# Make a Watershed Model

Grades: K-7

Subject, Science

Time required:30-60 minutes & 45 minutes sand play

*Key Concepts:*

*A watershed is the area of land that drains into a lake, stream or other water body.*

*Objectives:*
*Students will predict where water will flow in watersheds and understand the impact of water flow in their school yard and home.*

**Key Words:**
**Watershed, streams, lakes, rivers, wetlands, estuary, pollution**

**Skills:**
**Gathering information, organizing, discussion, analyzing, interpreting**

Background:

Watersheds are local, recognizable places for understanding the dynamics of ecosystems.

A watershed is the area of land in which precipitation all drains into one outlet. This outlet can be a lake, a stream, a river, or the ocean. The analogy of a huge deciduous tree may be helpful in explaining the concept of watersheds. When rain falls, one drop may join with others to form a rivulet. These rivulets join together (streams), which then join along branches (rivers), then trunk of the tree (large river leading to the ocean).

Watersheds are drainage basins and the separation between drainage basins is called a drainage divide. Watersheds are interesting because of the interaction between the physical landscape of the area (rock and soil formations), the climate, the ecosystems, and the human presence in that area. All of these components work together in order for the watershed to function.

The physical characteristics of the land are the very base of a watershed. They define in which direction water will flow. Physical characteristics are: rocks, soils, sediments and of course, water. In all of its forms it touches everything in the watershed.

Watersheds contain ecosystems that vary depending on location and climate. These ecosystems play an important role in

Materials:

- Chalk
- Popsicle sticks, bread tags or tokens
- Sand pile, sponges, watering can, plastic sheet, digging tools
- Rocks (optional)

# Make a Watershed Model

**Background continued:**
maintaining the health of a watershed.

A watershed is a close to home example of the water cycle; we all live in one. In a watershed everything is connected, the upper watershed impacts the lower watershed and the lower watershed impacts the upper watershed. Since watersheds are local, recognizable places, understanding the impacts of human actions are more visible and more accessible to everyone living in the watershed. A healthy watershed provides the people living in it with food, clean water, timber, and plenty of opportunities for recreational activities.

The Squamish watershed encompasses all the land from the Pemberton Icefield down to Howe Sound. All of the Squamish Nation traditional territory (Sḵwx̱wú7mesh-ulh Temíxw) is within this watershed.

The Squamish River originates at the Pemberton Icefield and it flows until it reaches its mouth into Howe Sound. The river is approximately eighty kilometers long, and although it is a relatively short river in BC, it is very large. It drains an area of 3,328 square kilometers. The Squamish River flows south from its source and collects the water from several other glacial streams. The Squamish River and the Elaho River meet about 21.8km southwest of its source. The Elaho River is one of the Squamish River's two largest contributors. The river then flows 24.8km southeast where the Ashlu River joins. The Cheakamus River joins the Squamish River another 16.4km along and then Mamquam River joins 4.7km farther to the south. From this point it is only six kilometers to its mouth in Howe Sound.

Did You Know?

- Five rivers drain into the Squamish Watershed (Elaho, Squamish, Ashlu, Cheakamus, Mamquam Rivers);
- Much of area was carved by glaciers during the last ice age approximately 10,000 – 25,000 years ago;
- Glaciers are still present as part of the headwaters of the Squamish and Cheakamus Rivers;
- The Squamish River watershed is the source of 90% of the fresh water that enters Howe Sound.

For the purposes of teaching the watershed concept, it is recommended to focus on a small watershed – play in a sand watershed model. Or, you can do a rainy day hike on the school grounds to investigate the flowing water into a puddle. Be sure to dress for the weather!

**Procedure:**

1. Use chalk to draw a large tree-like structure on a paved area of the school playground. (See diagram). Make sure there are enough "twigs" for each student at the tip of the "tree."
2. Give each student a blue chip/token or a bread tag. The tokens represent a water drop.
3. Ask students to walk down their twigs onto the nearest branch where they will join with other students. They should link hands. Like a grand march, keep joining

# Make a Watershed Model

the groups together until they are groups walking down the trunk of the tree.

