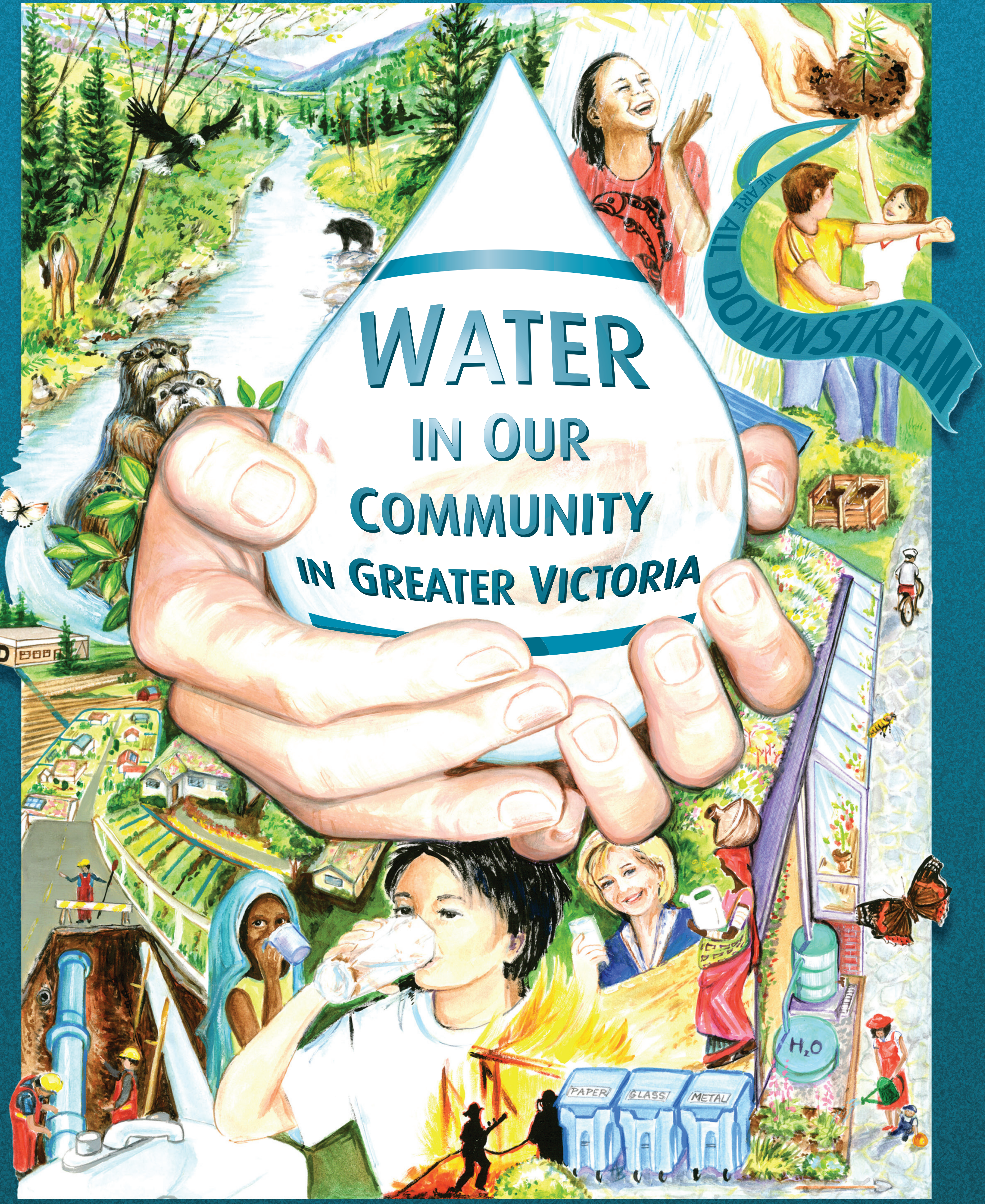

CRD

Making a difference...together

Water in Our Community: A Multi-Media Learning Resource For Grades 8 – 12 In Greater Victoria

CRD
Making a difference...together

Printed on recycled paper using vegetable-based inks.

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Water Services

FOREWORD

Today's youth are tomorrow's leaders in the stewardship of our water resources and systems. The Capital Regional District (CRD) recognizes that it has a role providing an awareness and understanding of the importance and value of a safe, affordable, reliable source of water.

"Water in our Community" is a curriculum-based teaching resource provided to every secondary school in the Greater Victoria area. The multi-media kit includes a teacher's lesson plan manual, a locally produced video series, PowerPoint presentations, maps, and classroom consumables. Students will learn about their local drinking water supply, management of the drinking water supply lands, urban watersheds, and water quality and water conservation. There are also opportunities for their families to participate in the learning activities.

The lessons will also expose youth to many career opportunities in the water profession, such as engineering, water quality technicians, meter reading, demand management, biology, and forestry, to name a few.

This project was a collaborative effort between the CRD (Water Services) and School Districts 61, 62 and 63. We appreciate the contributions by teachers in the districts that contributed to this project. They have ensured that the lesson plans meet the requirements of the British Columbia curriculum and, by piloting the lessons in classrooms, that they are stimulating and fun. This learning resource will be supported with annual teacher workshops and classroom consumables on an on-going basis.

If each of us saves a little, together we can save a lot. Be the difference.

Nils Jensen
Chair, Regional Water Supply Commission

WELCOME

Welcome to Capital Regional District (CRD) Integrated Water Services' multi-media Learning Resource on water designed for Grades 8-12 throughout Greater Victoria. CRD Integrated Water Services is committed to sustaining the health and lifestyles for the residents of Greater Victoria by providing an adequate supply of safe, clean drinking water in accordance with approved water quality standards. This Learning Resource is aimed at helping to educate Grade 8-12 students about water supply, water quality, and conservation. You will find lesson plans with accompanying locally-produced videos, PowerPoint (PDF) presentations, and graphics all relevant to our local area. We hope that in this Learning Resource you will find lessons and activities which you can easily carry out with your students.

CRD Integrated Water Services is responsible for demand-management programs that help foster efficient water use in all sectors of the community. CRD Integrated Water Services views education as a means of supporting water conserving activities and furthering the use of water efficient practices. CRD Integrated Water Services also supports many other water conservation programs as part of its work.

The project objectives are to:

- raise awareness, instill skills, and develop positive attitudes about CRD's water supply, water quality, and conservation;
- reach a Grade 8-12 audience with learning materials that educate, inform, and involve students in taking action toward preserving their own water supply with a focus on the teaching of skills and processes that are the basis for 'doing' science;
- provide information in a way that stimulates participants to discuss water conservation actions with their peers and families and begin to explore ways of incorporating these actions into their everyday lives;
- create a better understanding of the role water plays in life and lifestyles on the West Coast;
- encourage students to value water from an environmental viewpoint as well as exploring its scientific properties;
- achieve these objectives through the use of a teacher-led Learning Resource.

ACKNOWLEDGEMENTS

Water in Our Community: A multi-media Learning Resource for Grades 8-12 is the outcome of the lesson plan ideas and hard work of our teacher steering committee and CRD Integrated Water Services. Gratitude and appreciation goes to all members of the committee for their effort and commitment to compiling the best ideas for teaching secondary students about water in their community.

THANKS TO:

Mike Bobbitt School District No. 62

Michelle Choma School District No. 62

Bob Coulson School District No. 63

Jeff Duyndam School District No. 63

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Brad Hartley School District No. 61

Len Levere School District No. 63

Cheryl Nigh School District No. 61

Jim Pine School District No. 61

Margy Ransford School District No. 61

Angus Stewart School District No. 63

Thanks are also extended to the teachers in all three school districts in Greater Victoria who field tested the Learning Resource and provided their constructive feedback.

The Learning Resource benefited tremendously from the artistic talent of Anita Brunckhurst, to whom we are very grateful for all her beautiful paintings and drawings. Thanks also to Natural Resources Canada for the wonderful graphics they provided and to Richard Franklin for modifying them to the Greater Victoria region. Our deep appreciation is extended to Deepak Sahasrabudhe and Susan Millar from SomaTV for their work on the videos and to Alan Whitehead and Helen Dewar for technical review. The Learning Resource was compiled and edited by DG Blair-Whitehead.

Educational Objectives

The educational objectives of Water in our Community are to give students the opportunity to:

- Increase their knowledge about CRD water supply, water quality, and conservation;
- Develop an understanding of the local water cycle and how it affects their water supply;
- Develop an understanding of water conservation and water efficiency practices and its importance today and in the future;
- Increase their understanding of the importance of water to all people;
- Adopt appropriate socially responsible water conservation practices; and
- Compare water use within the CRD and other areas around the world.

Organization of *Water in our Community*

This Learning Resource is grouped into three main themes:

- Water and Watersheds
- Water: Source to Tap
- Water: Today and Tomorrow

Each theme has five lesson plans plus an accompanying video (DVD), PowerPoint (PDF) presentation, graphics and illustrations.

There is a fourth theme: Celebrating Water!, which gathers together ideas of how to culminate your unit on water.

Lesson Plan Format:

The lesson plans are intended to provide guidance and options for teaching the lesson for Grades 8-12.

Lessons are cross-referenced to British Columbia Ministry of Education Prescribed Learning Outcomes in Appendix A. Each lesson plan consists of the following:

Key Concepts: a list of key concepts the students are expected to understand after completing the lesson;

Method: a brief statement on how the lesson is to be carried out;

Activity Information: a sidebar includes lesson duration, grade level, key words, materials, setting, skills, and subject areas;

Learning Outcomes: the end result of the lesson that the students are expected to achieve;

Background: any necessary background information for teachers;

Procedure: the steps and the procedure to conduct the lesson;

Evaluation: some suggested evaluation methods to measure if the learning outcomes have been achieved;

Additional Resources: any additional resources that may aid in the completion of the lesson;

References: any references or resources that have been used to develop the lesson;

Student Worksheets: any student worksheets as appropriate to the lesson.

USING THIS LEARNING RESOURCE

The lessons are aimed at Grades 8-12 in general but some lessons are more suitable for Grade 8 while others are more suitable for the senior secondary level. In some lesson plans, attention is given to providing different options for middle and senior secondary students. In all cases, the lessons can be adapted to suit your classroom and student's needs.

The following table is intended to assist teachers in the selection of lessons based on grade level or subject area. It is recognized that completing all the lessons in the Learning Resource may not be feasible for all teachers; however, it is hoped that teachers complete at least one lesson per theme for optimum usefulness.

OVERVIEW CHART FOR WATER IN OUR COMMUNITY

THEME	LESSON	METHOD	SUBJECT / GRADE LEVEL
WATER AND WATERSHEDS	Water Wise in Greater Victoria	Students view a video on Greater Victoria water cycle and watersheds.	Science 8-10 Earth Science 11 Biology 11,12 Resource Science 11,12
	The Ways of Water	Students explore the value of water in different media.	Science 8-10
	The Water Cycle in Greater Victoria	Students learn about the local water cycle by building a watershed model in the school yard.	Science 8-10 Earth Science 11
	Plants and Animals of the Sooke Reservoir Watershed	Students complete research about the plants and animals of the Sooke Reservoir watershed and make a brochure.	Science 8-10 Biology 11,12 Resource Science 11,12
	The Clean Water Factory	Students view a demonstration and complete experiments demonstrating natural filtration processes of forests.	Science 8-10 Earth Science 11 Geology 12
WATER: SOURCE TO TAP	Greater Victoria Drinking Water: From Source to Tap	Students view a video on how water moves from CRD watersheds into Greater Victoria.	Science 8-10; Chemistry 11,12 Science and Technology 11
	Water Treatment in Greater Victoria	Students learn how tap water is treated in Greater Victoria.	Science 8-10 Chemistry 11,12
	Decisions, decisions: Tap or Bottled Water?	Students complete an experiment comparing tap and bottled water.	Science 8-10
	Water Monitoring Around the World	Students complete water testing in the field or laboratory.	Science 8-10 Chemistry 11
	Lake at Stake	Students complete a case study on water and watershed management issues.	Science 8-10 Biology 11,12
WATER: TODAY AND TOMORROW	Water Today and Tomorrow	Students view a video on Greater Victoria water use and are introduced to options for the future.	Science 8-10 Science and Technology 11
	New Ways for Water Efficiency	Students create design ideas for new water efficient technologies	Science 8-10 Science and Technology 11
	Water and Climate Change	Students explore aspects of water and climate change.	Science 8-10 Earth Science 11 Geography 12
	Design a Native Plant Garden	Students learn about water wise gardening and the use of native plants.	Science 8-10 Biology 11, 12
	The Water News	Students put together a magazine or other media on local water news.	Science 8-10 Social Studies 8-10

Water in our Community Conceptual Framework

The conceptual framework is made up of three guiding principles and their underlying key concepts:

Guiding Principle No.1: Water connects all earth systems.

- The Greater Victoria Drinking Water Supply System is dependent on annual precipitation, which falls mostly as rain.
- The Greater Victoria Water Supply Area is connected to our taps via water distribution systems.
- Water is important to all people.

Guiding Principle No.2: Water is essential for life to exist.

- Habitats and ecosystems within the Greater Victoria Water Supply Area need enough clean water to survive.
- Sustainability of water resources requires conservation and best management practices.
- Actions we take in our everyday lives influence the sustainability of the Greater Victoria water supply.

Guiding Principle No.3: Water is a natural resource.

- Responsibility for water is everyone's concern.
- Water supply is monitored in the reservoirs and distribution systems.
- Water resources in Greater Victoria are managed for their quality and quantity.
- A variety of factors will influence water quality and quantity in the future.

WATER LEARNING RESOURCE KIT CONTENTS:

Teachers Guide:

- Water in Our Community: A Multi-Media Learning Resource for Grades 8-12 in Greater Victoria Teachers Guide
- Water in Our Community – DVD (3 modules)
- Water in Our Community – Graphics CD (maps, graphs, graphics, PowerPoint (pdf) presentations

Print Material:

- Canada Mortgage and Housing Corp. *Household Guide to Water Efficiency*
- CRD – *A Homeowners Guide to Outdoor Water Use*
- CRD – *Native Plants for the Home Garden - South Coastal British Columbia* brochure
- CRD – various brochures and pamphlets about water. Go to **www.crd.bc.ca/water** for more information
- District of Saanich – *Wildflowers and other native plants of Saanich Garry Oak Ecosystems* brochure

Test Kits:

- Is Your Showerhead Water-Efficient?
- Plastic bag Leak Detector Tablets
- It Just Takes One – Water Gauge
- World Water Monitoring Day - Water Quality Test Kit (classroom kit available with 5 sets/kit)

Stickers:

- Don't Wash Me – bumper sticker
- Do Your Turn (and others) – stickers

Poster:

- Water in Our Community

HOW TO GET RESOURCES:

The learning resources included in this binder plus additional resources are available at: **www.crd.bc.ca/teacher**

For further information contact:

CRD Parks & Environmental Services
625 Fisgard Street
Victoria, BC V8W 2S6

education@crd.bc.ca
(250) 474-9684

Water & Watersheds

ALMOST ALL OF OUR WATER COMES FROM RAIN. This section is intended to introduce students to the Greater Victoria Water Supply Area and the watersheds that provide our water. The water cycle, plants and animals of local watersheds, and how water affects our lives in a variety of ways are also explored.

Most of the precipitation that falls within our water supply watershed is taken up by plants, evaporates, or flows into streams and then into the ocean. Some of it also ends up as groundwater. Because the Greater Victoria area does not have tall mountains with deep winter snow pack, water is not stored as snow and then released during the warmer spring and summer months. Rain that drains within the Sooke catchment is stored in Sooke Reservoir – a large dammed lake deep within the watershed.

Sooke Reservoir is located northwest of the City of Victoria in the Sooke Hills and supplies much of the water for our homes, schools and businesses. This watershed area supplies water to approximately 340,000 people in Greater Victoria. Sooke Reservoir lies within the boundaries of the Greater Victoria Water Supply Area, land that is owned and protected by the Capital Regional District (CRD). In 2007, the CRD added 8,791 hectares from the Leech River watershed – nearly doubling the Greater Victoria Water Supply Area to a total of nearly 20,000 hectares. In spite of the large watershed area, storage in Sooke Reservoir is limited and we depend on winter water stored in the reservoir to supply our needs throughout the year. Because of variation in winter rainfall, the probability that the reservoir will fill to capacity is only 6 out of every 10 winters.

The Greater Victoria Water Supply Area contains ecosystems and habitats that also depend on water that falls within the Sooke Reservoir and Leech River watersheds. Coniferous forests predominate: you will find trees such as Douglas-fir, Western Red Cedar, and Western Hemlock in these forests. Animals that call it home include the Black Bear, Columbia Black-tailed Deer, Pileated Woodpecker, and Roosevelt Elk, among many others. For example, scattered throughout the Sooke Reservoir watershed there are a number of old growth Douglas-fir trees –potential nesting sites for the threatened Marbled Murrelet.

“Green infrastructure” is the term used to define how natural systems such as forests and wetlands perform services for us. Often, infrastructure means things like roads, power lines, and water line systems – these systems provide a service to humans. Likewise, green infrastructure provides a service by filtering and storing water, recharging groundwater, preventing soil erosion, providing critical habitat, and other functions.

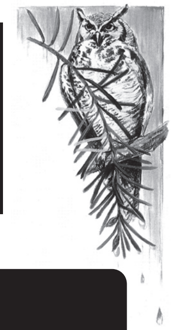
Local First Nations have relied on freshwater resources for thousands of years using Traditional Ecological Knowledge (TEK) to ensure the protection and stewardship of these resources. TEK is an important part of First Nations culture and should be included as an integral aspect of today’s water resource management – utilizing best practices for water resource stewardship from diverse perspectives.

Water plays a role in our lives for spiritual, recreational, or aesthetic reasons. It also plays a role in First Nation creation stories – with the belief that all life arose out of water. Water is important in many other types of cultural and spiritual practices from baptism to bird watching on the shore of a quiet lake to swimming with friends at a local lake. Water and watersheds – the source of the water we use everyday – are an important part of life in Greater Victoria.

THIS SECTION CONTAINS FIVE ACTIVITIES FOR STUDENT LEARNING:

- Water Wise in Greater Victoria
- The Ways of Water
- The Water Cycle in Greater Victoria
- Plants and Animals of the Sooke Reservoir Watershed
- The Clean Water Factory: Green Infrastructure

WATER WISE IN GREATER VICTORIA



KEY CONCEPTS

- THE GREATER VICTORIA DRINKING WATER SUPPLY SYSTEM IS DEPENDENT ON ANNUAL PRECIPITATION, WHICH FALLS MOSTLY AS RAIN.
- HABITATS AND ECOSYSTEMS WITHIN THE GREATER VICTORIA WATER SUPPLY AREA NEED ENOUGH CLEAN WATER TO SURVIVE.

METHOD

Students will watch the video *Water and Watersheds*, complete a worksheet, and participate in a review activity to identify a "Water Wise" team.

ACTIVITY INFORMATION BOX:

TIME REQUIRED: 50-60 minutes

GRADE LEVEL: Grades 8-12

KEY WORDS: *water supply, watershed, "clean water factory", wetlands, green infrastructure, turbidity*

MATERIALS:

- *Water and Watersheds* Video
- Student worksheets
- 3X5 cards (or pieces of paper)
- pen/pencil

SETTING: indoors

SKILLS: listening, observing, gathering information, recall

SUBJECTS: Science 8-10
Earth Science 11
Biology 11-12,
Resource Science 11-12

LEARNING OUTCOMES:

IT IS EXPECTED THAT THE STUDENT WILL:

- Be able to identify the source of tap water in the Greater Victoria area;
- Understand the local water cycle and its impact on water supply;
- Practice problem solving;
- Demonstrate their knowledge of the local water and watersheds by participating in the *Water Wise* game.

Background

This lesson is intended to be used with the *Water in our Community* video: *Water and Watersheds*. The video looks at where our tap water comes from: the Greater Victoria Water Supply Area. Viewers are taken to the watershed in the Sooke Hills and Sooke Reservoir. They are shown the physical features of this area and the local water cycle is described. They visit with a CRD watershed specialist who points out and explains various species that depend on this area for their habitat; and how a healthy watershed acts as a natural filter or "clean water factory" for our water. This function by the watershed is sometimes called a "green infrastructure" as it fulfills an important role in the operations of our water systems. The video also describes the uses of forest species such as red cedar by coastal First Nations.

Procedure

1. Before the video is shown, ask students:
    - Where does the water in your taps come from?
    - Where is the Greater Victoria Water Supply Area located?
    - What do you know about the Greater Victoria Water Supply Area?
    - How does CRD Integrated Water Services protect the Greater Victoria Water Supply Area?
2. Handout copies of the Student Worksheet to each student and review.
3. Challenge students to gather facts about Greater Victoria Water Supply Area as they watch the video using the video worksheet.
4. Show the video *Water and Watersheds*.
5. Explain that students will now participate in the "*Water Wise*" game (see box for instructions).
6. Wrap up by discussing any questions, misunderstandings, or other issues that come up during the game.
7. Score the correct responses and appoint the winning student team as the "Water Wise" team.

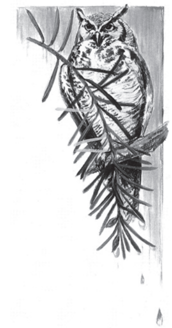
Evaluation

Have students:

- Complete the worksheet as they view the video;
- Describe what they have learned about the Greater Victoria Water Supply Area by creating questions for a game called "*Water Wise*".

Extensions

Ask students to identify local watersheds and learn about their particular characteristics.



Water Wise Game

1. Divide students into two teams and ask each student to record one question from their video worksheet on a 3x5 card or piece of paper.
2. Ask the team members to organize the questions in a logical order, eliminating any duplicates. If there are duplicates, ask them to create a new question to replace the duplicate. Each team should record the team questions and discuss the correct answer to each question that will be posed to the opposite team. Distribute cards amongst team members so that each student has a question card. Ensure that there are an equal number of question cards for each team.
3. Tell students that the aim of the game is to get the correct answer as quickly as possible.
4. The game begins by the first team selecting an individual member from the other team to pose the first question. Points are awarded according to the following criteria:
   - Gain 2 points for giving the correct answer without consulting with other team members;
   - Gain 1 point for giving the correct answer after consulting with other team members;
   - Lose 1 point for giving an incorrect answer without consulting with other team members;
   - Lose 2 points for giving an incorrect answer after consulting with other team members.
5. Begin the game, ensuring that each team poses all their questions to the other team and that all team members participate.
6. The team with the most points at the end is declared the "Water Wise" Team.

Community Connections

Invite a biologist or a forester from your community to visit the classroom and have him/her discuss the importance of protecting watersheds.

Video Student Worksheet – CRD Water and Watersheds

NAME:

INSTRUCTIONS: Use this worksheet is to assist you in gathering information to help carry out the *"Water Wise"* game.

1. How big is the Greater Victoria Water Supply Area? Where is it located?	2. Approximately how many people depend on this water supply?	3. What type of climate does Greater Victoria have?	4. Why did the CRD buy the Leech River watershed?
5. Describe the precipitation pattern in the South East area of Vancouver Island.	6. Name two types of trees often seen in the watershed and give some characteristics of each.	7. What kinds of wildlife can be found in the watershed?	8. How does a healthy forest clean water?
9. What are the names of the CRD Integrated Water Services Reservoirs?	10. What is the agreement between the T'Souke First Nation and the CRD about?	11. Wetlands are sometimes called "Nature's __________" Why?	12. When does our watershed receive most of its water and why?

INTERESTING FACTS FROM CRD WATER AND WATERSHEDS VIDEO

1. How big is the Greater Victoria Water Supply Area? Where is it located?

- 20,700 hectares or 207 square kilometres
- It's located northwest of the city of Victoria.
- Sooke Hills

2. Approximately how many people depend on this water supply?

- 340,000 people

3. What type of climate does Greater Victoria have?

Northern Mediterranean

- Dry summers
- High water evaporation during summers
- Wet winters
- Similar to Italy or Greece

4. Why did the CRD buy the Leech River watershed?

- For future water supply

5. Describe the precipitation pattern in the South East area of Vancouver Island.

- Mountains capture rain in rainy season (winter)
- We are in a rain shadow of the Olympic Mountains

6. Name two types of trees often seen in the watershed and give some characteristics of each.

- Douglas-Fir (thick bark, big fissures in bark, needles are bottle brush-like, main lumber tree in B.C.)
- Western Red Cedar (thin, stringy bark, "tree of life" for coastal First Nations, needles are scaly).

7. What kinds of wildlife can be found in the watershed?

- woodpeckers
- birds
- deer
- bears

8. How does a healthy forest clean water?

- forests hold soil in place
- soils filter water
- wetlands store and filter water
- creates natural filtration system
- process sometimes called green infrastructure

9. What are the names of the CRD Integrated **Water Services Reservoirs?**

- Sooke Reservoir
- Goldstream Reservoir
- Lubbe Reservoir
- Butchart Reservoir
- Deception Reservoir

10. What is the agreement between the T'Souke First Nation and the CRD about?

- Traditional fishing rights on the Sooke River.
- Water levels are maintained by the CRD via the Deception Reservoir to the Sooke River to protect fish habitat.

11. Wetlands are sometimes called "Nature's __________." Why?

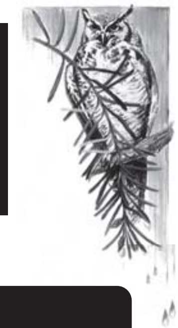
- **Sponge**

Because they hold and release water slowly

12. When does our watershed receive most of its water and why?

- Winter, because of the Mediterranean-type climate
- 1460 mm per average winter

THE WAYS OF WATER



KEY CONCEPTS

- RESPONSIBILITY FOR WATER IS EVERYONE'S CONCERN.
- WATER IS IMPORTANT TO ALL PEOPLE.

METHOD

Students read poems and verses about water, listen to music and write or create artwork that demonstrates their personal views of water.

ACTIVITY INFORMATION BOX:

TIME REQUIRED: 60 minutes

GRADE LEVEL: Grades 8-10

KEY WORDS: *Water, appreciation*

MATERIALS:

- poems
- verses
- music
- posters
- artwork about water and life (see resources)

SETTING: indoors or outdoors

SKILLS: participating, discussing, recalling, gathering information

SUBJECTS: Science 8-10

LEARNING OUTCOMES:

IT IS EXPECTED THAT THE STUDENT WILL:

- Be able to express an appreciation for the importance of water to the maintenance of life, cultures, and global balance;
- As a post activity, to reflect on what they have learned about water and will take with them into the future.

Background

Water plays a role in our lives for many reasons. It can be important in religious or cultural customs or may just be part of a fun way to spend the afternoon on a hot summer day. It plays a major role in maintaining healthy bodies – our bodies need clean water for all our bodily functions. The water cycle impacts ecosystems around the world and the way we live within those ecosystems. No matter where we live, water is a part of many facets of our daily lives.

Procedure

1. Play the Holly Arntzen's music "*Take me to the water*" or other music that reflects the importance of water for our culture and life on earth.
2. Have several water related posters, prints, and other media around the room, on the bulletin board, or for displaying in other ways. Use the media as a tool to lead the students in a discussion regarding the importance of water.
3. Reflect on water's importance to First Nations culture. Read the poem: *Water Drinker* by Philip Kevin Paul (local First Nations poet) or another poem about water.
4. If possible, show video or portion depicting water conditions in Third World countries. Use the video as a discussion tool to have students reflect on the richness of their position in terms of water and their need to protect the resource.
5. Have students write or produce a poem, verse, song, artwork, dance, play, PowerPoint® presentation or other media to show their understandings, feelings, and attitudes towards the importance of water in their life.
6. Bring out student work at the end of the unit for students to reflect on and discuss how their outlook about water may have changed.

Evaluation

Have students:

- Complete a verse, poem, etc. to be submitted or performed.

Extensions

1. Produce a class, hallway or community venue display of art and written work.
2. Host a performance night for parents and others.

Additional Resources

Holly Arntzen's *water music* CD available **www.artistresponseteam.com** or contact Holly at **artistresponseteam@shaw.ca**

Water Drinker by Phillip Kevin Paul in *Reading the Peninsula: Stories of the Saanich Peninsula* produced by Community Arts Council of the Saanich Peninsula. 2003

Two Houses Half-Buried in Sand: Oral Traditions of the Hul'Q'Umi'Num' Coast Salish. Chris Arnett, Ed. Talon Books. 2007

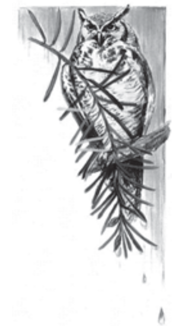
"Pretend you are a river" a poem by Derrick Jensen. **http://www.derrickjensen.org**

"Lost Streams of Victoria" poster - a full colour map on side one; and side two features ways to take part in stewardship activities; including stories of streams and creeks that need stewardship today; available from: **Fisheries and Oceans Canada; 200 - 401 Burrard Street; Vancouver, BC V6C 3S4; tel (604) 666-8171**

http://www.pac.dfo-mpo.gc.ca/sep-pmvs/sci-icp/pdf/publicationcat.pdf

Water Drinker

By Phillip Kevin Paul



The music in trees
is water. The only way

of learning that still counts:
I learned this summer
how a tree is a reflection
of a river or a stream.

A tree is like ancient love:
the love my parents gave me
came from a long ways away,
was divided over and over. *The oldest river*
will have the most branches.
it is the only thing
that remains uncomplicated,
grows outward and remains
uncomplicated.

How do you know these things?

The man, sick of the story and of his life, says:
I spent twelve years with the same river
measuring everything to learn
measuring is irrelevant.

There is only time
and looking.

After twelve years you can finally imagine
how a river grows old
and how the trees around it grow old.

They grow outward and remain uncomplicated.

I sat by a fishless stream for days
this summer, the place I fished
when I was small
as I remember being.
I felt in the heat the hope in me
being washed over and diluted.
I felt this way without knowing
the fish had all disappeared –

I'd imagined them all summer
swaying lazily in the dark,
murky water at the bottom of the stream
and the flash of their white bellies
as they twisted into the terrible light,
fighting at one end
of a handline.

Here - I bring you to the place
of maples, where on this steep hill
there is only one arbutus, the way
the blood from a fish looks
resting in the stones.

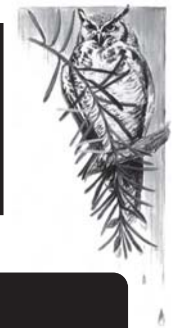
You can feel the stream
on that hill like a small animal
shaking in your hand. Its rhythm
comes up through the ground
just where the water is
about to roll over the edge.

Imagine what the Old People thought
when they saw one small red tree
growing between the grey-
white bodies of the maples.
imagine what their thought
when they realized
every stream has its own song
from the shape made by the trees around it,
the sound of the water
turning in the hollow,
returning to them from the leaves.

How long did they sit here
on this perfect flat rock beside
this single arbutus
to finally see
the trees around it were dying
because they weren't as deeply rooted?

When I tell you the word
is still old, I say that
because the first time
a man said ḰO, ḰO, IȽC,
said, *water drinker*,
it was because the generations
before him had sat on the rock
and looked at the tree.
They sat in name of the tree,
as in a song too familiar
to hear, and finally
recognized it. And when
I say the word now, ḰO, ḰO, IȽC,
It is the same word,
but said in an alien light.

The Water Cycle in Greater Victoria



Key Concepts

- The Greater Victoria drinking water supply system is dependent on annual precipitation, which falls mostly as rain.
- Responsibility for water is everyone's concern.

Method

Students learn about the local water cycle by building a watershed model in the school yard.

Activity Information Box:

Time Required: 120 minutes or more

Grade Level: Grades 8-11

Key Words: *water cycle, watershed, evaporation, condensation, precipitation, evapo-transpiration, infiltration, aquifer*

Materials:

- sloped area in schoolyard
- watering can or hose
- container to hold water
- plastic sheet & chairs (optional)
- a variety of rocks, sticks, model trees, garlands, foam blocks, model houses, sponges, bowls, carpet samples to add to watershed model
- Water Cycle diagrams
- food dye, juice crystals, soy sauce

Setting: indoors & outdoors

Skills: Gathering information, Hypothesizing, Interpreting, Analysing, Scientific processes

Subjects: Science 8-10
Earth Science 11

Learning Outcomes:

It is expected that the student will:

- Explain the Greater Victoria area water cycle and how it affects their water supply;
- Predict where water will flow in a watershed model.

Background

The **water cycle** is the term used to describe the movement of water – in our atmosphere, over our land, and through our soils. In the water cycle, water moves through different states such as liquid, solid and gas, all driven by the sun's energy. The water cycle has no starting point per se as water is continually changing states. The water cycle in the Greater Victoria area, as everywhere, has its own distinct pattern.

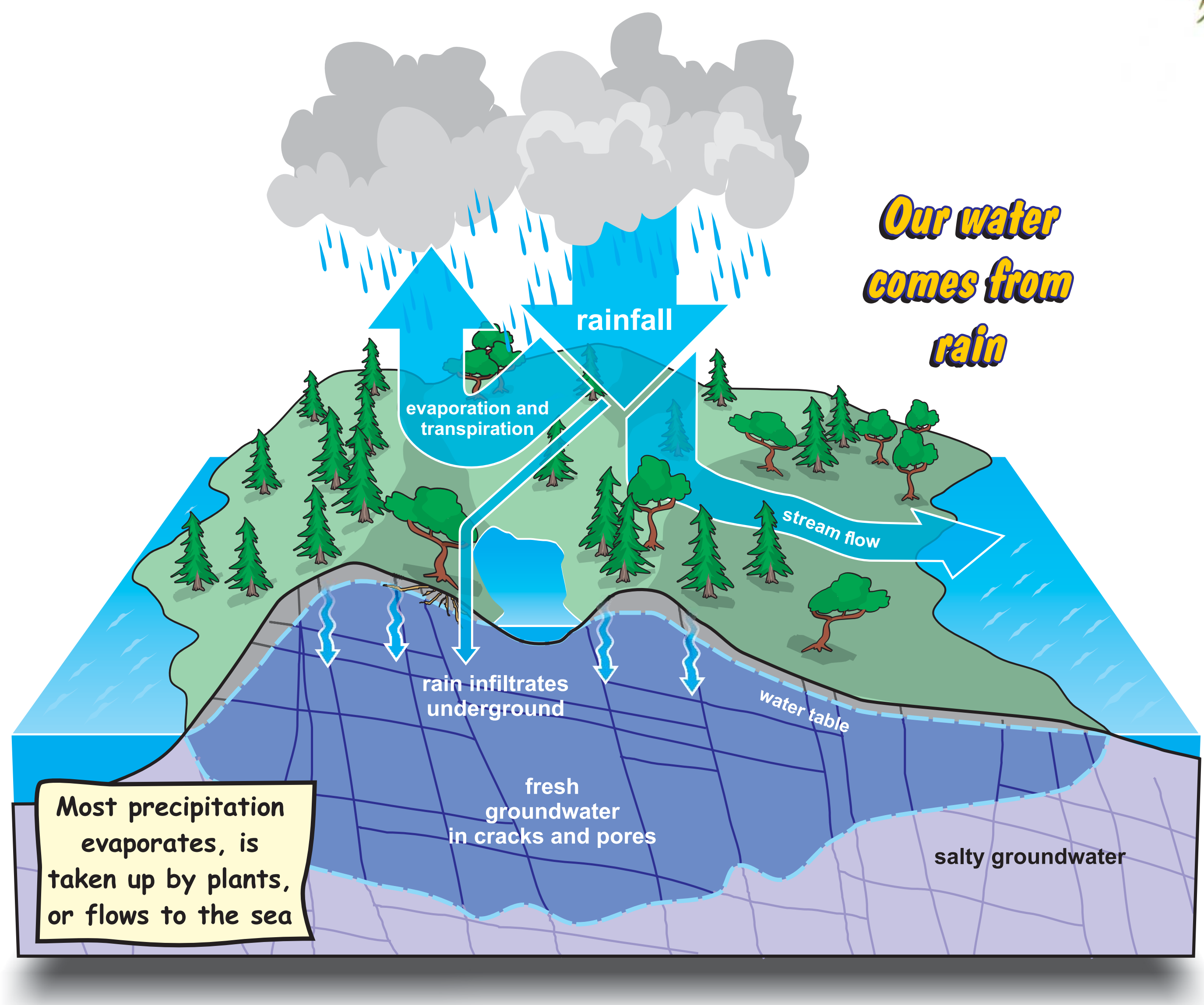
The lands around Greater Victoria lie within the Dry Coastal Belt and have a Northern Mediterranean type climate. If you look at the local water cycle from a starting point in the ocean, air masses over the Pacific Ocean pick up moisture through **evaporation** from the ocean. **Condensation** occurs when the vapour rises into the atmosphere where cooler temperatures cause it to condense into clouds. As winds push clouds towards Southern Vancouver Island, they lose much of their moisture in the Olympic Mountains to the south. How does this happen? The mountain ranges force air to rise and cool forcing moisture in the clouds to fall as **precipitation** - either rain or snow. As clouds move eastward over the island, little moisture is left in the air masses; as a result, the land on the southern tip of Vancouver Island and the east coast of the island lies in a dry coastal belt.

The precipitation that does fall on the Southern Vancouver Island comes from rain (or occasionally snow). Most of this precipitation evaporates off of the soil and water bodies, is taken up by plants (**evapo-transpiration**), or flows into streams and then into the ocean (**runoff or surface flow**). Rainwater flows into streams – sometimes with a pause in wetlands or lakes – or sinks into the ground (**infiltration**) to join the slow moving ground water system.

Watersheds connect us to the water cycle because the water that is collected in a watershed supplies the water we drink. In the case of Greater Victoria, the Sooke Reservoir watershed provides much of the tap water to our homes, schools, and businesses. Watersheds, also called "catchment" or drainage basins, can be defined as all the land area that drains into a stream system or other body of water such as a lake. There are many types of watersheds; drinking water supply watersheds, urban watersheds, underground catchments called aquifers, to name a few. A drinking water supply watershed is designated as such because it drains into a reservoir or other drinking water supply intake. Watersheds vary in size from that of a pond to very large areas such as the Fraser River watershed - the largest in the province of British Columbia.

One of the keys to understanding the local water cycle and how it affects our water supply is that, by far, most of our precipitation comes from winter rains; very little falls as snow; and relatively little water is stored as it moves through the water cycle.

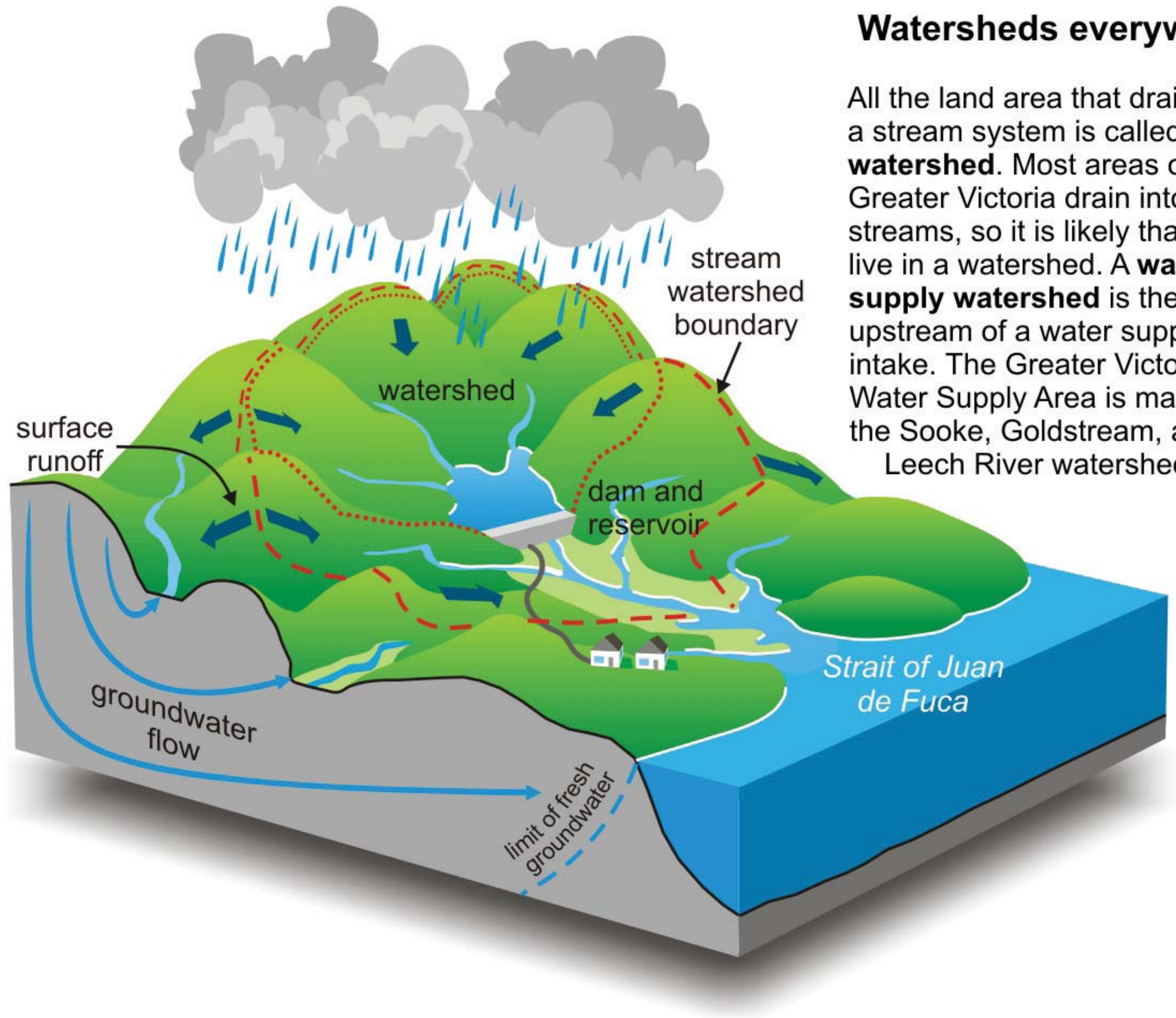
Storage of water in watersheds can take place in the form of yearly snowpack or glaciers, and in water bodies such as lakes and wetlands, which act as "sponges" to store and slowly release water. Because much of Greater Victoria's annual rainfall comes during the winter without the benefit of snowpack or glaciers, there is limited storage in reservoirs, lakes, and wetlands. It is this limited supply that provides us with the water we use every day throughout the year.



