Key Concept Two ~ The Water Cycle

Poster Panels, Activities and Essential Learnings for Key Concept Two

The Okanagan Water Cycle is complex and influenced by a variety of factors. Our water is limited, despite the visual cues that indicate otherwise. The amount of useable water within the watershed is limited by accessibility, hydrology and the seasonal timing of the water cycle.

Poster Panel Reference	Activities
Okanagan Water Cycle	4. What is the Water Cycle? 5. Water Cycle in a Bottle 6. Water Cycle Keeps on Rolling 7. Dance of the Water Droplet 8. Mountain Barriers 9. Measuring the rain with a Rain Catcher
Our Lakes: Looks Can be Deceiving	Where Does the Water Go?
Groundwater Commected to Surface Water	10. Go With the Flow 11. Watershed Down 12. Tasty Waste 13. Aquifir Xray 14. Alkali Lake
Our Challenging Climate: Less Water but Rising Demands	15. Climate Change ~ Hotter, Less Water

Essential learnings

- How the water cycle works – (where the water is)
- Rain shadow from Coast Mountains
- Importance of winter snows on annual water cycle
- Lake storage – replenishment cycle
- Only 15% of precipitation flows into lakes and streams while the rest is lost through other processes such as evapotranspiration
- Groundwater "sponges" feed/connect to basin streams and lakes
- Climate change means less water for the Okanagan basin

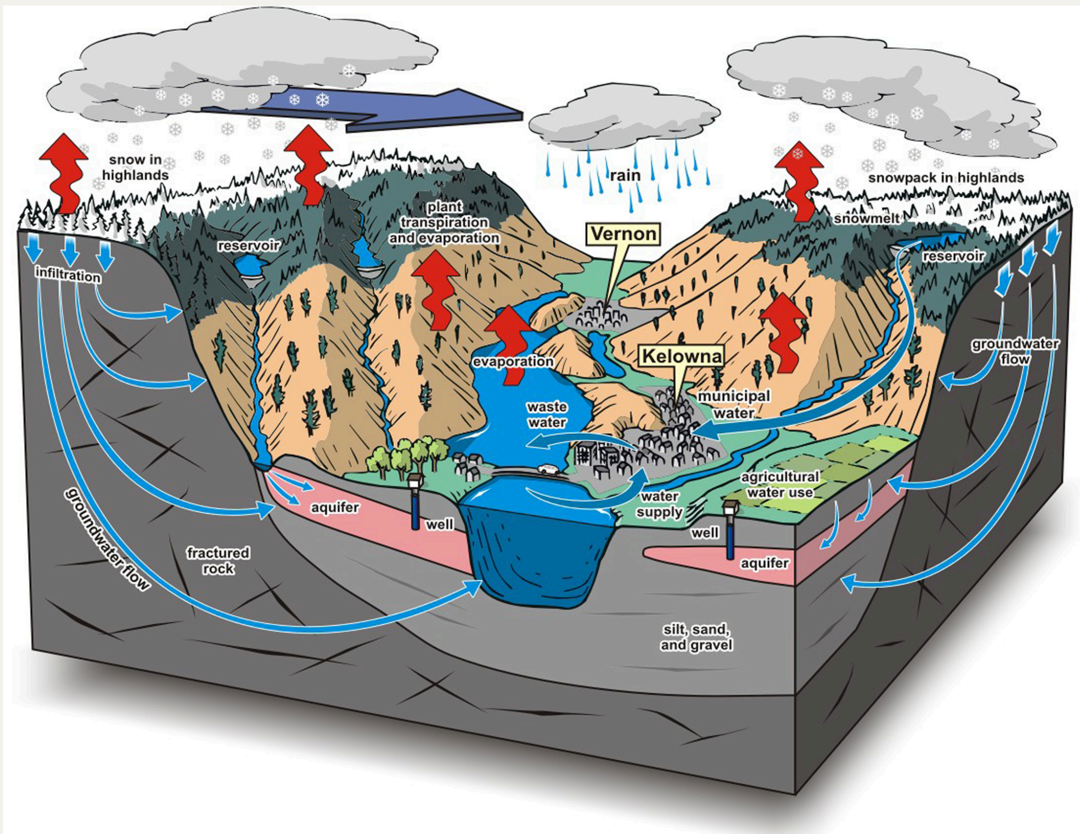
For related Grade 12 Activities See Appendix Grade 12 Activities

Okanagan's Water Cycle

Background Information

Dry to really, really dry

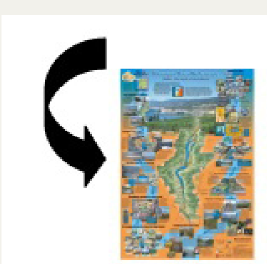
The Okanagan Basin is dry because it lies in the rain shadow of the Coastal Mountains. This high mountain chain strips moisture from Pacific storms, leaving little for the Okanagan. The further south you go, the drier it gets. Cacti grow in the Okanagan.



Geological Survey of Canada

Our upland snow catchers

Most water enters the Okanagan Basin as winter snow on the highlands. During the spring, snowmelt infiltrates into the ground or flows in streams to highland reservoirs and valley lakes.



We lose most of what we get

Only 15% of the rain and snow that fall in the basin flows to our lakes and remains there. The rest leaves the basin through transpiration from forests and crops and evaporation from lakes.

Note: the above vector diagram is available in Appendix: Maps and Illustrations.

Activity 4 ~ What is the Water Cycle?

Curriculum Connections

Grades 4 and 5: Earth and Space Science
Grade 5: Social Studies (until spring 2008)

Time Required

1 Hour

Materials

- Fish Tank
- Cookie sheet
- Bag of Ice
- Kettle

Key Vocabulary

- evaporation
- condensation
- evapro-transpiration
- infiltration
- precipitation
- transpiration

Objectives

- Identify how the water moves through the environment
- Illustrate the water cycle.

ACTIVITY

1. Where does the water come from? How does the river form? What creates the rain?
2. Show the water cycle drawing (on next page) and introduce the vocabulary.
3. Boil the water.
4. Place the fish tank on a slant so that one end of the tank is higher than the other.
5. Place cookie sheet on top of the fish tank.
6. Place the bag of ice at the higher end of the cookie sheet.
7. Pour boiling water into the fish tank so that the water pools at lower end of fish tank.
8. Observe the water droplets forming on the sides of the fish tank and on the underside of the cookie sheet.
9. Explain how evaporation and evapotranspiration processes in BC are important.

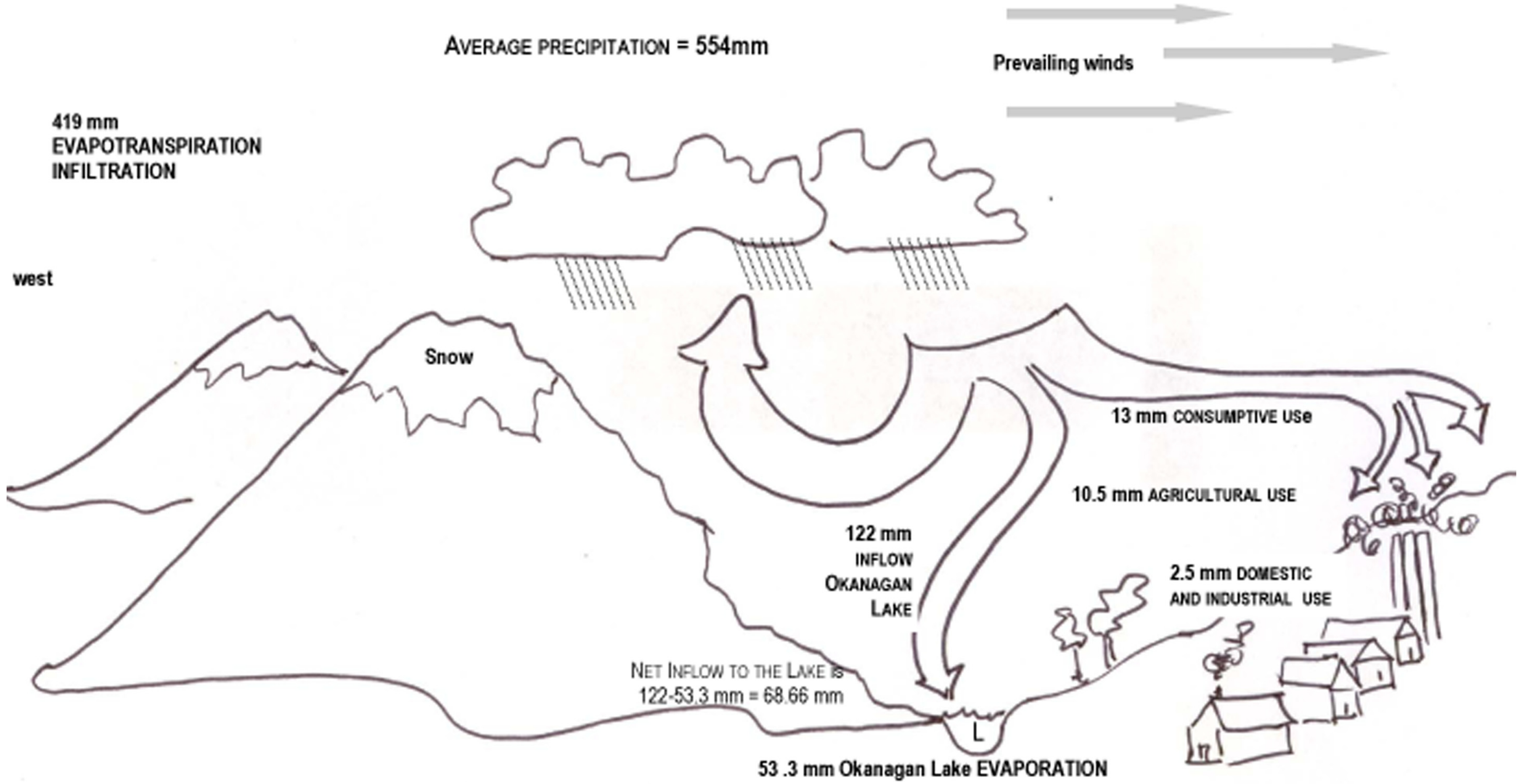
Guiding Questions

1. What causes the water to evaporate?
2. What causes the water to form clouds?
3. How does the changing seasons and temperatures affect the water cycle?