4. Explain that they started as individual water drops and they then joined with others into streams and rivers to form the water flow in their watershed.
5. When students have completed this exercise, ask them to summarize the general pattern of water flow through the watershed. If possible, point out local mountains where the rain drops start and then local streams and rivers where the drops eventually collect.
6. Repeat the procedure but give students in one branch a Popsicle stick or other (non-blue) token. These tokens represent pollution such as an oil spill. Have students do the Grand March of the raindrops one more time. What do students think happens when pollution is added to the watershed?
7. For the second part of this activity, gather students in the sand area of your school playground. (Extra sand may have to be delivered prior to completing this activity. Sand should be left in a pile or piled up to make a "mountain" prior to beginning.)
8. Ask students to guess where on the sand "mountain" the watershed "twigs and "branches" might be located. Point out that the smaller twigs (streams) are located in the uppermost areas of the mountain and the larger branches (rivers) are like the trunk of the tree which leads to the ocean. The ocean is located at the base of the mountain.
9. Have students dig out the streams and rivers of the watershed. Rocks may be placed for added dimensions. Wetlands, lakes and ponds can be added using sponges to represent them (water is stored in wetlands, lakes, and ponds similar to a sponge).
10. When students are satisfied with their watershed, carefully lay a plastic sheet over the watershed. Tuck plastic into the created streams & rivers. Sponges should be transferred to on top of the sheet. Rocks can be placed around the sheet to keep it in place (optional).
11. Ask students to predict what will happen when water is poured onto the watershed. Pour water from the watering can onto the watershed beginning at the mountain top and discuss what happens.
12. Repeat the exercise as many times as you have time for, changing the features of the watershed.

**Extensions:**

1. Add pollution to the watershed by placing food colour in a small sponge at a location in the watershed prior to pouring on the water. Have students predict what will happen to the pollution. How can we clean up pollution in the watershed?
2. Go on a rainy day hike around your school yard. Have students work in small groups to investigate sites of flowing water on the school grounds. They should observe water colour and which way water is flowing. Children can use natural material (twigs and the like) to make tiny "boats" to float down the "river" to the ocean (puddle).

**Evaluation:**

Have students:

1. Compare their ideas about watersheds from before and after the activity;

# Make a Watershed Model

2. Draw their idea of local watershed using a local river like the Mamquam River as a focus. Students can draw features from the mountains to the estuary and Howe Sound;
3. Discuss reasons why their watershed and school grounds must be kept clean.

**Community Connections:**

**1.** Invite a member of a local Streamkeeper group or fish and wildlife club to tell about the fish of the Squamish River Watershed.

**Taking It Home:**

1. Ask students to bring home the Squamish River Watershed Worksheet and ask their family if they can find all the major rivers that are in the watershed and colour them in.

**Resource:**

This activity has been adapted from "Making a Watershed Model" from Water Stewardship (1995).


References:

Blair-Whitehead, D.G. and W. Husby. 1996. *Water for Tomorrow: A Guide to Watershed Stewardship in the Howe Sound Basin*. Wild BC, Victoria.

Environment Canada. 2000. *A Primer on Fresh Water, 5th Edition*. Environment Canada, Ottawa

Jacobs, Peter. 2009. Personal Communication. Squamish Nation Language Technologist

