Lesson 6

Sooke Lake Watershed: Drinking Water Quality

Learning Standards & Assessment

Time

Resources

Activities

Handouts

Video

CRD

every drop counts

Lesson 6b:

Tap Map- Our Drinking Water's Journey

Purpose

The Sooke Lake Watershed lessons provide an opportunity for student to learn about where our drinking water comes from, what makes it is safe to drink and how it is delivered to our taps. They will also learn how it compares to well water and bottled water.

This lesson combines drinking water processing with mapping, tracking our drinking water's journey from the reservoir, through disinfection to our taps. Students use their knowledge of maps to determine the distance water travels from source to tap.

Preparation

- Copy student handout "Tap Map: Our Drinking Water's Journey" (1/student)
- Assessment Tool: "Where Does Our Water Come From?" photocopy (1/student)
- (optional) Cue *"Down the Drain and Back Again"* video to Chapter 3 where the water drop directs Dylan and Dana to the Intake Tower.

Procedure

Warm Up

1. Write the following riddle on the board "What do maps and fish have in common?" Have students discuss with a partner. Offer clues such as drawing a fish. Answer: Scales.
2. Briefly discuss how fish scales and map scales differ. Display the Greater Victoria Drinking Water System map or open Google maps.

Social Studies

Big Ideas

- Local actions have global consequences, and global actions of local consequences.
- Individuals have rights and responsibilities as global citizens.

Content

- How people's needs and wants are met in communities
- Relationships between people and the environment in different communities
- Rights and responsibilities of individuals regionally and globally
- Roles and responsibilities of regional governements

60-90 minutes

Educator's Kits, including hardcopy lesson plans and support materials, are available for loan through the CRD. For pickup locations, print-friendly materials and multimedia tools see **www.crd.bc.ca/teacher** or contact the CRD at 250.360.3133.

Teacher Resources

- Tap map- Our Drinking Water's Journey

Student Resources

- Handout " Tap Map: Our Drinking Water's Journey"
- Assessment Tool: Where Does Our Drinking Water Come From?
- Drinking Water Cycle Song

Lesson Resources

- Image of Sooke Lake Reservoir Globe or world map
- Map: Greater Victoria Drinking Water System
- String (length of the projection screen);
- String or strips of paper 8 to 11 inches long (1/student)
- video: *Down the Drain and Back Again* (optional)
- DVD player and TV OR computer and projector
- Glass of tap water
- Glass of water from a local stream or lake
- Glass of crushed ice water, a drinking straw, spray bottle trigger (optional)

GOOGLE MAPS

Create your own map

- Go to http://maps.google.ca/
- Click on "Get Directions"
- Beside A: Enter your school name or location
- Beside B: Enter the name or location of another community landmark

Use "Public Pools and Water Parks" Map

- Go to http://g.co/maps/kqkth
- In the search box, enter the name or address of your school.
- Click back to see your school and other locations pinpointed on the map.

Map Views

- Available in the top right hand corner, click on: "Satellite", "Earth", or "Map".
- "Street view" is only possible when in "Map" view. Simply click and drag the orange person (top of the zoom scale) to a road on the map. To exit this view, click on the minus symbol (zoom scale) until exited.
- Click on the walking, bus and driving icons to see different routes between locations.
- Weather, Webcam, Photos etc. - place cursor over "traffic" and select the items in the checklist to add or remove from the map

Note: To use Google Earth you will be prompted to download a free plug-in.

Transition- Explain that students will be using their mapping skills to show the drinking water journey from the Sooke Lake Watershed to the tap.

Review- Parts of a Map

- Display a globe, world map or open Google Maps http://maps.google.ca/ invite students to identify known parts of a map and their function- e.g. scale, legend, compass.
- Display the "Greater Victoria Drinking Water System" or use Google Maps and review:

• Scale

  » Identify two known points on the "Greater Victoria Drinking Water System" map (e.g. a pool or waterpark). Invite two students to help demonstrate how to use the scale, measuring the distance between the two known points with a piece of string. Have them measure the string against the map scale, counting out each section of string equal to the scale length. Calculate the distance.

Transition: What helps us know if this place is north, south, east or west of the school?

- Compass
    - » Review compass directions. Ask volunteers to draw lines between points following and/or giving cardinal directions. For a more physical exercise, label the classroom with cardinal points and have students walk around the room following directions. Note this section can also be completed with Google Maps, however, a legend and a compass will have to be created on the board with the class.