Extension

1. Have the students draw their own diagram of the water cycle.
2. Discuss the difference between the water cycle in Okanagan and other parts of BC such as coastal areas.

Activity : Watershed Down



Based on a figure from *Okanagan Geology* by the Okanagan Geology Committee

Activity 5 ~Water Cycle in a Bottle

Curriculum Connections

Grade 7: Processes of science

Time

- 2 hours to build
- Several days for observation

Objectives

- Understand atmospheric water, groundwater and surface water are interrelated.
- Understand the roles of evaporation, condensation and transpiration in the water cycle.

Materials

Enough for one water cycle model. If students are working in groups, each group can make their own model from which to make observations.

- Three 2-L clear plastic bottles
- Three bottle caps
- Marker
- Scissors
- Awl or nail
- 1 metre cotton string
- Masking tape
- 500 mL (2 cups) water
- 250 mL (1 cup) slightly moist potting soil
- Several fast-growing plant seeds (grass, beans or radishes work well)
- 10 ice cubes
- Drinking bird or celery–optional for prompt

Key Vocabulary

- atmospheric water
- groundwater
- surface water
- evaporation
- condensation

ACTIVITY

Building the Water Cycle:

1. Remove labels from three 2-L clear plastic pop bottles. Save the lids.

2. Draw a line around the top ridge of Bottle A. Cut around the line so that you have the body portion of the bottle.

3. For Bottle B and Bottle C, draw on the lower ridge. Cut around so that you have the head, shoulders and upper 2/3 of the bottle.

4. Bottle B:
   - Poke a hole in a cap using the awl or nail.
   - Cut 50 cm of cotton string.
   - Fold string in half and thread loop through the hole in the cap, leaving least 5 cm of string from each end hanging down.

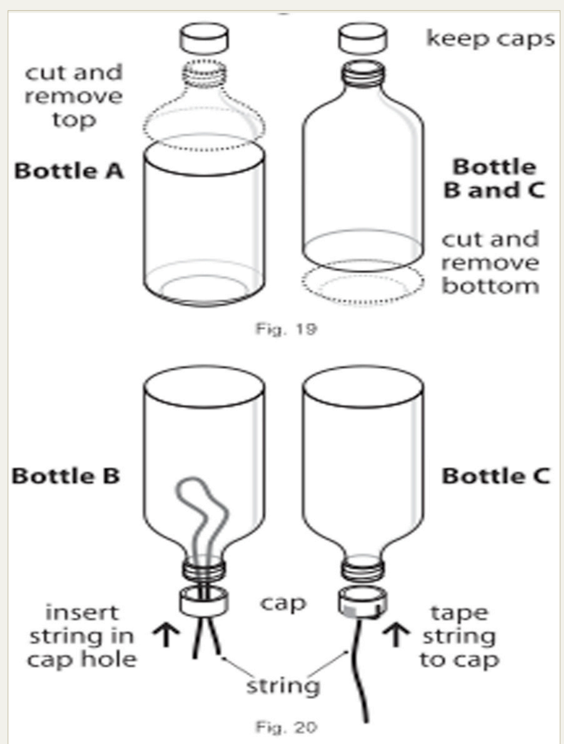
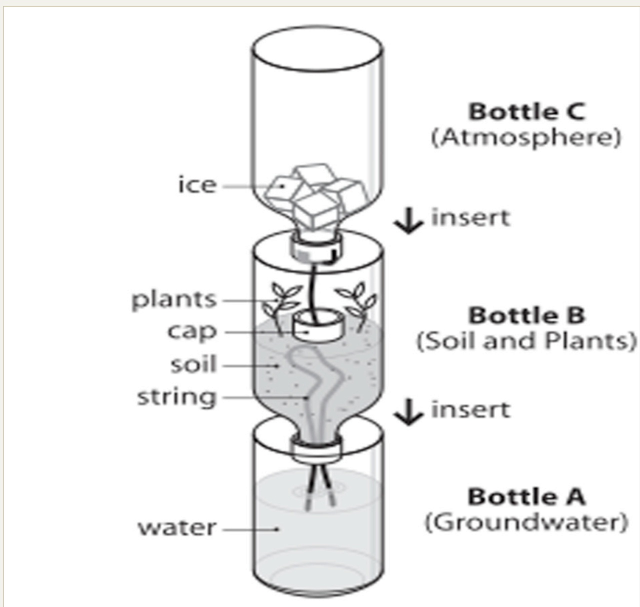


Fig. 19

Fig. 20

Teacher's Guides for the Bow River Basin Waterscape Poster

5. Bottle C:
   - Place a cap with no hole on Bottle C.
   - Tie 30 cm of string around the neck. Trim short end close to knot.
   - Tape string onto cap so that it hangs down from the centre of the cap. You will probably need to trim this so that neatly in the collector cap in Bottle B.
6. Assemble the bottles as shown in the diagram. These sections will be referred to as groundwater, surface water and atmospheric water.



Teacher's Guides for the Bow River Basin Waterscape Poster

Atmospheric water (Bottle C) with ice cubes (such as the cold layer of air above the Coast Mountains). Only use ice cubes when demonstrating. Layer C will still provide a green-house effect for Layer B. Surface water (Bottle B) with 250 mL potting soil and plants started from seed. Soil should just cover the top of the loop. Place an upside down cap on the surface of the soil. The string from the atmospheric water chamber sits in the upside down cap on the soil surface and acts as a "rain" collector. Groundwater (Bottle A) filled with 500 mL of water. This may need to be refilled.

Guiding Questions

1. Referring to the drawing of the water cycle model, predict what will happen within the model as a journal entry.
2. It will take a few weeks for the seeds to germinate and become an active part of the water cycle. Students record observations on a regular basis in their journal.
3. When the seeds have sprouted, place the ice in the atmospheric chamber (Bottle C). Students should write about what this represents in terms of the Coast Moun-tains.
4. Replace the ice daily and continue to make regular observations over the next few days. They should be looking for signs of evaporation, transpiration, condensation and precipitation.
5. As a final journal entry, have students predict how this water cycle will change over time if the predictions of global warming come true?
6. Using the notes from their observations, have the students write a summary of what they have learned about their water cycle. They must include the words water cycle, evaporation, transpiration, condensation and precipitation correctly in their creation.

Guiding Questions

1. How does the temperature affect the water cycle?
2. How does climate change affect the water cycle over time?
3. What is the role of vegetation in the water cycle?

Extensions

- How might you improve on this model? Suggest possible problems and ways that it could better represent the actual processes involved in the Earth's water cycle.

Activity 6 ~Water Cycle Keeps on Rolling

Curriculum Connections

Grades 4/5/8: Earth and Space Sciences, Science Processes

Time

1-2 Hours

Objectives

- To have the students moving through the water cycle as a water droplet.

Materials

- Game Cards
- Station Cards

Key Vocabulary

- Evaporation
- Infiltration
- Condensation
- Precipitation
- Evapo-transpiration
- Transpiration

ACTIVITY

1. Photocopy and enlarge 2 sets of the water cycle game cards. Cut apart and place cards into labelled envelopes.
   a) Ocean
   b) Atmosphere
   c) Ice pack
   d) Groundwater
   e) Rivers and lakes (surface water)
   f) Plants
   g) Animals
2. Set up 7 stations around the perimeter of the classroom. Label each station.
   a) Ocean
   b) Atmosphere
   c) Icepack
   d) Groundwater
   e) Rivers and lakes (surface water)
   f) Plants
   g) Animals
3. Place game cards for each category at the corresponding station.
4. To begin the cycle (game) have all the students start at the animal station. Give each student a card from that station. In turn, each student moves to the next station by following the instructions on the card.
5. Have students record the name of each station as they move to it. If a student chooses a card that tells them to remain at the same station, they must write the name of that station down a second time and then choose another card.
6. Stop the game after 5 minutes. Have the students note how many students are at each station. Continue the game stopping every 5 minutes and continue noting the students.
7. Game is over when all the students reach the ocean at least once.

Extensions

- Add 2 pollution cards to each station. If a student draws a pollution card they must keep it with them. they must write pollution beside each station name as they move through it.

- Have the student sketch the path they followed through the cycle.