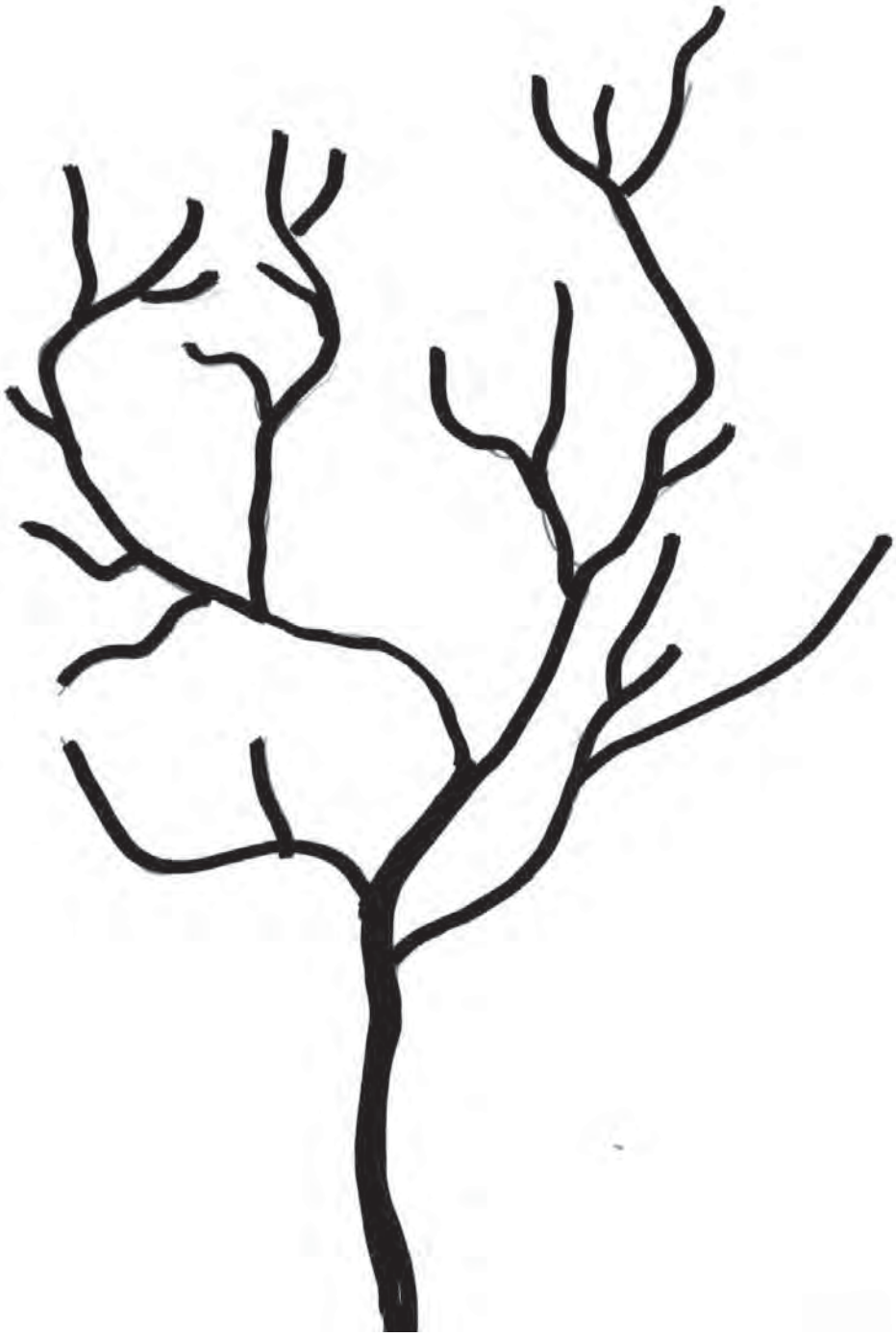
McClaren, Milton. 1995. *Water Stewardship.* Ministry of Environment, Lands, and Parks. Victoria, BC.