Transition: What part of a map tells us what the colours, lines and images on a map mean?

- Legend
    - » Review the existing legend. Create symbols for the school and other known landmarks in the legend and place them on the map.

Discuss and Discover- Drinking Water Journey

1. Ask students if they remember the route that Dylan and Dana took through the Sooke Lake Watershed back to their bathroom tap? Can cue and view the *Down the Drain and Back Again* video (Chapter 4 and 5).
2. Using the "Greater Victoria Drinking Water System" map, and images of Sooke Lake Reservoir, work through the following steps in the drinking water journey with students, reviewing and introducing new components such as:
    - **known locations or landmarks**
    - **salt and fresh bodies of water** - more salt than fresh water
    - **watershed** - an area that drains runoff into a lake or creek, Sooke Lake (primary drinking water supply where Dylan and Dana fell as raindrops), Goldstream (backup water supply), Leech (future water supply). Remember, to protect the drinking water supply from pollution, these areas are off limits to all visitors: no one can go hiking, fishing, or walking in this area unless they are on official CRD business. If a lot of people were to get too near to the water supply, it could cause problems for water quality.
    - **reservoirs** - hold fresh water for use by humans- Sooke Lake Reservoir holds 160 million m^3 (160 billion litres) of water, which 92.7 million m^3 (92.7 billion litres) is accessible for drinking water - that's enough to fill 31 thousand Olympic sized pools. Goldstream, Butchart, and Lubbe reservoirs combined hold 10 million m^3 (10 billion litres).
    - **dams** - hold water in the reservoir.
    - **intake tower** - where water flows from the reservoir into the pipes that eventually lead to our taps, it has gates at different heights to select the clearest water at any given time.
    - **Kapoor tunnel** - 2.3 m (7.5 feet) in diameter, 8.8 km long, water flows through the tunnel from the reservoir to the disinfection plant.
    - **disinfection plant** - here UV light and chloramine inactivate (stop from reproducing) bacteria, parasites, or viruses in the water that could make us sick; after disinfection the reservoir water is safe, healthy and clean to drink.
    - **pipelines** - bring water from Sooke Lake Reservoir to our communities, decrease in diameter from 2.3 m (7.5 feet) at the Sooke Lake Reservoir to 15 cm (6 inches) in our communities. (the smallest size able to provide enough water to fight fires.)
    - **holding tank reservoirs** - hold water to be distributed into our communities- Mctavish, Tolmie, Haliburton.

Note: 1 m^3 = 1000 litres

For complete journey see the teacher's resource Tap Map - Our Drinking Water's Journey.

BACKGROUND INFORMATION: LAYING PIPELINES

Tunnels direct water in a straight line, like the Kapoor tunnel to the disinfection facility. Water mains follow roads and weave around obstacles- lakes, rivers, large buildings and parks. Pipes are not laid under cement walkways. Water pipes can go under/through bodies of water, such as the pipeline to Piers Island. Water pipes become progressively smaller the farther away they are from the reservoir.

Map it Activity

1. Distribute string or strips of paper and the Student Activity Sheet: "Tap Map: Our Drinking Water's Journey" to each students and have them complete the activity.

KWL Chart

Revisit the KWL chart, and ask students to suggest additions and modifications based on what they learned from this lesson.

Demonstration Wells

1. Explain to students that while most people in the Greater Victoria area rely on the water system seen in the video for their water, some people get their water from wells. Wells tap into water underground in rock cracks and pockets in sandy/gravel layers. These pockets of water underground are called aquifers.
2. Present a slushy drink or fill a glass with crushed ice. The ice represents rock, sand or gravel. The liquid water or juice represents groundwater. The straw is the well. To bring the water up to the surface, a pump can be used or a bucket can be dropped into the well and pulled up to the surface. To demonstrate a pump, place the trigger for a spray bottle into the straw.

Discussion - Well Water in Our Region

- Not everybody in the Capital Region receives water from the Greater Victoria drinking water supply; some get their water from wells.
- Ask students:
  - » Have you ever seen a well?
  - » Does anyone in the class have a well?
  - » What does a well look like?
  - » Where does the water in a well come from?
- Notice that if all the liquid is used up too quickly it take time before more is available. Water conservation is necessary with well water too. (Note: Point out that the water in aquifers, unlike this demonstration, does not seep from the rocks/ice cubes themselves).