* Adapted from Evergreen Theatre "We're all Wet" Teachers Resource Guide 1997

Station Labels

OCEAN

ATMOSPHERE

ICE PACK

GROUNDWATER

RIVERS/LAKES

PLANT

ANIMAL


POLLUTION


POLLUTION

OCEAN
Go to end of line and select again

OCEAN
Go to end of line and select again

OCEAN
Go to end of line and select again

OCEAN
Go to end of line and select again

OCEAN
Go to end of line and select again

OCEAN
Go to end of line and select again

OCEAN
Go to end of line and select again

OCEAN
Go to end of line and select again

OCEAN
Go to end of line and select again

OCEAN
Go to end of line and select again

ATMOSPHERE
Go to end of line and select again

ATMOSPHERE
Go to Ocean

ATMOSPHERE
Go to Ocean

ATMOSPHERE
Go to Ocean

ATMOSPHERE
Go to Ocean

ATMOSPHERE
Go to Ocean

ATMOSPHERE
Go to Ocean

ATMOSPHERE
Go to Ice Pack

ATMOSPHERE
Go to Groundwater

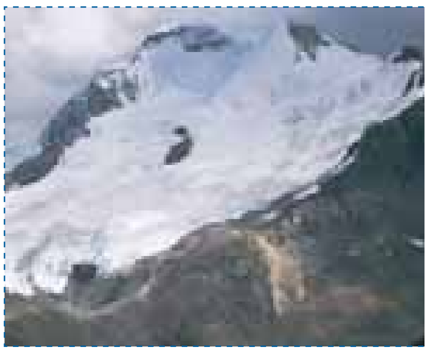
ATMOSPHERE
Go to Surface Water

ICE PACK
Go to
Groundwater

ICE PACK
Go to
Groundwater

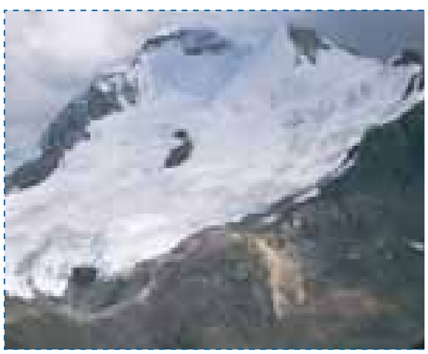
ICE PACK
Go to
Surface
Water

ICE PACK
Go to
Surface
Water

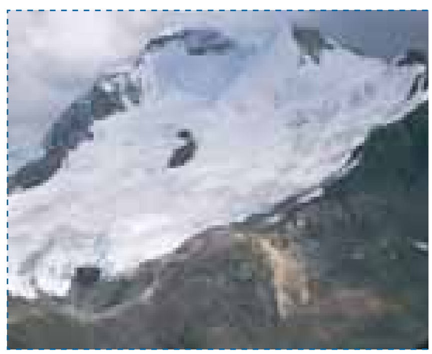


ICE PACK
Go to
Atmosphere

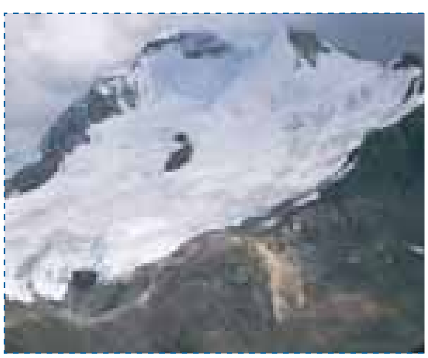
ICE PACK
Go to
Atmosphere



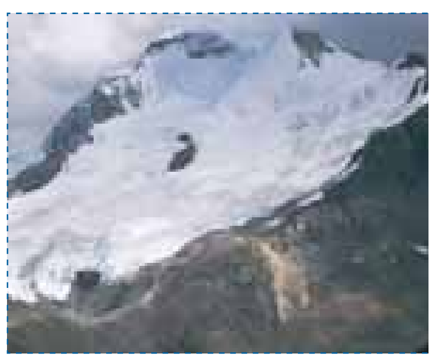
ICE PACK
Go to end
of line and
select again



ICE PACK
Go to end
of line and
select again



ICE PACK
Go to end
of line and
select again



ICE PACK
Go to end
of line and
select again

GROUNDWATER
Go to end of line and select again

GROUNDWATER
Go to end of line and select again

GROUNDWATER
Go to end of line and select again

GROUNDWATER
Go to end of line and select again

GROUNDWATER
Go to end of line and select again

GROUNDWATER
Go to Surface Water

GROUNDWATER
Go to Surface Water

GROUNDWATER
Go to Ocean

GROUNDWATER
Go to Ocean

GROUNDWATER
Go to Plant

RIVERS/
LAKES
Go to Ocean

RIVERS/
LAKES
Go to Ocean

RIVERS/
LAKES
Go to Ocean

RIVERS/
LAKES
Go to Ocean

RIVERS/
LAKES
Go to Plant

RIVERS/
LAKES
Go to Plant

RIVERS/
LAKES
Go to Atmosphere

RIVERS/
LAKES
Go to Atmosphere

RIVERS/
LAKES
Go to Atmosphere

RIVERS/
LAKES
Go to Animal

PLANT
Go to
Atmosphere

PLANT
Go to
Atmosphere

PLANT
Go to
Atmosphere

PLANT
Go to
Atmosphere

PLANT
Go to
Atmosphere

PLANT
Go to
Atmosphere

PLANT
Go to
Atmosphere

PLANT
Go to Animal

PLANT
Go to Animal

PLANT
Go to Animal

ANIMAL
Go to
Atmosphere

ANIMAL
Go to
Atmosphere

ANIMAL
Go to
Atmosphere

ANIMAL
Go to
Atmosphere

ANIMAL
Go to
end of line

ANIMAL
Go to
end of line

ANIMAL
Go to
Surface
Water

ANIMAL
Go to
Surface
Water

ANIMAL
Go to
Groundwater

ANIMAL
Go to
Groundwater

Activity 7 ~ Dance of the Water Droplet

Curriculum Connections

Grades 6: Drama
Grade 8: Fine Arts dance

Time:

2-3 hours

Objectives

- Create and perform a dance that demonstrates the movement of a water droplet through the water cycle.
- Understand the water cycle as continuous.

Materials

- Balloon
- Music
- Role cards (cloud, mountain, stream, river, ocean)

Key Vocabulary

- evaporation
- infiltration
- condensation
- precipitation
- evapo-transpiration
- transpiration

ACTIVITY

1. Divide the students into groups of 5.
2. Have each student choose a role card to identify their part in the dance.
3. Have each group spread out in a large space.
4. Review with students that a water droplet has a very long, difficult and continuous journey—one that never ends.
5. Fill the balloon with water.
6. Starting with the cloud person, have the cloud hold the water droplet and float gently around until it reaches the mountains where it freezes into a snow flake (hand off water drop to mountain) and remains there until the warm weather arrives with spring.
7. The snow melts (mountain gives droplet to stream) and the water drop begins its journey rushing, cascading, tumbling down the mountain-side forming streams that join into rivers (stream gives droplet to river).
8. The river twists and turns and winds its way through the hills and forests slowing as it crosses the prairies and out to the ocean (river gives drop-let to ocean).
9. With ocean, the water droplet moves back and forth with tides.
10. Slowly the sun warms the water droplet changing it to vapour and it rises back to the sky forming a cloud that floats across the sky. (Ocean gives droplet back to cloud).

    This dance demonstrates the water cycle. It could be performed in small groups or in a large group with many water droplets following the journey accompanied by classical music (perhaps something from Tchaikovsky's "The Nutcracker Suite"). This dance could be a powerful expression of learning.


CLOUDS


MOUNTAINS


STREAM


RIVER


OCEAN


SUN

Activity 8 ~ Mountain Barriers

Why So Little Rain Falls Here and What is a Rainshadow?

Curriculum Connections

Grade 4: Science Processes and Earth and Space Science
Grade 7: Processes and Life Science

Time

1-2 class periods

Objectives:

- Demonstrate understanding that mountains can create a barrier that blocks off rain to an area, possibly forming a desert ecosystem.
- Create a model to show the rain shadow effect in the Okanagan.
- Identify the importance of the desert ecosystem to plant and animal species in the South Okanagan.

Materials

- atlases or maps of British Columbia
- overhead of Diagram *British Columbia Terrain Features* (page 42)
- blank 'post-it' notes

Each group of students will need the following materials:

- open, clear container such as a glass baking dish
- rocks
- paper cup
- food colouring
- measuring cup
- hot water
- room-temperature water

ACTIVITY

Preparing your students

Using an overhead of Diagram *British Columbia Terrain Features,* have students verbally identify the topographical features of British Columbia and locate the Okanagan valley (Interior Plateau). Individually or in pairs, students then locate specific landforms in their atlas, and record the name of the landform and its elevation (above sea level) on their post-it notes. For example, Pacific Ocean–0 metres, Mount Waddington–3994 metres, Summerland–450 metres. (Note that some measurements will be estimates, based on the coloured topographical legend to the side of the map in their atlas).

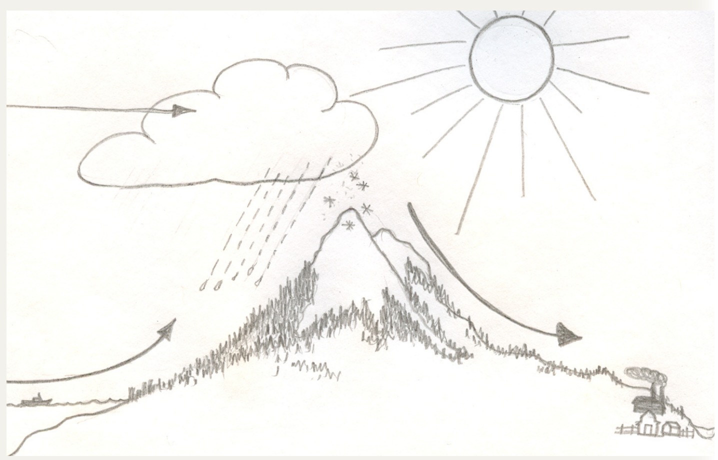


Illustration: Joanne Beaulieu

Activity 8 ~ Mountain Barriers cont'd

ACTIVITY cont'd

After all students have recorded their landform, have them come up and stick their post-it notes at the applicable place on the screen showing the terrain map. Discuss: Who found the lowest elevation? The highest elevation? Elevations in the Okanagan valley? The Coast Mountains?

Next, draw (or tape) a line across the province, intersecting the Okanagan. On chart paper beside the screen, sketch a cross-section of the line, using student's prompts and elevation data. Ask the question, "Looking at this cross-section, why do you think it rains more in Vancouver than in Kelowna? (1155 mm/yr vs. 370 mm/yr)"