U.S. Geological Survey. http://water.usgs.gov/

District of Squamish. http://squamish.ca/

Tourism Squamish
http://www.tourismsquamish.com/map


Watershed Drainage Pattern



# Taking It Home…

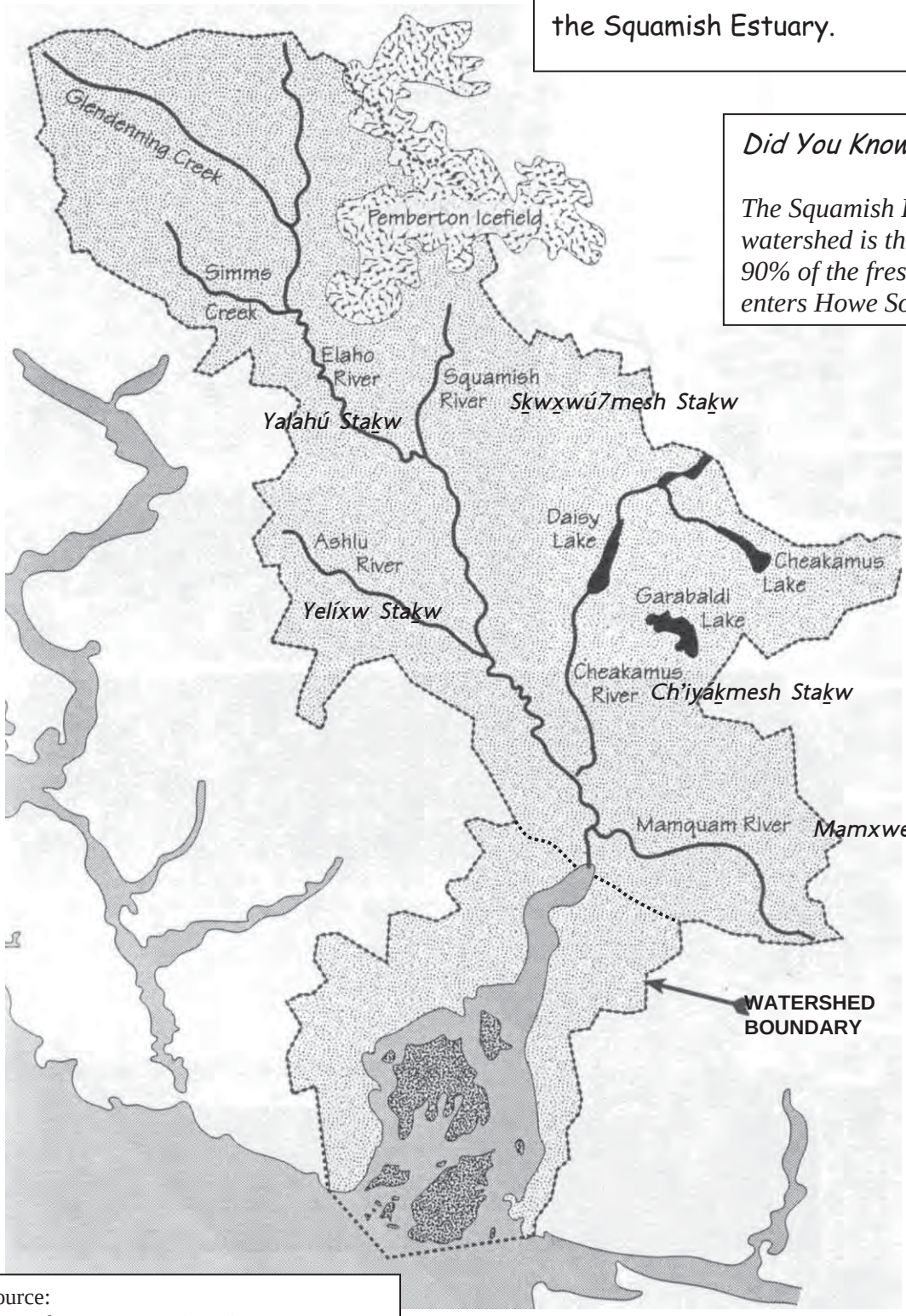
Name: _____

## Squamish River Watershed Map

Find and colour in the rivers from the top of the watershed…downstream to where the rivers meet Howe Sound at the Squamish Estuary.

*Did You Know??*

*The Squamish River watershed is the source of 90% of the fresh water that enters Howe Sound.*




Source:
*Water for Tomorrow (1995)*

# The Water Cycle in Squamish

Grades: 2-7

Subject, Science, Language Arts

Time required:20 minutes

Plus 30 mins. extension

*Key Concepts:*
*The water cycle describes how water moves through its different states: liquid, gas, and solid - driven by the sun's energy. ;.*

*Objectives:*
*Students will recognize the limited amount of fresh water that is available to living things*

SQUAMISH RIVERS & ESTUARY

**Key Words:**
**water cycle, liquid, gas, solid, drinking**

**Skills:**
**Observing, gathering information, interpreting**

Background:

In our solar system Earth is called the "water planet": seventy-one percent (71%) of our planet is covered in water. With this much water, it can be easy to forget that only a very limited amount is usable to humans. Water that is safe for human consumption is called potable water.

When our planet formed its oceans some 3.8 billion years ago there was a set amount of water on the earth. That amount remains the same today; the earth is a closed system. This means that there can be no additions or deletions made to the amount of water on our planet; water is a finite resource.

Water is simply recycled through a process called the water cycle, or the hydrological cycle. This cycle connects all forms of water on our planet; it connects the clouds in the atmosphere to the oceans and the rivers to the glaciers. Through this cycle Earth's water moves around the globe and in doing so connects with all the other cycles on Earth.