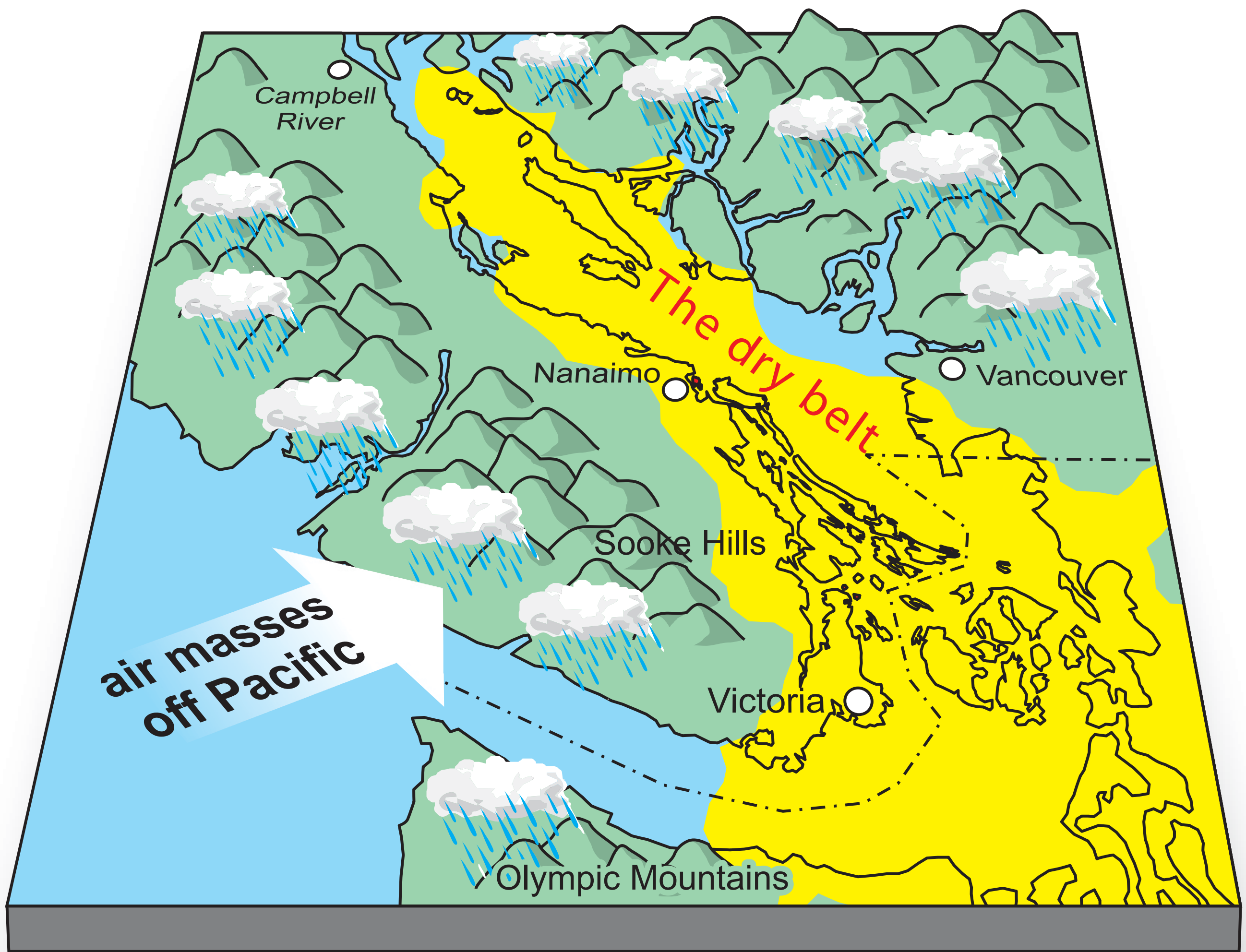
Our water comes from rain
rainfall
evaporation and transpiration
stream flow
rain infiltrates underground
water table
fresh groundwater in cracks and pores
salty groundwater
Most precipitation evaporates, is taken up by plants, or flows to the sea

Watersheds everywhere!

All the land area that drains into a stream system is called a **watershed**. Most areas of Greater Victoria drain into streams, so it is likely that you live in a watershed. A **water supply watershed** is the land upstream of a water supply intake. The Greater Victoria Water Supply Area is made up of the Sooke, Goldstream, and Leech River watersheds.

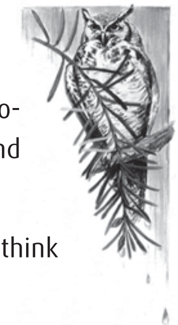


Greater Victoria: In the Dry Coastal Belt



Watersheds and Water Supply

Procedure



1. Review the water cycle with students and discuss how condensation, precipitation, evaporation, and evapo-transpiration work using the diagrams provided. For further information, see background information and graphics.

2. Introduce the concept of watersheds. Ask students – where do they think water comes from? Where do they think it goes? Record their answers.

3. Tell students that watersheds connect us to the water cycle because the water that is collected in a watershed may supply the water we drink. In the case of the Greater Victoria, the Sooke watershed provides most of the water to our homes, schools, and businesses. Refer to the graphic Watersheds and Water Supply.

4. Take the class outside to a sloped area in your school yard. Tell students they are going to make a model watershed to see how water moves through the water cycle. At the top of the slope is the top of the watershed or height of land while at the bottom is the ocean. Place a filled water container (garbage can) at the top of the slope, along with the filled watering can. You can also use a "Dig This" water adapter mister instead of a watering can.

5. With class gathered around the watershed area, review how the sun's energy drives the water cycle beginning with, for example, evaporation off the Pacific Ocean. Tell students that most of our weather systems come from the Pacific Ocean, moving east towards Vancouver Island. Ask students what happens to these weather systems when they hit the mountains north of Victoria and the Olympic range to the south? Have students demonstrate precipitation from the top of the watershed using a watering can or mister.

6. Now build the rest of the watershed – using sticks, rocks, etc. Place items on the slope, digging out streams, rivers, and lakes, carefully setting aside any vegetation to replace after you are done modelling. (Note: if you don't want to dig into the soil, you can build a watershed by placing chairs and other items on the slope, then placing a plastic sheet or tarp over them to represent the watershed area.) If desired, ask students to record their observations of the watershed model incorporating key terminology.

7. Ask students to predict what will happen to the watershed when it "rains."

8. Using the watering can, water the height of land to demonstrate precipitation and the movement of water into streams, rivers, lakes and ultimately the ocean.

9. Ask students whether all the precipitation flows into a stream or lake. Note that some of the water goes into groundwater via infiltration.

10. Introduce evapo-transpiration into the model by adding forests (model trees, cut up "Christmas garland", or sticks on samples of carpet), and increasing the water-holding capacity of the watershed by adding wetlands (sponges) and lakes (bowls). Let it "rain" again and have students explain the importance of forests, wetlands, and lakes.

11. Watersheds are homes to both wildlife and people. Ask students to add model houses, towns, or cities. What are the impacts of cities and towns on watersheds? How would logging or land development impact the watershed?

12. If pollution were to enter the watershed – what impact would it have? Add drops of food dye, juice crystals, or soy sauce to water flowing through the watershed to represent pollution.

13. If a watershed was a water supply watershed – how could human activities in the watershed affect water supply? Should we allow activities such as logging or development in our water supply watersheds? Why or why not?

14. Repeat the exercise as many times as you have time for, changing the features of the watershed. **<u>When done, carefully replace any vegetation you have removed.</u>**

Evaluation

Have students:

- Describe the water cycle in the Greater Victoria area by using at least five key words;
- Explain why Greater Victoria is in the Dry Coastal Belt;
- Discuss reasons why a water supply watershed must be protected.

Extensions

1. Do the activity The Incredible Journey from Project WET (page 161) for an active simulation of the water cycle and the many paths as water changes from state to state. Or, alternatively, complete Catching Clouds in a Bottle from BC Science 8 (page 363) to model cloud formation.
2. Compare two sites: one grassy sloped area and one with a bare slope (no plants)using two basins on a table. Ask students to predict any differences in the quality of water flowing through each system. Demonstrate how erosion on the bare slope increases when it "rains."

Community Connections

Go to **www.crd.bc.ca/water** to find information on watershed protection and local precipitation data.

Invite World Fisheries Trust to bring a local watershed model to your classroom **http://worldfish.org**

Informaton on local watersheds may be found at **www.crd.bc.ca/watersheds**

Additional Resources

BC Science 8. 2006. See section on the Water Cycle (pages 360-367)

Bill Nye the Science Guy: the water cycle video. Available from: **http://billnye.com/#videos**

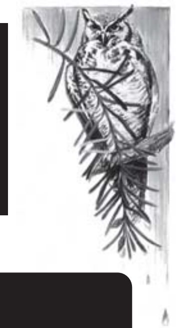
Teaching Green - The Middle Years: Hands-on Learning in Grades 6-8; and
Teaching Green - The High School Years: Hands-on Learning in Grades 9-12;
available from: **www.greenteacher.com**

Rivers Day: Celebrate BC rivers -**http://worldriversday.com**

References

What is the Water Cycle? US Geological Survey. **http://ga.water.usgs.gov/**

Plants & Animals of the Sooke Reservoir Watershed



Key Concepts

- Habitats and ecosystems within the Greater Victoria Water Supply Area need enough clean water to survive.
- Responsibility for water is everyone's concern.

Method

Students will complete research about the plants and animals of the Sooke Reservoir watershed and make a brochure.

Activity Information Box:

Time Required: 120 minutes for the Activity, plus additional student research and design time

Grade Level: Grades 8-12

Key Words: *food chain, ecosystems, producers, consumers, biotic, abiotic, watershed, catchment*

Materials:

- *paper*
- *pens/coloured markers*
- *maps of watershed*
- *Plants and Animals of the Sooke Reservoir Watershed* PowerPoint® (PDF) presentation
- other research material

Setting: indoors

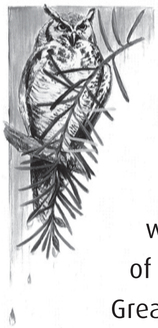
Skills: data collection, observation, analysis, interpretation, classification, drawing

Subjects: Science 8-10
Biology 11-12;
Resource Science 11-12

Learning Outcomes:

It is expected that the student will:

- Identify the main biotic (living) and abiotic (non-living) components of the Greater Victoria Water Supply Area (GVWSA);
- Describe factors that affect productivity and species distribution in the Sooke Reservoir watershed;
- Demonstrate knowledge of the plants and animals of the Sooke Reservoir watershed including the interrelationship with the physical environment.



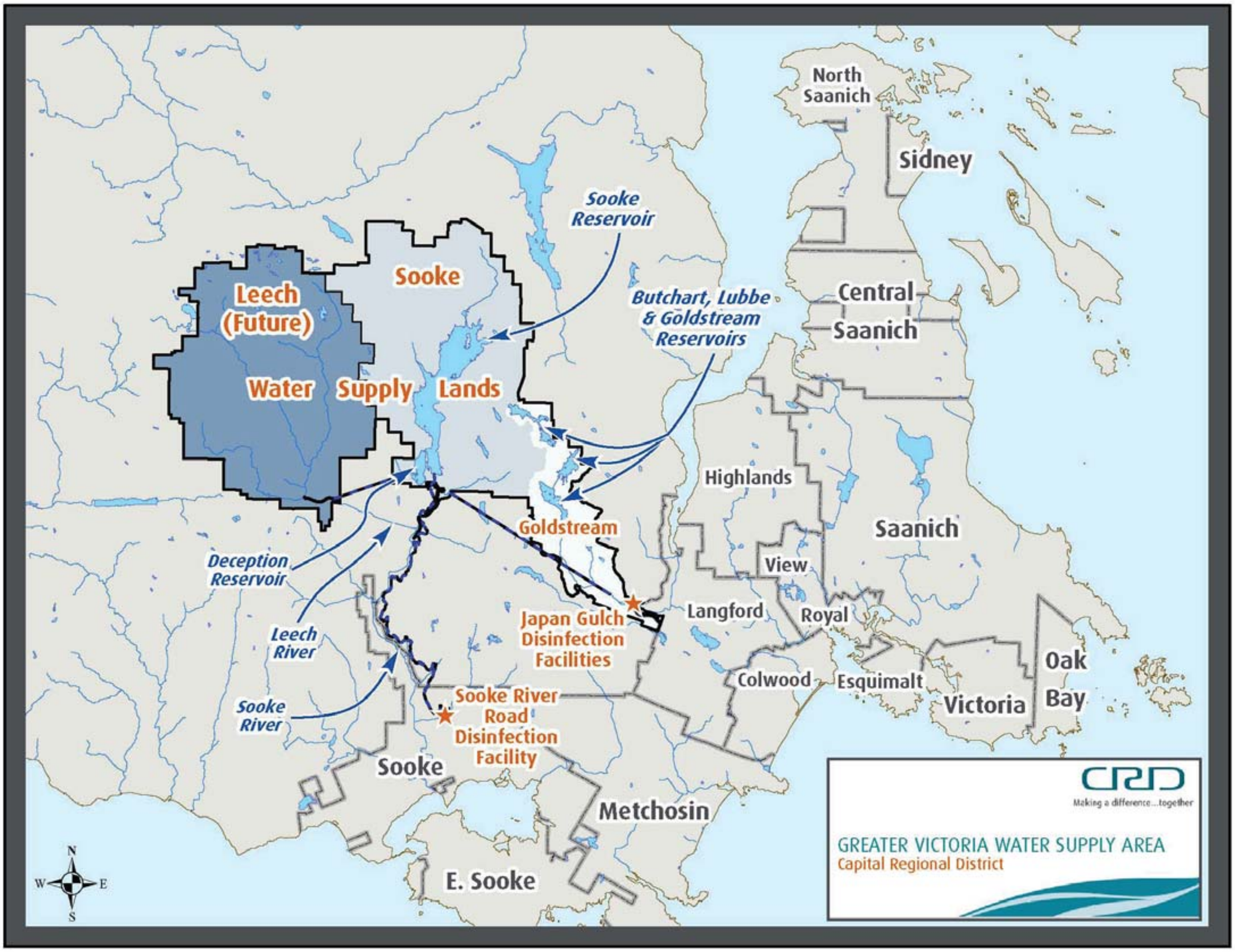
Background

Once a year, CRD Integrated Water Services offers tours of the Greater Victoria Water Supply Area. This area is typically off-limits to the public to help ensure that our water supply stays protected and pristine. The water supply area is made up of the Sooke, Goldstream (including the Butchart and Lubbe), and Leech River watersheds. A watershed can be defined as the area or catchment basin that drains into a river, lake, or other body of water. Why should we care about watersheds? Watersheds are more than the catchment basins in and around Greater Victoria. It is important to maintain the integrity of all watersheds because they support habitat for wildlife, space for native plants to grow, they can function as "green infrastructure", and they can provide drinking water for both people and wildlife.

The Sooke Reservoir is the primary reservoir in the Greater Victoria Water Supply Area. It supplies almost 100 percent of the water used by the 340,000 area residents, while the Goldstream Reservoir provides backup storage to be used during drought conditions or during annual routine maintenance and emergencies when water cannot be supplied from Sooke Reservoir.

Watersheds in British Columbia have a considerable diversity of habitats and ecosystems. What is an ecosystem? Ecosystems are interacting complexes of living organisms (plants, fungi, bacteria, and animals) and the physical environment (soil, air, water, and bedrock) immediately affecting them. Within an ecosystem, there is a dynamic and complex interaction amongst biotic (living things) and the abiotic (not associated with or derived from living organisms). Ecosystems vary in terms of topography, geological features, soil types and climate. The physical conditions in a particular watershed influence which plants and animals will be found there.

In order to better research and understand the great diversity of ecosystems – scientists have devised a classification system whereby ecosystems are grouped on the basis of climate, physical characteristics, and biology. In B.C., these units are called biogeoclimatic zones, each with sub-zones. The Greater Victoria region lies within the Coastal Western Hemlock biogeoclimatic zone, which is one of the most productive forest areas in Canada. It extends in a broad swath along the province's entire coast. The zone covers most of the lower elevation lands west of the Coast Mountains, from the very wet outer coast to the drier areas of the inner coast. Most of the water supply watersheds are within the Coastal Western Hemlock very dry maritime biogeoclimatic subzone although areas at the highest elevations are within the wetter moist maritime subzone.


North Saanich
Sidney
Central Saanich
Saanich
Highlands
View Royal
Langford
Colwood
Esquimalt
Victoria
Oak Bay
Sooke
Metchosin
E. Sooke
Leech (Future)
Sooke
Water Supply Lands
Sooke Reservoir
Butchart, Lubbe & Goldstream Reservoirs
Goldstream
Deception Reservoir
Leech River
Sooke River
Japan Gulch Disinfection Facilities
Sooke River Road Disinfection Facility
N
W
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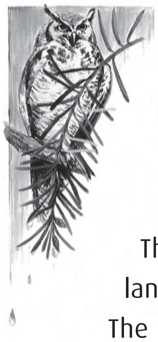
S
Making a difference...together
GREATER VICTORIA WATER SUPPLY AREA
Capital Regional District



Climate & Physical Setting of the Greater Victoria Water Supply Area

The climate of the Greater Victoria Water Supply Area (GVWSA) is a Northern Mediterranean-type climate with warm, dry summers and wet but mild winters usually free from freezing temperatures. The yearly snow pack in the GVWSA is minimal.

The watersheds lie northwest of the City of Victoria and have a gently rolling topography and relatively uniform landscape. However, the water supply area does contain a small amount of steeper terrain and rocky outcrops. The Sooke Reservoir watershed (catchment area) has a total area of 8153 ha. The Goldstream catchment area has a total area of 2,200 hectares. The newly acquired Leech River watershed, covering 8,791 hectares, is the largest in the GVWSA.

Rithet Creek is the primary tributary of Sooke Reservoir. It is one of the few streams that run year-round in this watershed. Its drainage area is about 1,740 hectares (4,299 acres), about 25% of the reservoir's total catchment area. The Leech River is the primary stream in the Leech River watershed, which flows into the Sooke River downstream of the Sooke Reservoir watershed.

Some Features of the GVWSA

- *Northern Mediterranean-type climate*
- *No snow pack in winter*
- *Gently rolling landscape*
- *Some steep terrain and rocky outcrops*
- *Rithet Creek*
- *Leech River*

Rithet's Creek

Forests of the Sooke Reservoir Watershed

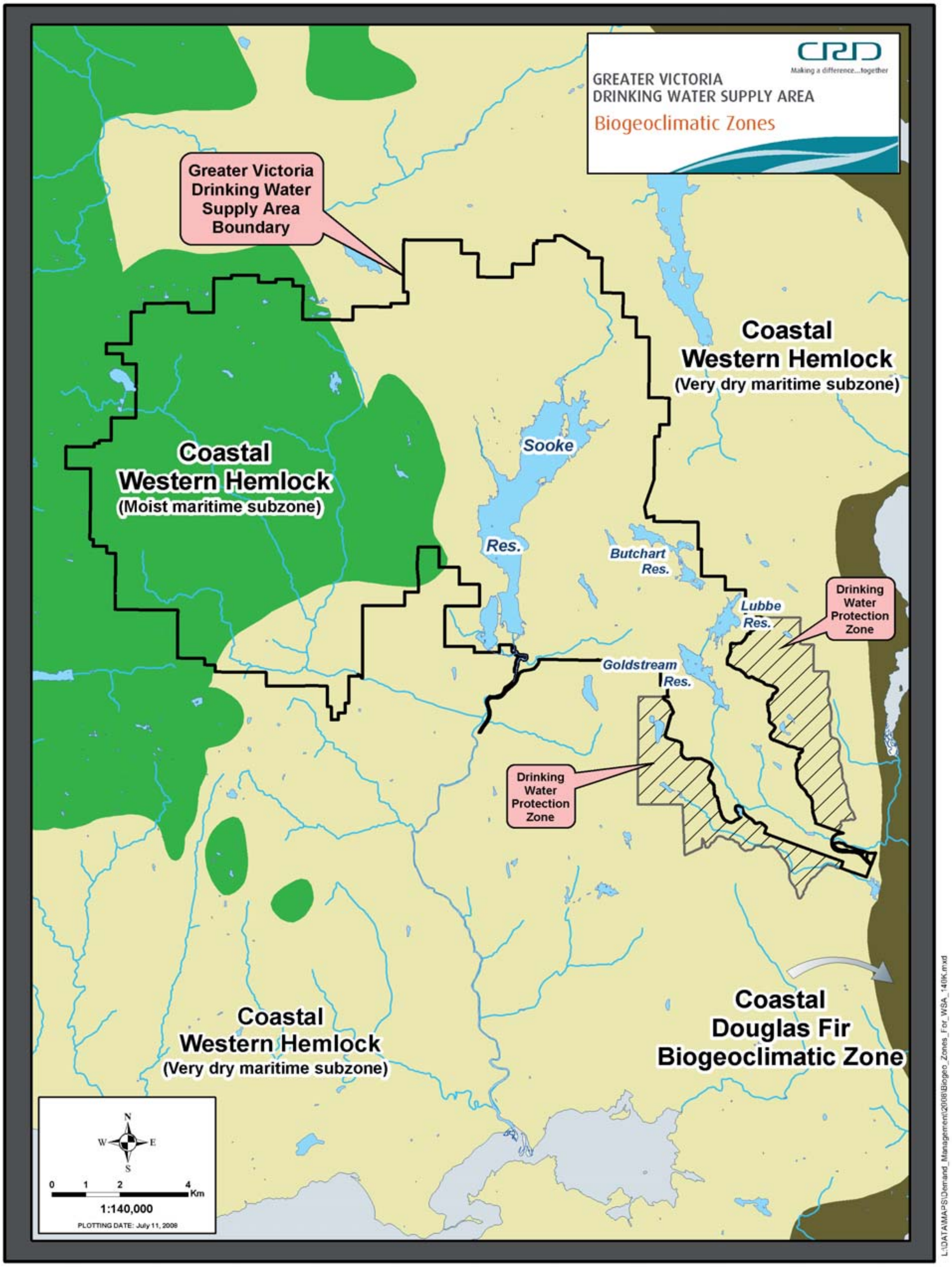
The Sooke Reservoir watershed is the primary water supply watershed in the Greater Victoria Water Supply Area. Because of its importance, a number of studies have been conducted to obtain information on forests and the ecosystems found there. The CRD has recently acquired the Leech River watershed and it will also be the subject of similar studies in the future.

Forests in the Sooke Reservoir watershed are mostly classified as belonging to the Very Dry Maritime subzone of the Coastal Western Hemlock Biogeoclimatic zone. Douglas-fir (*Pseudotsuga menziesii*) dominates forested landscapes throughout. Naturally occurring periodic fires help to maintain Douglas-firs in the watershed's landscapes. At lower elevations, big-leaf maple, (*Acer macrophyllum*), grand fir (*Abies grandis*), and western red cedar (*Thuja plicata*) are common components of the forest. Garry oak (*Quercus garryana*) has a rare occurrence while arbutus (*Arbutus menziesii*) is common on exposed rock outcrops at lower elevations. Shore pine (*Pinus contorta var. contorta*) is found on scattered rock outcrops at all elevations. With increasing elevation, big-leaf maple and grand fir are replaced by western hemlock (*Tsuga heterophylla*), and western red cedar occupies a lesser role. Red alder (*Alnus rubra*) is common throughout on disturbed sites and in rich/moist to wet ecosystems. Shrubs such as Salal (*Gaultheria shallon*) and softstemmed plants (herbs) and mosses are found throughout the GVWSA. Sword fern (*Polystichum munitum*) is an indication of moist, more nutrient rich forest stands.

Some Plants of the Sooke Reservoir Watershed

Douglas-fir
Big-leaf maple
Western red cedar
Arbutus,
Shore pine
Grand fir
Western hemlock
Red alder
Salal
Oregon-grape
Huckleberry
Bald hip rose
Ocean spray
False azalea
Salmonberry
Devil's club
Labrador tea
Sword fern
Mosses

Biogeoclimatic Zones of the Sooke Reservoir and Goldstream watersheds



The Sooke Reservoir watershed lies within the Coastal Western Hemlock Biogeoclimatic Zone. Most of the watershed is within the Very Dry Maritime Coastal Western Hemlock subzone while a small portion lies in the Moist Maritime Coastal Western Hemlock subzone.

Sooke Reservoir

Sooke Reservoir is monitored by CRD Integrated Water Services to better understand the aquatic ecosystem and its effect on drinking water quality. Bacteria are some of the smallest residents of Sooke Reservoir and are a natural, healthy part of all environments. In aquatic systems, including Sooke Reservoir, bacteria decompose organic material and cycle nutrients such as nitrogen and phosphorus. Algae (phytoplankton) are simple microscopic plants that range in size from 1-2 micrometres to over one millimetre; they live freely in the water where there is sufficient light for plant growth; along with all plants, they are known as the primary producers. Zooplankton are small, mostly microscopic animals that also live in the open water of the reservoir. They can swim, allowing them to move away from predators and toward food. Some can move up or down as far as ten metres in the water based upon light, food and other factors. They are known as primary consumers. Freshwater mussels are found in the Sooke Reservoir and typically live on the bottom, filtering decaying organic material and other food particles from the water. Aquatic insects such as the non-biting midges are one group that usually make up the greatest numbers of insects in aquatic systems. Members of this group spend the early stages of life in the water, moving to land once they are adults. The aquatic insects will eat algae growing on rocks as well as decaying organic material and, in some cases, other animals. Animals that eat plants are known as primary consumers, while those that eat other plant-eating animals are known as secondary consumers, and those that eat animal-eating animals are tertiary consumers.

Fish are present in Sooke Reservoir, where they feed upon zooplankton and aquatic insects. Four main types of fish were found in Sooke Reservoir in 2006: Rainbow Trout (*Oncorhynchus mykiss*), Cutthroat Trout (*Oncorhynchus clark*i), Dolly Varden char (*Salvelinus malma*) and Kokanee salmon (*Oncorhynchus nerka kennerlyi*). Kokanee is a land-locked salmon that lives in freshwater only, and belongs to the same species as the sea-going Sockeye salmon. Dolly Varden and Kokanee were found to be selective feeders since only one type of zooplankton was found in their stomachs. The same type of zooplankton was found in the stomachs of both Rainbow and Cutthroat Trout in addition to aquatic insects and other fish, indicating that they are more generalized feeders.

Eagles and black bear that eat fish from Sooke Reservoir are also tertiary consumers.

Some Plants and Animals that Live or Feed in Sooke Reservoir

Bacteria

Algae (phytoplankton)

Aquatic plants

Zooplankton

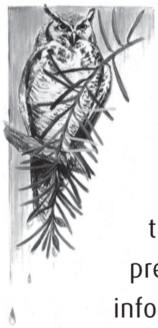
Aquatic Insects

Freshwater mussels

Rainbow Trout and other fish species

Eagles

Black bear



Wildlife in the Sooke Reservoir watershed

Columbia black-tailed deer are by far the most common large mammal wildlife species present in the watershed. Black bears and Roosevelt elk are less common. Bird species include the Pileated woodpecker and others such as Cooper's Hawk, Winter Wren, Bald Eagle, Golden Eagle, and Great Horned Owl. It is also thought that there are potential nesting sites for the Marbled Murrelet, a vulnerable population of seabird. Other species present include Cougar, Mink, River Otter, Red Squirrel and small mammals such as mice and voles. For more information please see Powerpoint (PDF) notes and Plants and Animals at Sooke Resevoir Watershed cards.

Some Wildlife of the Sooke Reservoir Watershed

Columbia black-tailed deer

Black bear

Roosevelt elk

Pileated Woodpecker

Cougar

Mink

River Otter

Red Squirrel

Cooper's Hawk

Winter Wren

Great Horned Owl

Bald eagle

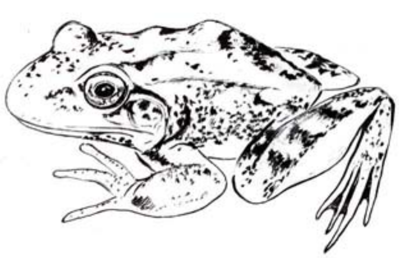
Golden Eagle

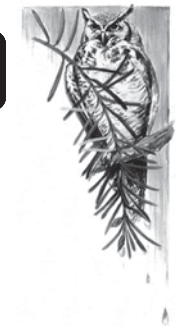
Rainbow Trout

Cutthroat Trout

Dolly Varden Char

Kokanee Salmon





COLUMBIA BLACK-TAILED DEER
(Odocoileus hemionus columbianus)

The Columbia Black-tailed Deer is found along the coastal mountain region of BC. These deer prefer grassy fields at forest edges, and are most active at dusk and dawn, feeding. They use their large rotating ears to let them know of predators nearby, and bound away at the first sign of danger. Black-tails feed on tender grasses, herbs, branch tips, and new leaves in spring and summer. In winter, they eat Douglas-fir, western cedar, Oregon yew, trailing blackberry, red huckleberry, and salal branches.

BLACK BEAR
(Ursus americanus)

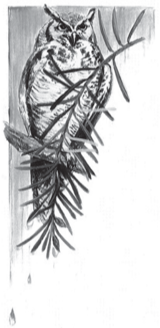
The black bear is the most common species of bear in B.C. Black bears prefer a forest habitat, especially ones with open areas such as meadows or wetlands. Although bears are classified as carnivores, they are actually omnivores and eat a variety of plants and animals. Plants make up about 75% of a bear's diet, including leaves, buds, catkins, stems, roots, grasses, nuts, and berries. They also eat a variety of insects, honey, and carrion (dead animals). Bears catch and eat spawning salmon and often leave old carcasses in the forest, providing key nutrients to the forest ecosystem.

PILEATED WOODPECKER
(Dryocopus pileatus)

The Pileated Woodpecker is widely distributed across southern British Columbia. It frequents forested areas in mature Douglas-fir and western hemlock forests, including adjacent logged and second growth areas, as well as open deciduous and mixed woods. It probes for insects deep within dead and rotting trees and excavates cavities for roosting and nesting. It is the largest woodpecker in North America and can often be heard before being seen by its distinctive "laughing" call.

COUGAR
(Felis concolor)

The cougar, the largest wild cat native to British Columbia, is an imposing but evasive member of our wildlife. Cougar are generally found from the British Columbia-Alberta border west, including most coastal islands. The cougar eats prey species such as deer, porcupine, beaver, hare, moose, elk, wild sheep, mountain goats, black bear (cubs), grouse, coyote, other cougar, domestic stock, and household pets. Cougar habitat generally follows the habitat of its prey species.



Some Plants & Animals of the Sooke Reservoir WATERSHED

Marbled Murrelet
(Brachyramphus marmoratus)

The Marbled Murrelet is a small sea bird found along the Pacific Coast from Alaska to California. Marbled Murrelets spend most of their time at sea where they feed on fish or invertebrates. They nest in forests within 75 km of the coastline, laying a single egg in a shallow depression formed on moss laden branches of old growth trees. Marbled Murrelets nest in old forests and are rarely seen. There are some potential nesting sites for these secretive birds in the GVWSA forests.

Oregon Grape
(Mahonia nervosa)

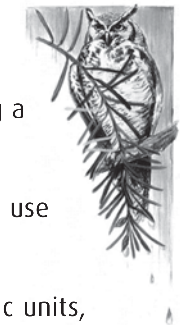
Oregon grape can be identified by its evergreen "holly-like" leaves, bright yellow flowers, and green berries that ripen into a waxy blue/purple colour. It commonly found in dry to fairly moist open forests at low to middle elevations. The tart, purple berries were sometimes mixed with salal or other sweeter fruit in traditional First Nations uses. The bark and roots of the Oregon Grape were also used to make a bright yellow dye for basket materials. Today, the berries are sometimes used for jellies and winemaking.

Western Red Cedar
(Thuja plicata)

The Western Red Cedar is a large tree, growing up to 60 metres tall when mature, with drooping branches. Its leaves are arranged on the twig in flat, fan-like sprays. It usually occurs in low to mid elevations along the coast where the climate is cool, mild and moist. Cedar has been called the "cornerstone of northwest coast Indian culture" as the easily split, rot-resistant wood was used to make important cultural items such as houses, baskets, boxes, clothing, and a variety of tools and other household items.

Salal
(Gaultheria Shallon)

Salal is a shrub with thick, tough, spoon-shaped evergreen leaves. It grows in coastal forests from sea level to mid elevations. Salal berries have long been an important food source for B.C. native peoples – the berries were eaten fresh or dried in cakes.



Procedure

1. Find out what students know about the plants and animals of the Sooke Reservoir watershed by creating a "KWL" chart or a mind-map either individually or as a class.
2. Show the PowerPoint® (PDF) presentation on Plants and Animals of the Sooke Reservoir Watershed or use slides and notes for further background information.
3. Review the concepts of watershed and ecosystems with students. Discuss the ecosystems, biogeoclimatic units, and some of the plants and animals found in the GVWSA (see Background), using the material provided such as:
   - map of the Greater Victoria Water Supply Area watersheds;
   - map of the biogeoclimatic zones of the Greater Victoria Water Supply Area;
   - lists of plants and animals found in the Sooke Reservoir watershed;
   - background cards on some common animals and plants of the Sooke Reservoir watershed.
4. Tell students that they are going to make a brochure on a plant or animal found in the Sooke Reservoir watershed.
5. Using the Brochure Student Assignment sheet, challenge students to use the information provided plus their own research on a plant or animal of the Sooke Reservoir watershed. Students can look at the CRD website (**www.crd.bc.ca/water**) for photos and other information about the water supply area.
6. All brochures should provide accurate information, illustrations/graphics, and effective design elements in accordance with the evaluation criteria.
7. Have students present their findings to the class. Discuss with students any differences and similarities there might be between the plants and animals found in the Sooke Reservoir watershed and the watershed in which they live.

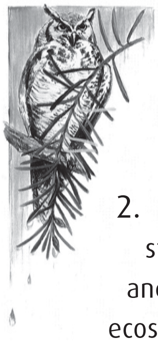
Evaluation

Have students:

- Describe plants and animals of the Sooke Reservoir watershed, including the interrelationship with the physical environment;
- Design and produce a brochure on a plant or animal of the Sooke Reservoir watershed.

Extensions

1. Instead of a brochure, ask students to create a card on a plant or animal of the GVWSA. Cards should provide information on the habitat, abundance, and how the plant or animal interrelates to the environment.
2. Grade 9-12: Compare the watersheds of the GVWSA to the watershed your school is in using the watershed maps provided in Appendix E. Compare watershed size and features. Discuss with students the amount of area that is urban or developed in the two watersheds, especially as it relates to protecting water quality.
3. Have a watershed food festival. Create a menu, prepare, and serve some locally grown foods.



Community Connections

1. Plan a field trip to Goldstream Nature House or Swan Lake Christmas Hill Nature Sanctuary to learn about the local watersheds and the plants and animals that live there.

2. Go on a local "watershed tour." Find out about local streams and where they flow – see Appendix B for a list of streams nearby Victoria area schools. What are the local native plants and animals found nearby? Do a walk-about and generate lists of plants and animals of the local watershed. Please be careful not to change or disturb sensitive ecosystems.

References

Ecosystem Units Of The Greater Victoria Water Supply Area; Volume 1 – Technical Report. CRD. 2004

Watershed Tours of Greater Victoria drinking water supply area and facilities. CRD.

www.crd.bc.ca/service/public-tours/watershed-tours

Watershed Protection. CRD. **www.crd.bc.ca/service/drinking-water/watershed-protection**

also at **www.crd.bc.ca/watersheds** *and* **www.crd.bc.ca/maps**

Cougar in British Columbia. BC Ministry of Environment. http://www.env.gov.bc.ca/wld/documents/cougar.htm

Birds of British Columbia. Vol Two. Campbell, R.W. et al. 1990. Royal British Columbia Museum

Plants of Coastal British Columbia. Pojar, Jim and A. MacKinnon (eds.). 1994. Lone Pine Press.

Trees, Shrubs, and Flowers to know in British Columbia and Washington. Lyons, C.P. and B. Meriless. 1995. Lone Pine Press.

Name:	Block:

Plants & Animals of the Sooke Reservoir Watershed

Assignment Instructions

Your task is to use your notes, the Internet and the information provided to research and create a brochure on some of the plants and animals of the Sooke Reservoir watershed. Your goal is to present high quality accurate information and illustrations/graphics about a plant or animal of the watershed. You may choose to complete this assignment in pairs or individually.

Tips for Brochure Planning

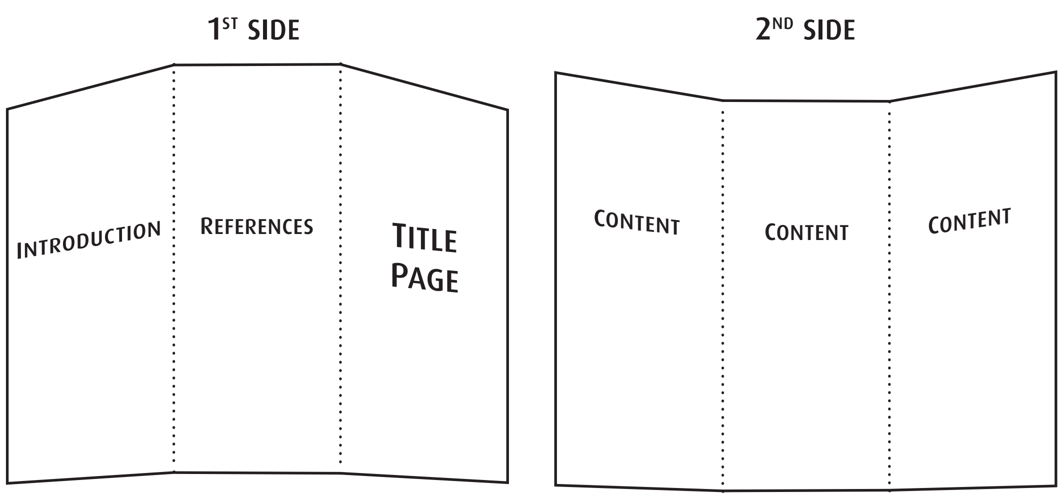
Content: Select a plant or animal of the Sooke Reservoir watershed from the material provided. Describe the information about the plant or animal features in clear, concise language with information from accurate sources. Include:

- Description
- Ecology
- First Nations or other uses

Pay attention to graphic design: highlight your main points with larger or bolder type. Details of the main points should be in smaller type. Use photographs or drawings to complement your text – make your design visually interesting and engaging.

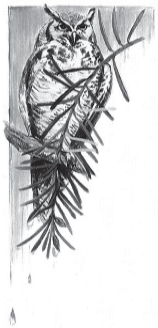
References: Include three or more reliable references.

Format: You are required to organize your information in a brochure format. This can be done by hand, or on the computer if you have a program on your own personal computer. You will need a blank piece of paper (8.5 X 11 inches) folded into three equal sections. Use the following layout as a guide.



Evaluation: Your brochure will be evaluated based on these four criteria:

1. Attractiveness and Organization
2. Research skills and References
3. Accuracy and Quality of information
4. Quantity of information



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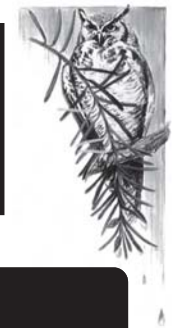
PLANTS & ANIMALS OF THE SOOKE RESERVOIR WATERSHED ASSIGNMENT EVALUATION

Mark:

CATEGORY	4	3	2	1
Attractiveness & Organization	Format is exceptionally attractive & information is well organized.	Format is attractive & information is well organized.	The brochure has well-organized information.	Format and organization of material are confusing to the reader.
Research Skills & References	Three or more reliable references are cited.	Only two references are cited.	Only one reference is cited.	References are not cited.
Content: Accuracy & Quality	All facts in the brochure are accurate.	99-90% of the facts in the brochure are accurate.	89-80% of the facts in the brochure are accurate.	Fewer than 80% of the facts in the brochure are accurate.
Quantity of Information	All topics are addressed in full.	One topic is incomplete or missing.	Two topics are incomplete or missing.	Three or more topics are missing.

The Clean Water Factory:
Green infrastructure in Our Watersheds



Key Concepts

- Sustainability of water resources requires conservation and best management practices.
- Responsibility for water is everyone's concern.

Method

Students view a demonstration and complete experiments demonstrating the natural filtration processes of forests.

Activity Information Box:

Time Required: 60-120 minutes

Grade Level: Grades 8-12

Key Words: *infiltration, green infrastructure, erosion, runoff, organic soils, mineral soils, scientific inquiry*

Materials:

- sponges or moss
- trays with lip
- 2 litre pop bottles
- scissors
- filter paper, or coffee filters
- water
- "dirty" water – water mixed with mineral soils
- sand, organic soil, gravel
- ring stands
- beakers
- pavement, compacted soils, soils with vegetation (optional)

Setting: indoors

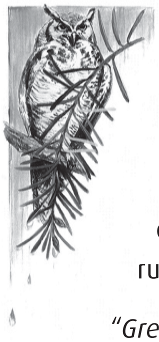
Skills: Gathering information, hypothesizing, model building, analysis, interpreting, presenting, science process skills

Subjects: Science 8-10
Earth Science 11
Geology 12

Learning Outcomes:

It is expected that the student will:

- Examine and compare filtration processes of natural systems such as streams, wetlands, and forests;
- Describe the importance of green infrastructure in keeping our water clean.