Implementing the activity

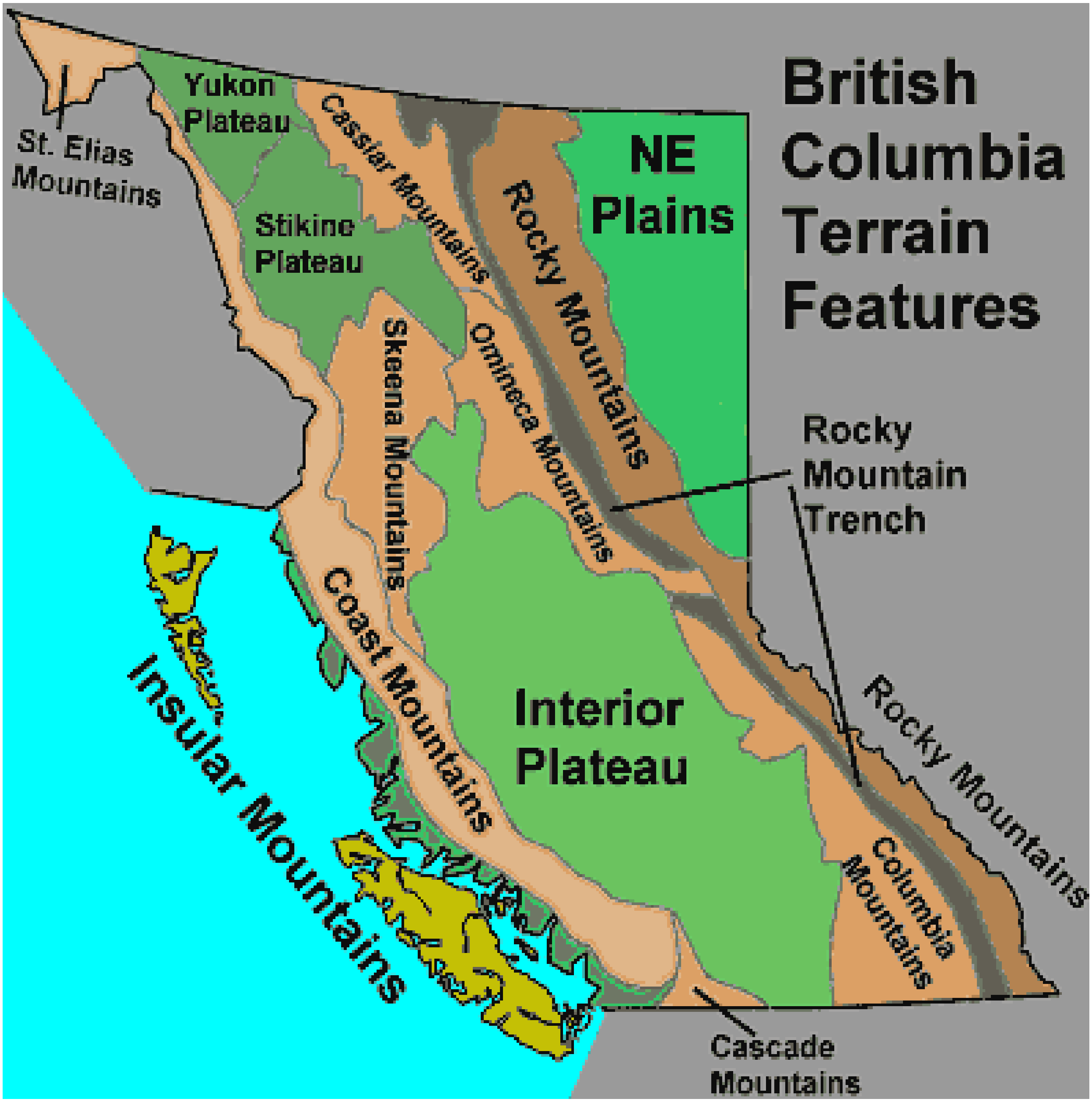
1. Divide your class into groups, and have each group prepare for the activity by creating the 'Coast Mountains' by arranging the rocks near the center of the bottom of the clear glass container.
2. Instruct students to use a pencil point to poke 10 holes in the sides of the paper cup, and then tape the cup into a corner of the glass container.
3. Students should fill the container with room-temperature water until the rocks are covered.
4. Have a member of each group add three drops of food coloring to one cup of hot water in the measuring cup and slowly pour the hot colored water into the paper cup.
5. Students will observe the colored water diffuse through the holes in the cup, but barely mix with the cold water. Most of the hot water will stay near the top of the container, "floating" on top of the colder water.
6. Have students repeat the experiment, filling the container with hot water and adding cold colored water to the cup. The cold water will sink to the bottom and diffuse through the hot water until it reaches the "mountain range," where it will be blocked. The cold water will not be able to pass the rocks because it will be unable to rise over them.
7. After explaining that hot and cold air move in similar ways to hot and cold water, lead a discussion about how the results of the experiment illustrate the way in which mountains can block rainstorms, which are usually brought on by cold-weather fronts.
8. Have each student write two paragraphs explaining, first, how she or he thinks the rise of mountains can affect the surrounding land, and second, how such changes in the land can cause changes in the plant and animal life in an area. (Students should note that the rise of mountains can create deserts.)

Extensions

- The South Okanagan contains Canada's only desert ecosystem. This 'pocket desert' is one of Canada's endangered ecosystems and the home of many endangered plant & animal species. What might happen to the desert and its wildlife if the Coast Mountain Range were to subside?
- Research and investigate which plant and animal species are indigenous to the desert, which are at-risk or endangered, and how their survival needs are met by these particular climatic conditions.

The following websites are recommended:

- The Osoyoos Desert Society
  www.desert.org
- Nk'Mip Desert Cultural Centre
  www.nkmipdesert.com


British Columbia Terrain Features
Yukon Plateau
St. Elias Mountains
Cassiar Mountains
Rocky Mountains
NE Plains
Stikine Plateau
Skeena Mountains
Omineca Mountains
Rocky Mountain Trench
Coast Mountains
Insular Mountains
Interior Plateau
Rocky Mountains
Columbia Mountains
Cascade Mountains

Activity 9 ~ Measuring Rain With a Rain Catcher

Curriculum Connections

Grade 4: Processes, Earth and Space Science

Time

One or two classes

Objectives

Students will make a rain catcher and examine and graph rain levels within one month to calculate the average precipitation at their home.

Materials

- Marbles or rocks for bottom of rain catcher
- Ruler
- Plastic bottle
- Scissors
- Extra fine point marker
- Tape
- Water
- Graph paper

ACTIVITY

1. Have students cut the top off the bottle so that the width is the same as the base.
2. Tape a ruler on the side of the bottle and using an extra fine point permanent marker, mark off each centimeter (millimeter if your class can handle it).
3. Put some marbles or rocks at the bottom of the bottle (this will prevent the rain catcher from tip ping or blowing away). Turn the top upside down and tape it inside the bottle.
4. Pour some water into the bottle to the first mark ing, so that everyone starts at the same level.
5. Tell students to place their rain catcher in a not so busy area in their yard at home. Ask them to check their rain catcher every morning.

   When there is some water in it, record the level and bring it to school. (dump the water out so a new recording can be made the next morning).

   At school, have the children record their rain level with the day's date on their own graph.

Precipitation in the Okanagan

2003	Kelowna	Vernon	Penticton
Jan	33.6	56.7	35.5
Feb	17.2	15.3	09.2
Mar	20.4	36.5	20.8
Apr	33.2	44.9	45.0
May	26.2	30.0	26.6
Jun	21.2	32.5	18.8
Jul	00.0	03.2	00.0
Aug	02.4	00.4	03.8
Sep	24.6	28.7	12.7
Oct	58.2	53.3	54.2
Nov	36.4	56.7	27.4
Dec	15.0	27.9	26.6

Extensions

Compare the average precipitations with the major cities in the Okanagan Region

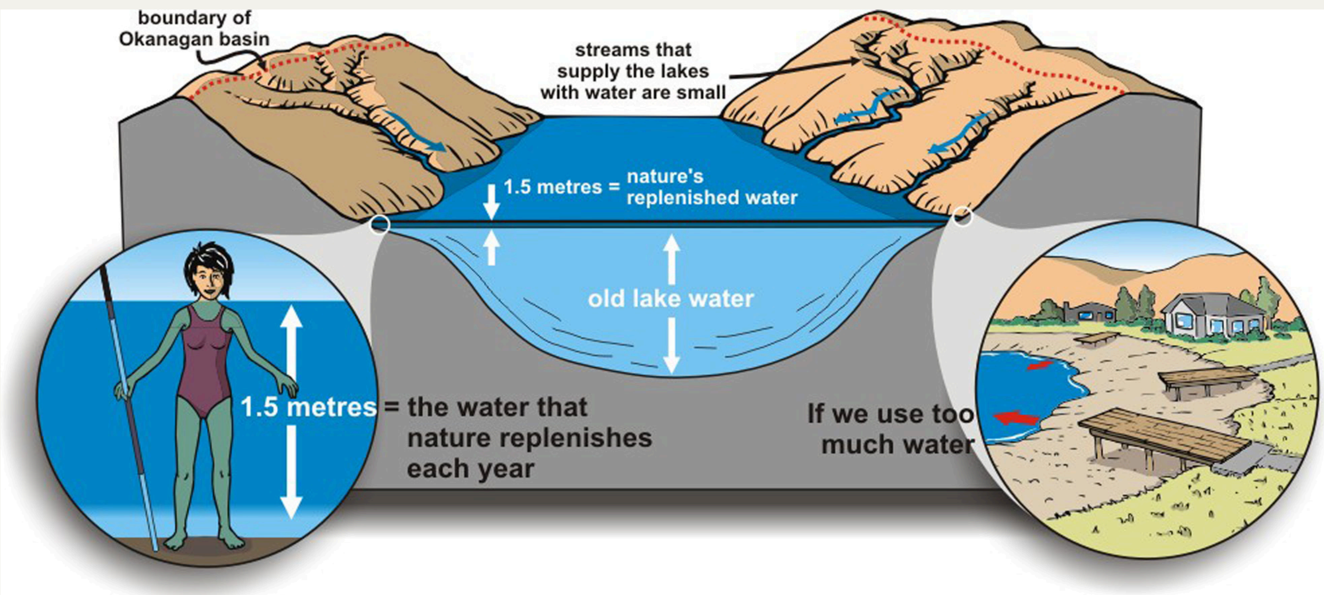
Internet Resources ~ Weather Office
www.weatheroffice.ec.gc.ca/canada_e.html

Our Lakes~Looks can be Deceiving

Background Information

Water shortage? Look at all that water!

With so many large lakes, how could we be short of water? Well, looks can be deceptive. Only the upper metre or two of lake water is replenished each year by stream flow, and much of that evaporates to the atmosphere. This thin layer is all that people and nature can use. If we withdraw more than that, the lake levels will start to fall. Imagine the impact on docks and marinas if the lakes fell to much lower levels.



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Poorly flushed lakes

Most of our big lakes are composed of "old water." Scientists describe the lakes as "poorly flushed" and estimate that water resides in the lake about as long as an average human life time. This is because outflow from the lakes is small relative to the volume of water in the lakes. So we literally "live with" whatever pollutants we put into the lakes.