Assessment Opportunity

Review student activity sheeta as a class and/or have students place it in their Water Portfolio. Use questions such as those outlined on the assessment tool, *"Where Does Our Water Come From"*, in a conference approach. Add the completed assessments to students' Water Portfolios.

Curricular Competencies

Look for evidence that students are able to:

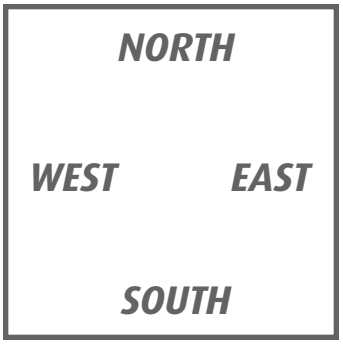
Social Studies

- Use Social Studies inquiry processes and skills to ask questions; gather, interpret, and analyze ideas; and communicate findings and decisions
- Explain why people, events, or places are significant to various individuals and groups (significance)
- Recognize causes and consequences of events, decisions, or developments (cause and consequence)

Extensions and Adaptations

"Drinking Water Cycle Song" extended version (includes drinking water) (Lesson 5d)

- **Monitor the flow of water**
  - Check the CRD website to see weekly pictures of the Sooke Lake Reservoir level and spillway. Look back over the year to see how water levels change throughout the seasons. **https://www.crd.bc.ca/about/data/sooke-lake-reservoir/sooke-lake-reservoir-photos**
- **Take it outside**
  Game- Students run to a location or make a motion that represents drinking water flow or actions. To practice vocabulary and cardinal directions.
- Intake Tower- south
- Rithlet creek- north



- Backup Reservoirs(Goldstream)- east
- Future Supply (Leech)- west
- Precipitation- jumping on the spot
- Run off- running on the spot
- Disinfection- standing still, pretending to wash
- Erosion (settles on the bottom of the lake)- falling to the ground

- **CRD Parks**
  Register for a CRD Parks school program in a local regional park. **https://www.crd.bc.ca/education/school-programs/for-k12-teachers/field-trips/park-interpretive-programs**

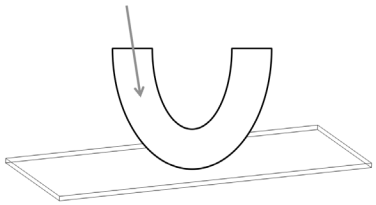
- **Dams**
  As a class, build a model of a dam, trying out different materials. Discuss: What are dams made out of today? *Clay core covered with earth and rock.* What did earlier residents of BC use to build dams? *Wood* Who else builds dams? *Beavers.* Read "The First Beaver" by Carol Simpson- a First Nation's story.

- **Water Pressure**
  In our drinking water system water builds up momentum going downhill to pressure water through most of the pipes. It's only in some very high places that we need to use pumps to push water uphill (for example, up to Triangle Mountain). To extend learning about how water flows uphill- demonstrate using a plastic or rubber tube in a tub. Pour water quickly into the tube forcing the water to move up the other vertical side of the tube.

- **The US Environmental Protection Agency**
  Developed a number of lesson plans related to water use and the environment. These activities are available online at **http://water.epa.gov/learn/kids/drinkingwater/index.cfm.**

  In particular, the following activities can be used to extend the learning in this lesson (in both cases, the models suggested would likely work best as whole class demonstrations):

  - K-3 — Aquifer in a Cup
  - 4-7 — Teach kids about the Water Filtration Process
  - Teacher Resource – watch a demonstration of how to build and aquifer and watershed in a fish tank. Suggest skipping to activity. **www.epa.gov/safewater/kids/flash/flash_aquifer.html**



  - Other groundwater resources:
    - » Ministry of Environment: Water Protection and Sustainability Branch **www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/index.html**
    - » The Groundwater Foundation: Information and Activities about groundwater for educators and students. **www.groundwater.org/kids**
    - » BC Groundwater Association **http://bcgwa.org/**

Curricular Integration

Science

Extend the concept of dams by including a study of beaver dams. Focus on how beavers, like humans, use dams to adapt their environment for their purposes.