The water cycle includes all forms of water that can be found on Earth. Starting with water in the form we know best, **liquid**. Water in its liquid form includes all oceans, rivers, lakes, puddles, and the liquid water that forms on the surface of ice (glaciers).

Materials

- water
- 1000 ml beaker
- 50 ml beaker/cup
- 10 ml measure
- Eye Dropper
- Earth Ball
- Paper & pencils

# The Water Cycle in Squamish

This water is exposed to the sun. The exposure to the heat from the sun causes it to change form; it changes from liquid to **gas**. The liquid water changes into water vapor, a gas. This process of change from liquid to gas is called **evaporation**. You can see the evidence of this water vapor in the air on cold days in the wintertime when you can see your breath. The process of us breathing out this water vapor is called **respiration**. Plants also lose water in a similar way; for plants this process is called **evapo-transpiration**. This term is derived from the combination of the ways a plant loses water; both the water on the plant's surface can evaporate (evapo) and the water within the plant itself can be lost to the atmosphere, which is called transpiration.

The water vapor, once in the atmosphere, is subject to global air currents. These can move the vapor long distances and therefore influence the climates all around the globe. As the water vapor in the atmosphere cools, it forms water droplets around very small dust particles; this process is called **condensation**. Once these water droplets have become large enough, they fall out of the sky due to gravity; this is called **precipitation**. Precipitation can be in the form of rain, or snow, or anything in between. The combination of condensation and precipitation is what first caused the Earth's oceans to form. Once the precipitation has reached the earth's surface it can do a variety of things; eventually it will return to either the ocean or the atmosphere. If the water becomes a part of a river or a stream, it is called **surface run-off**, and will reach the ocean quickly. As you know, water can also be held in lakes. Some of this water will evaporate up into the atmosphere again; and some of this water will become part of the living organisms that live in the lake. If the precipitation falls in the form of snow, the water can be held in glaciers or icecaps where it can be stored for a long time. Or it may simply melt the next day and join in the surface run-off water and journey back to the ocean.

Water that isn't taken up by glaciers, stored in lakes, or returned to the ocean by rivers right away can also become **groundwater**. This happens by a process called **infiltration**. Groundwater is water that is held in the pore spaces in the rocks and soil beneath our feet. The structure of the subsurface determines how and if the groundwater will flow. It can potentially flow downhill and pool in rivers and lakes, or if there is no slope to the subsurface the groundwater can simply pool and saturate the soil with water. Groundwater can also be stored underground in an **aquifer**, which is formed due to the rock structures of the subsurface.

We can think about watersheds to understand our **local water cycle**. A watershed, also called a catchment basin, is the area of land that all drains into one outlet. A watershed can give water to many ecosystems and human developments.

In the Squamish area, the primary source of water for human consumption is the Powerhouse Springs system of wells. However, during peak times of year – the summer months- these wells are combined with water from the Stawamus River and Mashiter Creek to cover the water needs of Squamish. The Powerhouse Springs well system is a system that extracts groundwater from aquifers rather than using surface run-off like the Stawamus River and Mashiter Creek. Using extracted groundwater is the preferable source of potable water because it needs less water treatment than surface run-off forms. There are a few disadvantages to using groundwater as the

# The Water Cycle in Squamish

main source for potable water; these include: elevated mineral levels in the water, the need for well head pumps, and that there is a restricted supply (only so much can be held in one aquifer). Surface water sources (rivers and lakes) usually have a higher quantity of water, but the quality is much poorer due to turbidity caused by storms (rain and snow fall). This turbidity (mixing) can cause more extensive and expensive water treatment to need to occur in order to make the water safe for human consumption. The keys to safe drinking water for humans: have clean enough water (high enough quality) and having enough to feed the needs of an area (high enough quantity) while leaving enough water in the system for the environment.

**Procedure:**

1. Study an Earth Ball or map of the Earth and have students guess how much of the Earth's surface is covered in water. (71% of the earth's surface is covered with water.) Record the guesses on the board.
2. Ask students to construct a pie chart or graph with their ideas of how much water on Earth is found in the ocean; groundwater; frozen; or freshwater.
3. Take a beaker with 1000 ml of water. Tell them it represents all the water on Earth.