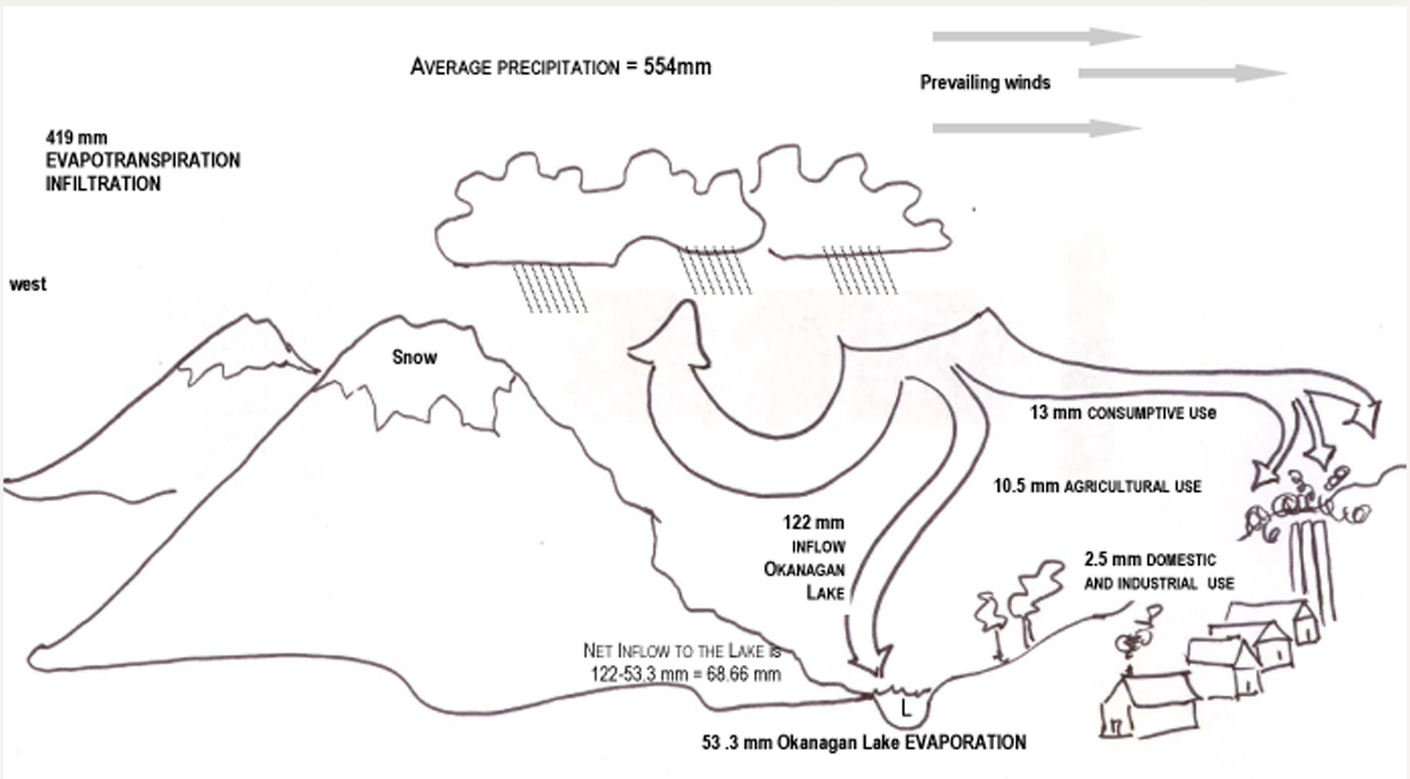
A "bank account" view of our lakes

Think of our lakes as a bank account. Lakes are big accounts but nature's annual deposit is small. If our withdrawls exceed the deposit we start drawing down the account.

Note: the above vector diagram is available in Appendix: Maps and Illustrations.

Where Does the Water Go?

What happens to the water that falls in the Okanagan Basin?



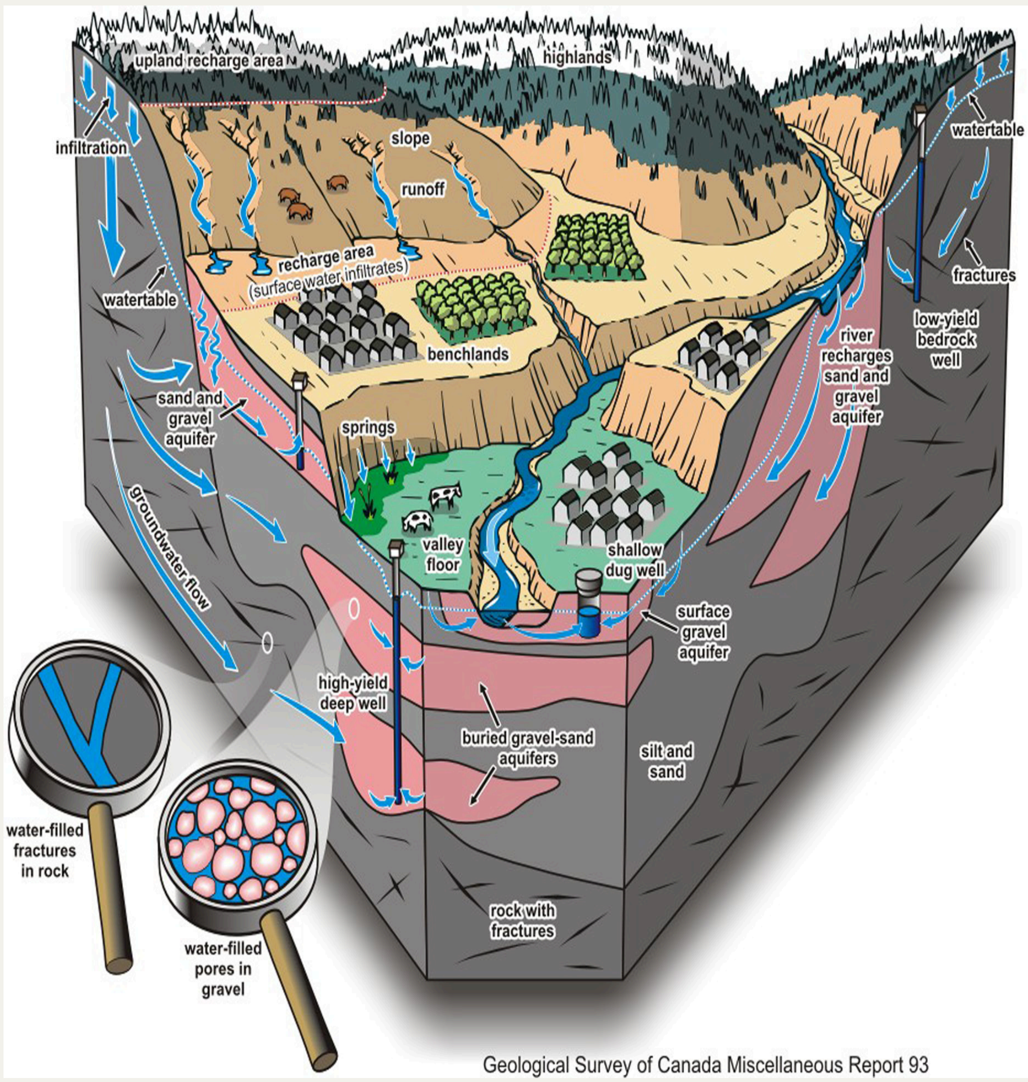
Based on a figure from *Okanagan Geology* by the Okanagan Geology Committee

The un-labeled illustration of the above diagram–suitable for copying–can be found in the Appendix: Maps and Illustrations

Groundwater ~ Connected to Suface Water!

Background Information

What is groundwater?
Water from rain, melting snow, streams and lakes infiltrate into the earth. The Okanagan's soil and rocks are giant sponges full of tiny pores and cracks. Below the water table, these open spaces are filled with groundwater. A well can extract this groundwater. Any rock or sediment that yields useful amounts of groundwater is called an aquifer.

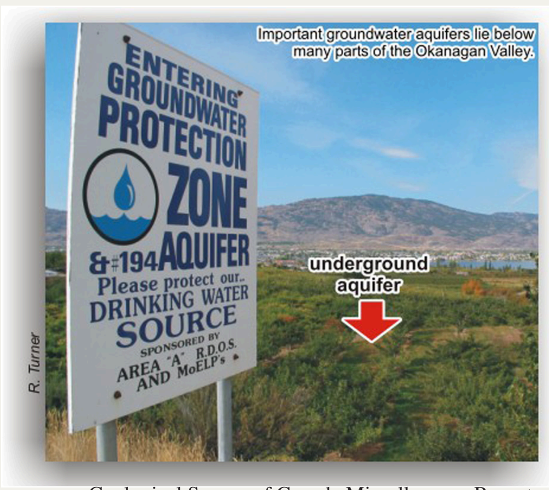


Note: the above vector diagram is available in Appendix: Maps and Illustrations.

Groundwater ~ Connected to Suface Water!

Groundwater feeds streams and lakes

Streams flow throughout the summer, even when it hasn't rained for weeks. This is because water stored as groundwater slowly leaks into streams. But beware! Wells that are over pumped can intercept this groundwater and cause a nearby stream to dry.



Geological Survey of Canada Miscellaneous Report

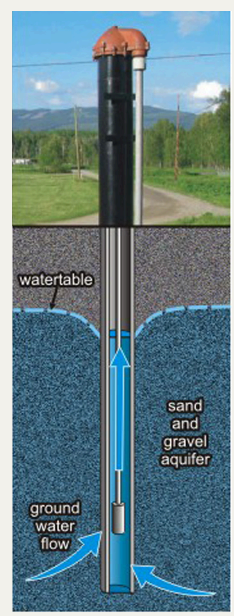
photo: Jennifer French

Disappearing streams

Groundwater is part of the cycle and is connected to surface water. Most groundwater flows into streams and lakes. Sometimes stream waters soak into the ground, feeding groundwater below.

Vital but vulnerable

We live above groundwater aquifers. Take care! Contamination from the surface can leek down into aquifers below, damaging their quality for decades.