Tap Map – Our Drinking Water's Journey

The following is a step by step explanation of our drinking water's journey from the sky to the tap. This can be paired with the Sooke Lake Reservoir image, the Greater Victoria Drinking Water Map and/or a Google map of the Capital Region.

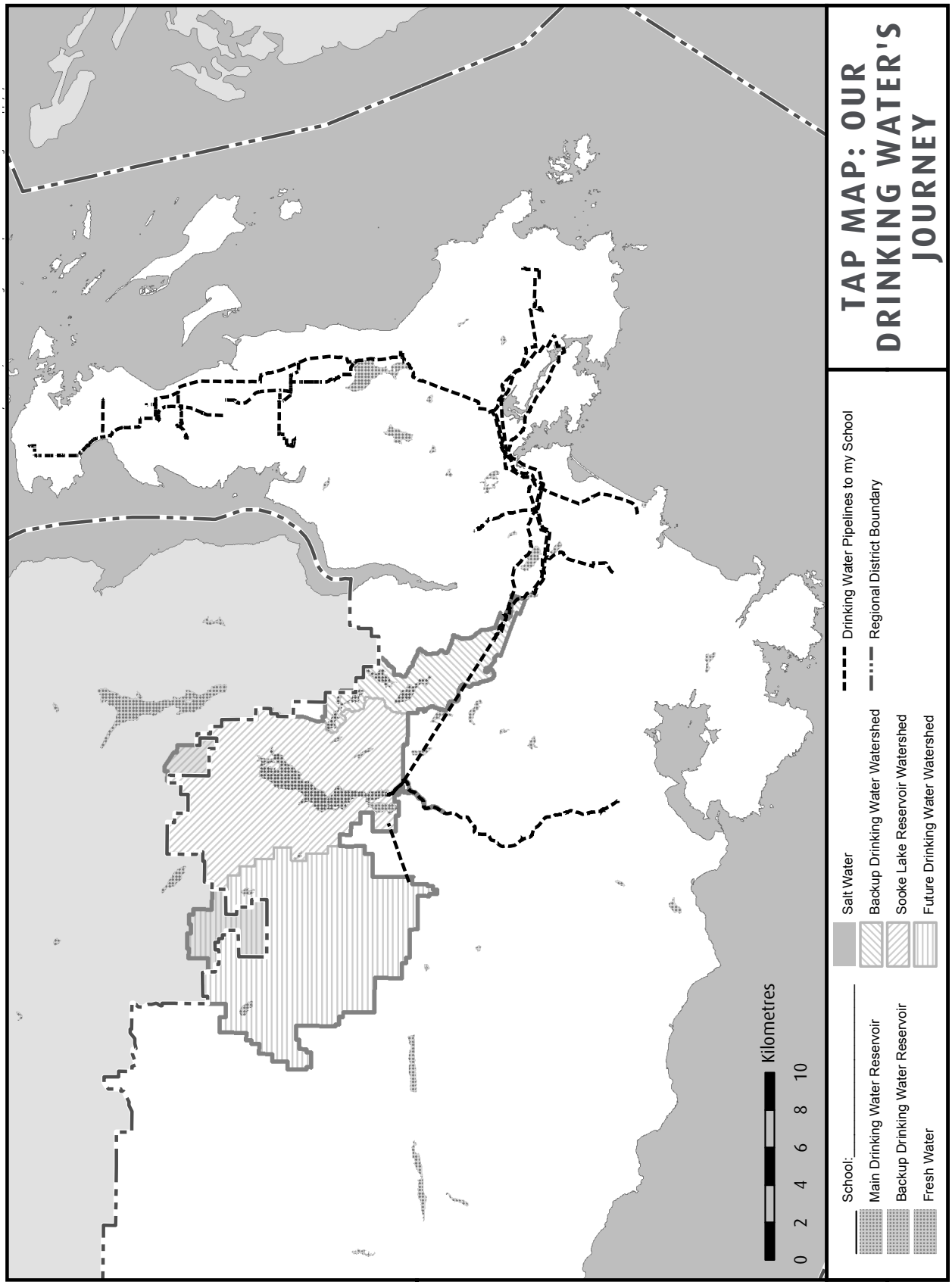
1. Precipitation (usually rain) becomes runoff- flowing over land in to the Sooke Lake watershed.
2. Most water enters the reservoir from creeks and streams at the north end of the lake.
3. Water flows from north to south end of the lake- a 2 year journey.
4. Material in the lake water settles to the lake floor.
5. At the Intake Tower, water quality is tested and gates at level of the best quality water are opened.
6. Water flows through the intake tower, through Kapoor Tunnel or Sooke Tunnel to a treatment plant.
7. At the treatment plant- The water passes through UV light, then chlorine is added and 10 minutes later ammonia (this makes chloramine, a longer lasting disinfectant). This combination kills pathogens- disease causing parasites, bacteria and viruses.
8. From the treatment plant water flows through pipes decreasing size, from the 2.3 m wide Kapoor tunnel down to 15 cm wide pipes (any smaller than this and fighting fires could be difficult).
9. Our driking water flows using gravity. Sooke Lake Reservoir is 187.5 m above sea level in the Sooke Hills, the Goldstream Backup Supply is even higher. Water flow builds up pressure, pushing water through the whole system, except for a few locations where electricity is needed to power a pumping station to push the water high uphill (e.g. Triangle Mountain).
10. Small covered holding reservoirs (essentially tanks) in the drinking water supply system hold water to be distributed through municipal pipes to our communities.
11. Once a year, when inspecting the Kapoor Tunnel and other infrastructure associated with the Sooke Lake Reservoir, the Goldstream System is used.

