum Connections:

- Grade 8 *Science Freshwater and Saltwater Systems*
- Grade 7-9 *Environmental Outdoor Education*
- Science 14 *Investigating Matter and Energy in the Environment*
- Biology 20 *Ecosystems and Population Change*

Objectives:

- Students will consider many environmental, social and economic factors surrounding a proposed dam building project.
- Students will determine stakeholder involvement in this decision and will take on the role of one of these stakeholders at a public consultation.
- Students will research, maintain and defend their position when challenged.
- Students will appreciate the complex nature of public consultation on issues related to the environment, economy and energy.

Materials:

- *Running Water* poster
- Poster paper, pens, etc.
- Internet access
- Weirville town hall meeting flyer

Background Information:

Refer to the "Water and Agriculture" section on the back of the poster.

Procedure:

1. Introduce this activity by reviewing the article "Water and Agriculture" from the back of the *Running Water* poster. Quickly brainstorm with students some benefits and drawbacks of the construction of a dam. Briefly explore some environmental, social, and economic impacts.
2. Show students the flyer on the upcoming Weirville town hall meeting. Students can be assigned a stakeholder group, or select a group they would like to represent from the front of the *Running Water* poster. Major stakeholders should be represented and may include government, agricultural groups, environmental community, municipalities, urban and rural residents, recreational water users, and aboriginal groups among others.
3. Stakeholder groups should have approximately the same number of participants. Students do not necessarily have to be on the side that they personally support and should be able to discuss many sides of the issue.
4. In their groups, students should research and discuss their thoughts. Through this sharing process, students should also anticipate opposing views they will encounter and prepare to defend their position on the matter. Depending on the amount of time available, groups may prepare a brief presentation that will help support their position. This presentation may be enhanced through graphs, images, or other visual aids.
5. When students are organized, provide guidelines for the town hall meeting. These may vary depending on the grade level of the class. The desks may be arranged in a large circle in the classroom. Every group should have an opportunity to speak and order should be maintained. Often a system to address speakers is helpful. For example, groups can place an object on their desk to indicate that they have the floor.
6. After every group has presented their ideas and there has been adequate debate, then take the time to highlight the complexities surrounding public consultations of this type. This may occur through discussion, or formally, through a written response by each student. Have students consider various aspects and questions about the activity. *See questions on next page.*

- Was there a clear outcome?
- What position stood out as the most memorable? Why?
- Was this process fair? Why or why not?
- What role did the research component of this activity play?
- If you were in this situation, what would your personal opinion be on the proposed development?
- As you learned more about the issues, was it easier or more difficult to determine your personal opinion? Do you think your position may have been swayed by any of the arguments presented by your classmates?

Extension:

- Students can compose mock "Letters to the Editor" explaining their position as it relates to the proposed dam construction.
- Have students design maps of location, both pre- and post-dam construction. Determine how much land would be covered by the reservoir.
- Beavers build dams regularly. How and why do beavers build dams? What similarities and differences are there between beaver dams and human-constructed dams? Should beaver dams be tampered with?

Suggested Evaluation Rubric

4 Position was very well stated and defended. Group demonstrated exceptional knowledge and understanding of the issue. Information had a high degree of clarity, accuracy, and thoroughness with clear evidence of research. The style of presentation/debate was highly engaging, effective and respectful. Position was very well supported with well-organized and relevant facts, statistics and/or visual aids.

3 Position was adequately stated and defended. Group demonstrated good knowledge and understanding of the issue. Information was clear, accurate and thorough with evidence of research. The presentation/debate was effective, engaging and respectful. Adequately supported with organized and relevant facts, statistics and/or visual aids.

2 Position was stated but lacked in clarity. When challenged, the position was weakly defended. Group demonstrated fair knowledge and understanding of the issue. Group was challenged by the clarity, accuracy or thoroughness of the information. There is evidence of some research. Presentation/debate could have been more engaging, effective and/or respectful. Position was somewhat supported with facts, statistics and visual aids, the relevance of which was somewhat questionable and/or poorly organized.

1 Position was unclear and/or undefended. Group demonstrated poor knowledge and understanding of the issue. Information was not clear, accurate or thorough with little evidence of research. Presentation/debate was not engaging, effective and/or respectful. Position was not supported with facts, statistics and/or visual aids. Group was disorganized.

TOWN HALL MEETING flyer

ATTENTION!!

All residents of Weirville and surrounding areas

The Flat Land Irrigation District is proposing the construction of a new dam on the Weir River to accommodate the increased population and agricultural activity in the area.