Geological Survey of Canada Miscellaneous Report

Activity 10
Go With the Flow: Building a Groundwater Model

Curriculum Connections

Grade 7: Processes, Social Studies Processes, Human and Physical Environment
Grade 8: Social Studies Applications and Environment

Time

70 minutes

Objectives

- Model groundwater movement as well as the movement of a contaminant through an aquifer to a lake or river

Materials

- One 1.89 L rectangular plastic juice bottle
- 1 ice cream pail of fine gravel (1/4 to 1/8 inch pieces)-use white aquarium gravel if doing as demonstration.
- nylon stocking
- rubber band
- water
- blue food coloring
- clear plastic or glass jar/beaker/glass
- cocoa (about1 tsp)
- clear 2L pop bottle
- film canister with holes punched in bottom (translucent is best)

Key Vocabulary

- groundwater
- surface water
- aquifer
- contaminant
- plume
- water table

ACTIVITY

1. Cut away one of the narrow sides of the bottle.

2. Fill the bottle 2/3 full of gravel — so that gravel completely covers the mouth of the bottle. This creates your aquifer. Put the nylon over the neck of the bottle using the elastic to hold it in place. Screw the bottle cap over top of the nylon.

Teacher's Guides for the Bow River Basin Waterscape Poster

Fig. Go With the Flow Step 1

Teacher's Guides for the Bow River Basin Waterscape Poster

Fig. Go With the Flow Step 2

Groundwater Demo

1. Pour the coloured water into the container and fill it until it is half way up the mouth of the bottle. This setup demonstrates the groundwater in the aquifer and the water table The groundwater model represents a cross-section of ground with gravelly soil underfoot. The nylon/rubber band represents the root structure on the bank of the river which prevents the gravelly soil from flowing freely into the "river" (clear container for catching water flowing from model). Discuss groundwater movement – does it flow or remain static?

2. To demonstrate the flow of groundwater, have a clear pop bottle full of the blue colored water and a clear container for catching the water ready. Remove the cap on the groundwater model, and simultaneously pour water from the pop bottle into the opposite end of the groundwater model. Collect the groundwater flowing through the model in a clear container.

Fig. Go With the Flow Step 3

Teacher's Guides for the Bow River Basin Waterscape Poster

Guiding Questions

1. What is the direction of groundwater flow? What direction do rivers flow?

2. Trace the flow of a nearby stream (Mission Creek, Upper Vernon Creek, etc.) until it empties into a large body of water. What is its primary direction of flow? Where does it end up? Can you find any rivers in Canada that flow north? Where do they terminate?

Activity 10 ~ Go With the Flow cont'd

Pollution Plumes!!

1. Now place the film canister (which has holes punched through the bottom) on top of the gravel bed at the far end from the mouth of the bottle, and close to the front side of the model. This represents a tank or any container from which a contaminant may leak onto the surface of the ground. With the lid screwed on the plastic groundwater model, fill the film canister with the cocoa water "contaminant". This could represent excess fertilizer, sewage from cattle, leakage from an oil storage tank, etc. Allow the canister to empty into the aquifer, watching the contaminant plume form.

2. Demonstrate the movement of this plume by carrying out the same procedure as was used for the groundwater flow.

3. Collect the water in the plastic container, and then compare to the water entering the groundwater model.

Extension

1. Examine the Okanagan watershed and list the types of contaminant plumes that might enter the groundwater system.

2. Over the last 20 years phosphorus inputs to the Okanagan Valley lakes have affected water quality. The increase has been most apparent in Kalamalka Lake, with lesser increases in Okanagan, Skaha and Osoyoos lakes and only minor changes in Ellison and Wood Lakes. Speculate on the sources of phosphorus to a local lake and the options to control each source.

3. Gravel was used to simulate the underground "soil" in this model. Make a prediction about using different materials for the soil in the model – for example clay, or sand. Design and carryout an activity to detect differences in groundwater movement as well as contaminant plume movement in different types of "soil".

Fig. Go With the Flow, Pollution Plume Step 1

Fig. Go With the Flow, Pollution Plume Step 2

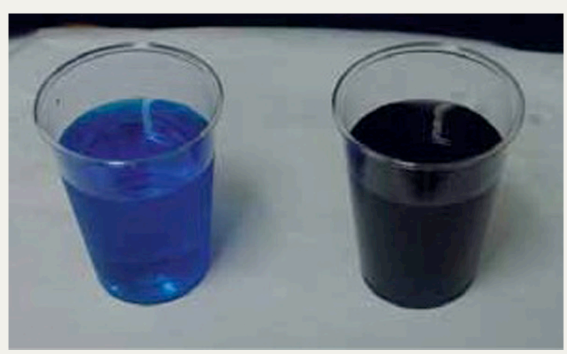


Fig. Go With the Flow, Pollutin Plume Step 3

Teacher's Guides for the Bow River Basin Waterscape Poster

Activity 11 ~ Watershed Down

Curriculum Connections

Grade 4: Science Processes, Life Science

Grade 5: Science Processes, Earth and Space Science

Grade 7: Processes and Life Science

Grade 8: Science Processes, Earth and Space Science: Water Systems on Earth

Time

1 - 2 lessons

Objectives

To observe the effect of lowering the water table on shallow wells, and to consider both human and environmental influences affecting the level of the water table.

Materials

- 60 cm clear beaker
- Several clear containers, varying sizes
- Metre stick, centimeter ruler
- Water (to fill to 55cm mark)
- One plastic groundwater model, half to two thirds filled with gravel
- One pump from an old soap dispenser or a straw
- Blue food colouring
- Sink, bucket or large bowl to catch water in

ACTIVITY

Preparing your students

Have the Okanagan Basin Water Cycle diagram (page 45 Where Does the Water Go? or appendix) as a visual reference on the overhead.

Fill a tall beaker with water to the 55 cm mark (if a beaker or tall clear container is unavailable, a metre stick may be used instead). This 55 cm (554 mm) represents the average annual precipitation in the Okanagan valley.

Ask students how much of this water do they think gets used by people? In a web, have students quickly brainstorm the uses of water, and make their guesses.

Using the beaker, carefully pour out water into other containers to represent the following amounts:

- 42 cm (419 mm) – Forests and vegetation, through transpiration and infiltration (some of which becomes groundwater)
- 12 cm (122 mm) – Flows into Okanagan Lake and surrounding lakes (53 mm of this evaporates back into the water cycle)
- 1.3 cm (13 mm) – Human use, including domestic use, industrial use, agricultural use

Activity 11 ~ Watershed Down cont'd

Preparing your students cont'd

- Can we depend on precipitation to meet our water needs?
- Lake water? The largest amount (42 cm) could become groundwater - this can then enter an aquifer and/or seep through to the lake for our use. But!
- What could affect the amount of groundwater available?
- What about climate change?

Implementing the activity

1. Set up plastic groundwater model as used previously in Go with the Flow (p. xx).
2. Insert the pump or "well" into the aquifer (gravel within the bottle).
3. Pour blue coloured water into "aquifer" until above the bottom of the "well".
4. Let water drain from aquifer without replenishing it by loosening the cap at the mouth of the bottle and having it drain into a sink or container.
5. Observe the level of water in the "well" as the water table drops.

Extensions

- List natural and human activities that could cause a drop in the water table.
- Do you see this decrease in the level of the water table as being serious only for those on wells or for all of the citizens in the watershed? Explain your answer.
- Assume that you are in a position to make political decisions — would you suggest specific action if there was a 15 year record showing the water table dropping consistently year after year? Explain your response.

Activity 12 ~Tasty Waste

Curriculum Connections

Grade 4 to 6: Social Studies Processes,
Grade 5: Science Processes, Earth and Space Science
Grade 6: Human and Physical Environment
Grade 8: Applications, Earth and Space Science

Time

- 1-2 Hours

Objectives

There are many different users depending on the Okanagan watershed as their only source of potable water. Even though users may be tens or hundreds of kilometres apart, their actions can have a direct impact on each other. In this activity, students gain an understanding of possible connections between groundwater and surface water (through wells, leaching, etc.), how can spread, and how contaminants can suddenly appear in someone's drinking water!

Materials

- Bag of miniature white marshmallows (20 per student)
- Ice cream – enough for class (individual, plastic ice cream cups which are available by the bag in any grocer are ideal for this activity since no one gets more than anyone else and there is less mess)
- Clear plastic drinking cups (enough for everyone in class)
- Straws – enough for 2 per student
- Masking tape ·
- Green food colouring
- Dropper
- Red sprinkles
- Plastic spoons (enough for everyone in class)

Key Vocabulary

- contaminant/leaching
- potable water
- surface water
- groundwater
- pollution plumes
- porous rock or
- sediment rock
- permeable rock

Fig. 38

Teacher's Guides for the Bow River Basin Waterscape Poster

ACTIVITY

1. Have students brainstorm about how pollution plumes might move from groundwater to surface water or visa versa (groundwater flow, leaching, well contamination, etc.).

2. Tell students that they are going to create an edible aquifer to demonstrate how areas that are far apart can still contaminate each other.

3. Demonstrate the building and subsequent contamination of the aquifer using the following steps:

STEP A:

Tape 2 straws to opposite insides of clear plastic cup. The bottom of the straw should be about 1 cm from the bottom of the cup.