Background

Forests, streams and wetlands can be called a "*clean water factory*." Why? Because they all provide an amazing service to us: clean water. A healthy forest ecosystem will act as a kind of giant filter. Rain falls on the forest floor and slowly soaks (infiltration) through porous organic soils – eventually reaching streams - bringing clean water to lakes like the Sooke Reservoir. Because of the filtering effect in healthy forests, streams commonly run clear even during rain storms.

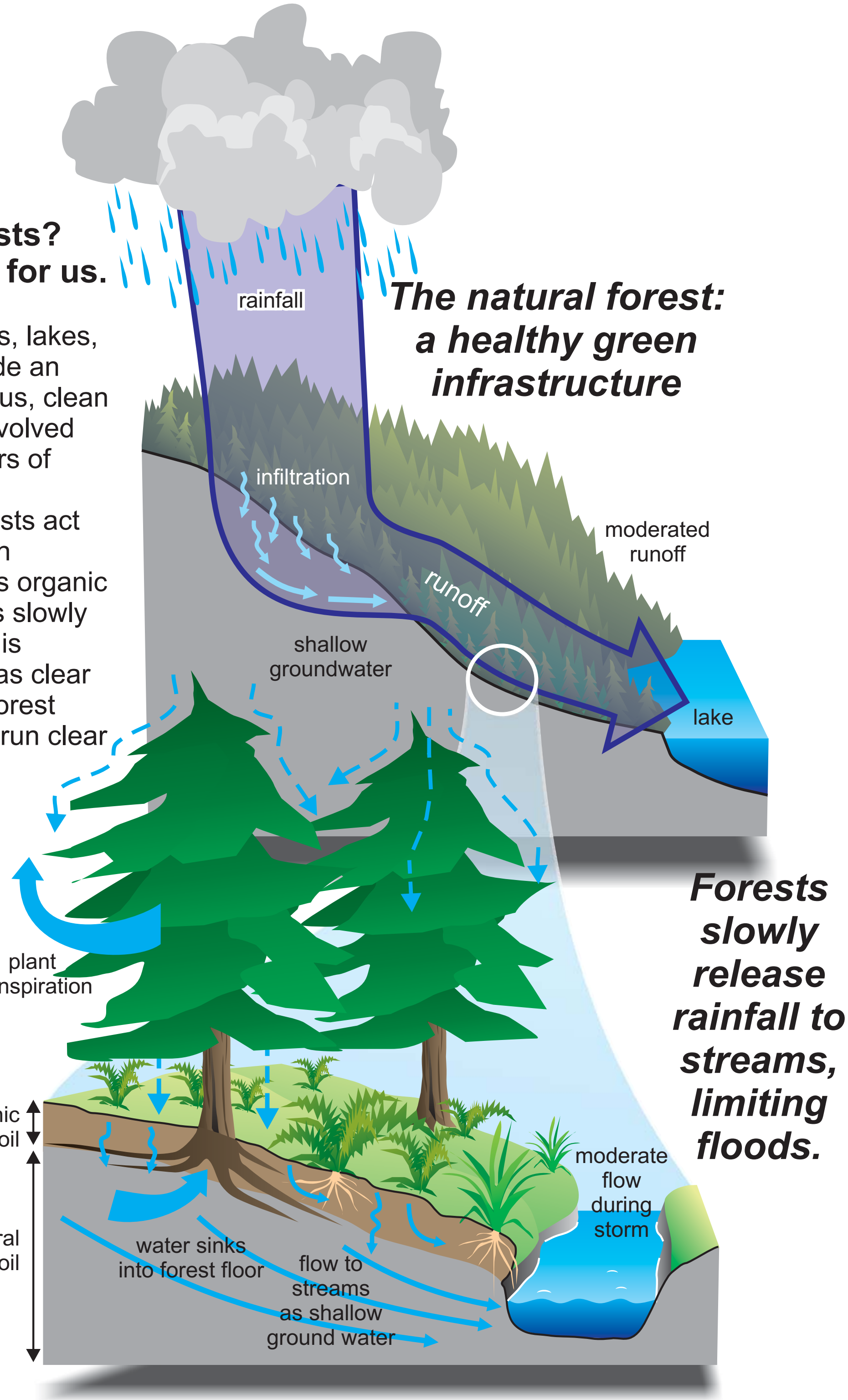
"*Green infrastructure*" is the term now used to help define ecosystems functions such as cleaning the air, filtering and cooling water, storing and cycling nutrients, conserving and generating soils, pollinating crops and other plants, regulating climate, sequestering carbon, protecting areas against storm and flood damage, and maintaining aquifers and streams. Often infrastructure means things like road, power line, water treatment and distribution systems. These systems provide a service to humans. Likewise, green infrastructure provides a service by filtering and storing water, providing critical habitat, and performing other functions as described. These services are all provided by the existing expanses of forests, wetlands, and other natural lands in the Greater Victoria Water Supply Area.

In contrast, when the green infrastructure is damaged, rain falling on cleared land mostly becomes surface runoff. As water flows over the surface of exposed soils, it picks up fine particles (soil erosion). These particles cause the water to become muddy or to have increased turbidity. Increased turbidity is a major problem as makes it more difficult to treat drinking water (reducing the ability of chlorine to disinfect) as well as harming habitat for fish and other aquatic creatures. The particles can settle out in lakes and streams (sedimentation), smothering existing bottom habitat. Another problem with damaged green infrastructure is that streams in the watershed are much more prone to flooding and storm surges due to a lack of natural infiltration. When the green infrastructure is damaged, we have to pay for constructed infrastructure, such as water treatment plants, dams, retaining walls and other services to clean up or store water. It makes more sense to keep our green infrastructure healthy to begin with, since it is free and self-maintaining.

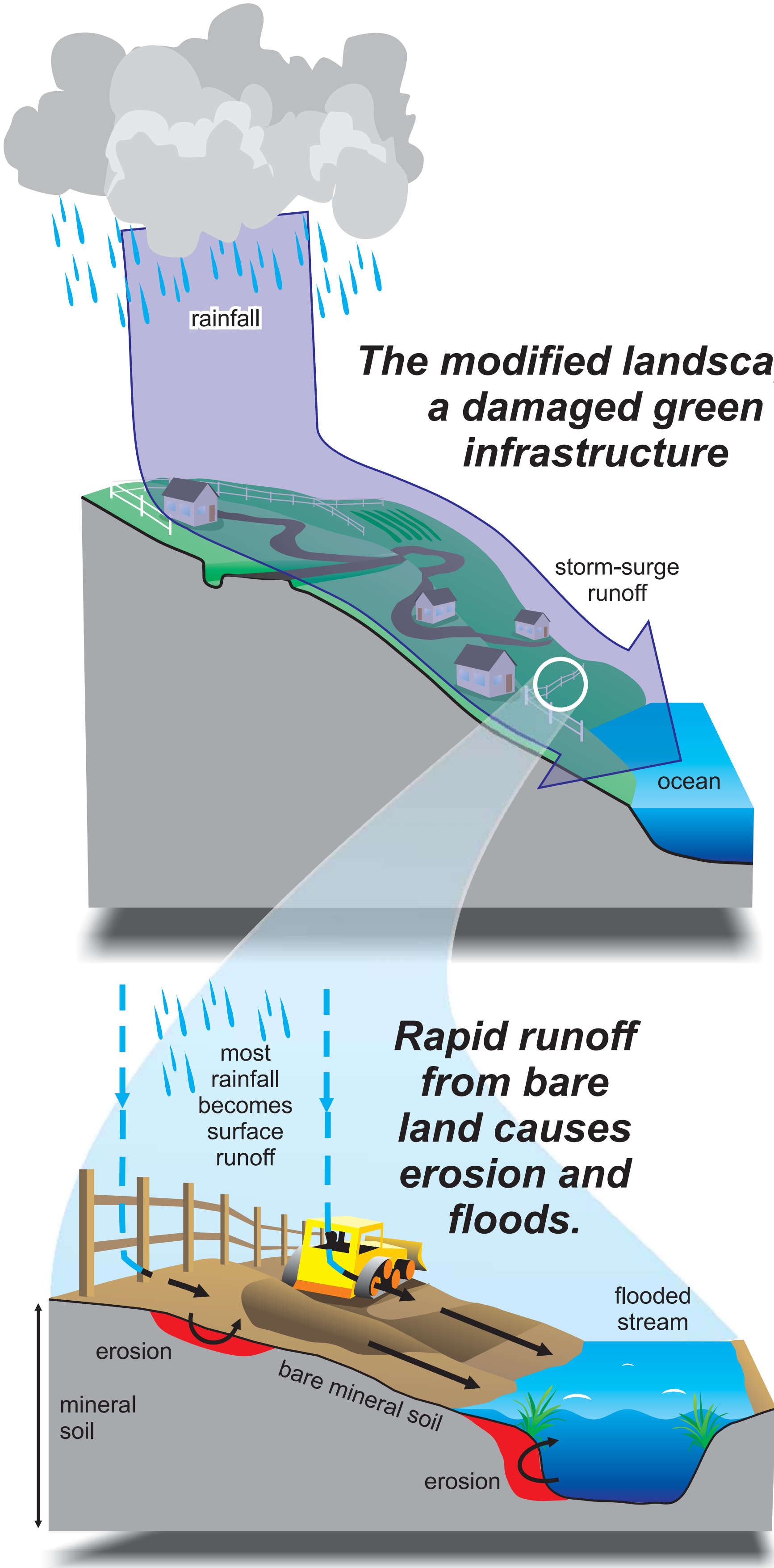
Wetlands also play an important role in maintaining watershed health by acting as a sponge and filter. Wetlands fill with water during rains and slowly release water (holding capacity) through periods without rain. They also filter stream water and offer critical habitat for wildlife.

Hi-tech forests? How they work for us.

Our forests, streams, lakes, and wetlands provide an amazing service to us, clean water! They have evolved over millions of years of “research and development”. Forests act as a giant filter. Rain infiltrates the porous organic soils and percolates slowly to streams where it is gradually released as clear water. As a result, forest streams commonly run clear



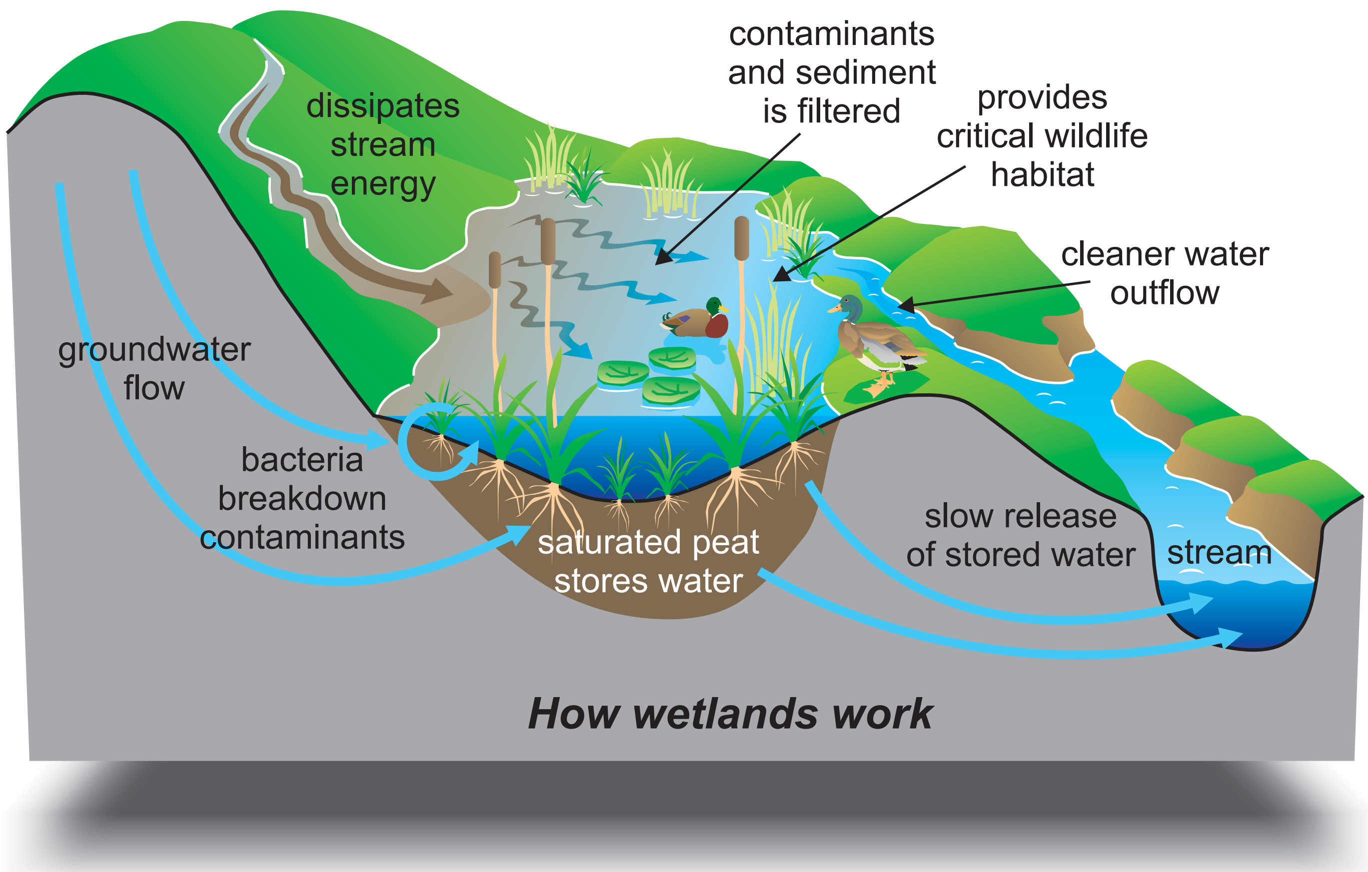
Forests: Most rainfall becomes shallow groundwater



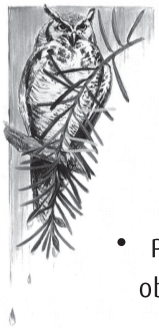
Cleared Land: Most rainfall becomes surface runoff

Wetlands: nature's sponge and filter

Wetlands swamps, marshes, bogs, and fens provide many services. They filter stream waters, store water, and offer critical habitat for many plants and animals. Wetlands fill with water during rains and slowly release water through droughts. Before we understood their critical role, we used to ditch and drain wetlands to create lawns, pastures, or farms.



How wetlands work



Procedure

1. Set up the following demonstration using a sponge or moss, tray with a lip, and a 250 mL beaker filled with water. Explain that the sponge/moss represents organic soils and wetlands in healthy green infrastructure as they absorb and hold water.

- Place a dry sponge on the tray and pour water slowly over the sponge – soaking it. Have students record their observations. The sponge should soak up most of the water.

Try also:

- Moistened sponge – representing soils with some moisture
- Sponge on a slope – representing soils or a wetland on a hill or sloped terrain
- Vary the rate of pouring the water over the sponge – representing light to heavy rainfall
- Moss – try all of the above with a piece of moss that fits in the tray

2. Explain to students that healthy green infrastructure helps keep our water clean by storing and filtering our water in a similar way as the sponge demonstrated. Introduce the terms "healthy" and "damaged" green infrastructure and describe how wetlands work using the graphics provided (see background).
3. Divide the class into small groups to complete an experiment on how healthy green infrastructure can act as a natural filter to clean water.
4. Provide each group with a 2 litre pop bottle with cap, organic soil, sand, sponge, filter paper, ring stand, and a container with 250 mL of a mixture of soil and water.
5. Students should first cut off the bottom of the bottle (see diagram) and then follow the diagram to place the filter paper, sponge, sand, and organic soil in the bottle – placing the whole unit in a ring stand (leave on bottle cap). A beaker should be placed under the bottle.
6. Have students use the Student Worksheet provided to record observations, hypothesis, predictions, variables, analysis and conclusions as they complete the worksheet.
7. To wrap up, students can present their findings and discuss the importance of natural processes such as infiltration and holding capacity as green infrastructure.

Evaluation

Have students:

- Explain how forests, soils, and wetlands act as green infrastructure;
- Describe how a wetland acts as a sponge and a filter;
- Explain the importance of protecting green infrastructure.

Extensions:

1. In the demonstration, instead of a sponge on a tray, put different media such as compacted soils, pavement, soils with plant cover such as grass or moss, or frozen soils on the tray. Do the demonstration again with increased/decreased slope, differing rates of "rainfall" intensity, etc.
2. Have students run the experiment again, this time using water that is cleaner or more dirty than the original sample. Record their observations.

Community Connections

Discuss that would happen if we logged or developed our water supply watersheds. What impact would these activities have on our other infrastructure such as water treatment and distribution? How would they affect conservation of our water supply? For further information on local watersheds go to;
www.crd.bc.ca/watersheds

Additional Resources

BC Science 8. 2006. See section on Science Skills – Scientific Inquiry (pages 476-479)

References

Waterscapes Posters from Natural Resources Canada from: **http://geoscape.nrcan.gc.ca** (archived)

NAME: | **BLOCK:**

CLEAN WATER FACTORY EXPERIMENT ASSIGNMENT INSTRUCTION:

AIM:

To demonstrate that healthy green infrastructure helps keep our water clean by storing and filtering our water.

MATERIALS:

pop bottle with lid, scissors, ring stand, beaker, water, sponge, filter paper, sand, organic soils.

PROCEDURE:

1. Cut off the bottom of the bottle, turn upside down and then following the diagram: place the filter paper, sponge, sand, and organic soil in the bottle – placing the whole unit in a ring stand (leave bottle cap on).

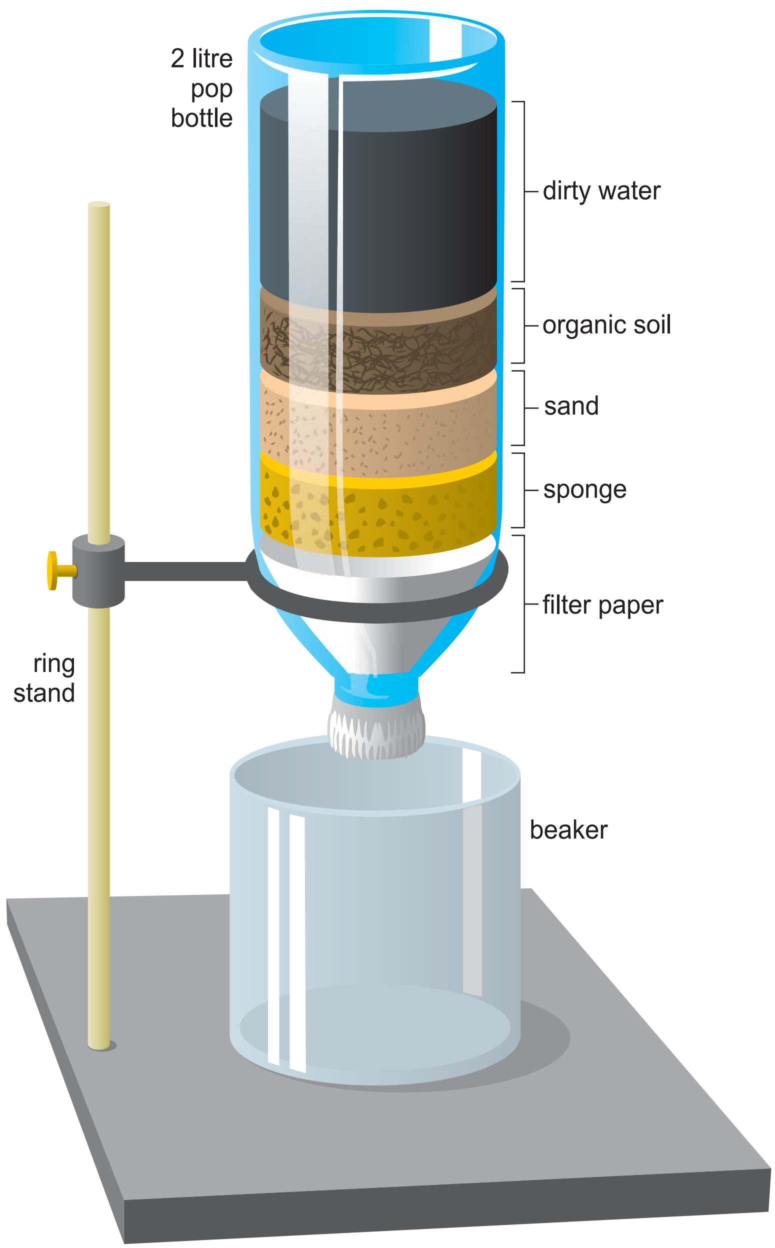
   A beaker should be placed under the bottle.

2. Observe the water sample provided: note water colour, smell, and any other features. Record your observations.

3. State a hypothesis and make a prediction about what you might expect to observe when you pour the dirty water through the pop bottle filter.

4. Remove the bottle cap and slowly pour the dirty water into the filter, observing the water that comes out of the bottom of the filter. Record your observations, noting any changes in water characteristics.

5. Fill remainder of worksheet.



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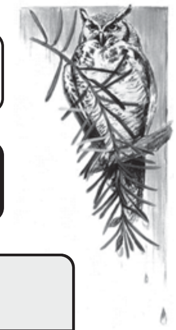

CLEAN WATER FACTORY EXPERIMENT: DATA SHEET

PRE-FILTER WATER SAMPLE:

COLOUR:

SMELL:

OTHER:

HYPOTHESIS:

PREDICTION:

POST-FILTER WATER SAMPLE:

COLOUR:

SMELL:

OTHER:

EXPERIMENT VARIABLES:

ANALYSIS AND CONCLUSIONS:

WATER: SOURCE TO TAP

GREATER VICTORIA WATER SUPPLY WATERSHEDS PROVIDE MOST OF THE WATER WE USE EVERY DAY. This section is intended to further the student's understanding of how drinking water moves from the Greater Victoria Water Supply Area (GVWSA) into our homes, schools, and businesses. The disinfection and distribution of water from the reservoirs is explored in addition to how this precious resource is managed.

Water flows from Sooke Reservoir through a series of pipes to disinfection facilities and then through another pipe network into the homes, schools, and businesses of the Greater Victoria area. Our drinking water begins its journey at the southern end of Sooke Reservoir and enters the intake tower where it is screened through stainless steel screens. From the intake tower, most of the water passes through two pipelines to the Head Tank and then through the 8.8 km long Kapoor Tunnel to the Japan Gulch Disinfection Facility. The Greater Victoria Drinking Water Supply System actually uses two disinfection facilities: the large one at the Japan Gulch Disinfection facility which disinfects all of the water in the Greater Victoria Drinking Water System except for Sooke and East Sooke, and a small one at Sooke River Road which disinfects the water for Sooke and East Sooke. From these facilities, the disinfected water is distributed via thirteen municipal and electoral area drinking water distribution systems. Once the water reaches the homes, schools, and businesses of the Greater Victoria, it is our responsibility. Sustaining this critical resource requires each of us to use water with care.

Water quality professionals use knowledge of water's unique physical and chemical properties to design effective water treatment systems. Because water can dissolve substances easily, it can pick up contaminants. Water quality professionals design disinfection processes to deal with any water contaminants and to maintain high water quality for our taps. Water quality is one of the critical aspects of managing our drinking water supply.

Water is an important natural resource and its management is critical to a variety of stakeholders. Most water supply and watershed management approaches focus on "best practices" that are intended to maintain healthy ecosystems for present and future generations. However, protecting and supplying high quality drinking water is a complex challenge in which land use, government regulation, and everyday water use by people all play a role.

THIS SECTION CONTAINS FIVE ACTIVITIES FOR STUDENT LEARNING:

- *Greater Victoria Drinking Water: From Source to Tap*
- *Water Treatment in Greater Victoria*
- *Decisions, Decisions: Tap or Bottled Water*
- *Water Monitoring Around the World*
- *Lake at Stake*

GREATER VICTORIA DRINKING WATER:
From Source to Tap

KEY CONCEPTS

- THE GREATER VICTORIA DRINKING WATER SUPPLY SYSTEM IS CONNECTED TO A SEVERAL DIFFERENT WATER DISTRIBUTION SYSTEMS.
- WATER IS IMPORTANT TO ALL PEOPLE.
- WATER RESOURCES IN GREATER VICTORIA ARE MONITORED FOR THEIR QUALITY AND QUANTITY.

METHOD

Students will view the video *From Source to Tap* on the movement of water from the watershed to the community and complete an information review using worksheets and a roundtable game.

ACTIVITY INFORMATION BOX:

TIME REQUIRED: 50-60 minutes

GRADE LEVEL: Grades 8-12

KEY WORDS: *Water system, disinfection, water supply*

MATERIALS:

- *From Source to Tap* video
- TV/DVD player
- Video Work Sheet
- one chair for each student, arranged in a circle broken in 3 places
- whistle/bell
- perspective signs

SETTING: indoors

SKILLS: listening, observing, gathering information, recall

SUBJECTS: Science 8-10
Chemistry 11-12
Science and Technology 11

LEARNING OUTCOMES:

IT IS EXPECTED THAT THE STUDENT WILL:

- Be able to explain the path of their drinking water from the reservoir to their taps;
- Understand the importance of monitoring the water supply;
- Describe of the water disinfection system process.

Background

The *Water in Our Community* video *Water: From Source to Tap* looks at where our water comes from and how it gets from the reservoir to our taps. Viewers are taken to the Greater Victoria Water Supply Area in the Sooke Hills. They are shown Sooke Reservoir, the Japan Gulch Disinfection Facility and how water moves from the reservoir to the taps in our communities. This lesson's purpose is to help students to recall critical information from the video and to help students to get a bigger picture of water usage from different perspectives using a review process.

Procedure

1. Ask students:
   - Where does drinking water come from in the Greater Victoria area?
   - What does the CRD Integrated Water Services do to ensure safety of the water we drink?
2. Handout the Student Worksheets to each student and allow a brief time for reviewing the map and worksheet questions before showing the video.
3. Show the video. Have students fill out the student worksheet and colour in the route water takes from the Sooke Reservoir watersheds to their community.
4. Set up the video review by asking students to pick up their chairs and arrange them in a circle. Make three breaks in the circle by separating the chairs. Assign a perspective or viewpoint to each of the sections formed: e.g., 1) Greater Victoria resident 2) Water Quality Professional 3) CRD Integrated Water Manager. You may want to make labels as reminders of the perspective of each section.
5. Allow some preparation time for the small groups to think of the points they could make from their starting position using the information they learned in the video. Remind students that they may only contribute comments that relate to their assigned perspective, and to use good discussion techniques.
6. Make up some questions that can be answered from a variety of perspectives. Such as:
   - How is your water supply protected?
   - How do we ensure quality of the water we drink?
   - Why is a three-step disinfection process used in Greater Victoria?
7. Starting at one section, ask students to provide an answer based on what they learned in the video - according to their section perspective. After all sections have answered, then move onto another question. To keep the activity exercise active: every few minutes, give a signal (e.g. by standing up; blowing a whistle; ringing a bell) and everyone moves around one seat to the left. After about 15 minutes, everyone is back in their original seat having spent around 3 or 4 minutes experiencing each of the three positions.

Evaluation

Have students:

- Complete the worksheets on the video segment;
- Describe how water moves from its source to the tap from a number of perspectives.

Extensions

1. Students research water supply and disinfection methods in the Third World and remote communities in Canada.
2. Have students complete the word search activity.

Community Connections

1. Invite a scientist to the classroom who can speak to different ways of water purification and the pros and cons of each method.
2. Invite a speaker who has worked in a Third World environment to talk about how people get and use water in that place.

Additional Resources

For additional information visit **www.crd.bc.ca/water**

Glossary:

Solvent: A solvent is a substance that dissolves, or breaks apart, another substance (known as a solute). Because of its high polarity, water is called the universal solvent.

Ultra Violet light treatment: the use of a disinfectant that kills micro-organisms only. It does not remove any other contaminants.

Guardia or Giardia lamblia: Giardiasis is an intestinal illness caused by a microscopic parasite called Giardia lamblia. It is sometimes referred to as Beaver Fever. It is passed in the feces of an infected person or animal and may contaminate water.

Chloramine (NH_2Cl): Chloramines comprise of three chemicals that are found when chlorine and ammonia are combined in water; Monochloramine (NH_2Cl), Dichloramine ($NHCl_2$), and trichloramine (nitrogen trichloride - NCl_3). From a water utility perspective, the desired form is monochloramine because of its biocidal properties and minimal taste and odour. The reaction of chlorine and ammonia in water is: $HCL + NH_3 \rightarrow NH_2Cl + H_20$

Cryptosporidium: a protozoan parasite found in the gut of vertebrates including humans, which sometimes causes diarrhoeal illness.

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STUDENT WORKSHEET – WATER: SOURCE TO TAP

ASSIGNMENT INSTRUCTIONS:

Read the following questions before watching the video and then answer them after watching the video.

1. Where is the water supply area for Greater Victoria?

2. What do CRD Integrated Water Services professionals monitor at the Japan Gulch Disinfection Facility?

3. Where is the water disinfected?

4. What are two parasites that could be found in our water before primary disinfection?

5. How is chloramine formed in the water?

6. What is a “multi-barrier” system to protect water quality? What barriers are used by the CRD ?

7. What does the CRD laboratory test for to ensure that water quality remains high?

Student Worksheet – Water: Source to Tap

ANSWER KEY

1. **Where is the water supply area for Greater Victoria?**

Northwest of Victoria in the Sooke Hills

2. **What do CRD Integrated Water Services professionals monitor at the Japan Gulch Disinfection Facility?**

- *Chlorine residual levels*
- *Turbidity*
- *Water flow*
- *Daily cyclical use of water*
- *UV lamps*

3. **Where is the water disinfected?**

- *At Japan Gulch Disinfection Facility*
- *At Sooke River Road Disinfection Facility*

4. **What are two parasites that could be found in our water before primary disinfection?**

- *Cryptosporidium*
- *Giardia*

5. **How is chloramine formed in the water?**

- *Chloramines are formed when chlorine and ammonia are combined in water*

6. **What is a "multi-barrier" system to protect water quality? What barriers are used by CRD?**

- *Protects all aspects of the drinking water process from source supply to the final product from the tap*
- *Watershed is off limits to the public*
- *Trees are planted on slopes to protect against erosion*
- *Floating barriers in front of the intake tower to prevent debris from entering*
- *Adequate treatment via UV, free chlorine, and secondary disinfection (Chloramines)*
- *Extensive water quality monitoring program*

7. **What does the CRD laboratory test for to ensure that water quality remains high?**

- *Bacteria (total coliforms and E. Coli)*
- *Organincs*
- *Turbidity (cloudiness)*
- *Parasites*
- *Taste and odour*
- *Others*

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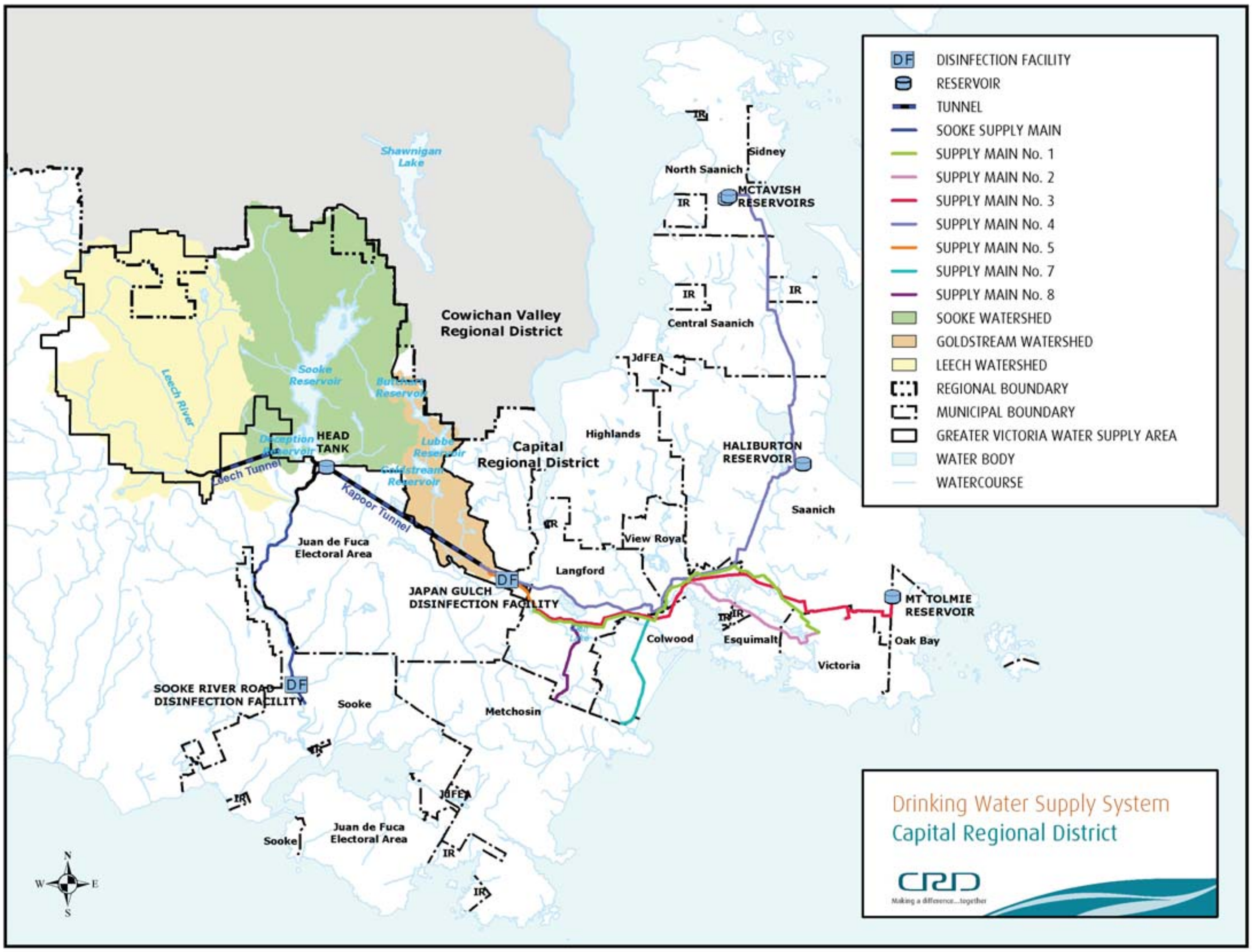
BLOCK:

Water: From Source to Tap - Assignment Instructions:

1. With a coloured pencil, mark the outline of the Sooke Resevoir watershed, Leech watershed, Goldstream Watershed that make up the Greater Victoria Water Supply Area.
2. From the Head Tank below the Sooke Reservoir, follow the route of your water supply main from the watershed to your community using a coloured pencil.



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BLOCK:

WATER: SOURCE TO TAP WORD SEARCH

ASSIGNMENT INSTRUCTIONS:

Find the following water-related words in this puzzle. The words may be spelled out backwards, forwards or even diagonally.

AMMONIA	INTAKE	QUALITY
BACTERIA	WATER	REACTOR
BARRIER	METER	RESERVOIR
BUILDING	WATERSHED	TREATMENT
CHLORAMINE	OPERATOR	ULTRAVIOLET

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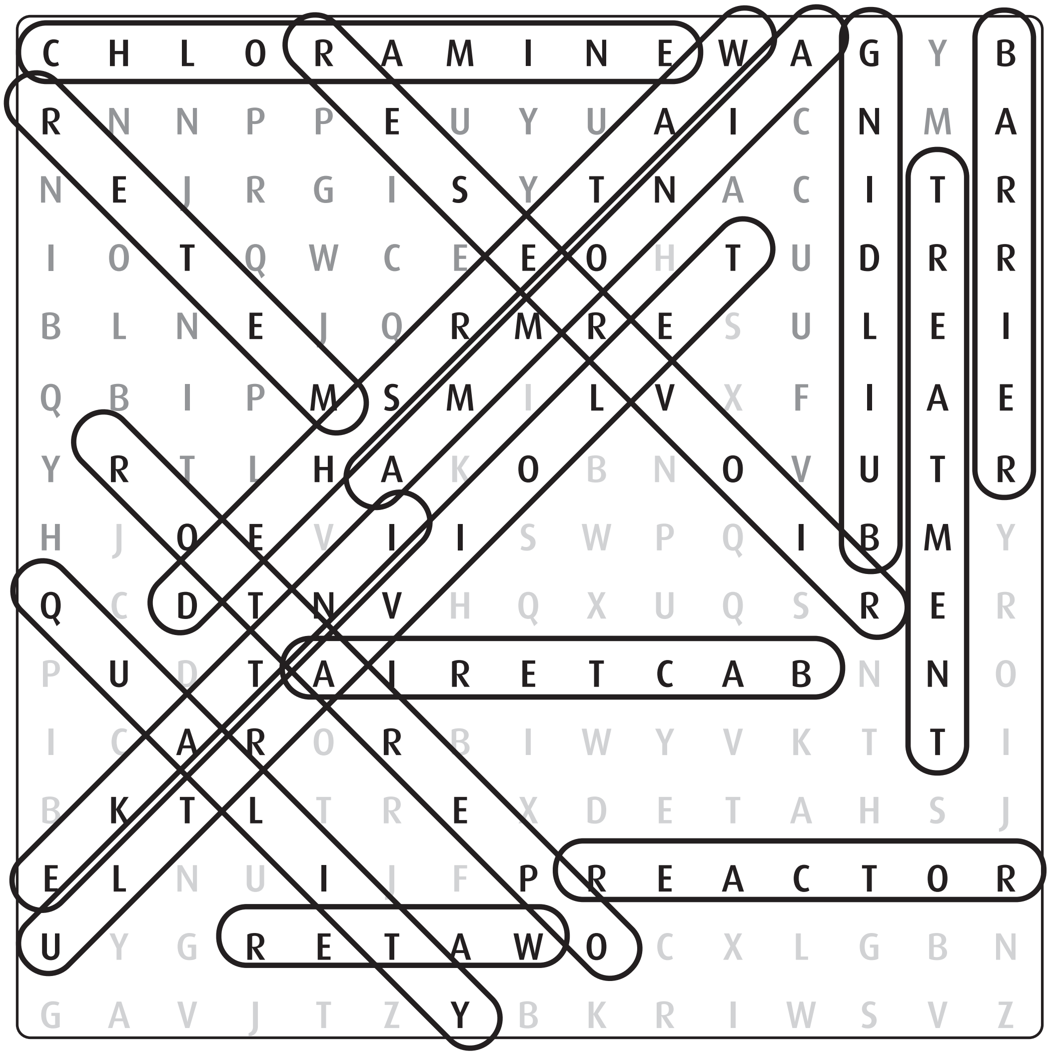
U	Y	G	R	E	T	A	W	O	C	X	L	G	B	N
G	A	V	J	T	Z	Y	B	K	R	I	W	S	V	Z

Word Search Solution



Water Treatment in Greater Victoria

Key Concepts

- Water resources in Greater Victoria are managed for their quality and quantity.
- Responsibility for water is everyone's concern.

Method

Students will learn about water disinfection at the CRD Japan Gulch Disinfection facility and can make an optional model water treatment filter.

Activity Information Box:

Time Required: 50-60 minutes

Grade Level: Grades 8-12

Key Words: *Disinfection, water treatment, Ultraviolet disinfection, Biofilm*

Materials:
- *Water Treatment in Greater Victoria* PowerPoint (PDF) presentation
- Student worksheets

Setting: indoors

Skills: data collection, observation, analysis, interpretation

Subjects: Science 8-10
Chemistry 11-12

Learning Outcomes:

It is expected that the student will:

- Describe the process that the Japan Gulch disinfection facility uses to purify water for drinking;
- Explain how water moves through the disinfection process to their tap.

Optional Materials:
- 2 litre pop bottles
- washed sand
- large and small gravel
- tubing
- water
- student work sheets
- filter diffuser material
- 500g yogurt (or other) plastic lids
- microscope
- silicon sealant

Background

Water treatment is the process of making water safe for people to use, especially for drinking. Water is not always clean and safe enough for people to drink. Water that looks clean may contain bacteria and other organisms that can cause disease. In the past, waterborne diseases were a major public health concern but today, thanks to improved water treatment, these diseases are no longer a health threat.

CRD Integrated Water Services and the municipal water suppliers in the Greater Victoria Drinking Water System must comply with the British Columbia Drinking Water Protection Act and Drinking Water Protection Regulation. CRD Integrated Water Services also uses the water quality parameters of the federal government's Guidelines for Canadian Drinking Water Quality. In addition to the Provincial and Federal regulations, on a voluntary basis, CRD Integrated Water Services also complies with most of the more stringent United States Environmental Protection Agency (USEPA) rules and regulations for surface water. Some of the limits in the USEPA rules are used as the basis for the Department's water treatment goals.

CRD Water Treatment

The Greater Victoria Drinking Water System is an unfiltered[1] drinking water system that continues to meet the stringent USEPA criteria to remain an unfiltered surface water supply. The treatment process consists of primary disinfection of the source water entering the treatment plant and secondary disinfection that provides a residual disinfectant that remains in the distribution system.