The dam will create an irrigation reservoir and will also serve as a hydroelectric power generating facility.

There will be a **town hall meeting** for all those with interest in this construction.

Meeting Location: Arena
(next to Weirville Sewage Treatment Plant)

* Please come prepared to share your ideas and opinions at this meeting! Expected participants include members of government, industry, the environmental community, and concerned citizens among others.

** Please register before the meeting to let us know which stakeholder group you belong to.

Topics to be discussed may include:

- Location of the dam
- Downstream flow rates
- Cottonwood forest habitat
- Fish migration and habitat
- Sedimentation
- Economic benefits and drawbacks
- Electric power generation
- Construction and maintenance
- Potential displacement of residents and wildlife

WATER ON THE WEB

Time: 60-90 minutes

Curriculum Connection:

- Grade 8 Science *Freshwater and Saltwater Systems*

Objectives:

- Students will look at the most common uses of water comparing Alberta, Canada, and other countries around the world.
- Students will link the quantity and uses of water to the geography, climate and social situation of the area.

Materials:

- "Water on the Web" handout - one copy per student
- Access to the Internet

Procedure:

1. Have students quickly brainstorm the common uses of water in Alberta. The Running Water poster may be used to generate ideas. Have students rate what they think would be the top three uses of water on a local, national and international level.
2. Provide each student with a copy of the student worksheet entitled "Water on the Web". Explain to students that they will be completing an online search to examine water resources and uses that will consist of two parts.
3. *Part 1* Using the websites and questions provided, students will research how water is used on local, national and international levels.
4. *Part 2* Case Study. Students will complete an independent case study on water use in a chosen country. A website is provided for gathering information, however, students may do an Internet search for further information.
5. Have students create a brief report (300 - 500 words) about the country they chose. Using the criteria given to them, they will describe the geographic and climatic features, the amount of available water resources, and how water supply and use in that country might differ from Alberta.

Extension:

- Students can present their report to the class. Make a bulletin board display representing water use around the world using a world map as the centre of the display. Post these reports around the world map.
- Have students create graphic representations of the information from Part 1 or Part 2 of their online search.

WATER ON THE WEB answer key

Answers For Part I

a) Non-consumptive water use

Water is withdrawn and directly returned to its source

b) Consumptive water use

Water is withdrawn and used so that it is not directly returned to its source (e.g. agriculture, industry, domestic/municipal)

1. What is the primary consumptive use of surface water in Alberta?

   Water for irrigation

2. What is the primary use of water in Canada?

   Industry (to cool equipment, produce energy, clean goods for manufacturing and act as solvents)

3. Looking closer at the graph, determine what the primary consumptive use of water in Canada.

   Water for agriculture

4. What is the primary use of water in of the world?

   Agriculture

5. How does the domestic water consumption in developed countries compare to that in developing countries?

   Domestic water consumption in developed countries is about seven times greater than developing countries. 300-600 litres/person/day versus 40-400 litres/person/day (source: UN water statistics)

6. Why do you think there is such a large difference in the domestic water use between developed and developing countries?

   Reasons may vary but may include: greater availability of water due to geography and climate; more effective and established water supply systems typically exist in developed nations; appliances and activities that consume large amounts of water are more prevalent in developed countries (e.g. shower, bath tub, toilets, dish washer, clothes washer, car washing, watering lawns, etc.). Poverty in general.

WATER ON THE WEB worksheet

Name: _____

PART 1 - LOCAL, NATIONAL AND INTERNATIONAL WATER USES

To begin, perform an Internet search and define the following terms:

a) Consumptive water use

_____

_____

b) Non-consumptive water use

_____

_____

Using the search words, find the information you need and answer the questions that follow.

SEARCH: Alberta Environment & Parks - sectoral water allocations

1. What is the primary consumptive use of surface water in Alberta?

_____

SEARCH: Environment Canada - Introduction to water use

2. What is the primary use of water in Canada?

_____

3. Determing what is the primary consumptive use of water is in Canada?

_____

SEARCH: UN vital water graphics - freshwater use by sector

4. What is the primary consumptive use of water in the world?

_____

5. How does the domestic water consumption in developed countries compare to that in developing countries?

_____

_____

6. Why do you think there is such a large difference in the domestic water use between developed and developing countries?

_____

_____

_____

_____

_____

PART 2 - CASE STUDY

Choose a country to research and in your own words write a brief (300 to 500 word) report summarizing its water resources. Be sure to choose a country where adequate information can be found. In your report, you must address all of the criteria below.