Tap Map – Our Drinking Water's Journey

Name: _____ Date: _____

1. Draw a compass on the map.
2. Create a symbol in the legend for each item and add them to the map.
   - Your school
   - Main drinking water reservoir
   - Back-up drinking water reservoir (hint: there are three)
3. Add colour in the legend for each item then colour the map:
   - Fresh Water
   - Salt Water
   - Sooke Lake Reservoir Watershed
   - Back-Up Drinking Water
   - Future Drinking Water Watershed
   - Drinking water journey. Draw a coloured line beside "Drinking Water Pipelines to My School". Use this colour to fill in the drinking water pipelines from the Sooke Lake Reservoir to your school.
4. Label your map:
   - Sooke Lake Reservoir
   - Pacific Ocean

Tap Map – Our Drinking Water's Journey



QUESTIONS:

5. How far would Dylan and Dana have to travel as water drops from the Sooke Lake Reservoir to your school?

   _____

   Place one end of the string at the Sooke Lake Reservoir Dam. Place the rest of the string on the coloured pipeline to your school. Draw a line on the string where it lands on the school. Measure the string along the scale. Calculate the distance.

6. Dylan and Dana want to go on an adventure from the Sooke Lake Reservoir through the drinking water pipelines to your school. Write down the directions to help them find their way. (Use cardinal directions, e.g. north, south, east, west)

Hi Dylan and Dana,

To travel from the Sooke Lake Reservoir to my school

_____ ***, you must flow...***

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Drinking Water Cycle Song

Sing-a-long to "She'll be Coming Round the Mountain"

Name: _____ Date: _____

Water travels in a cycle

Spin on the spot, with one hand making a circle overhead, like a lasso

Yes it does.

Stand facing front again

Water travels in a cycle

Spin on the spot, with one hand making a circle overhead, like a lasso

Yes it does.

Stand facing front again

It goes up as evaporation,

Make vertical wave motions with hands, raise them up overhead

And forms clouds as condensation,

Bring hands together to form a cloud

Then comes down as precipitation

Separate hands and wiggle fingers as arms are lowered, crouching down to the ground

And runs off.

Run on the spot

Water travels in a cycle

Spin on the spot, with one hand making a circle overhead, like a lasso

Yes it does.

Stand facing front again

Water travels in a cycle

Spin on the spot, with one hand making a circle overhead, like a lasso

Yes it does.

Stand facing front again

It flows down to the reservoir

Make horizontal waves with hands

Then through pipes to our taps afar

Motion as if turning on a tap to fill a glass of water and drinking, brushing teeth, washing hands

And goes down the drain, "au revoir"

Wave down the drain

Into the sea.

One hand on forehead looking into the distance

BUT

(spoken)

Water travels in a cycle

Spin on the spot, with one hand making a circle overhead, like a lasso

Yes it does.

Stand facing front again

Water travels in a cycle

Spin on the spot, with one hand making a circle overhead, like a lasso

Yes it does.