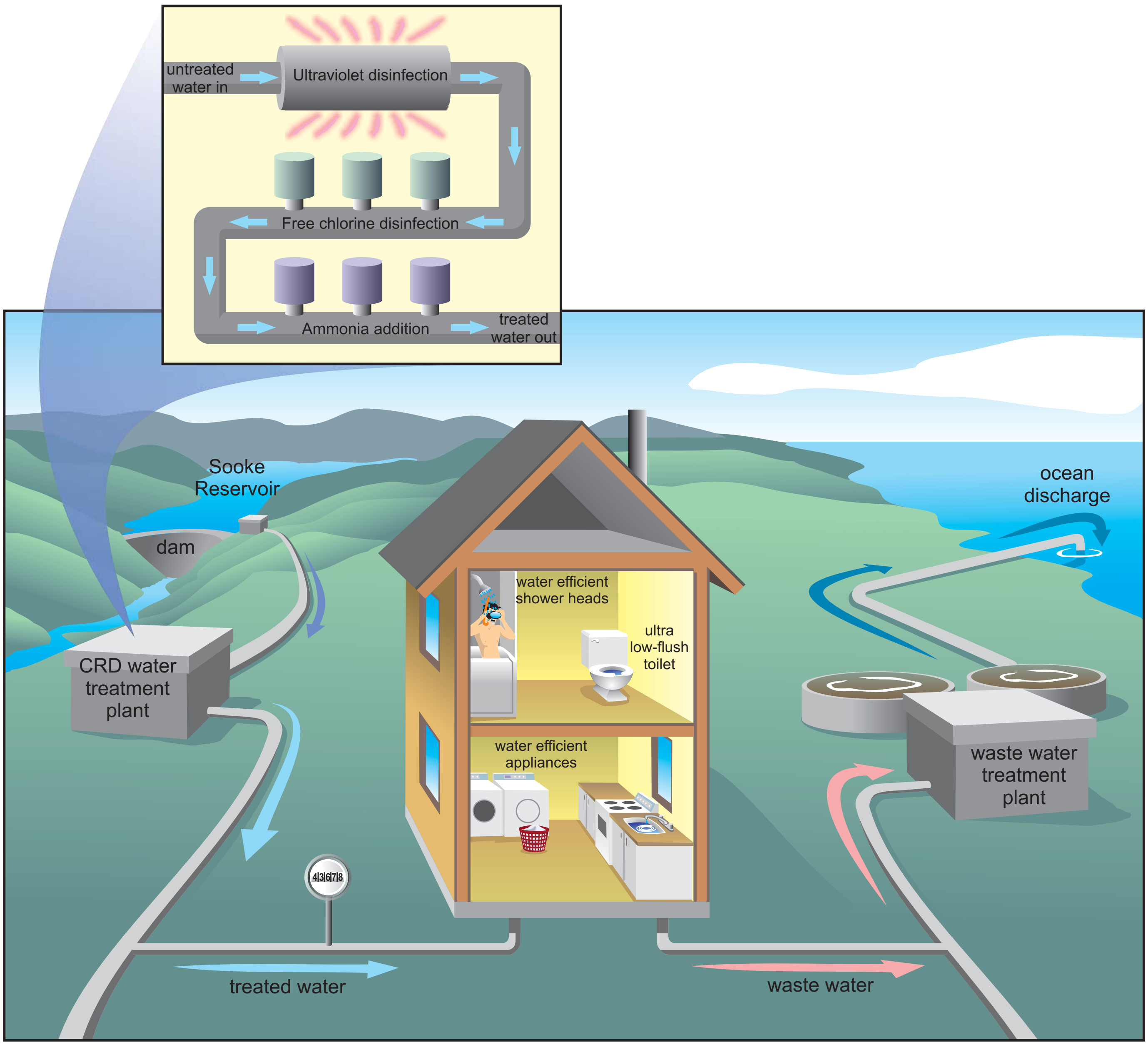
The treatment system employs two facilities: the larger one at Japan Gulch Disinfection Facility which disinfects all of the water in the Greater Victoria Drinking Water System except for Sooke and East Sooke, and the small one at Sooke River Road which disinfects the water for Sooke and East Sooke. At the Japan Gulch and Sooke River Road Disinfection Facilities the water passes through a three part disinfection process in sequential order:

- UV Disinfection. Ultraviolet (UV) disinfection provides the first step in the primary disinfection process (disinfection of the water entering the plants), which inactivates parasites such as Giardia and Cryptosporidium as well as reducing the level of bacteria in the water.
- Free Chlorine Disinfection. Free chlorine disinfection provides the second step in the primary disinfection process using a free chlorine dosage of approximately 1.5 mg/L for approximately 10 minutes (depending upon flow) of contact time between the free chlorine and the water. The free chlorine disinfection step inactivates bacteria and provides a 4-log (99.99%) kill of viruses.
- Ammonia Addition. The final step in the primary disinfection process is the addition of ammonia to form chloramines at a point "downstream" in the piping where the water has been in contact with the free chlorine for approximately 10 minutes or more. The ammonia is added at a ratio of approximately 5 parts chlorine to 1 part ammonia. In the water, these chemicals combine to produce chloramine, which is also a disinfectant, and is known as the chloramine residual. This residual (secondary disinfection) remains in the water and continues to protect the water from bacterial contamination as it travels throughout the pipelines of the distribution system.

$$HOCl + NH_3 \rightarrow NH_2Cl + H_20$$

1. Many water supplies in North America require a complex facility that passes water through a series of filters to remove organic materials, sediment, high levels of bacteria and other disease causing organisms and chemicals. The water in the Greater Victoria Water Supply is of such high quality that filtration is unnecessary.

Greater Victoria Drinking Water System and Wastewater System



After the water is treated, it is safe to drink straight from the tap, meeting federal and provincial standards for drinking water. Not all parts of the world have such effective water treatment as we have in Greater Victoria. In developing countries many millions of people – half of them children and teens – die each year from diseases related to unsafe drinking water. Water contamination is closely linked to bacterial, parasitic and other water-borne diseases, especially cholera and diarrhea.

Procedure

1. Ask students "who used tap water today?" and make a list of water uses. Then discuss with students "how do you know the water you used today is safe?" Explain that the water that comes out of our taps is safe because it is treated and monitored by CRD Integrated Water Services and meets both provincial and federal, and USEPA standards for safe water.
2. If students live in a home that is on a well, ask them to ask to find out if their water is tested for water quality? Do they have an in-home filtration or treatment system?
3. Show the PowerPoint® (PDF) presentation of the CRD Integrated Water Services treatment process and discuss how water is treated. Include information on the three steps of the process (UV Disinfection; Free Chlorine Disinfection; and Ammonia Addition – see background information above). For further information on UV disinfection, see Resources.
4. Have students complete the Student Worksheet.

Evaluation

Have students:

- Describe the process that the CRD water disinfection plants use to purify water for drinking;
- Draw a diagram showing how water gets from the source (Sooke Reservoir) to their tap.

Extensions

1. Grades 8/9. Have students make a simple water filter. A simple sand filter is commonly used in water treatment facilities to trap particles and impurities in the water. However, filtered water requires further treatment before it is suitable for drinking water supply. A student worksheet outlines how to make a simple sand filter.
2. Grades 10-12. Have students make a BioSands Filter Model as a project. They can save the BioSands model for two to three weeks to allow the biological layer or 'schmutzdecke' (as it is called in German) develop following instructions on the Student Worksheet.

Community Connections

1. Ask students to research water quality in developing countries. Find out if there are any local organizations - local chapter of Water for People, for example: **http://www.waterforpeople.org** - and what they could do to help.

Additional Resources

BC Science 8. 2006. See section on Science Skills – Scientific Inquiry (pages 476-479)

CRD Water Services. *Refreshing Information About Drinking Water Quality* Brochure available from **http://www.crd.bc.ca/water/**

Green Teacher, Spring 2008. Clean Water for the World activity (pages 31-34)

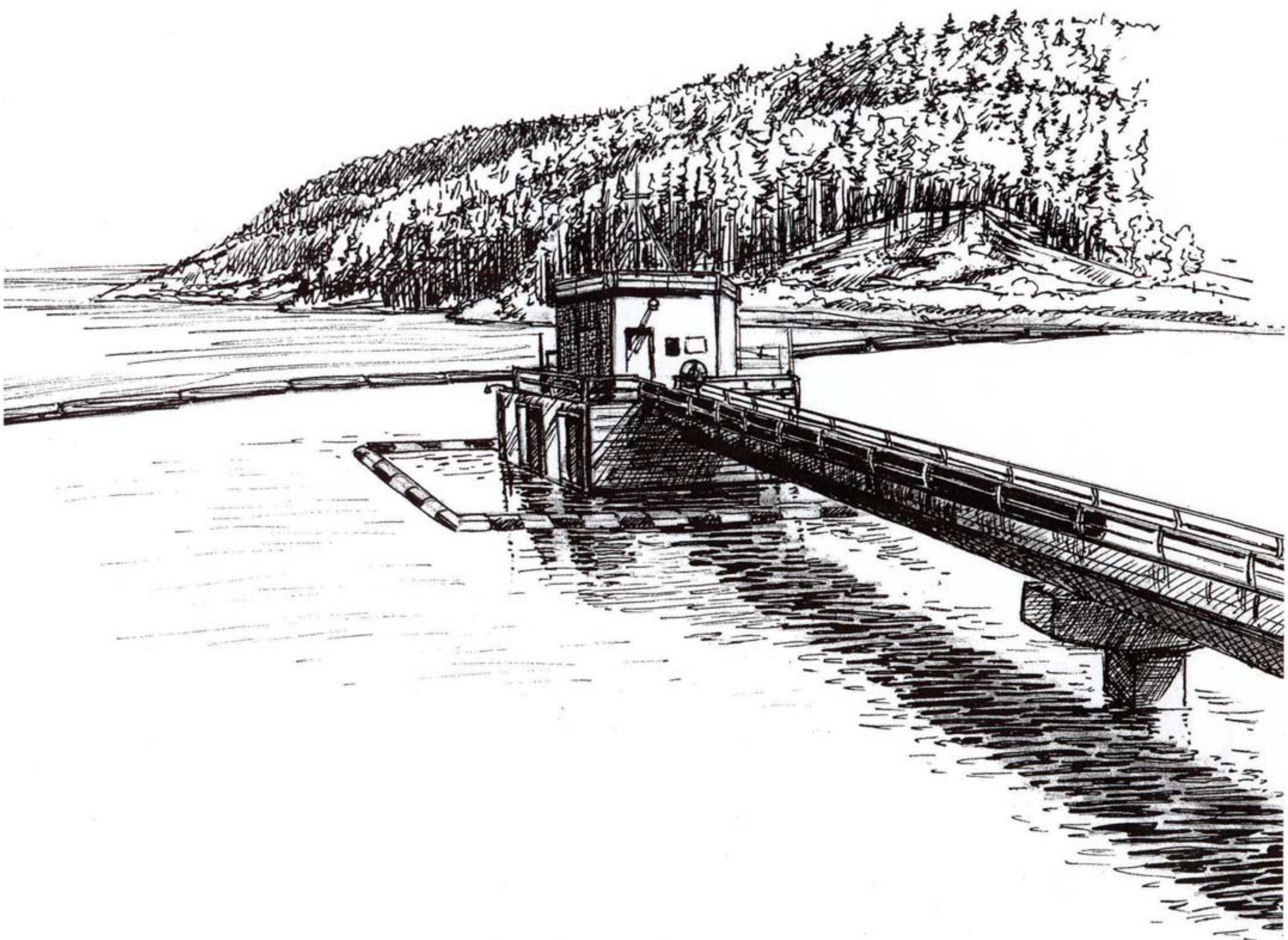
References

CRD Water Services: 2007 Annual Overview of Greater Victoria's Drinking Water Quality

CRD www.crd.bc.ca/water

Centre for Affordable Water and Sanitation Technology: www.cawst.org

EPA Water Source Books. *Drinking and Waste Water Treatment* grades 9-12. www.epa.gov/safewater/kids/wsb/



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Water Treatment in the CRD – Student Worksheet

1. Draw a simple diagram showing how water gets from the Sooke Reservoir into your home.

2. Describe and make a diagram of the three processes which are used to disinfect our drinking water.

3. Imagine you are hiking in a remote area. Describe and draw a personal water purification system that you can bring with you on your hikes.

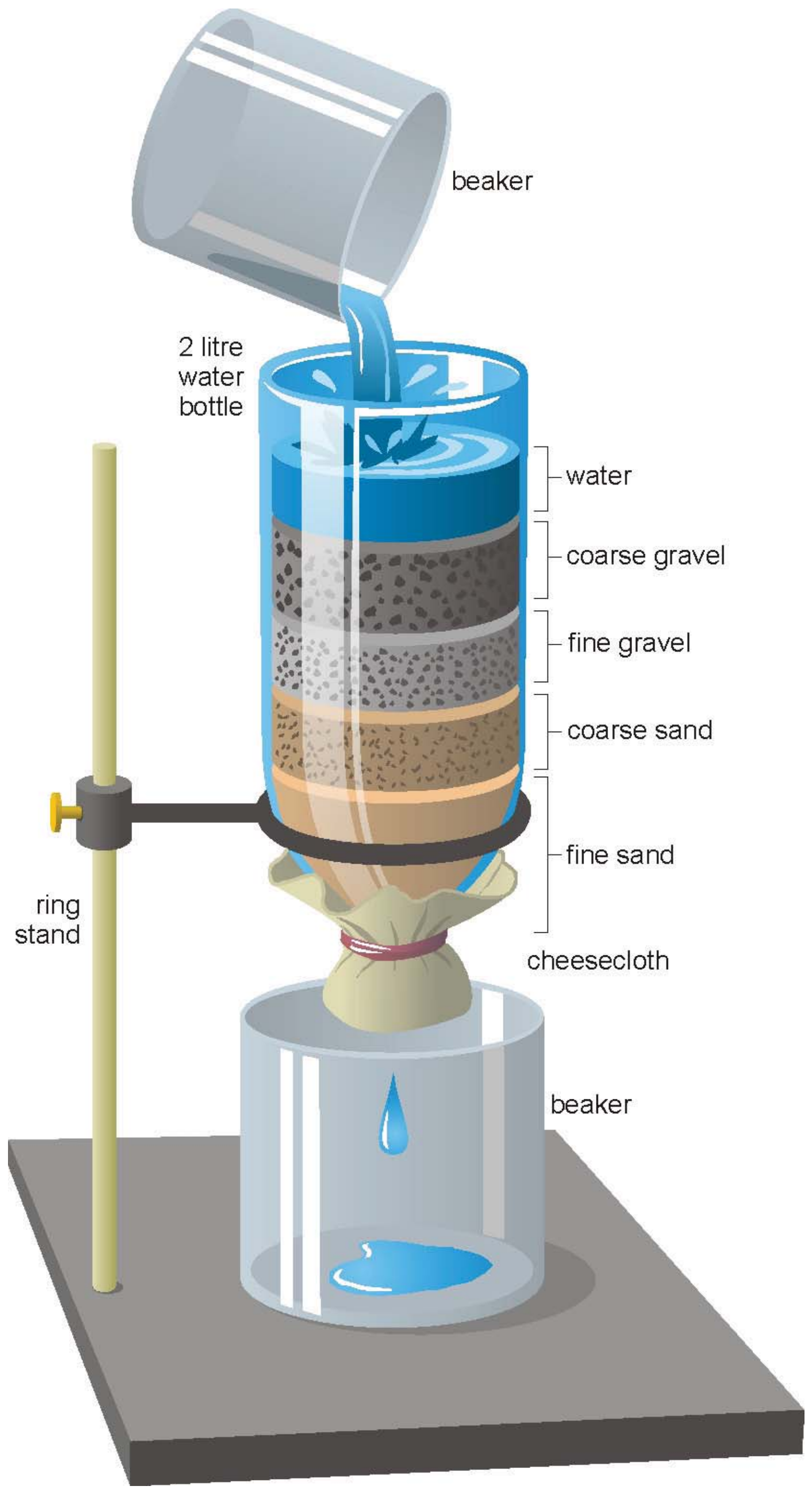
NAME: | **BLOCK:**

SIMPLE WATER FILTER EXPERIMENT - PROJECT INSTRUCTIONS:

AIM:
to make a model simple water filter for use in a water treatment experiment.

MATERIALS:
- pop bottle
- water samples
- cotton
- scissors
- cheesecloth
- beaker
- gravel (coarse and fine)
- sand (coarse and fine)
- elastic band

PROCEDURE:
1. Remove label from a 2-litre pop bottle.
2. Draw a line around the bottom ridge of the bottle and cut along the line so that the main part of the bottle remains.
3. Turn the bottle upside down so that the bottle spout is facing down. Place the cheesecloth over the bottle spout and secure with elastic. Place a small amount of cotton in the spout next to the cheese cloth. Follow with layers of fine sand, coarse sand, fine gravel, and coarse gravel as shown in the diagram. Place unit in ring stand.
4. Get a sample of "dirty" water (soil and water from a stream other natural water) and a sample of tap water from your teacher.
5. Compare the tap water and dirty water: look for differences in appearance and colour. Record your observations.
6. Examine your water samples with a microscope. Record your observations.
7. Pour dirty water in slowly to fill your filter so that water comes out of the spout.
8. Observe and record data on appearance, colour, and microscope obsevations of the filtered water sample.



EXTENSION:
1. Add garlic powder to the water sample, filter & then observe results.

NAME:

BLOCK:

BIOSAND FILTER EXPERIMENT - PROJECT INSTRUCTIONS:

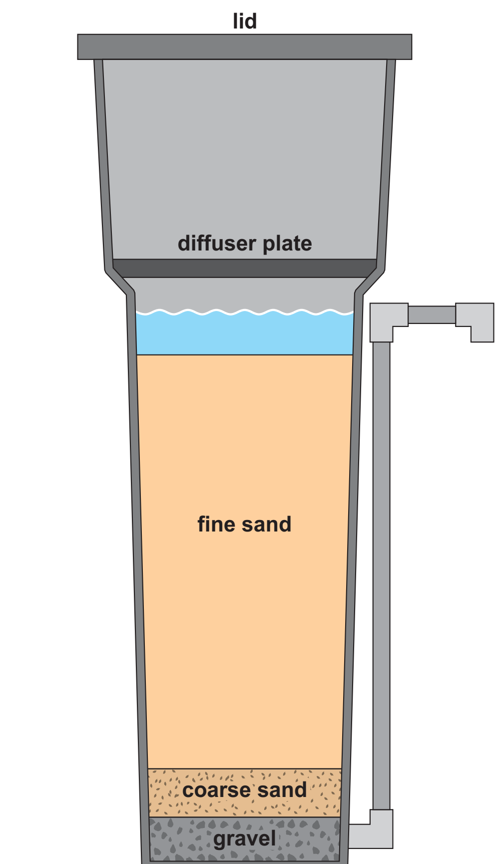
AIM: to make a model BioSands water filter for use in a water treatment experiment.

MATERIALS:

- pop bottle
- scissors
- beaker
- water samples
- gravel
- sand (coarse and fine)
- nylon stocking fabric
- elastic band
- plastic lid (diffuser plate)
- flexible tubing
- silicon sealant
- duct tape

PROCEDURE:

1. Remove labels from a 2 litre pop bottle.
2. Draw a line around the top ridge of the bottle and cut along the line so that the main part of the bottle remains.
3. Measure 3 cm down from the cut and mark a line around the outside of the bottle. This is the line where your diffuser plate will sit.
4. Make a hole for the tubing about 5 cm from bottle bottom. Thread the tubing through the hole into the middle of the bottle. Seal with silicon sealant.
5. Secure the tubing in place with duct tape on outside of bottle – the tape should be placed just below where the diffuser plate will sit. This is your spout.
6. Place 6 cm depth of gravel at the bottom of the bottle, covering the tubing.
7. Fill the remainder of the bottle with washed coarse and fine sand, leaving a space (at least 1 cm) between the tubing exit and the top level of the sand (see diagram).
8. Prepare the diffuser plate. Using scissors, punch at least 15 holes in the plastic lid.
9. Keeping the bottle upright, place the nylon fabric over the opening, securing with the elastic on the outside of the bottle. Push the diffuser plate down to the 3 cm mark on the bottle. Secure with smaller pieces of duct tape if necessary.
10. Get a sample of "dirty" water and a sample of tap water.
11. Compare the tap water and dirty water: record differences in appearance and colour.
12. Slowly pour dirty water to fill your filter so that water comes out of the spout.
13. Record observations in appearance, colour, and microscope observations of the biosands filtered water and compare with tap water.



BIOSAND FILTER

EXTENSION

1. Now it is time to have your filter develop its "biofilm" – like a yogurt culture. This layer is the most important part of the filter. It acts as a fine filter and actually 'eats up' some of the disease-causing microbes in the water. Everyday for the next 2 weeks, add untreated water (not tap water) to the filter.
2. While your filter is activating, research slow sand filters and how they work. You can go Centre for Affordable Water and Sanitation Technology: http://www.cawst.org/ or Water Tiger: http://www.watertiger.net/ to begin your research.
3. After two to three weeks your model is ready for your final observations. Complete the steps above with water treated with an active biosands filter. Record your observations and note any differences between the two samples of biosands treated water.

Student Background Information on the BioSands Filter Model

The BioSand Filter was developed by University of Calgary professor, Dr. David Manz.

The BioSand filter is an innovation on the traditional slow sand water filter. This is in contrast to a simple sand water filter. A simple sand filter is commonly used in water treatment facilities to trap particles and impurities in the water. However, water treated by a sand filter requires further treatment before it is suitable for drinking water supply.

The BioSand Filter works by removing pathogens through a combination of mechanical and biological processes. When water is poured into the top of the filter, the organic material it is carrying is trapped at the surface of the fine sand, forming a biological layer or '*schmutzdecke*' (as it is called in German).

Four processes remove pathogens and other contaminants in this filter:

- Mechanical trapping: sediments, cysts and worms are removed from the water by becoming trapped in spaces which lie between the sand grains. When additional chemicals are added to the incoming water as part of the process to form precipitates, the filter can also remove some inorganic compounds and metals from the water.
- Adsorption: viruses are adsorbed (become attached) to the sand grains. Certain organic compounds are also adsorbed to the sand and thus removed from the water.
- Predation: the *schmutzdecke* micro-organisms consume bacteria and other pathogens found in the water, thereby providing highly effective water treatment.
- Natural death: pathogens are removed due to food scarcity and less than optimal temperatures.
- Although the filter does eliminate 98% of bacteria, further disinfection is recommended for households with infants or elderly residents.

The BioSand filter is patented and made available to world aid organizations; it can be produced locally anywhere in the world because it is built using materials that are readily available. The BioSand Filter is a concrete container, enclosing layers of sand and gravel whose purpose is to eliminate sediments, pathogens, and other impurities from the water. It has been shown to be highly effective if maintained properly. It has uses for both developing countries and rural areas across Canada where large treatment plants are not suitable.

Decisions, Decisions: *Tap or Bottled Water?*

Key Concepts

- Sustainability of water resources requires conservation and best management practices.
- Responsibility for water is everyone's concern.

Method

Students will complete a series of "blind" tests on bottled and tap water, examining taste, water properties, and other factors.

Activity Information Box:

Time Required: 50-60 minutes

Grade Level: Grades 8-10

Key Words: *water quality, tap water, bottled water*

Materials:

- bottled water samples (various brands) and tap water
- paper bags
- elastic bands
- paper cups
- student worksheets

Setting: indoors

Skills: data collection, observation, analysis, interpretation

Subjects: Science 8-10

Learning Outcomes:

It is expected that the student will:

- List properties of bottled and tap water;
- Compare "taste test" results of various types of water;
- Report on the pros and cons of bottled and tap water.

Background

One of the fastest growing beverage choices in North America today is bottled water. People drink bottled water for many reasons. Some people drink bottled water because they think it tastes better or they think it is safer than tap water. But which is better: tap or bottled water? What are the similarities and differences between tap water and bottled water?

Safe drinking water is essential to good health. Tap water in the Greater Victoria area can come from surface water (Sooke Reservoir) or, in some cases, wells. Water is treated in all public water supplies to ensure that it meets water quality standards. Residents of Greater Victoria enjoy some of the best drinking water in the world. Our reservoir is fed by a pristine, protected watershed, which means our water supply is naturally clean and clear, and needs little treatment. Even so, the CRD's Water Quality Division keeps a close eye on our water, collecting samples from across the Greater Victoria Drinking Water System every day for testing. The CRD Water Quality and Aquatic Ecology Laboratories run daily tests on water samples to check for everything from bacteria and algae concentrations to pH, turbidity and conductivity. Dr. Richard Stanwick, Chief Medical Health Officer, Vancouver Island Health Authority, says that there is no need to buy bottled water for health reasons since the drinking water in Greater Victoria meets all health-based water standards.

Bottled water can come from wells, springs, artesian wells, or even public water supplies. For a listing and descriptions of different types of bottled water, see the accompanying table. In Canada, bottled water is considered to be a food and is regulated by Health Canada under the Food and Drug Regulations. All bottled water must be safe for people to consume. However, just like tap water, it can vary in taste and quality. The taste and quality of both tap and bottled water depends on the source water's natural mineral content, how (or if) it is treated, and the container used when drinking. The taste of tap water versus bottled water is a very personal thing. The differences between tap water and bottled water that are noted by people are due mainly to the source water and the way the water is disinfected.

Other considerations when deciding on the pros and cons of tap water versus bottled water include: cost, environmental impacts, and bottle maintenance. The cost of bottled water is considerably more than tap water – in Greater Victoria for example, bottled water costs up to 1,000 times more than drinking water! Then there is the environmental impact of all those discarded plastic water bottles. Water bottles often end up in land fills, contributing many millions of additional tons of long-lasting materials to our ecosystem. Production of the plastics the bottles are made of also consumes many millions of litres of oil during the manufacturing process. Finally, consideration must be given to "maintenance" of water bottles. Bacteria can grow in the water once the seal has been broken in an unrefrigerated bottle of water. This can produce unwanted health risks.

Different types of bottled water

Spring and Mineral Water	
Spring water	Bottled potable water derived from an approved underground source that contains less than 500 mg/L total dissolved solids. Spring water may be treated to remove unwanted chemical and microbiological components but may not be labelled as “natural” (see below).
Natural spring water	Same as “spring water” and in Europe must meet the collection requirements of “natural mineral water” (as below) without any treatment to remove bacteriological components.
Mineral water	Bottled potable water obtained from an approved underground source that contains 500 mg/L or more of total dissolved solids. In Europe, mineral water may be treated to remove unwanted chemical and microbiological components but may not be labelled as “natural” (see below).
Natural mineral water	Natural mineral water is mineral water (as defined above), but must meet the following conditions: it is collected under conditions which guarantee the original bacteriological purity; it is bottled close to the point of emergence of the source with particular hygienic precautions; it is not subjected to any treatments (other than removal of unstable constituents by decantation and/or filtration with the aid of aeration) that modify its essential mineral constituents; and it cannot be shipped in bulk.

Other Bottled Water	
Artesian water	Bottled water from a well tapping a confined aquifer in which the water flows freely at the ground surface without pumping. It has been proposed that the collection of the water can be enhanced with the assistance of external pressure so long as such measures do not alter the physical properties, composition, and quality of the water.
Bottled water	Water that is placed in a sealed container or package and is offered for sale for human consumption or other consumer uses.
Carbonated or sparkling water	Bottled water containing carbon dioxide.
Distilled water	Bottled water that has been produced by a process of distillation and has an electrical conductivity of not more than 10 μS/cm and total dissolved solids of less that 10 mg/L.
Drinking water	Bottled water obtained from an approved source that has undergone special treatment or that has undergone minimum treatment consisting of filtration (activated carbon and or particulate) and ozonation or equivalent disinfection process
Deionized water	Bottled water that has been produced through a deionization process to reduce the total dissolved solids concentration to less than 10 mg/L.
Fluoridated water	Bottled water containing added fluoride in such an amount that the total concentration of added and naturally occurring fluoride does not exceed 1 mg/L.

Other Bottled Water (continued)	
Glacial water	Bottled water from a source that is direct from a glacier. Glacial water shall meet the requirements of natural water.
Natural water	Bottled water (such as spring, mineral, artesian or well water) obtained from an approved source that is from an underground formation and not derived from a municipal or public water supply system. This water has undergone no treatment other than physical filtration, iron removal, and that has not had any significant change occur in the total concentration of the major ions in comparison with the concentrations occurring in the approved source water.
Purified water	Bottled water produced by distillation, deionization, reverse osmosis, or other suitable process that contains not more than 10 mg/L of total dissolved solids. Water that meets this definition and is vaporized, then condensed, may be labelled distilled water.
Well water	Bottled water from a hole bored, drilled, or otherwise constructed in the ground, which taps the water of an aquifer. Well water shall meet the requirements of natural water.

Source: *Health Canada* **http://hc.gc.ca/**

Procedure

1. Ask students whether they use the school's drinking fountains or drink bottled water. What do they think might be the pros and cons of bottled or tap water? List pros and cons on the board.
2. Tell students that they are going to research the properties of both types of water and their investigation will include a "*blind*" taste test.
3. Set up the blind taste test: divide students into small groups, giving each group a set of three or four bottles of water placed in labelled paper bags (sample 1, 2, etc.; use elastic bands to keep the bags closed); paper cups; and student worksheet.
4. Ask students to pour a sample from each bag into a cup and record their observations on the student worksheet.
5. After all samples have been observed and the observations have been recorded, combine the results of all groups to find out how each samples ranked compared to one another. You should have data on:
   - Taste
   - Odour
   - Visual Description
   - Rank
6. After "unveiling" the water samples, find out more about each water sample. Begin by reading the label on the water bottles and go to the CRD Water website (see Background) to find the annual report on water quality of treated water for the tap water sample. Ask students to find out:
   - What is the water's source? (Many students may be surprised that their favourite bottled water is actually from a public water supply!)
   - How is the water treated (if at all)?
   - How much calcium (Ca) and magnesium (Mg) is in the water? (These are minerals we want in our diet.)
   - How much does the bottled water costs per litre? How much does tap water cost?

7. Discuss the results. Refer to the students' initial list of pros and cons of tap versus bottled water – would students now change their lists? Which type of water is "better"?

8. Wrap up by writing on the board: "For me, healthy drinking water is..." and have students write a paragraph beginning with this statement.

Evaluation

Have students:

1. Give examples of water characteristics such as taste, odour, cost per litre, and mineral content.
2. List the pros and cons of bottled and tap water after completing the blind taste test.

Extensions

1. Test the water samples for pH, alkalinity, and hardness using a water quality test kit (see additional resources). Graph the results.
2. Ask students to research the how the increased use of bottled water may be contributing to climate change. What happens to plastic water bottles in their community? How many metric tons of plastics are used in water bottles in Canada each year? What might be some alternatives to using plastic water bottles?

Community Connections

1. Find out how bottled water is delivered to homes and stores in Greater Victoria. What might be transportation costs associated with delivering bulk water – either tap or bottled?
2. Find out if water bottles are recycled in Greater Victoria and what happens to them after they leave the recycling depot. Discuss.

Additional Resources

CRD Drinking Water quality, conservation and protection information **www.crd.bc.ca/water**

Project WET water education resources **www.projectwet.org**

Operation Water Drop. Safe Water Foundation. Water quality test kits are available for $50-100 per kit cost recovery basis. **http://www.safewater.org**

The Toxic Footprint of PET Water Bottles in British Columbia. Sean Griffin.
http://www.toxicfreecanada.ca/pdf/TFC%20bottled%20water%20report_final.pdf

Kairos Canada. Faithful action for ecological justice and human rights. Includes water education and action.
www.kairoscanada.org

Inside the Bottle: Exposing the bottled water industry (2nd edition). by Tony Clarke. Canadian Centre Policy Alternatives.
http://www.policyalternatives.ca/Reports/2007/07/InsideTheBottle/

References

2007 Annual Overview of Greater Victoria's Drinking Water Quality. CRD Water Services

Welcome to Water Services. CRD Water Services Website: **http://www.crd.bc.ca/water/**

Cruising Chemistry: Tap vs. Bottled Water. Duke University.
http://www.chem.duke.edu/~jds/cruise_chem/water/wattap.html

Bottled Water Basics. USEPA Water Health Series. **http://www.epa.gov/safewater/dwh/index.html**

Questions and Answers on Bottled Water. **http://www.hc.gc.ca/fn-an/** *Click on bottled water*

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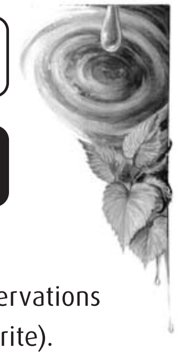


BOTTLED OR TAP: THE TEST

INSTRUCTIONS: Using the samples provided, pour a sample from each bag into a cup and record your observations on the worksheet. Provide as much detail as possible. Finally, rank the samples from 1 (best) to 4 (least favourite).

	sample 1	sample 2	sample 3	sample 4
Taste				
Odour				
Describe the Water				
Water Rank				

WATER MONITORING AROUND THE WORLD

KEY CONCEPTS

- RESPONSIBILITY FOR WATER IS EVERYONE'S CONCERN.
- WATER SUPPLY IS MONITORED IN THE RESERVOIRS AND WATER DISTRIBUTION LINES.
- WATER RESOURCES IN GREATER VICTORIA ARE MANAGED FOR THEIR QUALITY AND QUANTITY.

METHOD

Students complete a water monitoring activity in their local watershed and can compare their results with monitoring stations around the world.

ACTIVITY INFORMATION BOX:

TIME REQUIRED: 120 minutes plus optional half day at a stream.

GRADE LEVEL: Grades 8-12

KEY WORDS: *water quality, monitoring, pH, temperature, turbidity, dissolved oxygen, Invertebrate, biodiversity, Indicator species*

MATERIALS:

- pencils
- paper
- hand sanitizer
- latex gloves
- buckets
- WWMD* test kit

  OR

  - field thermometer
  - dissolved oxygen test
  - Secchi disk /Turbidity wedge
  - pH paper

SETTING: indoors and outdoors

SKILLS: gathering information, applying skills, analysis

SUBJECTS: Science 8-10
Chemistry 11

** World Water Monitoring Day*

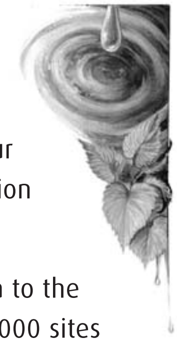
LEARNING OUTCOMES:

IT IS EXPECTED THAT THE STUDENT WILL:

- Describe pH, dissolved oxygen, turbidity, and temperature monitoring methods;
- Explain how water quality can impact many facets of life;
- Practice water monitoring skills;
- Compare their results with results in other communities around the world. (optional)

OPTIONAL MATERIALS:

- Surber sampler or D-Net
- macroinvertebrate ID sheets
- ice cube trays
- plastic pipettes/eye droppers
- dip net
- camera
- stream keepers manual / video



Background

Clean water in a watershed tells the story of watershed health. Knowing this and acting to protect water resources in Greater Victoria includes understanding how a watershed's water quality affects many facets of our lives. The action of water monitoring promotes social responsibility and community involvement in the protection of our water resources.

In this activity, students will monitor water quality in a stream near their school. They can also send their data to the World Water Monitoring Day (WWMD) database and join in the nearly 1,000 sites monitored in Canada and 4,000 sites around the world. Students can then compare their data with other sites in Canada and around the world. Site registration begins in July of each year and monitoring should be done between September 18th and October 18th if you want to participate in WWMD. However, this activity can be done at any time of year without registering with WWMD as an active site. Go to **http://www.worldwatermonitoringday.org** for more information on World Water Monitoring Day.

Or, teachers can collect water samples from a nearby stream and students can do the water testing in the classroom.

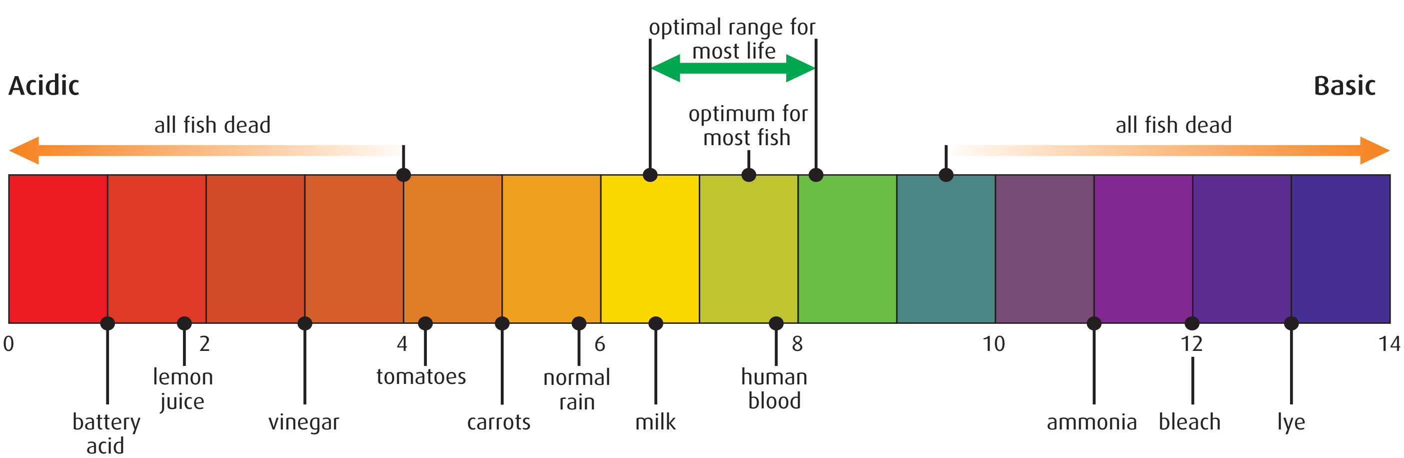
There are four simple monitoring tests that teach students about some of the more common indicators of water and watershed health. These tests, plus more sophisticated tests, are conducted regularly by CRD Integrated Water Services on water in the Greater Victoria Water Supply Area on a regular basis. The following four basic tests are the parameters that will be used as indicators of watershed health:

- pH
- Temperature
- Turbidity
- Dissolved Oxygen

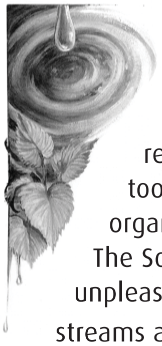
Another excellent way to study water quality is through the use of a benthic macroinvertebrates study. This type of study gives students the opportunity to identify and classify aquatic organisms according to their tolerance to pollution and other conditions found in the stream.

PH

pH is a measure of where a liquid is on a scale from basic to acidic. It is measured on a scale of 1 to 14 where 0 is the most acidic and 14 is most basic or alkaline. A value of 7 pH units is considered neutral. Waters with a range from 6.5 to 8.5 are favourable to supporting most aquatic life. pH can be measured using pH paper dipped into the sample or with the addition of reagents to a water sample then comparing the results to a colour scale.



(after Streamkeepers 2000)



Temperature

Temperature measures the warmth or coldness of a water sample using degrees Celsius ($^\circ$C). This test is important because it indicates how the sampled water is able to support photosynthesis and other chemical reactions, the amount of dissolved oxygen, and the aquatic ecosystem (food chain). Water that is too cold or too warm can have significant impacts on fish and other aquatic life. Different species of fish and other aquatic organisms have different optimal temperature ranges; some prefer colder water, while others prefer warmer water. The Sooke Reservoir, for example, can have algae "blooms" when water temperature rises. These blooms can cause unpleasant taste and odours in drinking water, even though the water is still safe to drink. In Greater Victoria, most streams are considered cold water systems and have an optimal range of 5 - 12 $^\circ$C.

Water temperature is measured in field sites using a field thermometer.

Description	Optimal Range $^\circ$C
Warm	**20° to 25°**
Cool	**13° to 19°**
Cold	**5° to 12°**

(chart adapted from: Bridging the Watershed, 2006)

Turbidity

Turbidity is a measure of the cloudiness or clarity of water. Erosion, debris, silt and sand can make water less clear or more turbid. Increased turbidity can affect aquatic life by decreasing light penetration and photosynthesis, increasing respiration, and affecting the availability of food sources and success of reproduction. Clarity of water is measured using a Secchi disk or turbidity wedge to determine how far light will penetrate in the water. A wedge or Secchi disk is used primarily for its simplicity and the results are recorded in units of distance (e.g., metres). Turbidity is measured using a turbidity meter that gives results in specialized units known as NTU (short for Nephelometric Turbidity Unit). Turbidity meters are very expensive and more complicated to operate compared to a simple wedge/Secchi disk. For this reason, the Secchi disk or a turbidity wedge are more commonly used with the understanding that the measurement of water clarity gives an indication of turbidity. At sites where water is too shallow or has limited access, a test such as the one in the WWMD test kit is used. This measures Jakson Turbidity units (JTU). Some waters are naturally turbid, such as waters coming out of a glacier, and aquatic organisms have adapted to those conditions. Optimal turbidity for a particular steam is usually done by comparing sampling locations (e.g. upstream and downstream of a disturbed site).

Dissolved Oxygen

Dissolved Oxygen (DO) is a measure of how much oxygen is present in the water. DO is measured by mixing a water sample with a chemical reagent. The results are measured in units of milligrams of oxygen per litre (mg/L). Oxygen is important to fish and other aquatic life. A higher DO reading indicates higher levels of oxygen in the water – water which is able to support the oxygen demands of a diverse ecosystem. Water with low levels of DO can support a less diverse ecosystem as it cannot supply enough oxygen for species that need high DO levels. Water with dissolved oxygen levels of less than 5.0 mg/L puts many species of aquatic life under stress. Oxygen levels below 1 to 2 mg/L for a few hours can result in large fish kills.