- ☐ Name of county
- ☐ Continent
- ☐ Population
- ☐ Include a map of the country
- ☐ Provide a brief description of the climate of your country.
- ☐ Provide a brief description of the geography of your country.
- ☐ List the top three uses of water and, if possible, give the percentage of each use.
- ☐ What is the primary source of water in your country?
- ☐ How do the climate and/or geography of you country affect the quantity of surface water?
- ☐ Is your country similar or different from Alberta in its water resources and use? How?
- ☐ Identify at least one major issue surrounding water management in your country.
- ☐ Include an interesting fact that you learned about water in your country.

MAKE YOUR OWN WATER FILTER

Time: 60-90 minutes

Curriculum Connections:

- Grade 8 *Science Freshwater and Saltwater Systems*
- Grade 9 *Science Environmental Chemistry*
- Grade 7-9 *Environmental Outdoor Education*

Objectives:

- Students will test different products for their filtering abilities and decide which combination of materials will make the most effective filter.
- Students will draw conclusions on how the filter affects physical, chemical and biological water quality.
- Students will become aware that some filters do not necessarily remove all types of contaminants.

Materials:

- *Running Water* poster
- "Make Your Own Water Filter" handout - one copy per student
- Empty 2 L pop bottle, cut in half (one per group)
- Napkins
- Paper towel
- Course sand
- Fine sand
- Cotton balls
- Activated charcoal
- Coffee filter
- Sponge
- Peat
- Cheese cloth
- Florist foam
- Sample of dirty water
- Gravel (different sized pebbles)

NOTE: You do not need all of these materials but a good selection of items will make the activity more interesting for the students.

Background Information:

Refer to the section on the back of the *Running Water* poster entitled "Watersheds".

Procedure:

1. After reading the section "Watersheds" on the back of the *Running Water* poster, provide each student with the handout, "Make Your Own Water Filter".
2. Divide students into groups of three. Explain to students that, as a group, they will be building water filters. Their task is to create the most effective filter for dealing with physical, chemical and biological contaminants.
3. Provide each group with a list of items that they may use to build a filter. Groups will brainstorm and discuss the combination of four materials that would make the best filter. They may need time to research a bit further.
4. Each group will obtain a pop bottle that has already been cut in half by the teacher. Both halves are needed.
5. Groups then gather the four materials they have chosen, wash the items and build a filter. To build the filters, organize the materials in layers in the top of the pop bottle. Have them complete part A on the student handout.
6. With a brief presentation to the class, students should describe their filter explaining why they selected the materials they did and how it will address the potential biological, chemical, and physical contaminants. Have each group demonstrate their filter to the class by pouring visibly dirty water through the filter and collecting it in the bottom half of the bottle.
7. Once all students have demonstrated their filters, have them complete part B of the student handout. Here, they will consider the limitations of the filter.

NOTE: Do not allow the students to taste the water, as there may be bacteria or other micro-organisms present. Be sure students wash their hands thoroughly when finished with the activity.

8. Conduct a discussion on the effectiveness of this type of filter. Look at the physical, chemical and biological contaminants that could be removed and those that cannot be removed using this primitive filter.

The more effective filters in the class would have used:

- Activated charcoal to improve taste and smell as well as remove some organic compounds, pesticides and benzene (chemical properties)
- Fine sand and gravel to remove sediment as well as some potentially dangerous biological components such as cysts, worms and some viruses.
- Other materials to remove particulates (physical contaminants)

Note for discussion: To make the water suitable for drinking and remove other dangerous micro-organisms, more treatment may have to occur (e.g. chlorine treatment, UV light treatment)

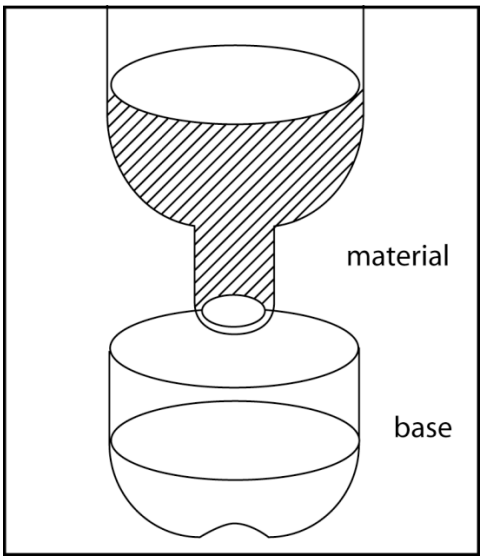
Extension:

- Have students compare the cost of this filter with its effectiveness. Further, students can research *BioSand Water Filters*, a Canadian-designed filter that allows communities in developing nations to filter drinking water using materials found in their local area at minimal costs.
- Have students research commercial water filters. What similarities did their filters have to commercial filters? How did they differ?