Stand facing front again

It goes up as evaporation,

Make vertical wave motions with hands, raise them up overhead

And forms clouds as condensation,

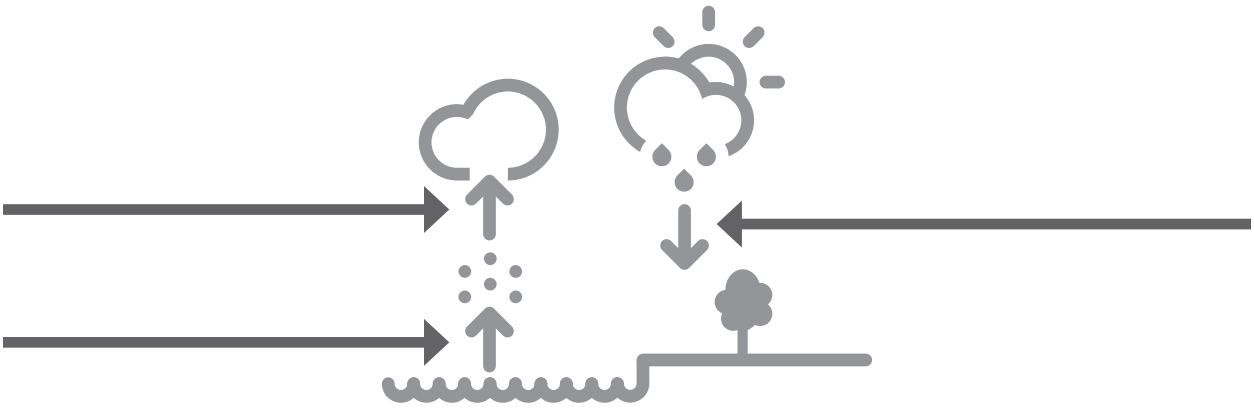
Bring hands together to form a cloud

Then comes down as precipitation

Separate hands and wiggle fingers as arms are lowered, crouching down to the ground

Back to me.

Label the water cycle: evaporation, condensation, precipitation



Drinking Water Cycle Song

Sing-a-long to "She'll be Coming Round the Mountain"

Name: _____ Date: _____

Chorus *Water travels in a cycle*
Yes it does.
Water travels in a cycle
Yes it does.

Verse 1 *It goes up as evaporation,*
And forms clouds as condensation,
Then comes down as precipitation
And runs off

Chorus *Water travels in a cycle*
Yes it does.
Water travels in a cycle
Yes it does.

Verse 2 *It flows down to the reservoir*
Then through pipes to our taps afar
And goes down the drain, "au revoir"
Into the sea.

BUT (spoken)

Chorus *Water travels in a cycle*
Yes it does.
Water travels in a cycle
Yes it does.

Verse 3 *It goes up as evaporation,*
And forms clouds as condensation,
Then comes down as precipitation
Back to me.

Where Does Our Drinking Water Come From?

Date: _____ Student: _____

What is the name for the place where most of the water for the Greater Victoria area is stored? How does it get from there to your home?

Is water in the reservoir safe to drink?

Is water you find in a pond, stream, or lake safe to drink?

Is water out of the tap safe to drink?

Why do we have to pay for water?

How would your life be different if you didn't have access to clean drinking water all of the time?

Why is it important to conserve and protect our drinking water?

Additional Comments:

Where Does Our Drinking Water Come From? - Answer Key

What is the name for the place where most of the water for the Greater Victoria area is stored? How does it get from there to your home?

Sooke Lake Reservoir; through pipes underground.

Is water in the reservoir safe to drink?

Not until it is cleaned at the disinfection plant.

Is water you find in a pond, stream, or lake safe to drink?

No. It should be cleaned/disinfected.

Is water out of the tap safe to drink?

Yes, it has been cleaned/disinfected.

Why do we have to pay for water?

The money is used to pay for :

- *drinking water pipes to be put underground and to fix them*
- *cleaning the water.*
- *buying land that will be used for drinking water in the future*
- *taking care of the drinking watersheds- like planting trees*

How would your life be different if you didn't have access to clean drinking water all of the time?

Answers may include walking long distances for water, no water fights or swimming pools.

Why is it important to conserve and protect our drinking water?

- *So there is enough clean, fresh water for everyone*
- *So we can have enough drinking water even when it doesn't rain for a long time*
- *Because we also need it to fight fires*
- *Because all living things need water to survive*