Stream Macroinvertebrate Study

The study and identification of stream macroinvertebrates found on stream bottoms can provide an indication of stream health. These creatures are mostly immature stages of insects (pupae, larvae, nymphs); however worms, snails, and clams can also be found. Some species of invertebrates require good water quality while others are more tolerant of a variety of stream conditions. When doing a macroinvertebrate study, organisms can be broken into three groups.

Group One organisms are generally pollution intolerant and their dominance signifies good to excellent water quality.
Group Two organisms can exist in a wide range of water quality conditions; members of this group are not as useful as indicators of water quality.
Group Three organisms are generally tolerant of pollution and their dominance generally indicates fair to poor water quality.

Further information on how to conduct a stream invertebrate study and a field identification chart can be found in Fisheries and Oceans Canada *Streamkeepers Module 4: Stream Invertebrate Stud*y. Go to: **http://www.pskf.ca/publications/download.html to download module 4.**

Streamside Field Study Etiquette

A visit to a nearby stream or pond can be an enriching experience for students. Check with your school district for any specific guidelines and permission forms as part of trip planning.

It is very important to prepare students to safely visit this sensitive ecosystem. It is a good idea to visit your proposed stream site before your field sampling day and scout out an area where stream banks are not steep and where students have plenty of room to conduct the tests. Look for potential risks from unstable banks, deep or fast moving water, wildlife, plants, etc. Be sure to get permission from private landowners first if you want to have your field site on private property. There are many streams around the CRD in local and regional parks, where permission is not needed. For a list of local streams nearby middle and secondary schools in Greater Victoria, see Appendix B of this learning resource.

Streamside Safety Rules:

- Bring a first aid kit;
- Define field study boundaries – make sure students understand where they can and can't go to safely gather water samples;
- Bring soap or hand sanitizer and towels so that students can clean their hands after the field work;
- Students should wear appropriate field gear – dress for the weather(rain gear) and stream conditions (rubber boots or old runners are preferable);
- Students should not enter the water without supervision;
- Students should not touch wildlife nor drink from the stream;
- Students should use care when collecting water samples: stream bottoms can be are slippery, can contain deep pools or sink holes, sensitive habitats that should not be damaged or destroyed;
- Students should be careful of stream.

Monitoring Protocol

If your class chooses to enter your data in the World Water Monitoring Day database, it would be useful to review the instructions for database entry prior to your field study. Go to the Resources page at: **www.worldwatermonitoringday.org for complete instructions.**

Procedure

Before conducting a water sampling lesson:

1. Decide whether you will complete the water sampling in the classroom or in the field. Field sampling will produce more accurate results and give students a greater appreciation of the stream you visit. If a field day is not practical, collect and refrigerate water samples from a nearby stream before class.
2. Gather your water sampling materials: review the equipment in the water monitoring kits available from World Water Monitoring Day and make copies of the water sampling instruction sheets or gather the required number of thermometers, pH paper, DO tests, a Secchi disk/turbidity wedge and the (optional) macroinvertebrate field identification charts and other equipment.
3. Before going conducting the water sampling, ask students how they think water quality might affect quality of life in the stream and watershed that they will be sampling. Post their answers on the board in the classroom.
4. Clearly explain the purpose of the water sampling: to join in with thousands of others around the world to monitor four indicators of water and watershed health. Note that the data they collect can be entered into a world-wide database as part of World Water Monitoring Day.
5. Explain the four monitoring tests that they will be conducting: pH, temperature, turbidity, and dissolved oxygen using the information provided.
6. Review how to use the macroinvertebrate field identification charts if using this method. The Pacific Streamkeepers program (**www.pskf.ca/video/**) has some excellent training videos that you can view beforehand:
   - Introduction to the Streamkeepers – 6 minutes
   - Module 3: Water Quality (temperature, pH, Dissolved Oxygen, and Turbidity) – 16 minutes
   - Module 4: Stream Invertebrate Study – 15 minutes

Note that although the equipment used in the Streamkeepers kit is not exactly the same as in the WWMD kits, the methods used are similar.

7. **Review Streamside Field Study etiquette and safety instructions from WWMD test kit with students.**

Water sampling:

8. Set up the sampling stations and divide the class into four groups – one for each test. If you are going to do the optional invertebrate study at a field site, divide the class into five groups.
9. Each group will rotate through the four or five test stations, gathering one type of data at each station. It might be useful for each group to have student(s) in the following roles: "facilitator": reads instruction sheet; "recorder": records results; "testers": conducts test. **All used chemical reagents in water samples should be collected in a bucket and disposed of properly (e.g., back in the school science lab) - NOT DIRECTLY BACK INTO THE STREAM.**
10. Each station should have an instruction sheet, the test materials, and a reagent bucket (for DO and pH).
11. After all students have completed each station, make sure the field site is clean of all monitoring materials and garbage.

Back in the classroom:

12. Debrief the water sampling activity – what were the challenges and successes? Was the water quality what they expected? Refer back to the students expectations.

13. Make a summary table of all results. Did all students get the same results? Why or why not? What sources of error might influence the results?

14. Results should be submitted by December 18th of each year if participating in WWMD.

15. Discuss the implications of their findings: how might the water quality of the stream they studied impact the local watershed ecosystem? Now that they know the quality of the water in the stream discuss:

    - What changes could be made to improve water quality? (if necessary)
    - What kind of pollution upstream or downstream might be present in this stream/watershed? What indicators are present?
    - How does the stream compare to other streams? (see WWMD website) how does it compare to water quality in the Sooke Reservoir? (see CRD *Greater Victoria Drinking Water Annual Reports*, section regarding Untreated (Raw) Water Quality at Japan Gulch. **https://www.crd.bc.ca/service/drinking-water/drinking-water-quality**
    - How might this stream/watershed have been used by First Nations people? Is the water quality sufficient for this type of use today? Why or why not?
    - If the optional invertebrate study was completed – ask students to evaluate the stream on the basis of their findings. Which group of invertebrates was predominant? What might this indicate about water quality and the health of the watershed?

16. (Optional) Report your data by submitting your results on the WWMD website. Go to **www.worldwatermonitoringday.com** to register and report your data.

Evaluation

Have students:

- Complete the water monitoring study data sheets;
- Understand and be able to define pH, temperature, turbidity, dissolved oxygen;
- Compare their results with other monitoring stations around the world using the WWMD database.

Extensions

1. Have students do further research on their stream's watershed. Go to **www.crd.bc.ca/watersheds** for detailed information on the local watersheds that includes information on plants and wildlife, geology, and First Nations historical uses. Or, explore local watersheds using Google Earth.

2. Compare the results from their field study site to a site in another country or region.

3. Invite a local First Nations Elder into the classroom to talk about the traditional uses of the stream or watershed. Alternately, ask students to interview an Elder or someone they know who has lived nearby the stream for a long time to find out how the stream or watershed has changed over the years.

Community Connections

1. Go to **https://www.crd.bc.ca/about/data/drinking-water-quality-reports**. Compare the water quality results with your field study results.
2. Contact your local Streamkeepers group for assistance with the field activity. See Additional Resources for more information.
3. Invite a speaker from a local laboratory that does water quality testing to discuss water contaminants such as heavy metals or other pollution.

Additional Resources

The Streamkeepers Handbook – Fisheries and Oceans Canada. Available for down load at: **http://www.pskf.ca/publications/download.html**

Lost Streams of Victoria Map. This Fisheries and Oceans Canada poster is a full colour map on side one; and side two features ways to take part in stewardship activities, including stories of streams and creeks that need stewardship today. It is available, free of charge, from **http://www.pac.dfo-mpo.gc.ca/sep-pmvs/sci-icp/pdf/publicationcat.pdf**

Oceans, Habitat & Enhancement Branch
Fisheries and Oceans Canada
200 - 401 Burrard Street / rue Burrard
Vancouver, BC V6C 3S4

For Streamkeeper Training, contact:

Don Lowen; Education Coordinator, Fisheries and Oceans Canada
250-388-4756 or h2oship@shaw.ca

Stream to Sea. Pacific region aquatic lesson plans and resources.

www.pac.dfo-mpo.gc.ca/education/index-eng.html

For links to local watershed maps go to **www.crd.bc.ca/watersheds** and go to Natural Areas Atlas.

World Water Day at **www.worldwaterday.org**

References:

World Water Monitoring Day: **www.worldwatermonitoringday.com**

Operation Water Drop: **www.safewater.org**

Pacific Streamkeepers Federation: **www.pskf.ca**

Bridging the Watershed: **www.fergusonfoundation.org**

Table 1. 2006 Untreated (Raw) Water Quality at Japan Gulch Plant

Parameter		2006 Analytical Results				2006 Canadian Guidelines	Ten Year Results (1997 -2006)			
Parameter Name	Units of Measure	Median Value	Samples Analyzed	Range		(provides reference only for untreated water)	Ten Year Median	Samples Analyzed	Range Minimum - Maximum	Sampling Frequency
				Minimum	Maximum					
Physical Parameters										
Alkalinity, Total	mg/L	15.0	23	9.1	17		14.7	316	7.0 - 17.6	26/yr
Carbon, Dissolved Organic	mg/L as C	2.4	14	2.2	3.3		2.5	81	1.8 - 7.0	12/yr
Carbon, Total Organic	mg/L as C	2.6	14	2.2	3.0	No Guideline Required	2.5	172	1.8 - 9.6	12/yr
Colour, True	TCU	7.9	57	4.4	17	≤ 15 AO	7.9	586	2.8 - 18	52/yr
Conductivity @ 25˚c	uS/cm	42.2	50	34.7	45.8		41.3	527	26.2 - 47.0	52/yr
Hardness	mg/L	17.4	20	15.5	34.7	No Guideline Required	17.1	130	9.3 - 34.7	24/yr
pH	pH units	7.29	50	6.68	7.51	6.5 - 8.5 AO	7.3	531	6.46 - 7.72	52/yr
Tannins and Lignins	mg/L	0.24	4	0.19	0.29	No Guideline Required	0.26	25	0.07 - 0.37	2/yr
Total Dissolved Solids	mg/L	25.4	43	20.5	34.2	≤ 500 AO	25.4	202	8.0 - 49.0	36/yr
Total Suspended Solids	mg/L	1.0	43	<0.1	6.0		0.7	201	0.1 - 7.7	36/yr
Total Solids	mg/L	26.5	43	22.0	35.0		26.4	202	8.0 - 53.0	36/yr
Turbidity, Grab Samples	NTU	0.41	247	0.26	2.8		0.36	2,151	0.12 - 2.8	250/yr
Ultraviolet Absorbtion, 5cm	Abs@254nm	0.322	50	0.247	0.575		0.325	397	0.215 - 0.656	52/yr
Ultraviolet transmittance	%	86	232	76	90		86	1,241	75 - 91	250/yr
Water Temp, Field	˚C	9.9	272	4.5	19.6	≤ 15 AO	10	2,772	3.0 - 23.0	250/yr

mg/L = milligrams per Litre
ug/L = micrograms per Litre
ng/L = nanograms per Litre

CFU = colony Forming Units
NTU = cNephelometric Units

TCU= True Colour
MAC = Max. Acceptable Conc.

Water Monitoring Data Sheet

Group Members:	Date:
	Stream Name:
	Location:

Station #1: pH pH is measured on a scale of 1-14 where 0 is the most acidic and 14 is most basic. A value of 7 is considered neutral. Waters with a range from 6.5 to 8.5 are favourable to supporting most aquatic life.	**pH Results:**
Station #2: Temperature Temperature measures the warmth or coldness of a water sample using C°. It is important to measure both air and water temperature as the air temperature affects water temperature. Use only a dry thermometer to measure air temperature (dry a wet thermometer with a handkerchief or tissue). Water Temperature should be in the 5 - 12°C range for most Greater Victoria streams.	**Air Temperature:** **Water Temperature:**
Station #3: Turbidity Turbidity is a measure of a water's clarity or cloudiness. Clarity is measured in cm using a Secchi disk or a Turbidity Wedge.	**Water Clarity:**
Station #4: Dissolved Oxygen Dissolved Oxygen (DO) measures how many molecules of oxygen are in the water. DO should be greater than 5 mg/L for healthy ecosystems.	**Dissolved Oxygen::**

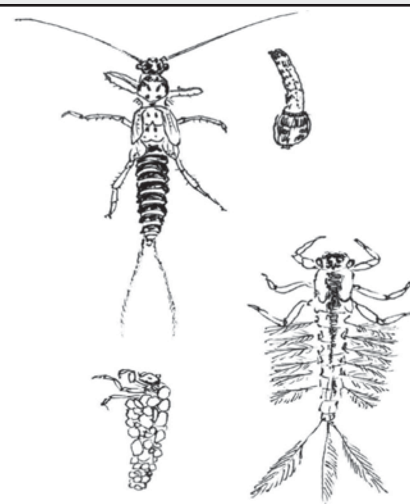
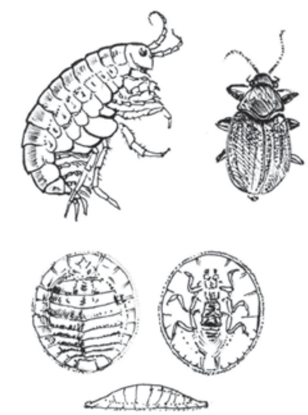
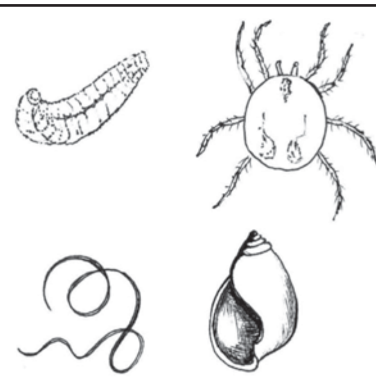
Station #5: Invertebrate Study

Group Members:

Date:

Stream Name:

Location:

Type	Number Counted	ID Sketches	Common Name
Group One: Pollution intolerant – good to excellent water quality			Mayfly, Stonefly, Caddis fly and the like: 2-3 tails; gills, can make its home with small twigs and rocks
Group Two: Wide range of tolerance			Aquatic beetle, Clam, Mussel, Scud and the like: Beetle-like, clam or mussel shape; scud looks like a shrimp
Group Three Pollution tolerant – Fair to poor water quality			Aquatic worm, Leech, Water mite and the like: Worm-like shape, water mite looks like a small tennis ball with legs

(adapted from Streamkeepers field data sheet, page 26)

Lake at Stake

Key Concepts

- Water is important to all people.
- Responsibility for water is everyone's concern.
- Actions we take in our everyday lives influence the sustainability of the Greater Victoria water supply.

Method

Students will use collaborative group work, research, role play, drama and/or debate methods to present a variety of points of view about a water supply lake and its surrounding land uses.

Activity Information Box:

Time Required: 120 minutes plus student research time

Grade Level: Grades 8-12

Key Words: *water supply, decision-making, watershed, land use*

Materials:

- Lake at Stake case study
- Internet and other information resources
- Student Worksheets

Setting: indoors

Skills: gathering information, persuasive argument, analysis

Subjects: Science 8-10
Biology 11-12

Learning Outcomes:

It is expected that the student will:

- Develop an argument representing a point of view about water and land use;
- Use persuasive language to present a point of view;
- Practice decision making.

Background

Why worry about a lake and what could be at stake? All things depend on water – life as we know it on Southern Vancouver Island would not exist without fresh water. For most of us, the water we use every day comes from a lake (reservoir) in a nearby watershed. Water has many uses – plants and animals require it to live, and humans use it for recreation, water supply, business and industry – to name a few. In addition to fulfilling physical needs of humans and non-humans, water also has aesthetic, spiritual, and community values. Whether we're splashing in our local pond or listening to loons call across a quiet lake, water sets the scene for some of our most enjoyable moments.

Though we can't live without water, we often forget to protect it. Sometimes, we use water without thought about conserving it or we damage sensitive aquatic habitat and impact water quality by developing nearby land. In order to safeguard our water supplies for future generations, we need to take care of where the water comes from and how we use it today.

Issues surrounding management of watersheds and water supply are complex and involve many differing perspectives. We are all stakeholders to one degree or another when it comes to our water. More than likely, different people may view water differently. For example, people who are concerned about maintaining biodiversity in a watershed may have different concerns about water supply and watershed management than a land developer who wants to put in a shopping centre or a farmer who is raising a crop. In Greater Victoria, the T'Sou-ke Nation has a special interest in the Sooke River, the management of its watershed, the maintenance of its fish populations, and the maintenance of the ecosystem of the river's watershed. These interests have led to an agreement with the CRD and the development of a Water Management Plan for the Sooke Watershed in which the T'Sou-ke Nation and the CRD have both had input. In this case, and in most water supply and watershed management plans, the approach focuses on best practices that foster healthy ecosystems so that these resources can be sustained and passed on to future generations.

Water quality and quantity, sustainability of watershed ecosystems, biodiversity, and land management are all important in water supply and watershed management. Today, in many cases, water use is characterized by an increased competition for a finite water as population and development pressures increase.

Procedure

1. Read aloud or have students read the case study about Green Lake.
2. Discuss with students:
   - What are the important issues in this case study?
   - Who are the key players (stakeholders)?
3. Tell students that they will represent the people interested in Green Lake and its watershed. Each student will be asked to determine what they think is the best use of the water and watershed land of Green Lake in the town of Smallville.
4. Divide the class into groups that will represent the stakeholders at Green Lake. (You should have at least 3 students in each stakeholder group). Some ideas for stakeholder groups:
   - Recreation users (boaters, hikers)
   - Developers (homebuilders, commercial)
   - First Nations
   - Industry (mining, logging)
   - Environmental groups
   - Plants and animals that live in Green Lake/Green Lake Watershed
   - Water Department (public water supply)
   - Agriculture (organic farmers, greenhouses)
   - Water Bottling Plant (commercial water exporter)
   - Other ideas as generated by the class.

5. Using the information given in the case study as preliminary background, have each stakeholder group research and then develop their argument as to why they should have the use of Green lake and its watershed.
6. With teacher guidance, students should access various web sites to find information about their type of land/water use, consult with experts electronically, and create the documents and visuals needed for their presentation. Using the student worksheet, they should research and develop statements, from their stakeholder perspective, on:
   - Description of proposed land use and/or water use;
   - Description of environmental impact - especially on the impact of proposed use on sensitive habitat or endangered or threatened species;
   - Why is the proposed use of the lake the best for all concerned, the majority, or for one particular group?
7. Students should prepare a set of speaking notes for their group describing their point of view and goals based on their research. Additional presentation media (posters, graphics, etc.) will help substantiate their position.
8. Set a date for the "Smallville Town Meeting" where students will present their findings. The town meeting can be presented in one of two ways:
   - Each stakeholder group will dramatize their presentation by role-playing their key findings, giving a 5 minute oral presentation using their prepared cards with accompanying poster (or other graphics and media) to make their points. Classes can be split into three simultaneous groups – making sure that there is at least one representative from each stakeholder group – to facilitate more speakers and discussion.

   OR,

   - Have a class debate. As students present their points of view, the teacher employs Socratic style questions to guide the debate. Teachers should: keep the discussion focused and intellectually responsible; ask questions about assumptions that may be made; stimulate the discussion with probing questions; and periodically summarize what has and what has not been resolved. It is important to draw as many students as possible into this discussion. Students should prepare background information for the debate with the appropriate student worksheet (grade 8-9 or grade 10-12).
9. While listening to presentations, the remaining students make a summary of each presentation. At the conclusion of all of the presentations each student will analyze all of their summary sheets, indicate his/her choice for the land use or land uses of choice, and write a paragraph substantiating the decision.
10. The teacher can then tally all votes and inform Smallville of the fate of Green Lake and its watershed.

Evaluation

Have students:

- Describe what they have learned about conflicting land uses in watersheds.
- Make a mind map of water supply, watershed, and land use issues.

Extensions

1. Water supply and watershed management often involves finding a balance of resource uses. Ask students to brainstorm ways in which multiple users may be accommodated. Are there uses that mean no other use of the lake can be accommodated? Discuss. Using a consensus style decision making process, have students come up with a plan that they all agree upon.
2. Apply the case study approach to a real life situation. Have student research and debate about the situation in Lake Chad in Africa, the Colorado River basin in the United States, the Columbia River – which has its headwaters in British Columbia – or the Three Gorges Dam on the Yangtze River in China.

Community Connections

Invite a land use planner from the CRD to visit the classroom and have him/her discuss local land use issues.

Additional Resources

Water: The fate of our most precious resource. (2nd edition). By Marq. D. Villiers, 2003. Houghton Mifflin Publishing

Reading the Peninsula. By Sara Dowse, (ed). 2003 Community Arts Council of the Saanich Penisula.

References

Water for Tomorrow: A Guide to Watershed Stewardship in the Howe Sound Basin. (1996). by DG Blair-Whitehead and W. Husby. Bowen Island, BC. Habitat Conservation Trust Fund

Case Study: Green Lake at Stake

"What I do in my own backyard is my business, so butt out!" yelled Harry Johnson as Sam Sheppard walked away. Shaking his head, Sam jumped into his '01 Ford pickup and drove off in a cloud of dust.

"Why me? Why now?" he asked himself as he drove. The past year had been a difficult one for Sam. Sam and his teenaged son, Travis, had moved to Smallville to try to start anew after Travis's mom died. Sam and Travis decided to try something new together and they were both volunteering at the local nature reserve and fish hatchery at Green Lake. Sam spent a fair amount of time trying to get the hatchery up and running while Travis volunteered a couple of days per week after school.

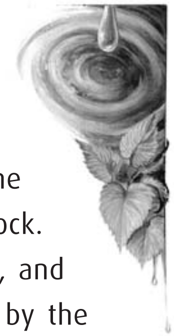
Earlier in the year Sam had spoken to their neighbour, Maggie O'Donnell, about the construction of her new horse barn. Sam had pointed out that land for the barn had been cleared nearby the lake and that the backhoe used in construction was dumping mixtures of earth, gravel, and manure along the shoreline. With the land clearing, when it rained, sediment from the pile flowed into the lake, increasing the turbidity of the water. Increased turbidity, or muddy water, can kill fish and other creatures and make it difficult to treat water for human consumption. Since Green Lake supplied water for both Smallville and the fish hatchery, Sam was concerned. Sam had explained to Maggie that he was trying to bring back the Kokanee salmon that were so plentiful here 25 years ago. Maggie had listened impatiently and told him to go talk to George whose factory was probably causing more damage to the lake than her horses. "And besides," she added, "I've lived in Smallville my whole life and I've always planned to put in this barn and now that I have the money to do so – nothing will get in my way."

Now Harry Johnson was building cement walls to prevent erosion along the banks of his Fairy Creek property. Harry owned a large piece of property in the watershed of Green Lake. Going through his property was Fairy Creek, the largest stream that flows into the lake. Harry had decided that he wanted to subdivide his property and build houses to meet the growing demand for residences in Smallville but first, he needed to "make sure" the stream bank stayed where it was so that as many houses as possible could be built along the stream's banks.

When Sam got home that night, he and Travis talked about what was happening around the nature reserve and hatchery. They really enjoyed their volunteer work at the reserve, but as relative newcomers they were concerned about all the different points of view of the reserve's neighbours and how this might lead to damage of the sensitive habitat of the reserve. "I think that we're going to have to look beyond our own backyards to keep the nature reserve and hatchery going" Sam said. "Yeah, Dad; how are you going to make *that* happen?" Travis replied. "Hmmm, good question," Sam answered, "maybe if I can get more people involved...."

Sam and Travis had lived in Smallville for the past year. After years of working full-time as an engineer in Vancouver, Sam decided to work part time as an engineer and do some volunteer work while he and Travis settled into their new routine. Travis attended the local high school. They both decided to work at the nature reserve and hatchery because they wanted to make a difference about preserving the environment.

But it was getting complicated with all the neighbours and what they wanted to do with their land surrounding the lake. And this afternoon's argument with Harry was the last straw! They had to do something – they decided that Sam should call a meeting for anyone interested Green Lake and its surrounding watershed.



Situated on the southern tip of a large island off the Pacific Coast, Smallville is a small community of about 8,000 people. It has a Mediterranean-type climate with wet, rainy winters and dry summers. Green Lake is a small, relatively pristine, lake surrounded by forested lands and farms. The nature reserve is at one end of the lake, while the water intake for the community water supply is at the other end. In the forests you will find trees such as western red cedar, Douglas-fir, and western hemlock. Animals that call it home include the black bear, Columbia black-tailed deer, Pileated woodpecker, and Roosevelt elk. The watershed of the lake is both private property and Crown Land – land owned by the province. There are no glaciers or heavy snow pack on the gentle hills surrounding Smallville and Green Lake; most of the annual precipitation comes as rain during the winter. The summers are often very dry.

The night of the meeting Sam was so nervous he couldn't eat dinner. Travis made him even more nervous by telling him all about a class where they talked about "social responsibility" and how he had better run a good meeting. "But really, Dad, you're doing the right thing by holding the meeting and you'll be fine" he added.

By the time Sam was ready to call the meeting to order, twenty-five people had taken their seats in the community hall. After introducing himself, Sam asked every one to say a few words about themselves and why they were at the meeting.

Jenny Thompson represented the Smallville Field Naturalists and indicated some concern for Marbled Murrelet nesting habitat deep in the forests. Marbled Murrelets nest only in old growth fir and their habitat could be destroyed if the watershed were developed. She said she was very worried about the possible effects of some proposed housing developments in the watershed.

Norma Turner represented the Smallville water district, reminding every one that Green Lake was the water source for all the houses, schools, and businesses of Smallville. She said that it is very important to keep the lake water clean so that they don't have to add more costly treatments to the water to keep it safe to drink. She was supportive of keeping as much of the watershed protected as possible. Norma also agreed with Jenny that she was concerned about any new developments which would require an expansion of the water system. This, she said, would be a huge problem especially in the summer months when our water supply is limited.

This is getting more complicated, Sam thought.

Sam tensed when Harry introduced himself as a developer. "I've lived in Smallville my whole life and I only have its best interests at heart. Don't you want more jobs that I could provide to local carpenters and other businesses?" he added. "And now, some people" – he looked over at Sam – "don't want me to build some simple concrete barriers?" and then went on to say that he had been building houses in the community for the past fifteen years and always did a good job.

Bill Lewis got up and said he represented the First Nations people of the Green Lake watershed. He told the group that his people have fished in Fairy Creek for many hundreds of years and that these fish and those downstream of Green Lake sustain his people. He reminded that Green Lake itself has been a part of his people's culture for its clean water and that his people have a sweat lodge site nearby for spiritual practices. He told how water was very important in his people's creation stories. He also reminded the group about the water agreement his band has with the water district to ensure enough water is left in the creek downstream of Green Lake to maintain fish habitat – fish, he added again, that his people depend on.

Sheila Matthews introduced herself as an avid boater on Green Lake. She and her family have been boating there every summer and they just love the lake. She described how she and her teenaged daughters used the lake for canoeing, swimming, and just hanging out. She didn't want to see a lot of houses built along the shoreline; "just some tasteful cottages – and maybe more docks", she added. She didn't see any problem with recreational use of a public water supply lake.

After everyone had introduced themselves, Norma Turner stood up again. "It seems that everybody here is concerned about Green Lake and its watershed" she said, "but we're not sure how our own needs can be met at the same time as those of our neighbours and the Smallville community." Most people nodded in agreement.

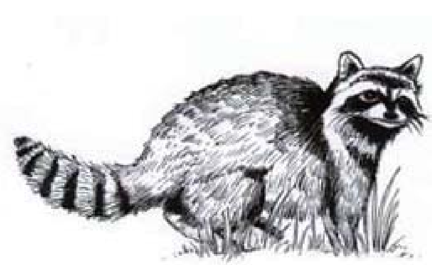
"I suggest that we talk about how we might proceed from here. What does everyone think?" Norma asked.

Sam was the first to stand up. "I think it's a great idea but we need to be careful about respecting other people's point of view. Let's make a list of all of our ideas and concerns and come up how to proceed from there later."

By the end of the meeting, everyone had a chance to voice their opinion and listen to one another. They decided that although there were many potential conflicts, everyone had an interest in Green Lake and its watershed. Most people had signed up for another follow-up meeting and agreed to invite anyone else that may be interested to attend.

Sam stood up and thanked everyone for coming. Just as he was sitting down, Harry jumped up. "This is all very fine," he said "but I'm going to have to put in those erosion barriers before the winter rains. I don't think we've done much to sort this issue out." The room was quiet as Harry hurried out into the night.

This case study was adapted from "Apples or Salmon" from Water for Tomorrow – a guide to watershed stewardship.



NAME:

BLOCK:

LAKE AT STAKE DEBATE:
Grade 10-12 Assignment Instructions

AIM:

Your task is to work collaboratively with your group to develop a proposal on your stakeholders' use of Green Lake and its watershed. Using the Green Lake Case Study, the internet and other resources, gather background information for your proposal:

- What is the proposed land use and or water use?
- What is the environmental impact of your land use or water use?
- How will you manage any potential conflicts with other users?

INSTRUCTIONS:

Develop a written report outlining your group's proposal. The report should include the following:

- Introduction – List the aims or goals of your proposal (What is the proposed land use and/or water use) and a description of your stakeholder group.
- Methodology – describe the background research that was used in approaching your proposal.
  Also, in this section, discuss the data sources you used and any assumptions/limitations that might be in the data sources.
- Research Findings and Analysis – present your background findings in the areas of environmental impact, management of potential conflicts, and any other issues that the background research provides.
- Conclusion – what do you propose to do with Green Lake and its watershed? Why? What are the strengths/weaknesses of your approach? Why should the citizens of Smallville vote to support your proposal?
- References – properly cite any academic articles or material from the Internet and data sources in this section. Proper citation format for this report will be based on the APA Style Manual.
- Be prepared to describe and defend your proposal in a class debate.

EVALUATION

- Stakeholder Proposal
  - 75% of the project grade, based on originality and completeness (see above).
- Presentation
  - 25% of the project grade.
  - Your group will be required to present your findings and state a clear argument for your proposal for Green Lake and Smallville. You will have 5 minutes for the presentation and may use this time in any way you like.

NAME:

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LAKE AT STAKE DEBATE:
Grade 8-9 Assignment Instructions

AIM:

To work collaboratively with your group to research, prepare, explain and defend a position on Green Lake and the use of its waters. Using the Green Lake Case Study, the Internet and other resources, gather background information for your position. Answer the following questions:

- What is the proposed land use and/or water use?
- What is the environmental impact of your land use or water use?
- Why is your proposal the best for all concerned, or the majority of residents, or your group?

INSTRUCTIONS:

Make notes on the information you have gathered to refer to during the debate. The notes must be complete. You will be required to provide your teacher with a written summary of your group's position.
Your notes and summary should include the following:

- Introduction – what is the issue and a brief description of your group's position;
- Methods – describe the research sources you used (bonus for describing any assumptions they or you make);
- Research Findings – present your findings in terms of impact on the environment, potential conflicts, and any other issues;
- Conclusion – what do you propose and why it is the best use of Green Lake and its watershed;
- References – list websites and other sources you used.

Be prepared to describe and defend your proposal in a class debate.

EVALUATION:

- Debate presentation, proposal, and behaviour
  - 75% of the project grade, based on originality and completeness (see above).
- Written summary from notes
  - 25% of the project grade.

NAME:

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LAKE AT STAKE DEBATE:
Presentation Summaries

INSTRUCTIONS: use this worksheet to write a summary of each presentation.

RECREATION USERS

DEVELOPERS

FIRST NATIONS

INDUSTRY

ENVIRONMENTAL GROUPS

PLANTS AND ANIMALS THAT LIVE IN GREEN LAKE

WATER DEPARTMENT

AGRICULTURE

WATER BOTTLING PLANT

Name:

Block:

Lake at Stake Debate:

1. List your preferred Choice(s) of land use at Green Lake and it's watershed

2. Write a paragraph defending your position

WATER: TODAY & TOMORROW

SUSTAINABILITY OF OUR WATER RESOURCES IS INFLUENCED BY THE ACTIONS WE TAKE IN OUR EVERYDAY LIVES. This section is intended to further students' understanding of Greater Victoria's current water use and how we will use water into the future. Many things influence how we use water – our everyday actions, the types of technologies we use, and the value we place on water. Water conservation, water (use) efficiency, and global water use are important concepts explored further in this section.

One of the ways we can conserve water is by using water more efficiently; this means reducing its use in order to protect the resource now and for the future. Using water wisely will reduce health risks, lower water bills, and extend the useful life of existing water supply reservoirs and sewage treatment facilities. Increased efficiency expands the possible uses of the water resource, accomodating population growth, new industry, fire fighting, environmental conservation and protection, and cultural practices/lifestyles/livelihoods. Water efficiency programs emphasize day-to-day improvements in water use that bring about lasting results.

Water availability with respect to climate change is a critical issue in Greater Victoria and throughout B.C. Climate change may affect Greater Victoria with an increased average air temperature which could lead to an increased demand for water, especially in the summer. This is coupled with predicted drier summers and increases in precipitation intensity during the winter months. Understanding weather patterns and how weather data is collected and used is important to the understanding of the potential impacts of climate change on our water supply.

Throughout the world, water use has increased dramatically over the last century due to population growth, industrial uses, and new technologies that enable us to take water from non-traditional sources. Water use per person varies greatly from country to country and depends on water availability, technologies, standard of living, and water use habits.

Finally, communication about local water issues and people brings the issue of water up-front and "personal". There are many forums to communicate about water, ranging from public media (magazines, newspaper, websites, radio, TV, etc.) to public or community meetings. Water can bring us together in many ways!

THIS SECTION CONTAINS FIVE ACTIVITIES FOR STUDENT LEARNING:

- *Water Today and Tomorrow*
- *Water and Climate Change*
- *New Ways for Water Efficiency*
- *Design a Native Plant Garden*
- *The Water News*

Water Today and Tomorrow

Key Concepts

- A variety of factors will influence water quality and quantity in the future.
- Water is important to all people.
- Actions we take in our everyday lives influence the sustainability of the Greater Victoria water supply.

Method

Students will watch a video and complete a video worksheet to gather facts about the way we use water now and what the future might hold.

Activity Information Box:

Time Required: 50 minutes

Grade Level: Grades 8-11

Key Words: *conservation, climate change, weather, water efficiency, native plants*

Materials:

- *Water: Today and Tomorrow Video*
- Student Worksheets

Setting: indoors

Skills: listening, observing, creative thinking

Subjects: Science 8-10
Science & Technology 11

Learning Outcomes:

It is expected that the student will:

- Understand the importance of conserving water for future generations;
- Identify ways water can be used efficiently at home.

Background

The *Water in Our Community video,* titled *Water: Today and Tomorrow,* looks at the way we use water today and looks ahead to what our drinking water supply may be in the future. Many things influence how we use water – everyday actions, types of technologies, and the value we place on water. The impact of population growth on water supply, climate change, and water conservation are important concepts explored in the video.

Procedure

1. Pre-video watching tasks: advise students that they will have to listen and watch the video carefully in order to complete notes and worksheet.
2. Divide the class into pairs. Assign each pair of students a set of questions (student worksheet). Their task is to take notes on the aspects of the video that relate to their questions and then work together to answer the questions.
3. Give students time to review the question sheets before showing the video. Then show the video, reminding each student to take notes.
4. After the video is shown, give students time to think about what they have seen and, together with their partner, answer the set of questions on the worksheet.
5. After all students have completed their worksheets, instruct each pair of students to share what they have learned with the whole class. Students may come up with slightly different answers to the same questions – try to come to consensus as to the correct answer – noting if needed, that more research may be done to answer that particular question!

Evaluation

Have students:

- Complete worksheets with a partner and participate in a class discussion;
- Understand the importance of water conservation and water use efficiency;
- List ways that they can change their own water use in order to reduce their water demand;
- Describe the value of native plant gardens for water conservation and wildlife habitat.

Extensions

1. Ask students to write a paragraph on their vision of water in the future – how will we manage our water supply needs? What is needed to ensure we have water for both human and non-human needs?
2. Have students list some suggestions for maintaining our water supply – send the suggestions to the CRD Regional Water Supply Commission.

Community Connections

Invite a municipal planner or public works engineer to come and talk about future growth of your community and/or Greater Victoria and how that might impact the community's way of life.

Additional Resources

Government of Science Canada; Educational Resources

http://science.gc.ca

NAME:

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STUDENT WORKSHEET #1 WATER: TODAY AND TOMORROW

ASSIGNMENT INSTRUCTIONS:

Read the following questions before watching the video and then answer them after watching the video.

1. What is a native plant garden? How does it help conserve water?

2. Discuss how climate change may impact our water supply.

3. Where can you find out more information on your water supply and how to conserve it?

4. Based on what the climate change expert discussed in the video, predict what changes may take place in your community's water supply. Include as much detail as possible.

5. List four things that people can do to improve water use efficiency at home.

NAME:

BLOCK:

STUDENT WORKSHEET #2 WATER: TODAY AND TOMORROW

ASSIGNMENT INSTRUCTIONS:

Read the following questions before watching the video and then answer them after watching the video.

1. Based on what you learned about native plant gardens, complete the following sentence: "My new native plant garden design will have......" List possible plantings.

2. How much more water is used in Greater Victoria in the summer than the winter? Why?

3. Describe at least two water-efficient technologies in the home and for the garden.

4. Discuss how water conservation regulations help to manage our drinking water supply.

5. List two or more changes that Greater Victoria may experience with climate change.

NAME:

BLOCK:

STUDENT WORKSHEET #3 WATER: TODAY AND TOMORROW

ASSIGNMENT INSTRUCTIONS:

Read the following questions before watching the video and then answer them after watching the video.

1. Discuss why it is important to reduce the amount of water we use in the summer.

2. What methods do climate change experts use to predict climate in the future?

3. Discuss how population growth in Greater Victoria will impact our water supply.

4. Compare at least four “water conserving” versus “water wasting” actions in or around the home.

5. How does the Victoria Weather Network help us learn about climate change?

STUDENT WORKSHEET #1 WATER: TODAY AND TOMORROW
ANSWER KEY

ASSIGNMENT INSTRUCTIONS:

Read the following questions before watching the video and then answer them after watching the video.

1. What is a native plant garden? How does it help conserve water?

- *Native plants adapted to our climate*
- *Conserve water*
- *Beneficial to wildlife*

2. Discuss how climate change may impact our water supply.

- *Intense winter storms (10% increase in winter)*
- *1 – 4 °C warmer on average*
- *Decrease in precipitation in summer (20% median decrease)*

3. Where can you find out more information on your water supply and how to conserve it?

- *CRD (Integrated Water Services Department & the CRD Parks and Environmental Services Department)*

4. Based on what the climate change expert discussed in the video, predict what changes may take place in your community's water supply. Include as much detail as possible.

- *Climate change is happening*
- *Not enough water storage*
- *Less water available in summer*
- *changes in water balance at Sooke Resevoir*
- *Increased storms and storm damage (blowdown)*
- *Increased turbidity, cloudiness affecting water quality*

5. List four things that people can do to improve water use efficiency at home.

- *Replace toilets, washing machines, dishwashers with water efficient models*
- *Native plant gardens*

STUDENT WORKSHEET #2 WATER: TODAY AND TOMORROW
ANSWER KEY

ASSIGNMENT INSTRUCTIONS:

Read the following questions before watching the video and then answer them after watching the video.

1. Based on what you learned about native plant gardens, complete the following sentence: "My new native plant garden design will have......" List possible plantings.

- *Nootka Rose*
- *Garry Oak*
- *Arbutus*
- *Dogwood*
- *Snowberry*
- *Oceanspray*

2. How much more water is used in Greater Victoria in the summer than the winter? Why?

- *Twice as much water is used in the summer.*
- *Water is used mostly for watering lawns and gardens*

3. Describe at least two water-efficient technologies in the home and for the garden.

- *Low flush toilets*
- *Water efficient washing machines*
- *Irrigation timers*
- *Automatic rainfall shutoff devices*

4. Discuss how water conservation regulations help to manage our drinking water supply.

- *Total water use is about the same as in 1997 – even with population growth.*

5. List two or more changes that Greater Victoria may experience with climate change.

- *Intense winter storms (10% increase)*
- *1 – 4˚C warmer than average*
- *Decrease in precipitation in summer (20% median increase)*

Student Worksheet #3 Water: today and tomorrow

ANSWER KEY

Assignment Instructions:

Read the following questions before watching the video and then answer them after watching the video.

1. Discuss why it is important to reduce the amount of water we use in the summer.

- *Summer is when we have the least amount of water available*

2. What methods do climate change experts use to predict climate in the future?

They measure

- *Wind speed (anemometer)*
- *Wind direction (wind vane)*
- *Precipitation (rain gauge)*
- *Humidity*
- *Sunlight*
- *UV radiation*
- *Temperature*
- *Atmospheric pressure*

3. Discuss how population growth in Greater Victoria will impact our water supply.

- *Larger houses on average*
- *More bathrooms, water appliances*
- *More need for water pipes, sewer lines and pumps*

4. Compare at least four "water conserving" versus "water wasting" actions in or around the home.

- *CONSERVING*
  native plant garden
  irrigation with timer
  golden lawn in summer
  turn off tap when brushing teeth
- *WASTING*
  non drought tolerant plants
  sprinkler with no timer
  green lawn in summer
  leave taps running

5. How does the Victoria Weather Network help us learn about climate change?

- *It collects data scientists will use to create climate models (including temperature, precipitation projections)*

New Ways for Water Efficiency

Key Concepts

- Responsibility for water is everyone's concern.
- Actions we take in our everyday lives influence the sustainability of the Greater Victoria water supply.
- A variety of factors will influence water quality and quantity in the future.

Method

Students will complete a water audit in their home and develop ideas for water efficient technologies and water conservation practices for the home.