MAKE YOUR OWN WATER FILTER activity

Group Members: _____

For this activity, you will be constructing the most effective filter possible using a maximum of four materials. Before collecting the materials, discuss with your group members which materials you think will filter the water most effectively – consider physical, chemical and biological contaminants. Once you have decided on the materials, collect the materials as well as a pop bottle cut in two. Layer the materials in the top portion of the bottle. Obtain a sample of water from your teacher. Pour the water through the filter and collect it with the bottom of the bottle. Keep this sample, as you will be comparing it to other groups in the class. **Do NOT taste the water sample** and be sure to wash your hands when finished this activity.



Part A

1. List the four materials used to construct the filter.

   _____ _____

   _____ _____

2. Draw your filter.

3. Explain your reasoning for choosing the materials used and the order that you arranged them.

   _____

   _____

   _____

   _____

Part B

You will now have a chance to present your group's filter to the class. Following all of the presentations you will be given time to complete the following questions.

4. a) After seeing all the filters, which group's filter do you think provided the best treatment?

   _____

   b) What four materials made up this filter?

   _____ _____

   _____ _____

   c) Why was this the most effective filter?

   _____

   _____

   _____

   _____

5. Is there anything that you can think of that may not be filtered by this homemade filter? If so, what would it be? What further treatment would be needed to further improve the water quality? Remember the three characteristics of water quality: physical, chemical and biological.

   _____

   _____

   _____

   _____

WOW - A WORKING WATERSHED

Time: 75-90 minutes (minimum)

Curriculum Connections:

- Grade 7 *Science Interactions and Ecosystems*
- Grade 8 *Science Freshwater and Saltwater Systems*

Objectives:

- Students will observe the connection between the geography of the land and the course that water flows. *(i.e. watershed function)*
- Students will consider the impact of human activities on a watershed.
- Students will describe the effect of a riparian area on water quality and quantity in a watershed.
- Students will observe water transforming from one state to another in a simulation of the hydrologic cycle.
- Students will determine the importance of temperature in driving the hydrologic cycle.
- Students will appreciate the connection between surface water and groundwater systems.

Materials:

- *Running Water* poster
- Large clear plastic tub or aquarium in which to construct watershed
- Gravel
- Piece of craft felt, slightly bigger than your container (available at fabric or craft stores)
- Sponge
- Wax paper, plastic wrap, aluminum foil or other impermeable surface
- Spray bottle
- Watering can (suggest small child's bathtub or beach watering can)
- Red, blue or purple juice crystals
- Soya sauce
- Small plastic container (e.g. sandwich container)
- Lamp
- Ice

Background Information:

Refer to the sections on the back of the *Running Water* poster entitled:

- Watersheds
- Water & Environment

Procedure for demonstration:

This activity is divided into four different sections. Section A and B are the foundation activities for understanding how a watershed works. Section C and D investigate riparian areas and wetlands; the effects of activities on the landscape; and the hydrologic cycle. **Pictures of the demonstration can be found in the appendix.**

A. Constructing the watershed:

1. Ensure materials are clean.
2. Spread gravel along the bottom of the tub to create a slope so that one end of the tub is about 2 cm deep while the other end is at least 7 cm deep.
3. Make a few holes in the plastic container; this will allow water to flow out of the container, connecting it to the groundwater system. Draw a line at the half-full mark and then place the plastic container at the bottom of the aquarium, or large tub, near the bottom of the slope. Build in the gravel around the container. This container is representative of a large water body such as a lake.
4. Pour water in the small container repeatedly until there is a stable amount of water in the container at the half-full mark. Water will now line the bottom of the bin as well, filling the spaces in the gravel representing groundwater. Draw a line at the water level on the side of the bin to indicate the level of the water table.
5. Create a channel down the middle of the bin, representing the main river in the watershed. Shape the gravel as desired to represent a landscape with hills and valleys, tributaries and other bodies of water.
6. Place the felt on top of the gravel, being careful not to disturb the slope. Leave a section of gravel at the lower end of the bin exposed. >

7. Flatten a small area next to the river and place a small rectangle of impermeable material (e.g. wax paper, plastic wrap, aluminum foil) over top to represent a developed area such as a parking lot. Rocks may be needed to hold the paper in place.
8. You may choose to use a variety of small toys to represent activities on the landscape (e.g. trucks, animals, houses, etc.)