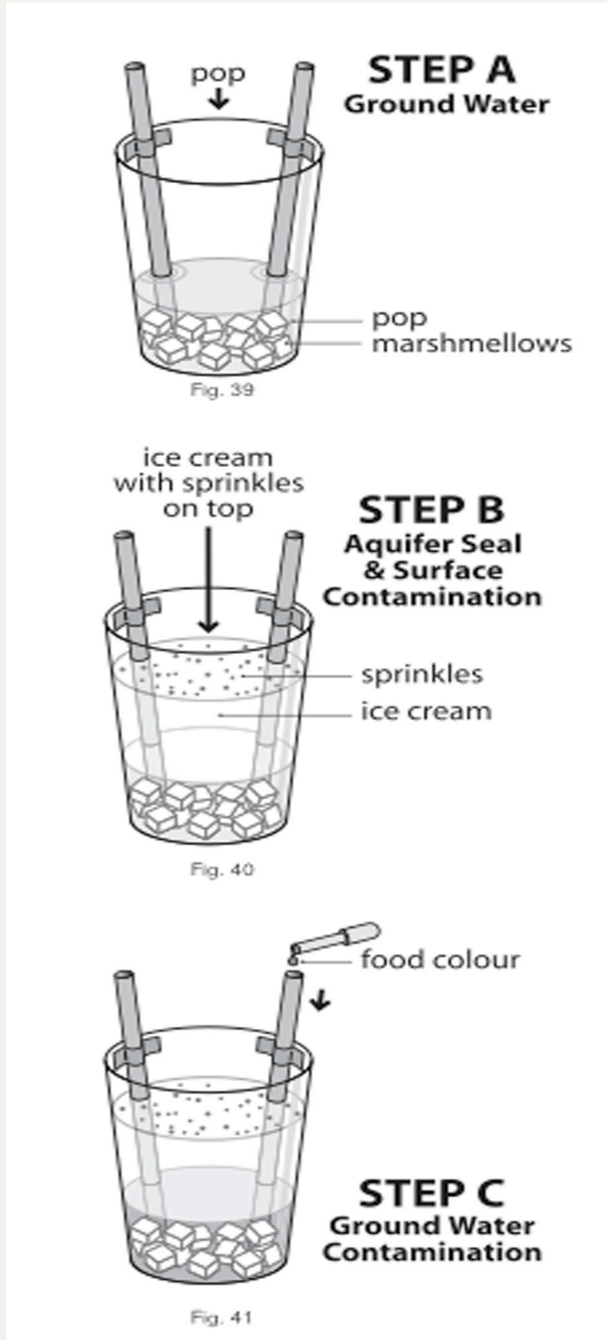
- Place marshmallows (20 is plenty) in bottom of cup. The marshmallows represent porous and permeable rock or sediment.

- "Charge" the aquifer by adding just enough clear pop (water) to almost cover marshmallows. If you put in too much, the marshmallows may float; just push them back down with the spoon. Aquifers are charged from rainwater percolating down through overlying sediment.

STEP B:

Take a spoon and remove the ice cream from its holder, carefully placing it in the cup on top of the marshmallows. It should be just about a perfect fit but you may have to push it down slightly with the spoon. This represents a less porous and permeable layer above the water table.

- It is now time to start contaminating this pristine environment. To represent contamination on the surface (fertilizer, pesticide, herbicide, etc.) distribute red sprinkles on top of the ice cream.



Teacher's Guides for the Bow River Basin Waterscape Poster

Activity 12 ~Tasty Waste cont'd

STEP C:

To represent contamination from an abandoned well, place one drop of green food colouring into the straw. It is recommended that this step be done by the teacher when the students are making their models, since food colouring can be a invitation to disaster in the wrong hands. Gently blow on the straws to move the contaminent down into the aquifer. Have students describe their observations of the aquifer.

- To represent rain, sprinkle some pop over the surface of the model. Have students observe as red contaminent is leaked from the surface and begins to percolate down through the soil toward the aquifer.
- The farmer is going to need to get some water from his well. Have students predict what will happen when he sucks some liquid up through the well. Suck some of the pop up as students watch what happens to both the well contaminant and the suface contaminant.

4. Students are now ready to make their own models. Management suggestion – have packages made ahead of time for students (cup, 2 straws, 20 marshmallows, plastic spoon). Because the ice cream melts fairly quickly, you may want to do half of students at a time while others work on a related task.
5. Lead them through building the basic model. You may want to have three stations set up. One for adding rainwater (pop), one for adding ground contaminant (sprinkles) and one for adding oil contaminant (food colour). Two dependable students can deal with rain and surface contaminant stations while the teacher does the food colouring. This is also a great day to have a parent volunteer, if you can round one up.
6. Students go through the same steps as the demonstration, adding straws, marshmallows, pop, ice cream, sprinkles, more pop and food colouring. All along, they make visual observations. However, because this process needs to be done quickly in order for the ice cream not to melt, they do not make written observations until the end.
7. When done, students draw a before and after picture of their aquifer. They should label the aquifer, groundwater, water table, sediment and soil, sources of contaminant and paths of contaminant. They then infer reasons for contaminant paths and connect their observations to a real life situation where this might occur.

Guiding Questions

1. How do the contaminants get into the water table?
2. What happens to the aquifers when the contaminants percolate into the groundwater?
3. What sources of contaminants are commonly found in urban areas?

Extensions

- A field trip to the Kelowna Ecco Centre is a wonderful experience for the class
- Design a way to remove or at least contain the contaminant from the polluted environment in the model aquifer. Of course, eating it will get rid of it but that is cheating.

Activity 13 ~ Aquifer Xray

Curriculum Connections

Grade 7: Life Science
Grade 8: Earth & Space Science

Time

1 class period

Objectives

- Build a profile model of the geologic layers found in the Okanagan.
- Compare movement of water through diverse substrates under our feet.
- Relate different types of land uses to potential ground water contamination.

Materials

- Clear plastic cups with small holes punched in the bottom
- Gravel(different sizes & types)
- Sand
- Clay
- Topsoil
- Silt or fine particles
- Jug of water
- Hand-held magnifying lens
- 1" x 12" strips of white paper
- Coloured pencils, rulers
- Overhead of Mission Creek escarpment and Rutland aquifer cross-section

ACTIVITY

Preparing your students

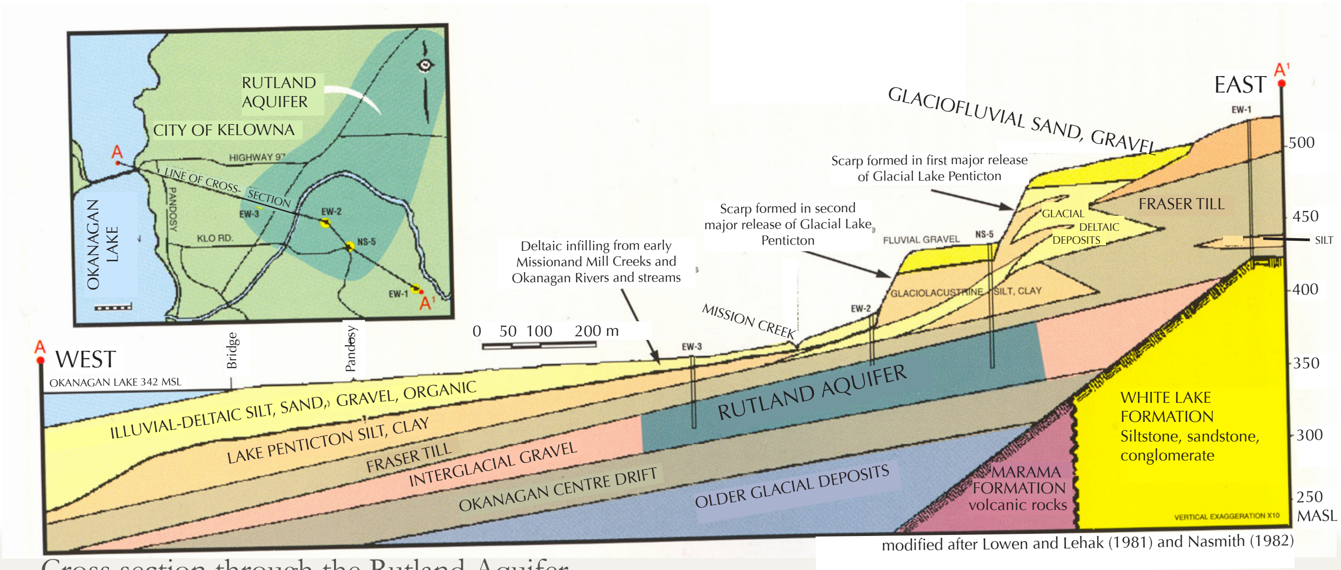
Show students an overhead or photo of the Mission Creek, Kelowna area. What do they notice about the layers they see in the cliffs?

Point out the water seeping out partway down the formation – why do they think the water runs out here rather than continuing down?

Finally, ask students to imagine they are a water droplet – what layers might they encounter as they travel downwards to 100 metres below the surface.

Prompt answers to include: soil, types of rock layers (sedimentary, igneous), clay, glacial till and gravel, volcanic debris, caves, fossils, etc.

'Hydro-geologist' – a scientist who studies groundwater, especially by drilling wells and analyzing the layers as they drill down.



Cross section through the Rutland Aquifer

Implementing the activity

1. Divide students into pairs or small groups to build a representational model of the earth layers and aquifer in the Mission Creek area.
2. Showing the overhead of the Rutland Aquifer cross-section, have students identify the known features – Lake Okanagan, Mission Creek, Rutland bench, etc.
3. Draw a line straight down from section EW2 – students are going to be hydro-geologists and imagine that they are drilling a well at this location. Discuss what layers they will encounter, and what each layer will look like. Have the class decide which soil/rock material would best represent each strata layer. What other materials will they need? (water) Is the Rutland aquifer entirely water, or do they think it is water that has seeped around and through rock? (Yes – interglacial gravel, larger sized). Why doesn't the water continue to seep down? What do you think the Okanagan Centre Drift is formed of? (clay, silt, impermeable layer)
4. Hand out a photocopy of the overhead to each group so that students can measure the layers to keep the same proportions in their model.
5. Each group of students will have a plastic cup to build their ground sample model in. Students should poke approximately 10 small holes in the bottom of their cup to permit groundwater flow.
6. Students will then choose the appropriate soil and rock materials to build their formations. After all the groups have completed their formations, add 50-100 ml of water to their cups and discuss where the water is settling.
7. Each student will then draw their model on a piece of white paper, with strata detail (texture or colour) and labeled sections.
8. Show the overhead of the Mission Creek scarp (cliff) again – if their models were part of a cliff, where do they think the water might seep out instead of continuing down? (at the clay layer)
9. Finally, have students either discuss or recreate groundwater contamination, by modeling a gasoline spill in the parking lot of Mission Creek. A few drops of coloured water or a solvent such as nail polish remover will effectively model groundwater contamination.

Extensions

- Have the students choose one strata layer and research how and when it was formed.