Activity Information Box:

Time Required: 120-150 minutes

Grade Level: Grades 8-10, 11

Key Words: *water conservation, water efficiency, technology*

Materials:

- Water Audit sheet
- PowerPoint (PDF) presentation (optional) *New Ways for Water Efficiency*
- House template (optional)

Setting: indoors

Skills: Interpreting, problem solving, presenting

Subjects: Science 8-10
Science & Technology 11

Learning Outcomes:

It is expected that the student will:

- Identify a range of water efficient technologies and practices in the home;
- Design a model home that incorporates new water efficient technologies;
- Practice every day actions that incorporate their personal commitment to water conservation.

Background

How much water do we use? We can make use of water conservation and water efficient technologies to decrease overall water use. In Greater Victoria water efficiency practices have accommodated an eight percent increase in population between 1998-2007 with a reduction in per person water consumption by twelve percent. This decrease in per-person water use means that we are using water more efficiently; it also delays the need for expansion of the water supply system – a costly endeavour of approximately 100-150 million dollars!

Water conservation practices and water-efficient technologies are the backbone of preserving our precious water. Some of the benefits of water conservation include lower water and energy bills, enhanced drinking water quality by maintaining higher levels in Sooke Reservoir, and less need for costly water system infrastructure. Greater Victoria enjoys some of the best quality drinking water in the world – provided at a reasonable cost – however, maintaining this critical resource requires that we use water with care.

Water conservation can have different meanings for different people. Simply stated, water conservation can be defined as any beneficial reduction in water use, loss or waste. It can include use of water-efficient fixtures, fostering of water conservation practices and habits, and employing techniques for rainwater collection. At the resource management level, it can mean implementing measures to decrease peak consumption and charging for water at the appropriate rates. Water conservation can also foster new developments in water-efficient technologies and help lead to establishing new or updated standards and regulations.

Four Ways to Save Water at Home:

Turn off the tap when brushing your teeth, shaving, or doing the dishes.

Take a short shower rather than a bath.

Let your lawn go golden in the summer.

Only run the dishwasher with a full load.

Increasing the efficiency of water use can be seen as one type of method to conserve water. It means that we use the least amount of water feasible to accomplish a particular task. Efficiency focuses on reducing waste rather than restricting the use of water. There are numerous ways to help reduce water wastage. For example, changes can be made in the water fixtures we use in the home – a 5-minute shower under a lowflow shower head uses much less water than a 5-minute shower under a conventional shower head. Water can be wasted through leaking taps and use of other less efficient appliances such as clothes washers and toilets. Habits too, can waste water. Flushing tissues and other garbage down the toilet, brushing teeth while leaving the water running, or running a less than full load of laundry or dishes can all contribute to water wastage. By changing technologies and our habits, we can decrease water wastage on an everyday basis. For a more complete description of water saving tips go to **http://www.crd.bc.ca/water**.

How does water use in Greater Victoria compare to other countries around the world? Total world water use has increased dramatically over the last century due to population growth, industrial uses, and new technologies that enable us to take water from non-traditional sources. Water use per person varies greatly from country to country and depends on water availability, technologies, standard of living and water use habits. One of the challenges to understanding water availability and use is that some countries have a lot more water available than others. Some interesting facts include:

- Almost a quarter of the world's supply of fresh water lies in Lake Baikal located in sparsely populated Siberia, Russia.
- Latin America has 12 times more water available per person than South Asia.
- Sub-Saharan Africa has the largest number of water-stressed countries of any region in the world.
- Nature's needs for water are higher in areas that have more water available.
- In 2000, Canadians used an average of 326 litres of water per person (per capita) each day.
- A mere 12% of our home water usage is used in the kitchen and as drinking water.

- About 60% of indoor home water use occurs in our bathrooms. Toilets are the single greatest water user.
- Indoor water use peaks twice a day year-round, in the mornings and evenings.
- The biggest peaks during the year occur in the summer, when about half to three quarters of all municipally treated water is sprinkled onto lawns and gardens.
- The average daily domestic (residential) water use per capita is:
    - 425 litres in the United States
    - 326 litres in Canada
    - 250 litres in Italy
    - 200 litres in Sweden
    - 150 litres in France
    - 135 litres in Israel.

HOW MUCH WATER DO WE USE?

Flushing Toilet

Brushing Teeth

Showering/Bathing

Shaving

Cooking

Dishwashing by hand

Dishwashers

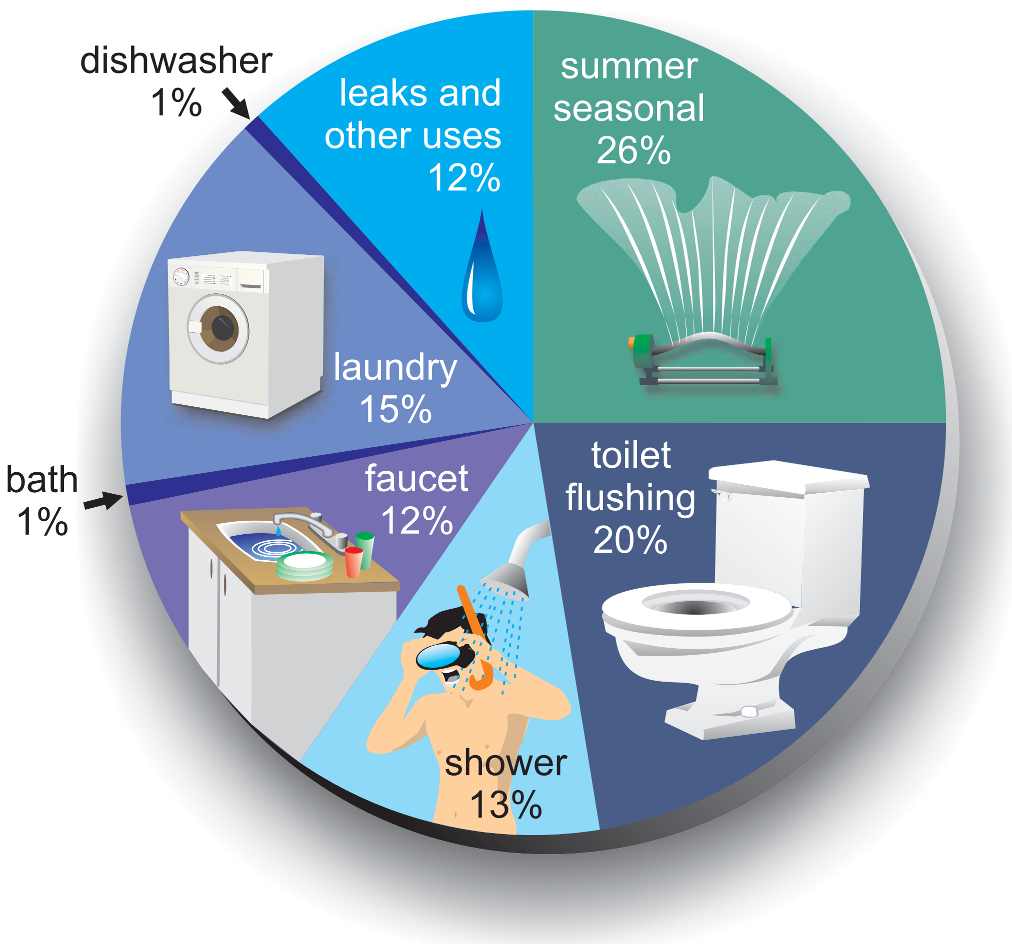
Washing Machine

Car Washing

Garden Watering

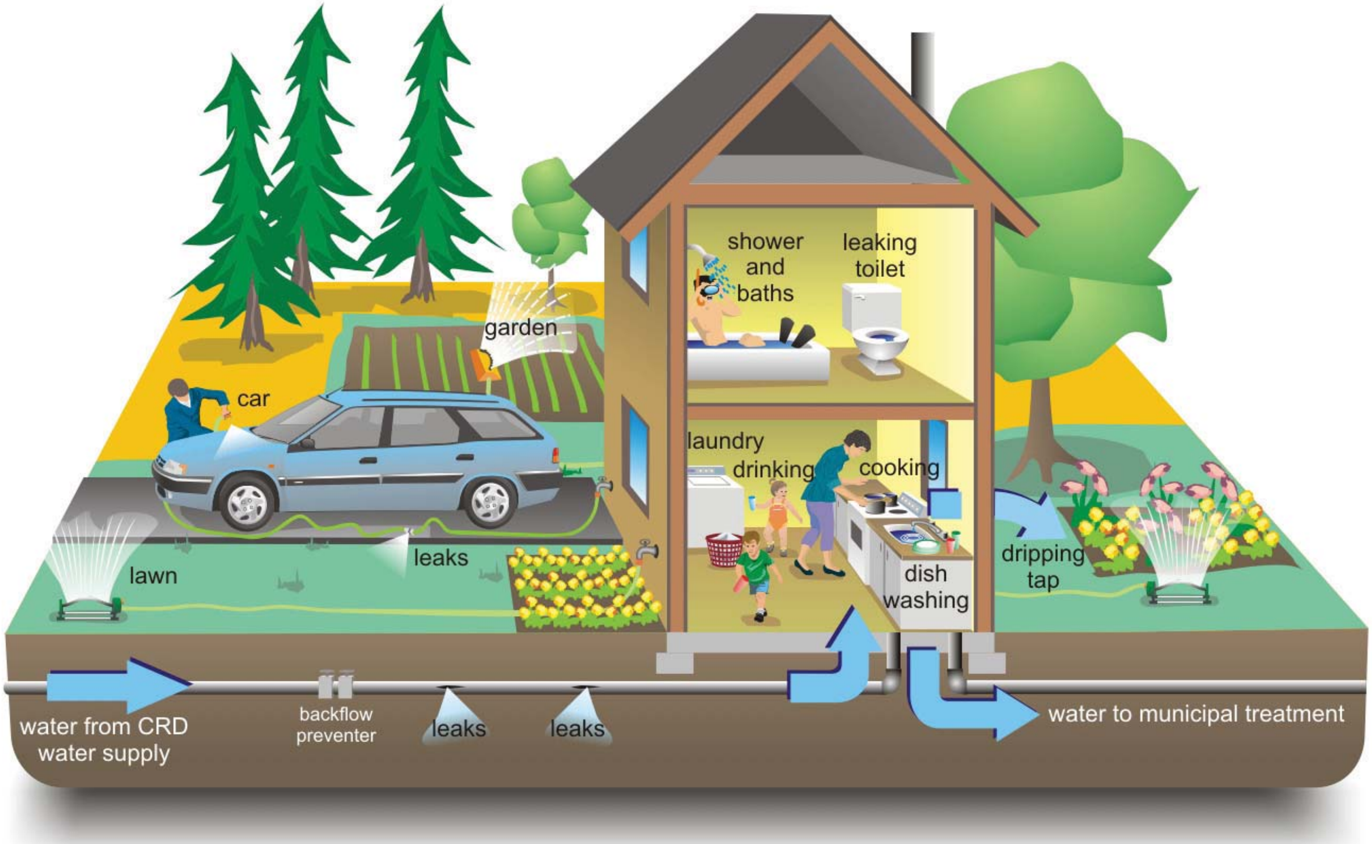
Residential Water Use in Greater Victoria

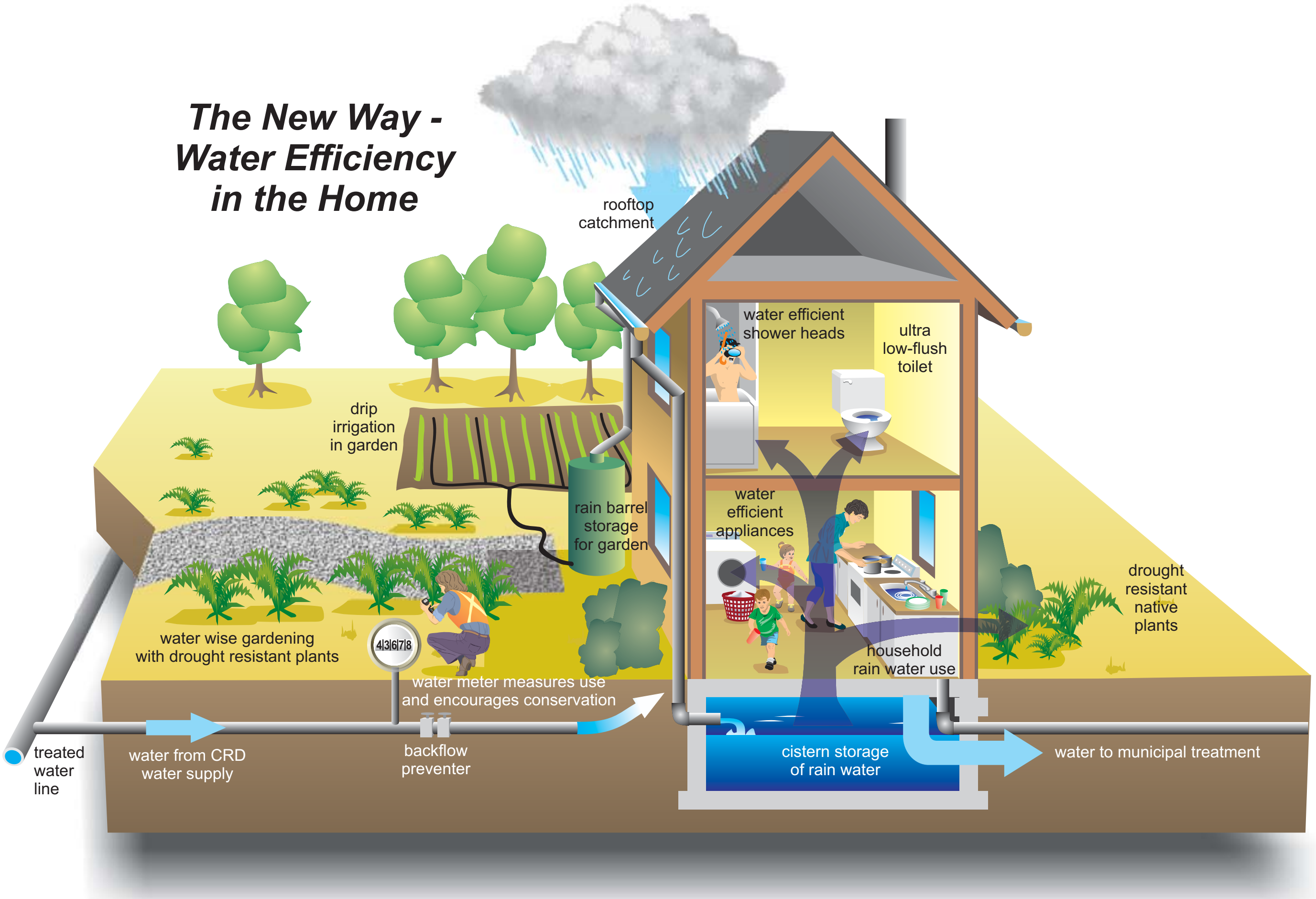
We flush almost a quarter of the water we use down the toilet. In the summer, watering our gardens can cause household use to jump by double!



(Source: CRD Water Services Dept. & CMHC – Household Guide to Water Efficiency)

The Old Way - Wasteful Homes




The New Way -
Water Efficiency
in the Home
rooftop
catchment
water efficient
shower heads
ultra
low-flush
toilet
drip
irrigation
in garden
rain barrel
storage
for garden
water
efficient
appliances
drought
resistant
native
plants
household
rain water use
water wise gardening
with drought resistant plants
4|3|6|7|8
water meter measures use
and encourages conservation
treated
water
line
water from CRD
water supply
backflow
preventer
cistern storage
of rain water
water to municipal treatment

Procedure

1. Tell students that they are going to assess their water use at home and then come up with ideas to use water more efficiently. Use the PowerPoint® (PDF) presentation or view the video *Water Today and Tomorrow* to provide an overview of water use in the home and around the world (optional).
2. Give students the Student Water Audit checklist to complete for three days.
3. Back in the classroom, discuss and compare the findings from student water audits. Where was the most water used? The least? Brainstorm ways that water use could be reduced at home – How can students practice water conservation?
4. Ask students to generate new ideas about how water could be used more efficiently. For example, students could think of ways to save water that we are now sending down the drain. Areas of the home that should be considered include:
   - In the bathroom
   - In the kitchen
   - In the laundry room
   - Outside the home.
5. Divide students into design teams. Tell them their job is to design a model home that incorporates new water conservation practices and water-efficient technologies. On each team, new options for reducing water waste from the above areas should be devised.
6. Students should create a house design that demonstrates their ideas and provides an explanation of how their model works. They can use the House Template as a starting point or use a design of their own. Or alternatively, ask students to produce a poster of a water-conserving/water-efficient home.

Evaluation

Have students:

1. Complete a three day water audit and write a paragraph on how to conserve water;
2. Make a pledge sheet and have students adopt (at least one) new water-efficient or water-conservation action for one week and describe how their personal lifestyle has changed (or will change) in relation to the need for water conservation;
3. Design new water-efficient technologies for the home.

Extensions

1. Give students water dye tablets to check their toilets for leaks and showerhead bags to test their showers for water use.
2. Ask students to research more information on water efficiency or water conservation.
3. Have students explain how their new water technology or practice works in a mini "Science Fair."

Community Connections

1. Ask students to read their home water meter – for an overview of how to do this, go to http://www.h2ouse.net/resources/meter/index.cfm
2. Find out more about new "green" building initiatives such as the LEED program and projects such as Dockside Green in Victoria.

Additional Resources

1. www.getwatersmart.com
2. www.ec.gc.ca/water
3. www.waterforpeople.org
4. www.docksidegreen.com
5. http://greenlivingideas.com

References

1. Canada Mortgage and Housing Corp. "*Household Guide to Water Efficiency*." Available from CRD Integrated Water Services Dept., Victoria, BC.
2. UNESCO . "*Human development report, 2006: beyond scarcity; power, poverty and global water Crisis*" from **http://hdr.undp.org**
3. Environment Canada – 2001 figures from **http://www.ec.gc.ca/water/en/manage/use/e_facts.htm**
4. CRD. "*Water Facts 6 – Straight Talk about Water Saving Actions for the Home.*" Available from CRD Integrated Water Services Dept., Victoria, BC

NAME:

BLOCK:

HOME WATER AUDIT

		LITRES USED PER ACTIVITY		QUANTITY USED PER WATER USAGE	
	A	B	C	D	E
ACTIVITY	TIMES PER DAY	AVERAGE (LITRES)	EFFICIENT (LITRES)	ACTUAL	TOTAL (A X D = E)
IN THE BATHROOM					
Toilet flushes		13.5 to 20	3 to 6		
Showers		100	7 per minute		
Bath		150	20 minimum		
Brushing Teeth		10	8		
Shaving		20	10		
IN THE KITCHEN					
Cooking		20	20		
Dishes by Hand		35	35		
Dishwasher		40	11 to 26		
IN THE LAUNDRY					
Washing Machine		225	113		
OUTDOORS					
Car Washing		400 estimate	200 estimate		
Garden Watering		27 per minute	15 per minute		
TOTAL					

NOTE: WHEN DOING YOUR WATER AUDIT, YOU MUST ABIDE BY THE WATER CONSERVATION BYLAW!

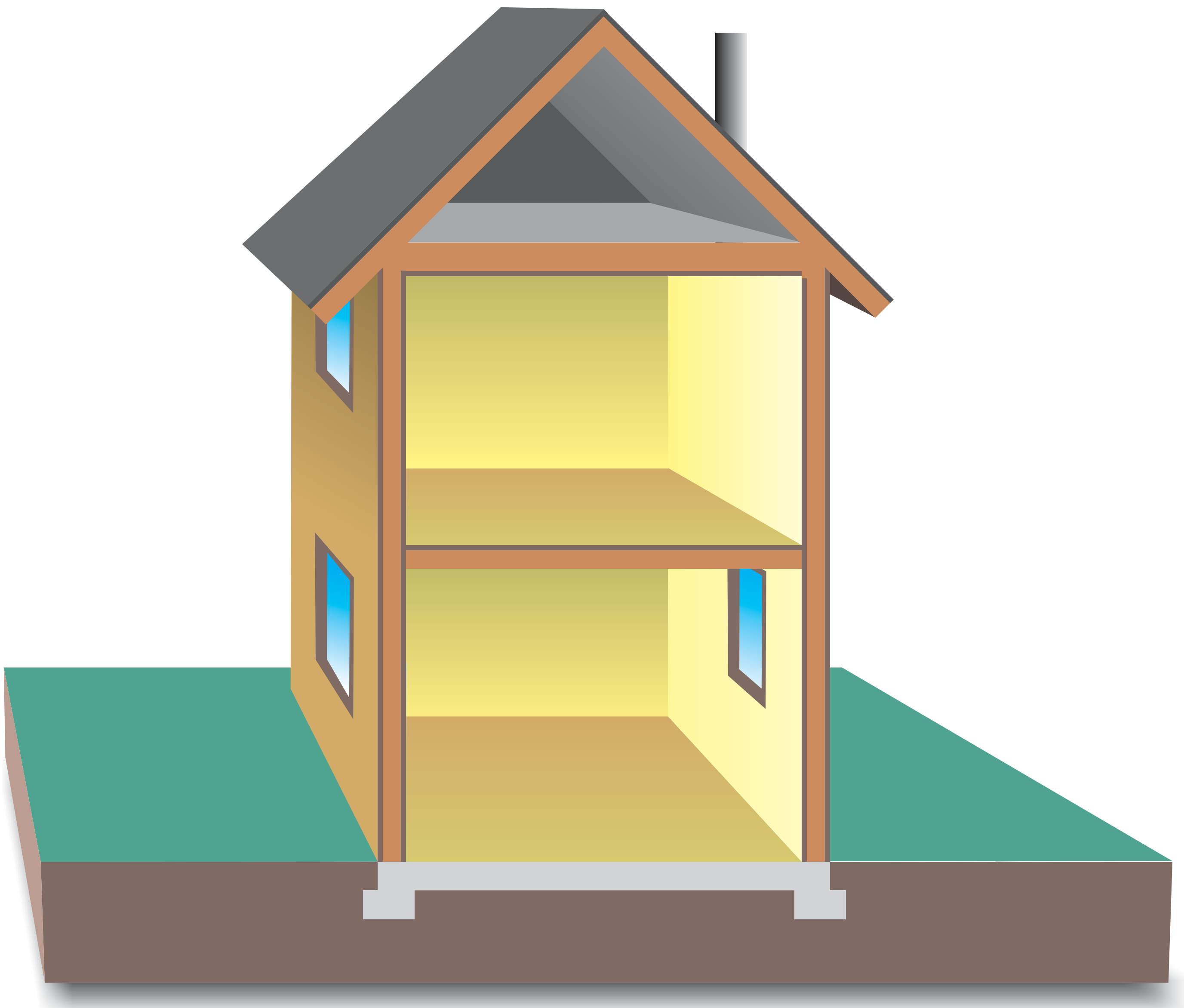
NAME:

BLOCK:

NEW WAYS FOR WATER EFFICIENCY

ASSIGNMENT INSTRUCTIONS:

Add your own water efficient technologies using the house template or make up your own house design.



Water & Climate Change

Key Concepts

- A variety of factors will influence water quality and quantity in the future.
- Actions we take in our everyday lives influence the sustainability of the Greater Victoria water supply.

Method

Students examine local precipitation data and other factors and discuss the impact of climate change for the Greater Victoria area.

Activity Information Box:

Time Required: 90 minutes

Grade Level: Grades 8-12

Key Words: *climate change, precipitation, rainfall, microclimate, future trends, variables, x-axis, y-axis, graphing*

Materials:

- Student worksheets
- Rainfall data sheets (CRD and school-based)
- Internet and other information resources
- Graph templates (optional)
- Water gauge (optional)
- Computer lab (optional)

Setting: indoors

Skills: gathering information, data interpretation, analysis

Subjects: Science 8-10
Earth Science 11
Geography 12

Learning Outcomes:

It is expected that the student will:

- Describe, using graphs, the relationship between rainfall in two different microclimates in Greater Victoria;
- Discuss the relationship between rainfall and water consumption trends;
- List ways that we can manage potential impact of climate change on our water supply.

Background

Water availability in response to climate change is a critical issue in Greater Victoria, throughout B.C. and the world. Most of our drinking water comes from reservoirs which are replenished in the winter and drawn down in the summer. Climate change involving rising temperature and decreasing rainfall may affect our water supply through increased water losses due to evaporation and increased water demand for drinking and irrigation, for example. Current climate change models predict longer drier summers, increased precipitation intensity (heavier rain and snow storms) during the winter months, and 1 – 4 ˚C warmer weather on average. We need to know how much water will be available and how will we manage our water resources in the years to come. Climate scientists can gather climate data and use computer programs to analyze how the climate may change. By understanding climate trends, decision-makers can plan for future reservoir needs and develop programs to manage water resources efficiently.

Weather:

Weather stations are one of the ways that scientists gather data about climate. Weather is the specific condition of the atmosphere at a particular place and time. It is measured in terms of such things as wind, temperature, humidity, atmospheric pressure, cloudiness, and precipitation. In most places, weather can change from hour to hour, day to day, and season to season.

Climate:

A region's climate is based on long-term weather conditions. Climate is the average weather pattern over longer periods of time – generally tens to thousands or even millions of years. Temperature ranges, amounts of precipitation, and wind are the atmospheric variables that most often characterize climate at the Earth's surface. Climate in Greater Victoria is based on its location on the planet, nearness to the ocean, and the circulation of planetary winds. Location mainly determines temperature and precipitation trends. Climate profoundly affects the total amount and seasonal timing of water availability in our reservoirs.

The climate in the Greater Victoria area is generally called a Northern Mediterranean type climate. This means that, in the summer months, our weather is dominated by masses of warm air moved by winds from the south, known as subtropical high pressure cells. Rainfall is generally less and we can go for weeks without any measurable precipitation. During the winter months, a series of Pacific storms reaches the shores of Southern Vancouver Island, bringing rain with snow at higher elevations. As a result, areas with this climate receive almost all of their yearly rainfall during the winter season, and may go anywhere from two to three months during the summer without having significant precipitation. The term microclimate describes the variations within a region's climate.

FTS RG-T Tipping Bucket

Old saying: "*Climate is what we expect, and weather is what we get.*"

Monitoring Rainfall and Reservoir Levels at Sooke Reservoir

The reservoir water level is recorded hourly using a float and pulley type system which is located at the intake tower in the reservoir. The precipitation (rain and snow) for Sooke Reservoir is recorded every 15 minutes using an FTS RG-T heated tipping bucket rain gauge, located at the toe of the dam. There are additional rain gauges located at the toe of the dam and on the intake tower for data verification.

CRD Integrated Water Services maintains a "Weekly Water Watch" to help manage water resources and to educate local citizens. The Weekly Water Watch is available on the CRD website:

https://www.crd.bc.ca/about/data/sooke-lake-reservoir/sooke-lake-reservoir-weekly-photos

The Weekly Water Watch provides data on:

- Usable water volume in the Sooke and Goldstream reservoirs;
- Average daily water demand (water usage);
- Average 10 year daily demand;
- Rainfall for the month (average, actual); and
- Rainfall for the week (average, actual).

School-based weather stations are installed in many schools throughout the CRD, all part of the School-Based Weather Station Network (**www.victoriaweather.ca**). This network operates out of the University of Victoria. The measurements from the school weather station network are measured using the Davis Vantage Pro2 Plus weather station. The stations measure temperature, humidity, atmospheric pressure, wind speed, insolation (sunshine), UV index and rain.

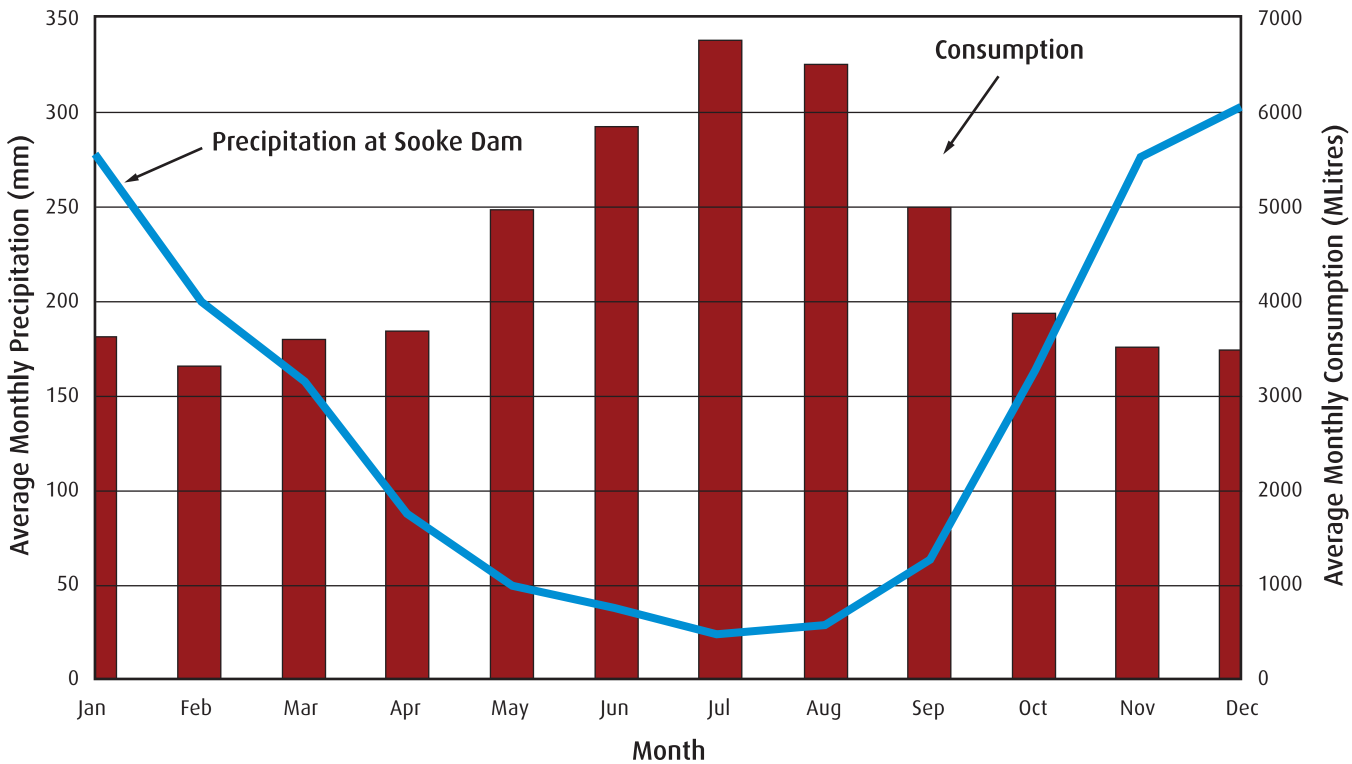
Davis Vantage Pro2 Plus Weather Station

Water Daily Demand

Water daily demand is a measurement of the amount of water used by the people on the water system in a day. These measurements are taken to help plan how best to meet current and future water needs. The CRD IntegratedWater Services monitors daily, weekly, and monthly patterns of both rainfall and water use. Daily demand is often converted to monthly demand. As the graph below indicates, seasonal patterns of weather (rainfall) and average monthly demand help tell the story of when we receive the most rainfall and when we use the most water.

By understanding these seasonal patterns, water managers can make decisions about when to implement the Water Conservation Bylaw. For example, the Water Conservation Bylaw for Stage 1 is applied from the period from May 1st to September 30th each year. This bylaw defines watering schedules and other water use restrictions applicable during that time.

Greater Victoria
Average Monthly Precipitation and Consumption



Procedure

Prior to class, reserve the computer lab (if needed) and decide which set of data to use: either the data tables provided or data from the CRD website and the Victoria Weather Network and then gather the data for in-class use.

To gather data from the CRD website, go to page **https://www.crd.bc.ca/about/data** and extract the **Weekly Water** Watch data on a month-by-month basis for your selected year. Do this by taking the actual rainfall **from the last** week of each month to generate monthly data for the year. You can use the Water Watch data provided in the lesson plan as a template.

Teachers can find out if their school has a weather station, by going to the following website:
www.victoriaweather.ca/all_current_data.php

If there is no local school-based weather station, pick a weather station closest to you on the network. To gather rainfall data from the School-Based Weather Network go to: **www.victoriaweather.ca/** and go to " *Stations in the Network.*" Pick your school or a school close to your school and click on the link to that school's data page. Click on "*More Data*" to access Data Summary Options. Click on "*Total Rain.*"
The table that results will be for the current year. To get data to compare to the CRD watershed, click on "*Select a Year*" and click on your preferred year. This will bring up a table for that year. See the example for Mount Douglas High School included in this activity. This data can be printed out prior to this activity or, alternatively, the teacher can ask students to print the table as homework prior to the lesson.

Part A:

1. Start this activity by asking a question such as: "with all the rain we get in the Greater Victoria, why should we be concerned about how much rainfall we get?" "Why might we be worried about water and climate change?" Ask students to make a list of what they know about this topic and what questions they might have.
2. Explain to students that they will examine and graph actual rainfall data from the CRD's Sooke Reservoir watershed as well as data from their school. In this case, actual data from CRD Integrated Water Services "Water Watch" and local school data from the School-Based Weather Station Network will be used.
3. Explain that rainfall is measured in millimeters or "mm". Show students a photo of the school's weather station or an actual water gauge supplied from CRD Integrated Water Services and demonstrate how precipitation is measured.
4. Give students the CRD data from the table provided (Table 1: 2007 data/Table 2: Water Watch) or use the Water Watch data, for the year you have selected.
5. Explain to students that total rainfall will be compared month by month, using data from the school weather station (see Table 3 example) and from the CRD watershed to further understand the microclimates of the Greater Victoria area.
6. Review the data tables with students. Ask them to examine the data provided on the two tables by:
   - Finding the total rainfall per month;
   - Having them select a month from each season (e.g., spring, summer, fall, winter) in each data table and compare figures. By doing this, students should get the general idea of the trends represented by the data.
7. Review how to set up graph paper using the template provided or how to create a graph using Excel®. See Additional Resources for websites for educators wanting to learn how to use Excel for graphing. This graph will be used in Part B of this lesson with the addition of a third variable (water usage).
8. Hand out the Student Activity Worksheet Part A and have students complete the graph of School rainfall and CRD watershed rainfall.

9. Review the results with students and discuss the following questions:
    - Which area has more rainfall?
    - Is the rainfall pattern similar for each area, why or why not?
    - If you were a climate scientist or water resource manager, what other variables might you want to plot to help you manage water resources?

Part B:

1. In this second part of the lesson, students will use the graph they created in Part A to compare rainfall patterns and water demand (that is, water use by consumers) within the CRD system. The objective of this part of the lesson is to understand that, within the CRD, the greatest demand on our water resources occurs when we receive the least amount of rainfall to recharge our reservoirs. In addition, this already challenging situation may become more difficult for our water supply in the future due to the effects of climate change and population growth.
2. In this case, we make use of the Water Watch average monthly consumption data. Students can get the CRD data from the table provided (Table 4: 2007 data) or go to the Water Watch page and extract the data on a month-by-month basis (Hint: take the Average Daily Demand for the month and multiply it by the number of days in that month). This data is provided in "ML" or million litres.
3. Review the graph "Average Monthly Precipitation and Consumption" with students and tell them they will make a similar one that includes their own microclimate at their school.
4. Hand out the Student Activity Worksheet Part B and have students complete the graph of Monthly Precipitation and Monthly Consumption.
5. Go over the results with students and discuss the following questions:
    - Based on the graph, what is the relationship between rainfall and water consumption?
      (We use nearly twice as much water in the summer than in winter, with the increase due mostly to watering lawns and gardens. This can mean that we can have summer water shortages because we have limited storage in our reservoirs and get most of our annual rainfall during the winter months.)
    - Climate scientists predict that climate change may bring more winter rainfall and longer, hotter and drier summers. How will this affect the supply of water in the CRD?
      (We will receive more water that we might be able to store, yet will have to increase the storage capacity in our reservoirs to take advantage of this additional supply. Increasing storage capacity has significant financial and environmental costs that must be considered. If there is no increase in storage capacity, there will be longer time periods during which we would have to use a limited supply – this means that there will be a need for water conservation and water efficient technologies.)
    - What are some of the ways that we might be able to manage the potential impacts of climate change on our water supply?
      (Brainstorm ideas for water conservation, water efficient technologies, and other ways to manage water usage at home, schools, and businesses.)
6. Wrap up the lesson by reviewing what students knew about the topic of water and climate change and the questions students had at the beginning of the lesson. Discuss any outstanding questions.

Evaluation

Have students:

- Complete graphs of rainfall and rainfall versus water usage and discuss the relationship between the two variables;
- Predict what will happen to our water supply if climate change increases rainfall during winter and lessens rainfall during the summer months;
- Describe possible impacts of climate change on water availability and how those impacts might be managed.

Extensions

1. Students have graphed current data of rainfall and water usage. Ask students to predict what the impacts will be if the CRD population increases by 5% with the same amount of rainfall. What about if population increases by 5% and there is a 20% decrease of summer rainfall?
2. Create one or more simple computer models using Excel® by changing the data; discuss the resulting graph(s).

Community Connections

Ask students to research other ways to find out about local climate trends, such as local weather media (TV, radio, newspapers, nearby schools in the weather network, University of Victoria Climate Lab, etc.).

Invite a local TV station weather reporter into the classroom.

Additional Resources

Canadian Centre for Climate Modeling and Analysis. **http://www.cccma.bc.ec.gc.ca/eng_index.shtml**

Graphing links using Excel:

http://www.ncsu.edu/labwrite/res/gt/gt-menu.html

http://chemed.chem.purdue.edu/genchem/lab/datareports/excel/plotting.html

http://chemed.chem.purdue.edu/genchem/lab/datareports/excel/excel.html

References

CRD website: **www.crd.bc.ca/water**

Lemmen, D.S., Warren, F.J., and Bush, E., Editors; *From Impacts to Adoption: Canada in a Changing Climate 2007.* Government of Canada, Ottawa, ON 2008.

Table 1: CRD Water Watch

Rain Totals for Sooke Reservoir Intake for 2007

Month	mm
January	495.4
February	162.6
March	340.8
April	102.3
May	24.0
June	21.6
July	41.1
August	33.0
September	64.4
October	195.1
November	120.1
December	323.0

Table 2: CRD Water Watch Sample Page

Capital Regional District - Water Services

Water Watch for September 30th 2007

1. Useable Volume in Storage

Reservoir	September 30 10 year average		September 30/06		September 30/07		% existing full storage
	ML	MIG	ML	MIG	M33,	MIG	
Sooke	33,915	7,461	55,588	12,229	61,931	13,625	67%
Goldstream	6,983	1,536	7,486	1,647	7,365	1,620	75%
Total	**40,898**	**8,997**	**63,074**	**13,876**	**69,296**	**15,245**	**68%**

2. Average Daily Demand

For the month of September	165.3 ML	36.37 MIG
For the week ending September 30, 2007	139.7 ML	30.73 MIG
Max. day September 2007, to date:	207.4 ML	45.64 MIG

3. Average 10 Year Daily Demand for September

Actual	175.8 MLD [1]	38.68 MIG [2]
Adjusted for Population	139.7 ML	40.48 MIG

[1] MLD = Million litres Per Day [2] MIGD = Million Imperial Gallons Per Day

4. Rainfall September

Average (1914 - 2006)	62.4 mm
Actual Rainfall to Date	64.4 (103% of average)

5. Rainfall Sept 1 - Oct 1

Average (1914 - 2006)	62.4 mm
2007	64.4 (103% of average)

6. Water Conservation Action Required:

Stage 1 of the water conservation bylaw has ended for the year, but using water wisely is a year round activity.

Check our website at www.crd.bc.ca/water for more information on the bylaw.

If you require further information, please contact:

Capital Regional District Water Services
479 Island Highway
Victoria, BC V9B 1H7

(250) 474-9600

Table 3: School Based Weather Network - Sample School Data

Rain Totals for 2007 at Ian Stewart Complex/Mt. Douglas High School

Month	mm
January	169.5
February	68.5
March	95.2
April	25.7
May	9.4
June	20.1
July	26.3
August	15.7
September	11.3
October	48.1
November	57.4
December	128.9

Table 4: CRD Water Monthly Consumption Summary

CRD Monthly Water Consumption Tables for 2007

Month	million litres
January	3,639.4
February	3,236.8
March	3,630.1
April	3,693.0
May	4,950.7
June	5,850.0
July	6,736.3
August	6,500.7
September	4,959.0
October	3,868.8
November	3,516.0
December	3,499.9

NAME: | BLOCK:

WATER AND CLIMATE CHANGE – PART A

ASSIGNMENT INSTRUCTIONS:

AIM: The objective of this activity is to graph data similar to what climate scientists and water resource managers use to identify climate and rainfall trends.

You will use actual data from CRD Integrated Water Services "Water Watch" and from your own school or from the School- Based Weather Station Network. Total rainfall will be compared month by month with data from the school's weather station and from the CRD watershed to further understand the microclimates of the Greater Victoria area. Finally, you will consider what impacts climate change may have on your water supply.

MATERIALS:

- Tables of Rainfall data
- Coloured pencils (at least three colours)
- Excel Spread Sheet or Graph paper

PROCEDURE:

1. Select a colour for each line on your graph. Place the Month on the horizontal axis and Rainfall (mm) on the vertical axis (determine your scale based on your rainfall data).
2. Plot each measurement from your first table as a point on your graph. Make a line graph using Excel or connect the points with a line using one of the coloured pencils.
3. Plot the measurements from the other table as points on the graph. Make another line graph using Excel or fill connect the points each month with different coloured pencil.

DISCUSSION:

Answer the following questions:

Which area has more rainfall in July? In December?