B. Simulating rainfall:

The spray bottle is used to represent a light rain and the watering can will simulate a heavy rain.

1. Use the spray bottle to spray water over the surface. Observe what happens.
2. Use the watering can to pour water over the surface. Suggest that some students observe the sides of the container while others observe the surface. Draw attention to the runoff, infiltration and percolation.
3. Observe what happens at the impermeable surface where development has occurred.

C. Riparian areas and wetlands:

Riparian areas are the areas located along the edges of water bodies. A healthy riparian area consists of vegetation that will slow and filter water as it moves to the water bodies. Wetlands are low-lying areas of land that are saturated with water for all or part of the year. Wetlands also filter and store water. Here, damp sponges will be used to represent wetlands and riparian areas.

1. Construct riparian areas by placing sponges along the rivers edge. The sponges may have to be held in place with rocks, or pins.
2. Construct a wetland by making a depression in the landscape and inserting a sponge.
3. Add more water and now observe the surface water flow. It should be slower, and more water should be stored in the wetland and riparian areas.
4. Sprinkle juice crystals onto different areas of the watershed. This can represent pollution of some sort (e.g. excess fertilizer). Observe the movement of the materials when it rains. Compare the water in the aquifer to the water in other parts of the watershed. Is there any difference in the clarity of the water in different parts of the watershed?
5. Sprinkle soya sauce on areas of the watershed, this can represent a chemical spill of some sort (e.g. oil from cars). Make the same observations.
6. Pretend development of the landscape has occurred by removing the wetlands and riparian areas. Repeat steps 2 through 4 and observe any differences that may occur. Students should observe that less water is stored, and more contaminants enter the lake and groundwater system.

D. Hydrologic Cycle

1. Cover the system with either a clear lid or plastic wrap and set up a lamp directly over the container of water. Leave the light shining directly on the body of water overnight.
2. During the next class period, examine the system. DO NOT REMOVE THE COVER. Have the students compare the water levels from the day before and look for evidence of evaporation and condensation. If no evaporation has occurred, leave the system for an extended period. Placing ice on top of the container should help create condensation.
3. If the temperature is cooled sufficiently, enough water may collect to simulate precipitation. Observe where the condensed water forms. What does this suggest?

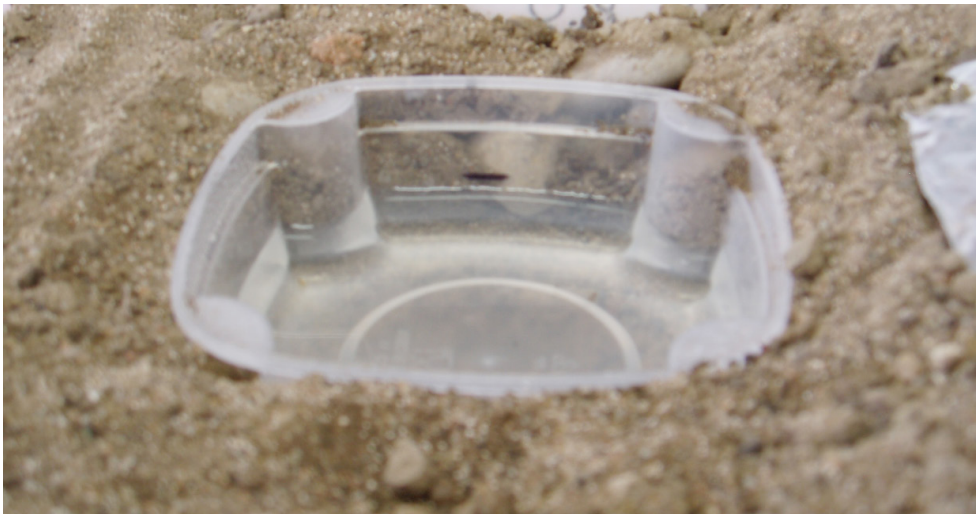
Extension:

- Insert a turkey baster through the top of the landscape into the groundwater table and withdraw some groundwater. This represents a water table well. Here the groundwater aquifer is not under pressure (not confined) and a pump is necessary to bring water to the surface. Notice the effect on the water table and the lake levels. Discuss the importance of groundwater to rural communities in Alberta's semi-arid south.
- Leave the watershed model, with the lid off, for a couple of days. Notice how the water levels lower, and the model begins to dry up. Here, evaporation levels are greater than precipitation levels, much like that of a semi-arid environment. Discuss how seasons affect the quantity of water in a watershed. Discuss methods to help ensure a stable water supply year-long (e.g. dams, reservoirs, canals, etc.).