Activity 14 ~ Alkali Lake

Curriculum Connections

Grade 5 Social Studies
Grade 7 Science Processes, Life Scientc
Grade 8 Earth & Space Science

Time

One class to construct
One week for class to observe

Objectives

- To model the formation of an Alkali Lake
- To relate the high evaporation rate of water in the Okanagan and the low precipitation to this process.
- To recognize the gradual process of Alkali Lake formation

Materials

For each Group

- Tin foil – piece approx 30 cm long by the width of the roll
- Clear plastic wrap – slightly longer length than the foil
- Measuring cup (or other container to hold water)
- Spoon (approximately Tablespoon size)
- Salt – approx 4 tablespoons
- Warm water – approx 2 cups
- Small pebbles – 20 or more – approx "pea sized"

ACTIVITY

Preparing your students

Refer to photo of White Lake from Panel 3 of Okanagan Basin Waterscape as well as the photos below. Students might know of similar lakes in their area. Question: Why do these lakes have white areas around them?

The water in the Spotted Lake contains high amounts of dissolved magnesium which is a salt . As the weather gets warmer and the water evaporates from the surface of the lake, the minerals are carried up to the surface and then deposited on the surface of the soil which was part of the bottom of the lake.

photo: Gayle Lyman

Spotted Lake near Osoyoos

Activity 14~ Alkali Lake cont'd

photo: Benjamin Rondell

photo: Benjamin Rondell

Roberts Lake, Kelowna, mid-summer

Implementing the Activity

1. Students form a long shallow lake basin from the tin foil. This should have an outside edge to keep the water in. Small ridges can be moulded inside the "lake". Figure 1

2. To ensure that leakage does not occur, place plastic wrap as a single layer over the "lake" and gently press so that it is not noticeable.

3. Place the small pebbles around the edge of the foil lake, at the inside edge of where the lake will occur and so that they will not be in the water.

4. Stir the salt into approximately 2 cups of warm water (a saline solution but not saturated) Figure 2.

5. After ensuring that the lake has been located in a place where it can stay for the next week or 2 while evaporation occurs, gently pour the salt water into the "lake" basin.

6. Sprinkle a very few salt crystals into the lake as "seed crystals."

7. Let stand and make daily observations. Figure 4

8. More of the saline can be added after a few days if the students wish.

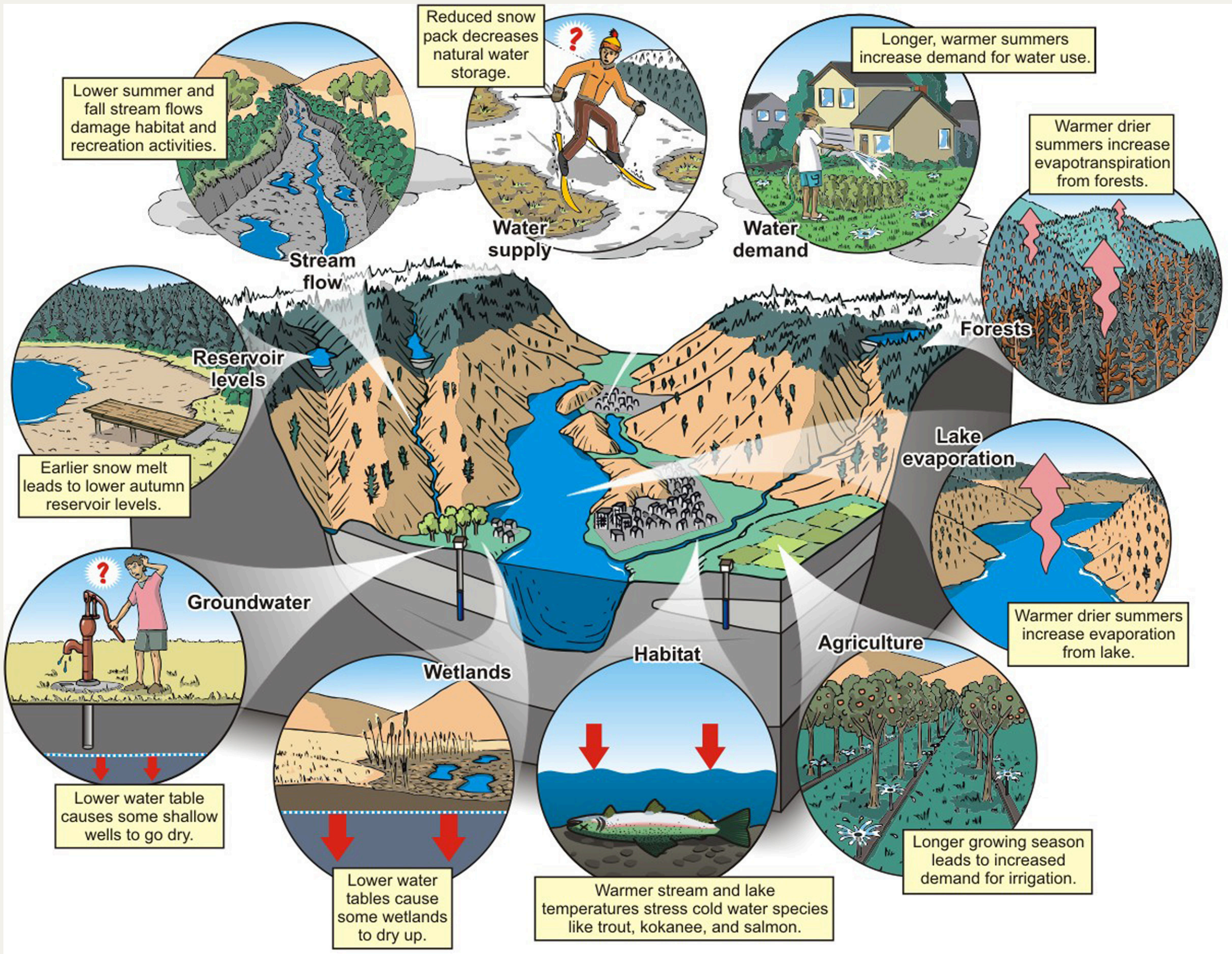
Extensions

1. Daily observations can be written up in a log book and can be written up as a study.

2. Students can research and report on the process by which salinity and alkalinity can increase in a lake over time. Does this happen at all lakes ?

3. Relationship between high evaporation and low flow to volume ratios can be explored over time.

Our Changing Climate ~ Less Water but Rising Demands



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Activity 15
Climate Change ~ Hotter, Less Water

Curriculum Connections

Grade 7: Science Processes, Life Science: Ecosystems
Grade 8: Processes, Earth and Space Science

Time

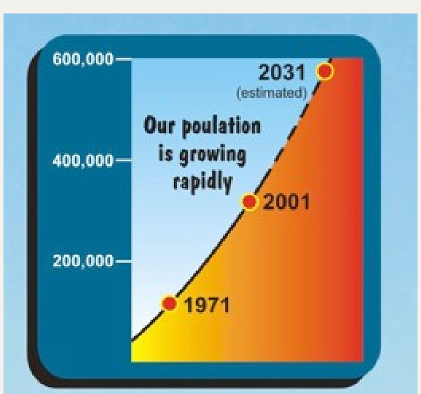
- 2 - 3 class periods

Objectives

- The Okanagan is growing and our climate is warming up. This is good news for sun worshipers but bad news for the watershed and its sustainability. In this activity, students will analyze data and interpret patterns in order to predict the availability of water for future generations. Based on their conclusions, students generate a list of recommendations.

Materials

- Graphic data – post pages at stations around the class-room (see Appendix)
- Station summary sheets, (1 per group)
- Temperature Rising poster if available
- 2 litres lemonade and cups



ACTIVITY

Preparing your students

Imagine that we all needed lemonade to survive. We need at least 42 ml per day to stay alive.

Bring in a 2L bottle of lemonade and enough cups for every-one in class. Start out by asking how much each person will get from the bottle (2000÷25 = 80 ml per student). Have the cups marked with a line showing the 80 ml level. Pass out a cup to each student.

But wait, we are going to travel 10 years into the future for just a few minutes. We now have 35 people in class because of increasing population. How much will each person get from the bottle (2000÷35 = 57 ml)? Everyone is still alive. Students can estimate where this line will be on their cups.

Because of global warming, it will be hotter 10 years from now so 500 ml of our lemonade just evaporated. Each student will now have 1500÷35 = 43 ml. We are not happy with half of the lemonade we started with but we are alive.

Because it is hotter, some people decide they need to drink more so 10 students drink 50 ml which is more than their share. How much does that leave for the rest of us to share? (1000 ÷ 25 = 40 ml per person). A few of us just died!

Could this scenario actually happen with real water in real life? Let them think about that as you give each of them their lemonade and introduce the activity.

Activity 15
Climate Change ~ Hotter Less Water cont'd

Implementing the activity

1. While students are drinking their lemonade, lead a class discussion of how water supply is affected by climate change. What have students personally noticed in the Okanagan? What do they predict might happen in the future?

2. Set up Climate Change Information Stations around the classroom. See Activity Support appendix for the climate change information stations Stations include maps, graphs, statistical projections, photographs, news-paper articles and textual information for the fol-lowing: Temperature, Precipitation, Stream Flow, Population Growth, Water Consumption, Green-house Gas Emissions, Animal Habitat, Forests. Stations may include 1 or all of the following pages.

3. Prompt the class to verbally define what each station is about, for example, "What is stream flow? What can stream flow information tell us about climate change? About the Okanagan watershed?"

4. In this puzzle activity, students work in groups to visit each station, record their findings on their Summary Sheets, and bring their information back to their group. Each group will then piece together their information and make predictions in each area for the year 2050.

5. Groups take turn presenting their findings, their predictions and their recommendations.

Extensions

- Individually or in their groups, students choose one station to research climate change further. They may then present their research orally, in writing, or by developing a poster.

- Debate the causes of climate change from two perspectives – those who believe it is part of a natural planetary cycle and those who believe it is due to increased greenhouse gas emissions.

- Create an awareness campaign within the school that will encourage everyone to become more conscientious about water conservation.

- In this puzzle activity, students work in groups to visit each station, record their findings on their Summary Sheets, and bring their information back to their group. Each group will then piece together.

photo: Don Weixl, Tourism Kelownal

Activity ~ Climate Change Stations

As you visit each station, list the main information presented and write down your predictions for the future.

Station	Summary of information (trends, cycles, predictions)
1 Temperature	
2. Water Supply	
3. Water Demand	
4. Stream Flow	
5. Amimal Habitat	
6. Forests	

Predictions - Ten years into the future ______________________________

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Note: support document for this activity are in Appendix: Activity Support and include the information sheets on the six topics for each group.