Is the rainfall pattern similar for each area? Why or Why not?

If you were a climate scientist or water resource manager, what other variables might you want to plot to help you manage water resources?

Precipitation Template

Monthly Precipitation at Sooke Reservoir and ________ School

Average Monthly Consumption (M Litres)

Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec

Average Monthly Precipitation (mm)

NAME: | **BLOCK:**

WATER AND CLIMATE CHANGE – PART B

ASSIGNMENT INSTRUCTIONS:

AIM: The objective of this activity is to graph rainfall data from the CRD Sooke Reservoir watershed and monthly water consumption from CRD Integrated Water Services to better understand the relationship between the water that is available to us at any given time and the water we use in our homes, schools, and businesses.

MATERIALS:

- Tables of Rainfall data and CRD Water Consumption Totals
- Graph from Part A
- Coloured pencils
- Excel Spreadsheet or Graph paper

PROCEDURE:

1. Make a copy of your graph from Part A.
2. Add a new right hand axis for Water Consumption (million litres).
3. Plot the measurements from the Water Consumption table as points on the graph. Make a bar graph using Excel or fill in the bars with one of the coloured pencils.

DISCUSSION:

Answer the following questions:

Based on the graph, what is the relationship between rainfall and water consumption?

Climate scientists predict that climate change may bring more winter rainfall but longer, hotter summer dry seasons. How might this affect the supply of water in Greater Victoria?

List some of the ways that we might be able to manage the potential impacts of climate change on our water supply.

PRECIPITATION & CONSUMPTION TEMPLATE

SCHOOL ____________________

	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
AVERAGE MONTHLY CONSUMPTION (M Litres)												
ACTUAL MONTHLY PRECIPITATION (mm)												

Design a Native Plant Garden

Key Concepts

- Sustainability of Greater Victoria water resources requires conservation and best management practices.
- Responsibility for water is everyone's concern.

Method

Students design a native plant garden for their school and present a poster of their design.

Activity Information Box:

Time Required: 120 minutes plus optional student research and design time;

Grade Level: Grades 8-12

Key Words: *native plant, water conservation, drought tolerant, water efficiency*

Materials:

- Paper, pens / coloured markers
- Background Material
- Native Plant Garden Site Observation Sheet
- Soil Test Sheet (optional)
- Plant Propagation Lab (optional)

Setting: indoors and outdoors

Skills: communicating, discussion, analysis, interpretation, observation, drawing

Subjects: Science 8-10
Biology 11, 12

Learning Outcomes:

It is expected that the student will:

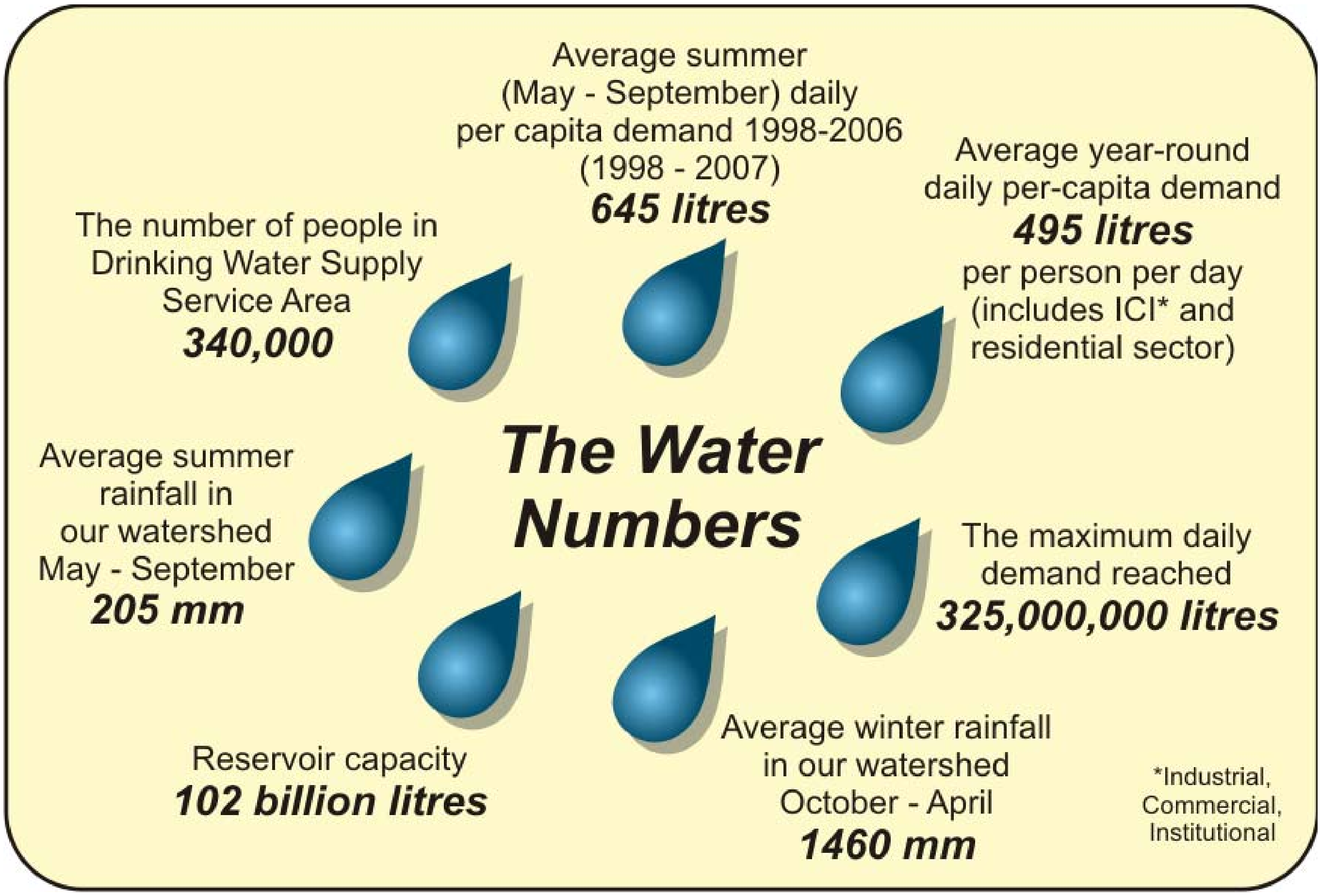
- Identify local native plants;
- List options for less water intensive landscapes;
- Identify at least three types of water conservation practices.

Background

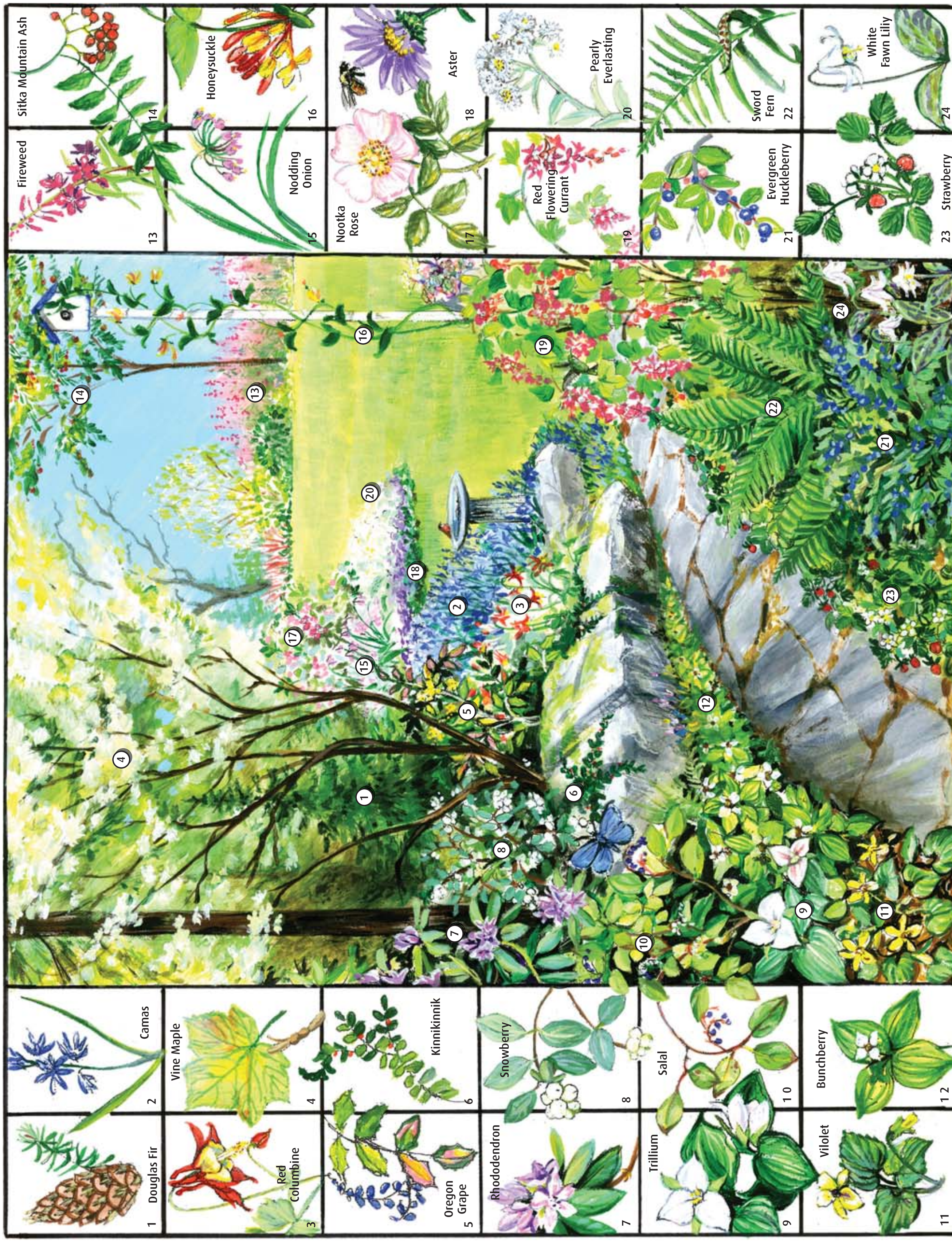
Drinking water use in Greater Victoria more than doubles in the summer months. The Greater Victoria Water Supply Area barely receives an average of 205 mm of rainfall in the summer, when the demand for water is the highest. Compare that to an average winter rainfall of 1460 mm, and you can understand the challenge we face. All of our water supply comes from reservoirs that are replenished during the winter months and have limited capacity. This means that no matter how long and hard it rains, we can only capture a limited supply during those rainy winter months. If we have a drier winter and our reservoir levels are low to start with, there is little chance that summer rainfall will make up the difference.

Greater Victoria enjoys a wonderful climate for growing gardens and the region is famous for our gardens and gardeners. However, the largest drain on our water supply during the summer months is outdoor use - mostly lawn and garden watering. We increase the amount of water used in the summer by almost 100% over winter use. Local studies show that as much as 65% of water used for irrigation is wasted through inefficient watering practices. One way to increase our water efficiency is to plant a garden with native plants that needs less irrigation and are adapted to our local soils and climate.

In this activity, students will design a garden with water conservation and wildlife habitat in mind. The principles of efficient water use in the garden make great sense - indeed, they're simply good gardening practice! Sometimes this type of garden is called a "*Water-wise Garden.*" The design of such a garden usually incorporates water-efficient watering practices, soil health maintenance techniques, and the selection of appropriate plant species to create healthy, beautiful gardens. A native plant is one that occurs naturally in our region as opposed to the many plants that have been introduced by settlers, farmers, and gardeners. Native plants are adapted to growing in our soils and climate and, as a result, tend to do well in our dry summers if planted in an appropriate way. In addition, they provide food, shelter, and nesting sites for wildlife. Native plants are particularly valuable for native animals because they help wildlife survive in areas of urbanization or habitat fragmentation. Making a native plant garden not only conserves water but increases wildlife habitat – a "win/win" situation.


The Water Numbers
Average summer (May - September) daily per capita demand 1998-2006 (1998 - 2007)
645 litres
The number of people in Drinking Water Supply Service Area
340,000
Average year-round daily per-capita demand
495 litres
per person per day (includes ICI* and residential sector)
Average summer rainfall in our watershed May - September
205 mm
The maximum daily demand reached
325,000,000 litres
Reservoir capacity
102 billion litres
Average winter rainfall in our watershed October - April
1460 mm
*Industrial, Commercial, Institutional

Greater Victoria Native Plant Garden



Procedure

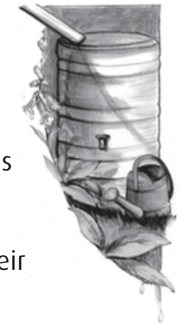
Prior to class, gather the following background material:

- CMHC Household Guide to Water Efficiency;
- Naturescape British Columbia – the Provincial Guide: Caring for Wildlife Habitat at Home;
- A Homeowners Guide to Outdoor Water Use;
- Native Plant Garden Design – student background information (pg. 153 & 154)

In the class,

1. Introduce the concept of the need for converting water-intensive landscapes to landscapes that use less water. Refer to the following information from Environment Canada:
   "Water is a natural resource circulating back and forth in the hydrologic cycle. However, pressures on water resources are growing in Canada. For example, between 1972 and 1996, Canada's rate of water withdrawals increased by almost 90 percent, from 24 billion m^3/yr (cubic metres per year) to 45 billion m^3/yr. But, our population increased by only 33.6 percent over the same period, illustrating the growth in our thirsty lifestyles. As the readily available supplies of fresh water are being used up, we begin to see that there are real limits to how much water we can count on. We can, however, make a significant contribution to solving these problems by reducing unnecessary levels of water use. To do so requires that we identify the areas within our homes, businesses, buildings and processes where we waste water and then make appropriate changes, either in our fixtures, or in our water-using habits."
2. Ask students to complete the student worksheet on comparing "water-efficient" versus "water-wasting" practices. Discuss with students any reasons why water should not be wasted. Students could consider future water supply, climate change, the costs of water supply, sharing a limited resource, etc.
3. Explain that one way we can use water efficiently is by creating careful, realistic garden designs that make the most of the water we use. Native plant gardens are a beautiful way to create gardens that thrive in our climate all year long and thrive with little, if any, irrigation. Show students a copy of the sample Greater Victoria Native Plant Garden design.
4. Divide students into Native Plant Garden Design teams; alternatively, students can work individually. Tell students that they are going to design a native plant garden for the school. After identifying a site at school, have students read background information on Native Plant Garden Design. (Optional) Make additional resources available to students as noted above and in additional resources.
5. After completing a Native Plant Garden Site Observation Sheet, have each student or group design a native plant garden for their selected site. Each garden design should:
   - Identify the native plant species used in the design;
   - List how any plants selected were used by First Nations (Traditional Ecological Knowledge) and their importance;
   - Identify wildlife habitat created in the design;
   - List water conservation practices used;
   - Identify any special features of the garden.
6. The garden design should be presented on a poster board or paper.

Evaluation



Have students:

- Identify at least three water conservation techniques for outside the home and discuss any implications to their lifestyle.
- Describe the importance of native plants to First Nations and contemporary societies and explain their value.
- Design a Native Plant/ Wildlife Garden.

Extensions

1. Do a soil lab session outside on your school grounds using the Student Soil Test Work Sheet.
2. Select and grow plants for the garden. Students can further their knowledge and skills by growing some of the plants that are in their garden design using the techniques outlined in the Plant Propagation Worksheet. Sample native plant seeds may be obtained from CRD Integrated Water Servicesand grown in the classroom. When plants are grown to a suitable size, they may be transplanted into the school garden or taken home by students to plant in a home garden.
3. Student research different garden styles (meditation, healing, butterfly sanctuary, cuttings, or vegetable or herb).

Community Connections

Students can visit local native plant gardens or take a workshop on gardening with native plants – see the CRD website for dates and times.

Demonstration Gardens:

- CRD Integrated Water Services offices at 479 Island Highway, Victoria, BC.
- Springridge Commons Demonstration Gardens at Fernwood
- Swan Lake Christmas Hill Nature Sanctuary
- Oak Bay Native Plant Garden
- Royal BC Museum
- Glendale Gardens and Woodland

Native Plant Growers:

The following centres specialize in propagating native plants that thrive in our climate:

- Fraser's Thimble Farms, Salt Spring Island **(250) 537-5788**
- Russell Nursery, North Saanich **(250) 656-0384**
- Natural Resource Native Plant Nursery, Duncan **(250) 748-0684**
- Streamside Native Plants, Courtenay **(250) 338-7509**
- Woodgate Native Plant Services, Duncan **(250) 245-7635**
- Yellow Point Propagation, Ladysmith **(250) 748-2558**

Additional Resources:

Go to **https://www.crd.bc.ca/education/natural-gardening** for the following CRD-specific documents:

- Native Plant Resource List
- Native Plants in Moist or Wet Gardens
- Evergreen Native Plants
- Native Plant Ground Covers
- Native Plant Meadow Flowers
- Native Plants for Shady Conditions
- Native Plants for Sunny Conditions
- Native Plants for Sun-Loving Thickets-Hedgerows
- Native Plants for the Seashore
- Some Common Plants of the Garry Oak Ecosystem
- Some Native Plants for Rock Gardens
- Some Native Plants for Woodland Gardens
- Native Plants for Container Gardening

References:

CRD – *A Homeowners Guide to Outdoor Water Use* (CRD Integrated Water Services; 479 Island Highway, Victoria, BC V9B 1H7 **www.crd.bc.ca/water**

CRD – *Native Plants for the Home Garden - South Coastal British Columbia* (CRD Integrated Water Services; 479 Island Highway, Victoria, BC V9B 1H7)

District of Saanich – *Wildflowers and other native plants of Saanich Garry Oak Ecosystems.*

Pettinger, April and B. Costanzo (2002). *Native Plants in the Coastal Garden, (Revised).* Whitecap books, North Vancouver B.C.

Household Guide to Water Efficiency. Canadian Mortgage and Housing Corp. available from CRD Integrated Water Services; 479 Island Highway, Victoria, BC V9B 1H7

Sustaining Water Supply. Environment Canada from **www.ec.gc.ca/WATER/en/manage/effic/e_sustws.htm**

Go for Green from **www.goforgreen.ca/gardening/index.html**

Food Plants of Coastal First Peoples. 1995. by Nancy J. Turner. Royal British Columbia Museum Handbook.

The Provincial Guide: Caring for Wildlife Habitat at Home. Naturescape British Columbia. **www.hctf/naturescape**

Backyard Habitat for Canada's Wildlife Guidebook. Canadian Wildlife Federation. **www.wildeducation.org**

Plants of Coastal British Columbia. Pojar, Jim and A. MacKinnon (eds.). 1994. Lone Pine Press.

Trees, Shrubs, and Flowers to know in British Columbia and Washington. Lyons, C.P. and B. Meriless. 1995. Lone Pine Press.

Design a Native Plant Garden Student Background Information

Site Considerations

What is the size of the site? Is it sunny or shady? What are the soil conditions? Is it level or sloped? Are there existing plants, shrubs or trees that you want to include in your design? What about wildlife – any signs of wildlife visitors? Are there wildlife species that you would like to encourage to come to your garden? Visit the site at different times of day to see how the sun and shadows move across the space. Are there other design considerations such as traffic (people or other), trails, how close the site is to a water supply, or anything else that might affect the garden? Sketch the garden outline and mark existing features in the sketch.

Plan for Wildlife Habitat

To create or enhance wildlife habitat in a garden, think about types of habitat, wildlife, the physical landscape, and local conditions in your area. What type of habitat will work for your garden? — is it woodland, forest edge, wildflower meadow, or pond and marsh? Wildlife habitat areas can be tidy, attractive, and blend easily into adjacent, more traditional gardens. More indigenous or native plants are favoured for habitat projects because they provide natural shelter and food for native wildlife. Plantings are closer together, pruning is less rigid, lawn area is less extensive, and ground cover mulches are left in place. Some insect damage may be evident; however, this is often considered a blessing, as leaf-eating caterpillars will become butterflies. Rather than emphasizing the cultivation of plants only, animal life is also nurtured and enjoyed in a wildlife habitat garden. (The above information was obtained from *Caring for Wildlife at Home* -Naturescape BC 2003)

There are a number of components to consider in a native plant garden design:

- Diversity
- Layering
- Edges
- Native Plant selection
- Water Efficiency.

Diversity - Plan for a good mix of plants

Use a variety of these types of plants to ensure a diverse garden and attract wildlife:

- Evergreen & Deciduous
- Young & Old
- Tall & Short
- Nectar Plants
- Seeds, Nuts, and Berries
- Grasses and Sedges
- Mosses and Lichens.

Layering – Create a variety of layers

Plants in natural areas grow in many layers. This variation in height enhances habitat diversity.

To create layers:

- Place tallest trees at the edge of your garden, in front of these place the smaller deciduous trees, then tall shrubs, lower shrubs, and finally ground cover.
- Locate shade-tolerant shrubs and ground covers underneath taller plants.

Edges

Edges occur where one type of wildlife habitat meets another, such as where trees and shrubs meet a meadow or stream. Edges are beneficial and support a great variety of wildlife – try to create at least two edge habitats in your garden.

Native Plants

Native plants are uniquely adapted to both our wet winters and dry summers and have little dependence on supplemental water during dry weather. They also express the ecology of our region and portray the beauty of our indigenous plant communities. The best habitat for native wildlife includes plants that occur naturally in the region. Native plants are better adapted to local soils, temperature and rainfall. They are also better able to satisfy wildlife needs by providing the right kinds of food, shelter and nesting sites. Indigenous plants usually need less water, pruning, and other maintenance than exotic or imported plants if planted in a suitable location. While some native plant species are readily available, others may be difficult to find. Do not collect plants from the wild. Interference with wild plant populations is often harmful, and the destruction of natural habitat to create backyard habitat is hardly appropriate. (The above information was obtained from Naturescape BC 2003)

The following native food plants of the Coastal Aboriginal Peoples can be planted in the garden:

Lady Fern (*Athyrium filix-femina*)

Licorice Fern (*Polypodium glcyrrhiza*)

Nodding Onion (*Allium cerruum*)

Common Camas (*Cammassia quamash*)*

Cow Parsnip (*Heracleum lanatum*)*

Oregon Grape (*Mahonia aquifolium*)

Hazelnut (*Corylus cornuta*)

Soapberry (*Shepherdia canadensis*)

***these plants can have poisonous parts or can be confused with poisonous plants – use care when planting!**

The scientific names provided in italics are useful when ordering plants from a nursery. Native plants are readily available at the annual Native Plant Sales at Swan Lake Nature Sanctuary.

NAME:

BLOCK:

NATIVE PLANT GARDEN POSTER ASSIGNMENT EVALUATION

CATEGORY	4	3	2	1	Mark:
Attractiveness & Organization	Format is exceptionally attractive & information is well organized.	Format is attractive & information is well organized.	The poster has well-organized information.	Format and organization of material are confusing to the reader.	______
Research Skills & References	Three or more reliable references are cited.	Only two references are cited.	Only one reference is cited.	References are not cited.	______
Content: Accuracy & Quality	All facts in the poster are accurate.	99-90% of the facts in the poster are accurate.	89-80% of the facts in the poster are accurate.	Fewer than 80% of the facts in the poster are accurate.	______
Quantity of Information	All topics are addressed in full.	One topic is incomplete or missing.	Two topics are incomplete or missing.	Three or more topics are missing.	______

NAME:

BLOCK:

NATIVE PLANT GARDEN POSTER

ASSIGNMENT INSTRUCTIONS

Your task is to use your notes, the Internet, and the information provided below and in class to research and design a garden using native plants with the aim of using water-efficient garden design principles and creating wildlife habitat. Your goal is to present accurate information and illustrations/graphics about your chosen design. You may choose to complete this assignment in a small group or individually.

TIPS FOR GARDEN DESIGN

Content: Select plants and animals that you want to include in your garden from the material provided and your own research. Describe the garden features in a clear, concise way (both graphic and text) with information from accurate sources. Posters should:

- Identify the native plant species used in the design;
- List how any plants selected were used by First Nations (Traditional Ecological Knowledge) and their importance;
- Identify wildlife habitat created in the design;
- List water conservation practices used; and
- Identify any special features of the garden.

Make your design visually interesting and engaging.

REFERENCES: Include three or more reliable references.

FORMAT

You are required to organize your information in a poster format. This can be done by hand or on the computer if you have a suitable program on your own personal computer.

EVALUATION

Your poster will be evaluated based on these four criteria:

1. Attractiveness and Organization
2. Research Skills and References
3. Accuracy and Quality of information
4. Quantity of information.

Name:	Block:

Water Efficient & Water Wasting Garden Practices

1. List examples "*water efficient*" versus "*water wasting*" practices in and around the garden or outside your home:

Water Efficient	Water Wasting

2. What do you know about native plants that live in your area? List as many plants as you can (use common or scientific name).

NAME:	BLOCK:

NATIVE PLANT GARDEN SITE OBSERVATION SHEET

SCHOOL:		DATE:
DESIGN TEAM MEMBERS:		BRIEF SITE DESCRIPTION:
SITE CONDITIONS:	TEMPERATURE:	CLOUD COVER:
	TIME OF DAY:	SUN OR SHADE?
LOCATION OF WATER SUPPLY:		SPECIAL FEATURES (INCLUDE WILDLIFE):

Draw the site here. Include site dimensions (m) and surface area (m^2); orientation (where is north?); existing plants or features, and make note of any hills or slopes.

Name: | **Block:**

Native Plant Garden Soil Test

Soil is a crucial part of the garden. Different soils hold different amounts of water and nutrients. The sandier the soil, the more freely water runs through, so a sandy garden needs watering more often. A soil that is richer in clay holds water more easily. Soils must also contain sufficient amounts of organic matter and minerals to provide nutrients to garden plants. Find out what is in your garden site's soil by using this simple test. The ideal soil mixture for the average garden is 50% sand; 20% silt, 10% clay, and 10% organic matter. Try the following test to find out how much sand, silt and clay there is in your garden soil. This test takes two days. Organic matter is not measured with this test, as it can only be measured in specialized laboratories.

Materials:

- 1 litre jar with lid
- 250 ml of soil (air dried)
- 1 felt-tipped marker
- 1 teaspoon (tsp) plain (low-sudsing) detergent
- Tap water (approx. 750 mls)

Procedure:

1. Put all ingredients into the jar and shake the mixture hard for two minutes then let it sit for one minute. Mark the level (on the jar) of the material that has settled to the bottom of your jar. This is the sand.
2. Let the jar sit for another two hours and mark the level again. This layer is the silt.
3. Leave the last layer to settle for two days. This layer is the clay.
4. Measure the individual layers and you can calculate the particle make-up of your soil. For example, if the total height of the settled soil is 10 cm and the sand is 2 cm, the silt is 3 cm and the clay is 5 cm, your soil is 20% sand; 30% silt, and 50% clay.

Brief Site Description of where Soil Was Taken:	**Date:**

Draw your jar & label your results (% sand, % silt, % clay).

NAME:

BLOCK:

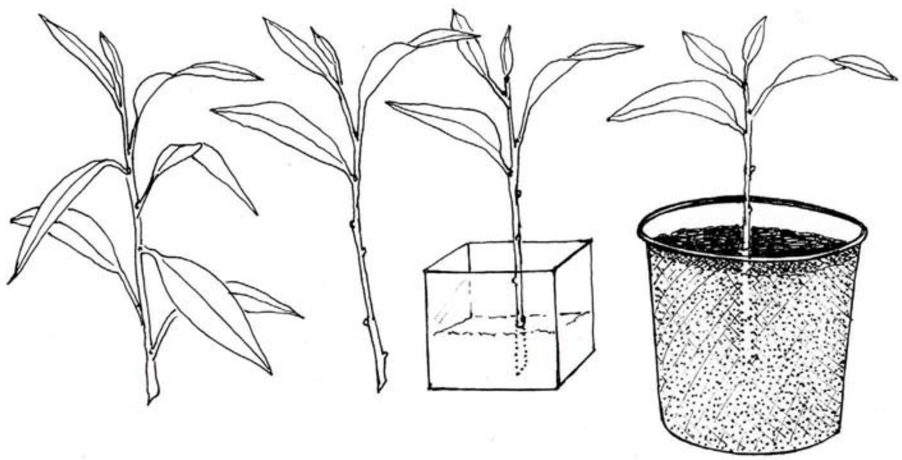
PROPAGATING PLANTS FOR YOUR NATIVE PLANT GARDEN

Propagating native plants from cuttings is not difficult. Many people get hooked on the challenge of starting a wide variety of plants from cuttings.

- Softwood cuttings - cuttings from succulent new growth, can be taken in the Spring until late Summer.
- Semi-hardwood cuttings - cuttings taken after a new growth flush, from wood that will snap when bent sharply, are usually taken in summer or early Fall.
- Hardwood cuttings - cuttings taken from growth that will not snap when bent sharply, are best taken during the Fall to Spring from dormant wood.

MATERIALS:

- small plant pots in nursery flats (nurseries may donate new or used pots)
- rooting hormone
- disposable plastic gloves
- pruners or scissors
- rooting medium
- potting soil
- clear plastic bags & twist ties.



PROCEDURE:

1. Take soft or semi-hardwood cuttings just below a leaf. Cut a length approx. 11 cm long. Don't let the cut tip dry out.
2. Strip off the lower half of leaves.
3. Dip lower tip (approx 1/2 cm) into rooting hormone, tap excess powder back into rooting hormone container.
4. Plant into a rooting medium which is half sand - half peat moss or half-and-half perlite and peat moss. The rooting medium must drain well.
5. Water regularly and keep in a warm area but out of direct sunlight to avoid drying out.
6. To increase humidity for your cuttings place container with several cuttings into a clear plastic bag and tie the bag at the top.
7. Open bag every day or two for a few minutes to the change air.
8. Keep a lookout for new growth - you can be pretty sure your cuttings have rooted once new growth is seen.
9. Carefully loosen rooting medium so as not to disturb root hairs and transplant into a new container of soil. Take care not to let roots dry out. Place in a sunnier spot.
10. Pencil-thin cuttings are generally most successful for hardwood cuttings.

11. Cut hardwood cuttings approx. 16-24 cm long with approx. 6 buds each. In order to tell the top from the bottom, cut the bottom straight across below a leaf bud and the top at an angle just above a leaf bud.
12. Dip the lower ends in rooting hormone, tap off excess.
13. Lay your leafless stick bundles down sideways in rooting medium about 6-9 cm below the surface.
14. Water.
15. Place in a refrigerator or outside where it is cool but avoid letting them freeze by covering with mulch.
16. As spring approaches dig them out and plant in open ground or in containers in indirect light.

ROOT CUTTINGS: Any plant that will grow new shoots from the roots can be started by root cuttings.

17. Select roots that are between 1/2 - 1cm thick.
18. Cut the roots into pieces 3-8 cm long.
19. Lay flat in half and half soil/sand potting mix and cover with approx 21/2 cm of the same. Or poke down into a pot vertically.
20. Water and wait for new plant growth, then transplant.

The Water News

Key Concepts

- Responsibility for water is everyone's concern.
- Sustainability of watershed ecosystems in Greater Victoria is influenced by actions we take in our everyday lives.
- A variety of factors will influence water quality and quantity trends into the future.

Method

In small groups, students will produce a student magazine or other media on local water issues.

Activity Information Box:

Time Required: 150 minutes in class plus student research time

Grade Level: Grades 8-10

Key Words: *water related issues*

Materials:

- a variety of local and regional newspapers, media, Internet and other information resources
- computer lab time

Setting: indoors

Skills: gathering information, analysis, presenting information

Subjects: Science 8-10
Social Studies 8-10

Learning Outcomes:

It is expected that the student will:

- Describe a variety of water-related issues in their local or regional area;
- Apply skills to research, write, present information on local water issues.

Background

Water is in the news through print, television, Internet and other media on an ongoing basis. We watch and read media about storms, droughts, water supply and conservation issues – to name a few. Students are often exposed in the major media to world-wide campaigns for various causes or stories about issues far away. This can give students the impression that active, committed people or important stories cannot be found near their homes and schools. In fact, there are many people working on water related issues in Greater Victoria and these stories can be found locally.

Media such as a magazine or other news source is a collective effort of many people – each with a role and skill set. Assembling a magazine or other media pulls together a diverse number of tasks including research, interviewing, writing, photography, graphic design, editing and production. Magazines, for example, are usually divided into sections such as Cover stories/Key features, Arts and Life, Commentary, News Briefs, or other relevant sections.

In this activity, you can choose to focus on one or more aspects of pulling together a "*Water News*" while tapping into student strengths. Students can create:

- Magazine articles
- PowerPoint® presentations
- Visual collages
- Drawings
- Comic strips
- Posters
- Games
- Video.

All "*Water News*" projects must demonstrate appropriate research, knowledge of the issue(s), and have the message conveyed successfully. By creating a magazine or other media on local water topics, students can describe important local water issues and apply their skills to share that information with others.

Procedure

1. Have students read several magazines or newspapers with short articles on a water topic.
2. Tell students that they are going to develop a project on local water-related issues.
3. Discuss with students what they think makes a good presentation of "news."
4. Brainstorm topics related to local water issues and select five or more topics that interest students the most. Use the sections listed above in the Background to ensure that water issues are covered from a variety of perspectives.
5. Divide students into groups for each of the topics selected. Each group should decide on the type of media (article, PowerPoint, collage, etc.) that they wish to use.
6. Discuss with students how to research a topic. Remind students that the approach will be to seek and gather information using the traditional "who, what, where, why, when, and how" style. This research will then be used to create their media presentation.
7. Some students may wish to interview "sources." Review interview techniques with students. See side bar on the following page for some interviewing tips.
8. Allow 3-5 (or more) classes for researching and developing articles. Remind students that magazines are always produced to deadline!

9. Reserve computer time to put articles or other media in good copy and incorporate graphics. Each group is responsible for their own graphics – stress the use of digital cameras and original photographs.

10. Publish the "Water News" and distribute to school and community. Consider publishing an "e-zine" to minimize paper waste. Visual media can be scanned together with written work.

11. Have a class discussion on how it felt to pull together the Water News - what were the challenges and successes?

EVALUATION

Have students:

- List at least four water-related local or regional topics;
- Act collaboratively within their group;
- Participate in the creation of a "Water News".

EXTENSIONS

Invite a local TV or newspaper reporter into the classroom to speak to the students. The reporter should discuss the techniques he/she uses to gather information and the process of putting together a news article.

COMMUNITY CONNECTIONS

Send your Water News to the CRD Integrated Water Services Department or local politicians and invite them to provide comments.

ADDITIONAL RESOURCES

Learning Blog NY Times. Questions built in for classroom use.

http://learning.blogs.nytimes.com

Project WILD – activity "*Aquatic Times*" page 310

INTERVIEWING TIPS:

- Prepare for your interview:
  - *Call ahead to schedule interview.*
  - *Do background research on your interviewee.*
  - *Plan your interview – come up with a set of questions you want to ask focusing on who, what, where, why, when, and how.*
  - *Practice asking questions prior to the interview.*
  - *Dress with respect for your interviewee.*
- Gather information for your article using your questions and take careful notes and/or ask permission to tape record the interview.
- Thank the person for taking the time to share his/her story.

NAME:

BLOCK:

WATER NEWS ASSIGNMENT EVALUATION

CATEGORY	Exceptional	Admirable	Acceptable	Amateur	Mark:
Organization	Extremely well organized; logical format that was easy to follow; flowed smoothly from one idea to another and cleverly conveyed; the organization enhanced the effectiveness of the project.	Presented in a thoughtful manner; there were signs of organization and most transitions were easy to follow, but at times ideas were unclear.	Somewhat organized; ideas were not presented coherently and transitions were not always smooth, which at times distracted the audience.	Choppy and confusing; format was difficult to follow; transitions of ideas were abrupt and seriously distracted the audience.	________
Content Accuracy	Completely accurate; all facts were precise and explicit.	Mostly accurate; a few inconsistencies or errors in information.	Somewhat accurate; more than a few inconsistencies or errors in information.	Completely inaccurate; the facts in this project were misleading to the audience.	________
Research	Went above and beyond to research information; solicited material in addition to what was provided; brought in personal ideas and information to enhance project.	Did a very good job of researching; utilized materials provided to their full potential; at times took the initiative to find information outside of school.	Used the material provided in an acceptable manner, but did not consult any additional resources.	Did not utilize resources effectively; did little or no fact gathering on the topic.	________
Creativity	Was extremely clever and presented with originality; a unique approach that truly enhanced the project.	Was clever at times; thoughtfully and uniquely presented.	Added a few original touches to enhance the project but did not incorporate it throughout.	Little creative energy used during this project; was bland, predictable, and lacked "zip."	________

CELEBRATING WATER!

THERE ARE MANY REASONS TO CELEBRATE WATER AND ITS MEANING IN OUR LIVES. Water connects us to our environment. It can connect us to each other, it can be a source of learning and fun and, through actions to sustain water resources, it can empower us as we work for a positive future. This section is intended to give ideas and inspiration on how to celebrate water – in all its meanings – in your classroom, school, and community. These ideas may serve as a way to bring closure to your water unit.

"Water flows over these hands.
May I use them skilfully
to preserve our precious planet."
- Thich Nhat Hanh

"Water is life; and Water is sacred; Water is the life breath of the Creator."
- Darlene Sanderson

"We're all downstream."
- Margaret and Jim Drescher

Some ways to celebrate the learning of your students:

- Hold an open house on water in your school to showcase student work. Ask CRD Integrated Water Services Department for a display board and/or staff to attend your Open House.
- Take your students to the Victoria Home Show and look at models of new water efficient technologies. Then, back at the classroom, research interesting new technologies that you saw.
- Take the "Two Litre" challenge. Ask students to bring in two litre pop bottles and stack them up in a display that represents water consumption per person per day around the world. See how Canada stacks up compared to other countries.
- Create an interpretive dance on water.
- Join the River of Words poetry contest with your class at www.riverofwords.org
- Make a chart that compares and contrasts how different cultures around the world use water. Give each student a Water Wise Award Certificate for completing their water studies.
- Organize a writing contest on Water and send the finalist's essay to the CRD Regional Water Supply Commission.
- Produce a video or a multi-media presentation on water in your community. Present it to your local council, school board, or at parent teacher night.
- Put a "We Made a Difference" ad in your local paper.
- Submit a summary of your water studies from your class or school for CRD Integrated Water Services to showcase.
- Post student work on your school's website or on a class blog.
- Have students create a game of "Water Jeopardy" and play it.
- Partner with the Royal Roads, University of Victoria or other college or university environmental studies departments for student mentoring.
- Ask the local radio or TV station if your students can do a short presentation on Water on their local news show.
- Post water posters in school corridors.
- Give a "Watershed Pizza" (one with locally grown toppings) reward for excellence in student work.
- Have a "Water Fair" and invite parents, politicians, and other classes to the Fair. Give student participants a certificate for their work.