WOW - A WORKING WATERSHED pictures

These pictures are included to give you an idea of the basic set up of the watershed model. You may choose to modify yours. Please see page 27 of the teacher's guide for detailed instructions.

Step A-2: Spread gravel along the bottom of the tub to create a slope so that one end of the tub is about 2 cm deep while the other end is at least 7 cm deep.



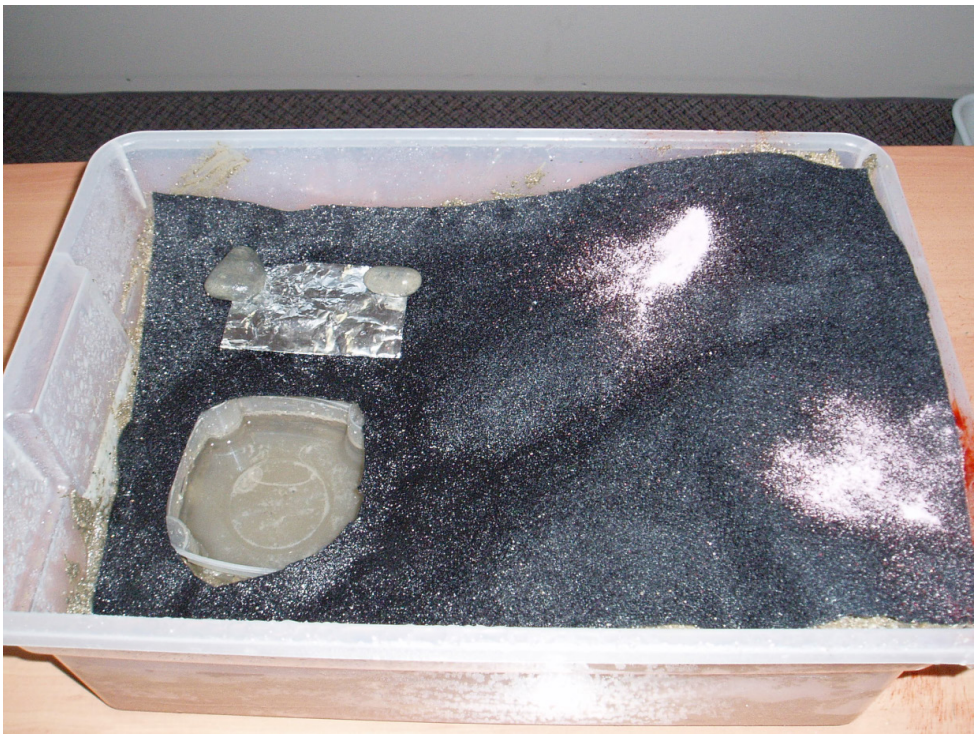
Step A-3: Make a few holes in the plastic container, this will allow water to flow out of the container, connecting it to the groundwater system. Draw a line at the half full mark and then place the plastic container at the bottom of the aquarium, or large tub, near the bottom of the slope. Build in the gravel around the container. This container is representative of a large water body such as a lake.

Step A-4: Create a channel down the middle of the bin, representing the main river in the watershed. Shape the gravel as desired to represent a landscape with hills and valleys, tributaries and other bodies of water.

Step A-5: Place the felt on top of the gravel, being careful not to disturb the slope. Leave a section of gravel at the lower end of the bin exposed.

Step A-6: Flatten a small area next to the river and place a small rectangle of impermeable material (e.g. wax paper, saran wrap, aluminum foil) over top to represent a developed area such as a parking lot. Rocks may be needed to hold the paper in place.

Step B-2: Use the watering can to pour water over the surface. Suggest that some students observe the sides of the container while others observe the surface. Draw attention to the *runoff, infiltration* and *percolation*.



Step C-6: Pretend development of the landscape has occurred, removing the wetlands, and riparian areas. Repeat step 2 though 4 and observe any differences that may occur (i.e. Less water is stored, and more contaminants enter the lake and groundwater system.)

www.insideeducation.ca