References

Present Moment, Wonderful moment. Thich Nhat Hanh *Water Works Journal*, Vol. 5: Celebrating Water **www.nationalwatercenter.org**

Darlene Sanderson. *Our Waters, Our Responsibility: Indigenous Water Rights Forum.* Pinewa, Manitoba, May 13-16, 2004

Margaret and Jim Drescher. *Water: The fate of our most precious resource.* (2nd edition). By Marq. D. Villiers, 2003. Houghton Mifflin Publis

APPENDICES

Appendix A: Prescribed Learning Outcomes Grades 8-12

Lesson	Science 8	Science 9	Science 10
Water Wise in Greater Victoria	Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Describe the relationship between scientific principles and technology; Describe how water and ice shape the landscape; Describe factors that affect productivity and species distribution in aquatic environments; Demonstrate knowledge of the characteristics of living things;	Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Describe the relationship between scientific principles and technology;	Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Describe the relationship between scientific principles and technology; Describe the interaction of abiotic and biotic factors within an ecosystem; Explain various ways in which natural populations are altered or kept in equilibrium;
The Ways of Water	Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour;	Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour;	Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour;
The Water Cycle in Greater Victoria	Demonstrate ethical, responsible, cooperative behaviour; Describe how water and ice shape the landscape; Describe factors that affect productivity and species distribution in aquatic environments;	Demonstrate safe procedures; Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Describe the relationship between scientific principles and technology;	Demonstrate safe procedures; Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Describe the relationship between scientific principles and technology; Describe the interaction of abiotic and biotic factors within an ecosystem; Explain various ways in which natural populations are altered or kept in equilibrium;

Lesson	Science 8	Science 9	Science 10
Plants and Animals of the Sooke Reservoir Watershed	Represent and interpret information in graphic form; Use models to explain how systems operate; Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Demonstrate competence in the use of technologies specific to investigative procedures and research; Describe factors that affect productivity and species distribution in aquatic environments; Demonstrate knowledge of the characteristics of living things;	Represent and interpret information in graphic form; Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Demonstrate competence in the use of technologies specific to investigative procedures and research;	Represent and interpret information in graphic form; Demonstrate scientific literacy; Demonstrate competence in the use of technologies specific to investigative procedures and research; Describe the interaction of abiotic and biotic factors within an ecosystem; Assess the potential impacts of bioaccumulation; Explain various ways in which natural populations are altered or kept in equilibrium;
The Clean Water Factory	Demonstrate safe procedures; Perform experiments using the scientific method; Use models to explain how systems operate; Demonstrate ethical, responsible, cooperative behaviour; Describe the relationship between scientific principles and technology; Describe how water and ice shape the landscape; Describe factors that affect productivity and species distribution in aquatic environments; Demonstrate knowledge of the characteristics of living things;	Demonstrate safe procedures; Perform experiments using the scientific method; Demonstrate ethical, responsible, cooperative behaviour; Describe the relationship between scientific principles and technology;	Represent and interpret information in graphic form; Demonstrate scientific literacy; Demonstrate competence in the use of technologies specific to investigative procedures and research;
Greater Victoria Water: From Source to Tap	Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Recognize similarities between natural and constructed fluid systems;	Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Demonstrate competence in the use of technologies specific to investigative procedures and research;	Demonstrate scientific literacy; Explain various ways in which natural populations are altered or kept in equilibrium;

Lesson	Science 8	Science 9	Science 10
Water Treatment in Greater Victoria	Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Recognize similarities between natural and constructed fluid systems Demonstrate knowledge of the characteristics of living things;	Demonstrate safe procedures; Perform experiments using the scientific method; Represent and interpret information in graphic form; Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Describe the relationship between scientific principles and technology; Demonstrate competence in the use of technologies specific to investigative procedures and research;	Demonstrate safe procedures; Perform experiments using the scientific method; Represent and interpret information in graphic form; Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Describe the relationship between scientific principles and technology; Demonstrate competence in the use of technologies specific to investigative procedures and research; Describe the interaction of abiotic and biotic factors within an ecosystem; Assess the potential impacts of bioaccumulation; Explain various ways in which natural populations are altered or kept in equilibrium;
Decisions, decisions: Tap or Bottled Water?	Demonstrate safe procedures; Perform experiments using the scientific method; Represent and interpret information in graphic form;	Demonstrate safe procedures; Demonstrate scientific literacy;	Demonstrate safe procedures;
Water Monitoring Around the World	Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Describe the relationship between scientific principles and technology; Describe how water and ice shape the landscape; Describe factors that affect productivity and species distribution in aquatic environments; Demonstrate knowledge of the characteristics of living things;	Demonstrate safe procedures; Perform experiments using the scientific method; Represent and interpret information in graphic form; Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Describe the relationship between scientific principles and technology; Demonstrate competence in the use of technologies specific to investigative procedures and research;	Demonstrate safe procedures; Demonstrate competence in the use of technologies specific to investigative procedures and research; Explain various ways in which natural populations are altered or kept in equilibrium;

LESSON	SCIENCE 8	SCIENCE 9	SCIENCE 10
LAKE AT STAKE	Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Describe factors that affect productivity and species distribution in aquatic environments;	Represent and interpret information in graphic form; Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Describe the relationship between scientific principles and technology; Demonstrate competence in the use of technologies specific to investigative procedures and research;	Represent and interpret information in graphic form; Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour;
WATER TODAY AND TOMORROW	Demonstrate ethical, responsible, cooperative behaviour; Describe the relationship between scientific principles and technology;	Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Describe the relationship between scientific principles and technology;	Evaluate possible causes of climate change and its impact on natural systems;
WATER AND CLIMATE CHANGE	Demonstrate scientific literacy; Describe how water and ice shape the landscape; Describe factors that affect productivity and species distribution in aquatic environments; Demonstrate knowledge of the characteristics of living things;	Represent and interpret information in graphic form; Describe the relationship between scientific principles and technology;	Represent and interpret information in graphic form; Evaluate possible causes of climate change and its impact on natural systems;
NEW WAYS FOR WATER EFFICIENCY	Demonstrate ethical, responsible, cooperative behaviour; Describe the relationship between scientific principles and technology;	Represent and interpret information in graphic form; Demonstrate scientific literacy; Describe the relationship between scientific principles and technology;	Represent and interpret information in graphic form; Evaluate possible causes of climate change and its impact on natural systems;
DESIGN A NATIVE PLANT GARDEN	Describe factors that affect productivity and species distribution in aquatic environments; Demonstrate knowledge of the characteristics of living things;	Represent and interpret information in graphic form; Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Describe the relationship between scientific principles and technology; Demonstrate competence in the use of technologies specific to investigative procedures and research;	Represent and interpret information in graphic form; Evaluate possible causes of climate change and its impact on natural systems; Explain various ways in which natural populations are altered or kept in equilibrium;

LESSON	SCIENCE 8	SCIENCE 9	SCIENCE 10
THE WATER NEWS	Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Describe factors that affect productivity and species distribution in aquatic environments;	Represent and interpret information in graphic form; Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Describe the relationship between scientific principles and technology; Demonstrate competence in the use of technologies specific to investigative procedures and research;	Represent and interpret information in graphic form; Demonstrate scientific literacy; Demonstrate ethical, responsible, cooperative behaviour; Describe the relationship between scientific principles and technology; Demonstrate competence in the use of technologies specific to investigative procedures and research; Describe the interaction of abiotic and biotic factors within an ecosystem; Assess the potential impacts of bioaccumulation; Explain various ways in which natural populations are altered or kept in equilibrium;

LESSON	EARTH SCIENCE 11, GEOLOGY 12	BIOLOGY 11, 12	CHEMISTRY 11, 12	RESOURCE SCIENCE 11,12	SCIENCE & TECHNOLOGY 11
WATER WISE IN GREATER VICTORIA	Describe the function of the hydrologic cycle; Relate the processes associated with weathering and erosion to the resulting features; Analyse features and processes associated with weathering and erosion; Analyse features and processes associated with stream erosion and deposition; Evaluate the importance of ground water;	Interpret data from a variety of text and visual sources; Analyse the functional inter-relationships of organisms within an ecosystem; Describe the characteristics of water and its role in biological systems;		Describe factors affecting forest-use decisions; Demonstrate awareness of a variety of perspectives and values related to forests and forest use; Demonstrate awareness of and appreciation for Aboriginal peoples' relationship with the forest in British Columbia; Assess the importance of forests to British Columbians; Describe processes in and components of ecosystems; Demonstrate awareness of forests as complex ecosystems; Describe the roles that fungi, microbes, and lichens play in a forest ecosystem; Define structural diversity and biological diversity; Assess the effects of natural and human forces on the forest; Describe a variety of food chains and food webs;	Identify resources used in B.C. and the costs and benefits of their use; Describe the technological advances in the use and management of resources over the past 100 years; Describe how supply and demand create stress on particular resources; Analyze the economic significance of our resources in the context of political and ecological concerns; Identify, compare, or analyze techniques used to extract resources from their natural location;
THE WAYS OF WATER					

LESSON	EARTH SCIENCE 11, GEOLOGY 12	BIOLOGY 11, 12	CHEMISTRY 11, 12	RESOURCE SCIENCE 11,12	SCIENCE & TECHNOLOGY 11
THE WATER CYCLE IN GREATER VICTORIA	Describe the function of the hydrologic cycle; Relate the processes associated with weathering and erosion to the resulting features; Analyse features and processes associated with weathering and erosion; Analyse features and processes associated with stream erosion and deposition; Evaluate the importance of ground water;				Describe the types of pollutants that influence air, land, and water; Describe the effects and possible solutions to various sources of pollution;
PLANTS AND ANIMALS OF THE SOOKE RESERVOIR WATERSHED		Interpret data from a variety of text and visual sources; Analyse the functional inter-relationships of organisms within an ecosystem; Describe the characteristics of water and its role in biological systems;		Describe processes in and components of ecosystems; Demonstrate awareness of forests as complex ecosystems; Describe the roles that fungi, microbes, and lichens play in a forest ecosystem; Identify a variety of local animal species and their habitat requirements; Describe factors affecting local animal populations and behaviours; Demonstrate awareness of the social and economic value of forest animals; Identify agents that have an impact on forest health;	Identify resources used in B.C. and the costs and benefits of their use;

Lesson	Earth Science 11, Geology 12	Biology 11, 12	Chemistry 11, 12	Resource Science 11,12	Science & Technology 11
The Clean Water Factory	Relate the processes associated with weathering and erosion to the resulting features; Analyse features and processes associated with weathering and erosion; Analyse features and processes associated with stream erosion and deposition; Evaluate the importance of ground water; Explain the processes and features associated with glaciation;	Interpret data from a variety of text and visual sources; Analyse the functional inter-relationships of organisms within an ecosystem; Describe the characteristics of water and its role in biological systems;	Demonstrate appropriate safety techniques and proper use of protective equipment; Demonstrate skills in measuring and in recording data; Communicate results and data in clear and understandable forms;		
Greater Victoria Water: From Source to Tap		Analyse the functional inter-relationships of organisms within an ecosystem; Describe the characteristics of water and its role in biological systems;		Describe the technological advances in the use and management of resources over the past 100 years; Describe how supply and demand create stress on particular resources;	
Water Treatment in Greater Victoria		Analyse the functional inter-relationships of organisms within an ecosystem; Describe the characteristics of water and its role in biological systems;			
Decisions, decisions: Tap or Bottled Water?					

Lesson	Earth Science 11, Geology 12	Biology 11, 12	Chemistry 11, 12	Resource Science 11,12	Science & Technology 11
Water Monitoring Around the World		Demonstrate safe and correct technique for a variety of laboratory procedures; Interpret data from a variety of text and visual sources; Apply the Kingdom system of classification to study the diversity of organisms; Analyse the functional inter-relationships of organisms within an ecosystem; Describe the characteristics of water and its role in biological systems;	Demonstrate appropriate safety techniques and proper use of protective equipment; Demonstrate skills in measuring and in recording data; Communicate results and data in clear and understandable forms;		
Lake at Stake		Analyse the functional inter-relationships of organisms within an ecosystem;		Describe factors affecting forest-use decisions; Demonstrate awareness of a variety of perspectives and values related to forests and forest use; Demonstrate awareness of and appreciation for Aboriginal peoples' relationship with the forest in British Columbia; Compare historical and current forest practices; Assess the importance of forests to British Columbians;	

Lesson	Earth Science 11, Geology 12	Biology 11, 12	Chemistry 11, 12	Resource Science 11,12	Science & Technology 11
Water Today and Tomorrow					Describe how supply and demand create stress on particular resources; Analyse the economic significance of our resources in the context of political and ecological concerns; Identify, compare, or analyze techniques used to extract resources from their natural location;
Water and Climate Change					
New Ways for Water Efficiency					Describe the interactions of technology and society in the historical development of specific waste management technology; Relate individual and community responsibilities to societal waste problems;
Design a Native Plant Garden					Describe how supply and demand create stress on particular resources; Analyse the economic significance of our resources in the context of political and ecological concerns; Identify, compare, or analyze techniques used to extract resources from their natural location;
The Water News					

Appendix B: Community Connections

Use the following table to find maps and listings of streams nearby your school. Please note that when planning a field study to a stream that student safety and protection of these sensitive ecosystems are paramount. If you have questions about the suitability of a particular stream field study site, contact your local Streamkeepers for assistance.

School District #61 – Greater Victoria

	Number on Map	Map Name	Streams & Parks Nearby
Middle Schools			
Arbutus Middle	1	Saanich – South Watersheds	Bowker Creek, Hobbs Creek, Goward Park, Lambrick Park, Cadboro Gyro Park
Central Middle	2	Victoria Watersheds	Stadacona Park, Central Park, Beacon Hill Park, Hollywood Park, Ross Bay Cemetary
Cedar Hill Middle	3	Saanich – South Watersheds	Bowker Creek, Big Barn Creek, Cedar Hill Park, Feltham Park, Braefoot Park, Mount Tolmie Park, Lambrick Park, Reynolds Park, Playfair Park
Colquitz Middle	4	Saanich – South Watersheds	Colquitz River, Swan Creek, Colquitz Park, Cuthbert Holmes Park, Hampton Park, Swan Creek Park, Tillicum Park, Hyacinth Park, Glanford Park, Marigold Park, Swan Lake Nature Sanctuary
Glanford Middle	5	Saanich – South Watersheds	Colquitz River, Swan Creek, Durrell Creek, Gabo Creek, Baxter Park, Glanford Park, Christmas Hill Park, Christmas Hill Nature Sanctuary, Colquitz Park, Panama Hill Park, Copley West Park, , Hyacinth Park, Swan Creek Park, Rithet's Bog Conservation Area, Beckwith Park
Gordon Head Middle	6	Saanich – South Watersheds	Douglas Creek, Cumberland Brook, Big Barn Creek, Lambrick Park, Tyndall Park, Mount Douglas Park, Feltham Park
Landsdown Middle	7	Victoria Watersheds	Bowker Creek, Carnarvon Park, Oaklands Park, Cedar Hill Park, Mount Tolmie Park, Henderson Park
Monterey Middle	8	Victoria Watersheds	Bowker Creek, Windsor Park, Anderson Hill Park, Mary Tod Island
Rockheights Middle	9	Victoria Watersheds	Gorge Creek, Highrock Park, Bullen Park, Esquimalt Gorge Park, West-song Walkway, Saxe Point Park
Shoreline Middle	10	Colwood – Langford Watersheds	Craigflower Creek, Hospital Creek, Colquitz River, Portage Park, Helmcken Centennial Park, View Royal Park, Knockan Hill Park
Secondary Schools			
Esquimalt High	11	Victoria Watersheds	Gorge Creek, Cecelia Creek, Banfield Park, Highrock Park, Esquimalt Gorge Park, West-song Walkway, Gorge Park, Vic West Park, Bullen Park, Tillicum Park
Lambrick Park Secondary	12	Saanich – South Watersheds	Douglas Creek, Bowker Creek, Cumberland Brook, Big Barn Creek, Lambrick Park, Tyndall Park, Feltham Park, Mount Douglas Park, Braefoot Park

Mount Douglas Secondary	13	Saanich – South Watersheds	Bowker Creek, Lambrick Park, Tyndall Park, Feltham Park, Mount Tolmie Park
Oak Bay High	14	Victoria Watersheds	Bowker Creek, Carnarvon Park, Windsor Park, Mary Tod Island, Uplands Park, Cattle Point
Reynolds Secondary	15	Saanich – South Watersheds	Blenkinsop Creek, Big Barn Creek, Cumberland Brook, Reynolds Park, Playfair Park, Swan Lake Nature Sanctuary, Braefoot Park, Cedar Hill Park, Christmas Hill Nature Sanctuary, Christmas Hill Park, Feltham Park, Blenkinsop Lake Park
Spectrum Community	16	Saanich – South Watersheds	Colquitz River, Peers Creek, Cuthbert Holmes Park, Marigold Park, Colquitz Park, Tillicum Park, Hyacinth Park, Swan Creek Park, Knockan Hill Park, Hampton Park, Panama Hill Park
Victoria High	17	Victoria Watersheds	Stadacona Park, Central Park, Oaklands Park

School District #62 – Sooke

	Number on Map	Map Name	Streams & Parks Nearby
Middle Schools			
Journey Middle	18	Sooke Watersheds	DeMamiel Creek, Sooke River, Throup Road Park, Sooke Flats, Fred Milne Play Field, Murray Road Park
Dunsmuir Middle	19	Colwood – Langford Watersheds	Selleck Creek, Bee Creek, Hatley Park National Historic Site, Oceanview Park, Perimeter Park 3, Royal Roads Park, Esquimalt Lagoon Park, Havenwood Park
Spencer Middle	20	Colwood – Langford Watersheds	Millstream, Colwood Creek, Centennial Park
Secondary Schools			
Belmont Secondary	21	Colwood – Langford Watersheds	Colwood Creek, Galloping Goose Regional Trail, Colwood Creek Park, Centennial Park,
Edward Milne Community School	22	Sooke Watersheds	Sooke River, De Mamiel Creek, Lannon Creek, Saseenos Creek, Fred Milne Play Field, Galloping Goose Regional Trail , Sooke Flats, Throup Road Park
Pacific Secondary	23	Colwood – Langford Watersheds	Colwood Creek, Millstream, Galloping Goose Regional Trail, Hatley Park National Historic Site, Mill Hill Regional Park

School District #63 –Saanich

	Number on Map	Map Name	Streams & Parks Nearby
Middle Schools			
Bayside Middle	24	Central Saanich Watersheds	Tod Creek, Graham Creek, Gore Park, Oak Haven Park, Gowlland Tod Provincial Park
Saanich Middle	25	North Saanich Watersheds	Blue Heron Creek, Blue Heron Park, McDonald Park (part of Gulf Islands National Park Reserve)
Royal Oak Middle	26	Saanich – South Watersheds	Colquitz River, Normandy Creek, Gabo Creek, Beaverdale Creek, Quick's Bottom Park, Colquitz Park, Commonwealth Place, Rithet's Bog Conservation Area, Shadywood Park, Elk/Beaver Lake Regional Park, Layritz Park, Boulderwood Hill Park, Copley West Park
Secondary Schools			
Claremont Secondary	27	Saanich – North Watersheds	Doumac Park, McMinn Park, Boulderwood Hill Park, Sayward Hill Park, Elk/Beaver Lake Regional Park
Parkland Secondary	28	North Saanich Watersheds	Blue Heron Creek, Blue Heron Park, McDonald Park (part of Gulf Islands National Park Reserve), Horth Hill Regional Park
Stellys Secondary	29	Central Saanich Watersheds	Graham Creek, Hagan Creek, Centennial Park

Independent Schools

	Number on Map	Map Name	Streams & Parks Nearby
Cathedral	30	Victoria Watersheds	Beacon Hill Park, Central Park, Stadacona Park
Continuing Ed SD 61	31	Victoria Watersheds	Cecelia Creek, Bowker Creek, Topaz Park, Summit Park, Central Park, Cedar Hill Park
Discovery	32	Victoria Watersheds	Bowker Creek, Oaklands Park, Stadacona Park, Carnarvon Park, Central Park, Summit Park, Cedar Hill Park
Glenlyon-Norfolk - Jr Boys	33	Victoria Watersheds	Bowker Creek, Windsor Park, Mary Tod Island, Cattle Point, Carnarvon Park, Uplands Park
Glenlyon-Norfolk - Jr Girls	34	Victoria Watersheds	Bowker Creek, Hollywood Park, Stadacona Park, Ross Bay Cemetary
Glenlyon-Norfolk Sr	35	Victoria Watersheds	Bowker Creek, Hollywood Park, Stadacona Park, Ross Bay Cemetary
Lighthouse Christian Academy	36	Colwood – Langford Watersheds	Colwood Creek, Galloping Goose Regional Trail, Mount Wells Regional Park
Maria Montessori Academy	37	Saanich – South Watersheds	Colquitz River, Peers Creek, Durrell Creek, Gabo Creek, Rosedale Park, Colquitz Park, Knockan Hill Park, Panama Hill Park, Strawberry Knoll Park, Marigold Park, Hyacinth Park, Swan Creek Park, Copley West Park, Layritz Park

Pacific Christian	38	Saanich – South Watersheds	Swan Creek, Blenkinsop Creek, Colquitz River, Gabo Creek, Christmas Hill Park, Glanford Park, Christmas Hill Nature Sanctuary, Baxter Park, Swan Lake Nature Sanctuary, Swan Creek Park, Beckwith Park, Hyacinth Park, Colquitz Park, Panama Hill Park, Colquitz Park
S J Willis Alternative	39	Victoria Watersheds	Cecelia Creek, Bowker Creek, Topaz Park, Summit Park, Central Park, Cedar Hill Park
Saanich Storefront Alternate	40	North Saanich Watersheds	Iroquois Park, Tulista Park
Safe Harbour Christian	41	Victoria Watersheds	Gorge Creek, Cecelia Creek, Esquimalt Gorge Park, Gorge Park, Banfield Park, Highrock Park, West-song Walkway, Tillicum Park
South Island Distance Education	42	Saanich – South Watersheds	Colquitz River, Normandy Creek, Gabo Creek, Beaverdale Creek, Quick's Bottom Park, Colquitz Park, Commonwealth Place, Rithet's Bog Conservation Area, Shadywood Park, Elk/Beaver Lake Regional Park, Layritz Park, Boulderwood Hill Park, Copley West Park
St Andrews Regional High	43	Saanich – South Watersheds	Blenkinsop Creek, Swan Creek, Cumberland Brook, Big Barn Creek, Colquitz Creek, Gabo Creek, Swan Lake Nature Sanctuary, Christmas Hill Nature Sanctuary, Christmas Hill Park, Glanford Park, Baxter Park, Playfair Park, Reynolds Park, Beckwith Park,
St Margaret's	44	Saanich – South Watersheds	Blenkinsop Creek, Cumberland Brook, Big Barn Creek, Lochside Creek, Blenkinsop Lake Park, Beckwith Park, Christmas Hill Nature Sanctuary, Mount Douglas Park, Rithet's Bog Conservation Area, Braefoot Park, Shadywood Park, Christmas Hill Park
St Michaels University Sch-Mid	45	Victoria Watersheds	Bowker Creek, Mount Tolmie Park, Cedar Hill Park, Henderson Park, Carnarvon Park, Oaklands Park
St Michaels University Sch-Sr	46	Victoria Watersheds	Bowker Creek, Mount Tolmie Park, Cedar Hill Park, Henderson Park, Carnarvon Park, Oaklands Park
Storefront Broadmead	47	Saanich – South Watersheds	Normandy Creek, Colquitz River, Gabo Creek, Beaverdale Creek, Shadywood Park, Rithet's Bog Conservation Area, Commonwealth Place, Boulderwood Hill Park, Elk/Beaver Lake Regional Park, Quick's Bottom Park, Colquitz Park
Strorefront Sidney	48	North Saanich Watersheds	Iroquois Park, Tulista Park
Victor	49	Victoria Watersheds	Bowker Creek, Stadacona Park, Oaklands Park, Central Park
Western Opportunity Network	50	Colwood – Langford Watersheds	Colwood Creek, Millstream, Galloping Goose Regional Trail, Hatley Park National Historic Site, Mill Hill Regional Park

Appendix C: References

Alice Ferguson Foundation (2002). *Bridging the Watershed* from **www.fergusonfoundation.org**

Arnett, Chris (Ed). (2007).*Two Houses Half-Buried in Sand: Oral Traditions of the Hul'Q'Umi'Num' Coast Salish*. Talon Books

Arntzen, Holly. (1999). *Water Music* CD. Wild BC from **www.hctf.ca**

BC Ministry of Environment (2008) *Cougar in British Columbia* from
www.env.gov.bc.ca/wld/documents/cougar.htm

Blair-Whitehead, DG and W. Husby (1996). *Water for Tomorrow: A Guide to Watershed Stewardship in the Howe Sound Basin*. BC Habitat Conservation Trust Fund, Victoria, BC

Campbell, R.W. et al. (1990). *Birds of British Columbia. Vol. Two*. Royal British Columbia Museum, Victoria, BC

Canadian Centre for Climate Modeling and Analysis from **http://www.cccma.bc.ec.gc.ca/eng_index.shtml**

Canada Mortgage and Housing Corp. *Household Guide to Water Efficiency.* Available from CRD Integrated Water Service Dspt., Victoria, BC

Canadian Wildlife Federation (2007). *Backyard Habitat for Canada's Wildlife Guidebook* from
www.wildeducation.org

Centre for Affordable Water and Sanitation Technology from **www.cawst.org**

CRD Watershed information available from **www.crd.bc.ca/watersheds**

CRD Water Services Department (2004).
Ecosystem Units of the Greater Victoria Water Supply Area – Volume 1 – Technical Report. Victoria, BC

CRD Integrated Water Services Watershed Tours **www.crd.bc.ca/service/public-tours/watershed-tours** (also available for middle and secondary classes **www.crd.bc.ca/teacher**)

CRD Website: Watershed Protection from
www.crd.bc.ca/service/drinking-water

CRD Water Services Department (2007). *Annual Overview of Greater Victoria's Drinking Water Quality* Victoria, BC

For the following CRD-specific documents, visit **www.crd.bc.ca** and/or **www.crd.bc.ca/education/natural-gardening**

- *Water Facts 5- Straight Talk about Landscape Care During Water-use Restrictions*
- *Water Facts 6 – Straight Talk about Water Saving Actions for the Home*
- *Native Plant Resource List*
- *Native Plants in Moist or Wet Gardens*
- *Evergreen Native Plants*
- *Native Plant Ground Covers*
- *Native Plant Meadow Flowers*
- *Native Plants for Shady Conditions*
- *Native Plants for Sunny Conditions*
- *Native Plants for Sun-Loving Thickets-Hedgerows*
- *Native Plants for the Seashore*
- *Some Common Plants of the Garry Oak Ecosystem*

- *Some Native Plants for Rock Gardens*
- *Some Native Plants for Woodland Gardens*
- *Native Plants for Container Gardening*

CRD – *A Homeowners Guide to Outdoor Water Use* CRD Integrated Water Services; 479 Island Highway, Victoria, BC V9B 1H7 **www.crd.bc.ca/water**

District of Saanich – *Wildflowers and other native plants of Saanich Garry Oak Ecosystems.* From CRD Integrated Water Services; 479 Island Highway, Victoria, BC V9B 1H7

De Villiers, Marq. (2003) *Water: The fate of our most precious resource*. (2nd edition) Houghton Mifflin Publishing

Dowse, Sara, (ed). (2003) R*eading the Peninsula. Community Arts Council of the Saanich Penisula.*

Drescher, Margaret and Jim (2003) in *Water: The fate of our most precious resource*. (2nd edition). By Marq. D. Villiers, Houghton Mifflin Publishing

Duke University (2007). *Cruising Chemistry: Tap vs. Bottled Water* from **www.chem.duke.edu/~jds/cruise_chem/water/wattap.html**

Environment Canada *Sustaining Water Supply* from **www.ec.gc.ca/eau-water/**

Environment Canada (2001) *Water Use figures* from **www.ec.gc.ca/eau-water/**

Fisheries and Oceans Canada. (No Date). "*Lost Streams of Victoria*" poster . Vancouver, BC

Go for Green from **www.goforgreen.ca/gardening/index.html**

Present Moment, Wonderful moment. Thich Nhat Hanh *Water Works Journal*, Vol. 5: Celebrating Water **www.nationalwatercenter.org**

Jensen , Derrick (no date) "*Pretend you are a river*" **www.derrickjensen.org**

Lyons, C.P. and B. Meriless (1995).*Trees, Shrubs, and Flowers to know in British Columbia and Washington*. Lone Pine Press, Vancouver, BC

National Research Council of Canada; Student Science and Tech website from **http://science.gc.ca/default.asp?lang=en&n=BB254133-1**

Natural Resources Canada (2008). *Waterscapes Posters* from **http://geoscape.nrcan.gc.ca**

Naturescape British Columbia (2007). *The Provincial Guide: Caring for Wildlife Habitat at Home* from **www.hctf.ca**

Operation Water Drop from **www.safewater.org**

Pacific Streamkeepers Federation from **www.pskf.ca**

Paul, Phillip Kevin (2003). *Water Drinker* in *Reading the Peninsula: Stories of the Saanich Peninsula*. Community Arts Council of the Saanich Peninsula.

Pettinger, April and B. Costanzo (2002). *Native Plants in the Coastal Garden, (Revised).* Whitecap books, North Vancouver B.C.

Pojar, Jim and A. MacKinnon (eds.). (1994). *Plants of Coastal British Columbia*. Lone Pine Press.

Sanderson, Darlene. *Our Waters, Our Responsibility: Indigenous Water Rights Forum*. Pinewa, Manitoba, May 13-16, 2004 from **www.kairoscanada.org**

Turner, Nancy J (1995). *Food Plants of Coastal First Peoples*. Royal British Columbia Museum Handbook. Victoria, BC

U.S. Environmental Protection Agency (2008) EPA Water Source Books. *Drinking and Waste Water Treatment grades 9-12* from **http://water.epa.gov/learn/kids/drinkingwater/wsb_index.cfm**

USEPA Water Health Series (2007). *Bottled Water Basics* from **http://www.epa.gov/safewater/dwh/index.html**

UNESCO . "Human development Report (2006) *Beyond scarcity; power, poverty and global water crisis* from **http://hdr.undp.org/en**

US Geological Survey (2008). *What is the Water Cycle?* From **http://ga.water.usgs.gov/**

World Water Monitoring Day from **www.worldwatermonitoringday.com**

Water in Our Community (8-12)

Order, Registration & Feedback

ORDER: Resources

Educators in the capital region can order the Water in Our Community (Grade 8-12) Educator's Kit free-of-charge, including:

- lesson plans and activities (binder)
- videos (DVD)
- images (CD)
- USB (loaded with the above resources)
- water monitoring tests
  - showerhead water efficiency test bags (per student)
  - toilet leak detector tablets (per student)
  - water monitoring field kit (one of either of the below per school)
    - single kit: water temperature, turbitidy, pH and disolved oxygen (50 pH & 50 DO) tests
    - classroom kit : 5 sets of the above (only 50 pH & 50 DO tests)

REGISTRATION: Professional Development Workshops

Book or join an Educators' Workshop to gain knowledge of regional environmental services (drinking water, garbage and recycling, parks and environmental protection) and explore the CRD environmental education resources designed for you and your students.

FEEDBACK

Your feedback is important to us. It will help us to identify areas where we can improve our environmental education programs and better understand the needs of teachers and students.

HOW

Order resources, provide feedback and register for workshops at **www.crd.bc.ca/teacher**.

Questions?

Contact CRD Parks & Environmental Services
education@crd.bc.ca | 250.474.9684

July 14, 2008 - Technologist: SR - Map Document: School_Watershed_Series.mxd

 School Locations

Major Roads

Minor Roads

Streams (Open Channel and Stormdrain)

Water Bodies

Watershed Boundaries

Orthophoto Flown in 2007

0 100 200 400 600 800 1,000 Meters

Projection: Universal Transverse Mercator
Zone 10 North - North American Datum 1983

Making a difference...together

Victoria Watersheds

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School Locations
Major Roads
Minor Roads
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Orthophoto Flown in 2007

0 100 200 400 600 800 1,000 Meters

Projection: Universal Transverse Mercator
Zone 10 North - North American Datum 1983

Sooke Watersheds

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Projection: Universal Transverse Mercator
Zone 10 North - North American Datum 1983

Saanich - South Watersheds

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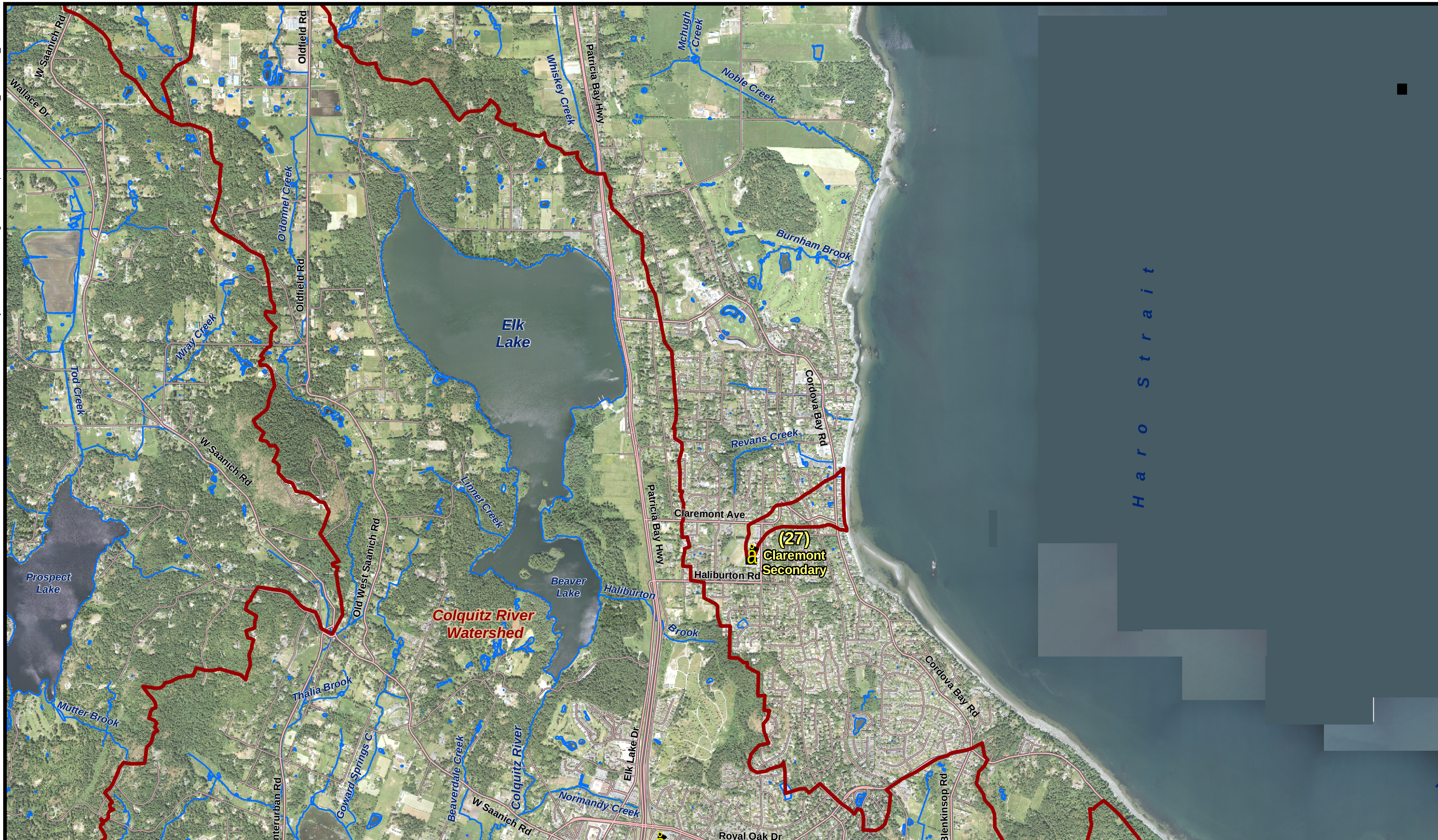

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0 100 200 400 600 800 1,000 Meters
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Saanich - North Watersheds

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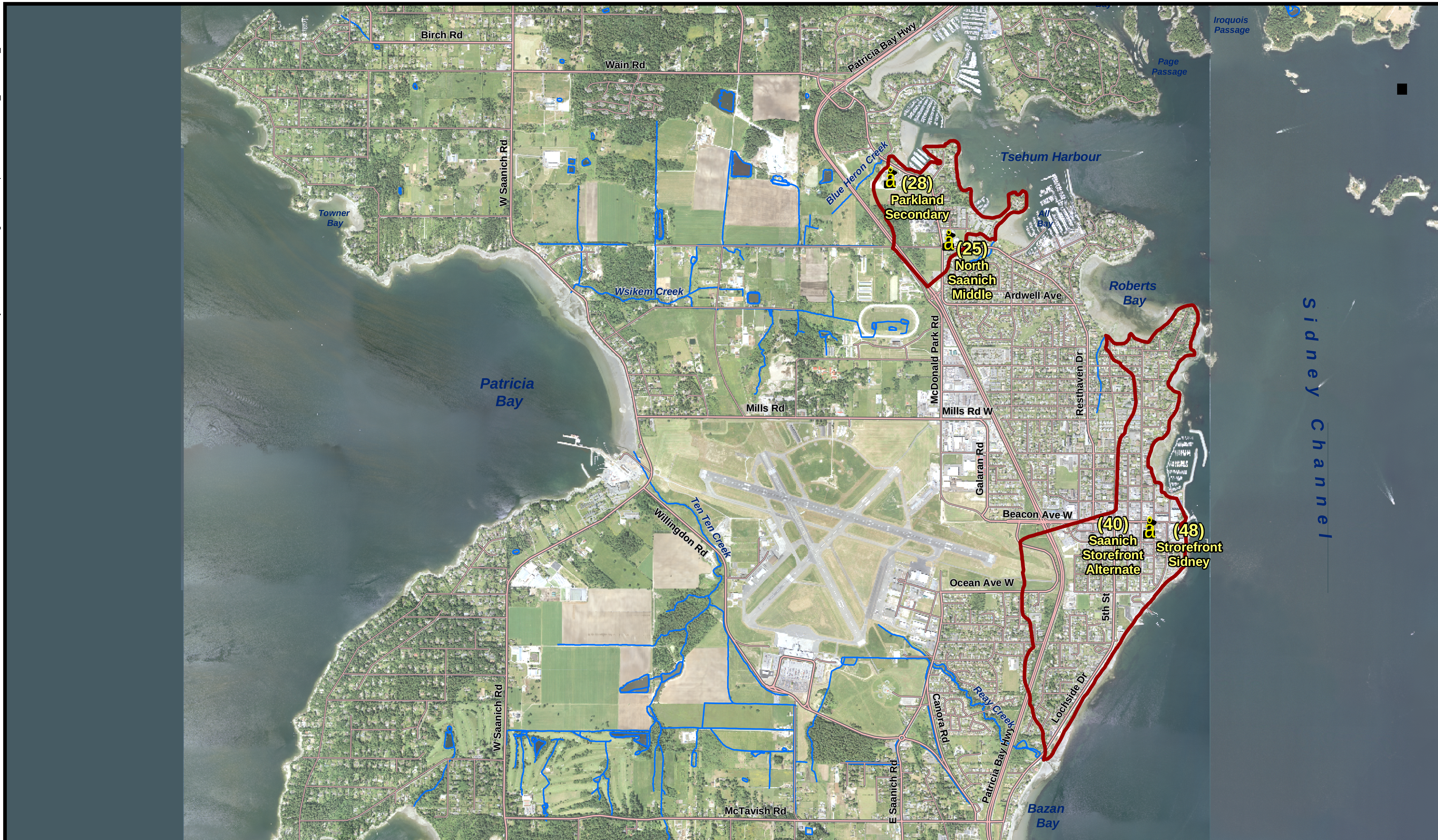

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School Locations
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Watershed Boundaries

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0 100 200 400 600 800 1,000 Meters

Projection: Universal Transverse Mercator
Zone 10 North - North American Datum 1983

North Saanich Watersheds

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Water Bodies
Watershed Boundaries

Orthophoto Flown in 2007

0 100 200 400 600 800 1,000 Meters

Projection: Universal Transverse Mercator
Zone 10 North - North American Datum 1983

Colwood - Langford Watersheds

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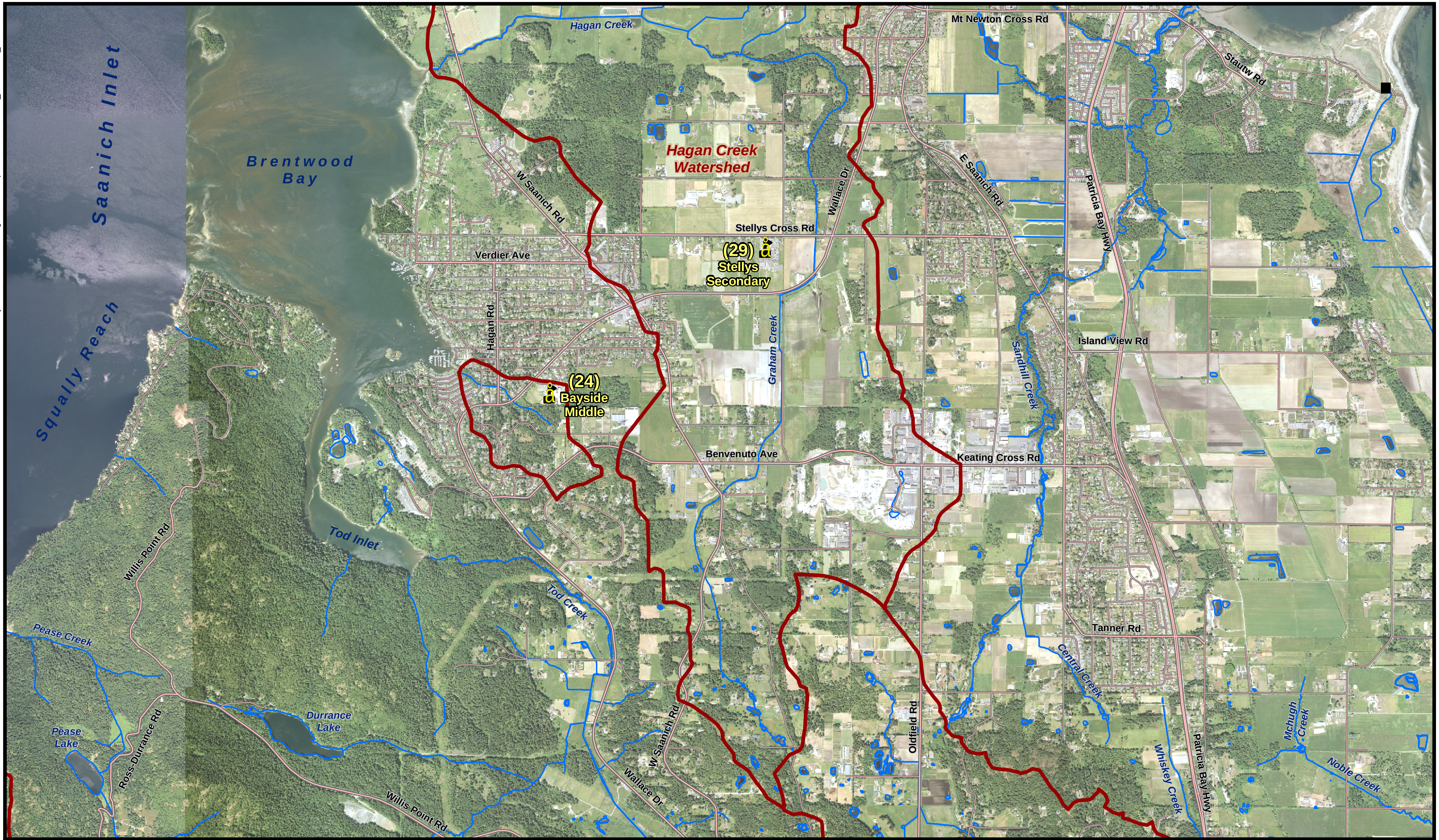

Making a difference...together

School Locations
Major Roads
Minor Roads
Streams (Open Channel and Stormdrain)
Water Bodies
Watershed Boundaries

Orthophoto Flown in 2007

0 100 200 400 600 800 1,000 Meters

Projection: Universal Transverse Mercator
Zone 10 North - North American Datum 1983

Central Saanich Watersheds