Pour out 28 ml of water into a100 ml cylinder or container. This represents the Earth's fresh water, about 3% of the total. Put salt in the remaining 972 ml to simulate the water found in oceans.

4. Almost 80% of the Earth's fresh water is frozen in polar ice-caps and glaciers. From the 28 ml, pour out 5 ml into a 10 ml measure and place the rest into an ice cube tray. The water in 10 ml measure (around 0.6% of the total) represents the non-frozen fresh water, while the water in the ice cube tray represents the water frozen in ice caps and glaciers.
5. From the 5 ml, pour out 4 ml to present the ground water in aquifers and underground streams. That leaves 1 ml of water that is surface water, found in lakes, rivers, streams, marshes, and wetlands.
6. From the remaining 1 ml, use an eyedropper to remove a single drop of water. Release this drop into a cup. This drop represents clean, fresh water that is available for human use, about 0.00003% of the total!
7. Read the following information:
   - 95% of the world's water is ocean water
   - 3.4% is ground water
   - 1.6% is frozen0.005% is water in lakes, streams & rivers
8. Refer students to the recorded guesses about the Earth's water to the figures above. Have students explain their reasoning for their initial guesses. How would they adjust their estimates now?

**Extensions:**

1. Have student do research water in Squamish. Where does their drinking water come from? Are there glaciers;

surface water; aquifers; and ocean water nearby? Where are they located?

2. Have students complete the Water Cycle in Squamish Word Search.

**Evaluation:**
1.Have students:

a. Describe the relative amount of fresh water that is available for living things.

**Community Connections:**
1. Have someone from the District of Squamish water utility come in to speak to the class about the community water supply and water conservation.

**Taking It Home:**

Complete a water audit of your home: how much water does your household use per day? Are there ways which you can conserve water?

**Resource:** This activity has been adapted from"Analyzing the World's Water Supply" from Water Stewardship (1995).

There are many worksheets on water audits: the City of Calgary (Water Services) has a good template. Google "Water Audit Worksheet" to see a selection of water audit forms.

For a great animated video clip on groundwater and why it should be protected go to:
www.leapingmedia.com/groundwater.html

**References:**

District of Squamish. 2005. Growth Management Study, Squamish BC (DRAFT) http://squamish.ca

Environment Canada. 2000. *A Primer on Fresh Water, 5th Edition*. Environment Canada, Ottawa.

Environment Canada. 1990 *Fact Sheet - Water: Nature's Magician*. Minister of Suppy and Services, Ottawa, Ontario.

Environment Canada. 1990 *Water—Here, There and Everywhere. Environment Canada, Conservation and Protection Fact Sheet No.2: Water*. Environment Canada, Ottawa, Ontario.

McClaren, Milton. 1995. Water Stewardship. Ministry of Environment, Lands, and Parks; Victoria, BC.

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

Name: _____

# The Water Cycle in Squamish

## Word Search

l n w f s h m n h
e a r a b g w i t
y n k l t o u a r
m o r e n e n r a
z a c s q t r l e
c x e e b i c e i
b h q r a b a k k
n q s i t n r t b
r i v e r s r k e

Find these words:

earth
ice
lake
river
snow
ocean
rain

Name: _____

# The Water Cycle in Squamish

## Word Search

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| l | n | w | f | s | h | m | n | h |
| e | a | r | a | b | g | w | i | t |
| y | n | k | l | t | o | u | a | r |
| m | o | r | e | n | e | n | r | a |
| z | a | c | s | q | t | r | l | e |
| c | x | e | e | b | i | c | e | i |
| b | h | q | r | a | b | a | k | k |
| n | q | s | i | t | n | r | t | b |
| r | i | v | e | r | s | r | k | e |

Find these words:

earth
ice
lake
ocean
rain
river
snow


# Taking It Home…

Name: _____

List or draw five ways you and your family can save water at home:

_____

_____

_____

_____

_____

*Did You Know??*

Ways to Save Water at Home:

*Turn off the tap when brushing your teeth or doing the dishes;*

*Limit your shower to under10 minutes;*

*Let your lawn go golden in the summer;*

*Use a watering can to water the summer garden rather than the sprinkler;*

*Run the dishwasher with a full load only.*

# Our Estuary

Grades: 4-7

Subject, Science, Language Arts

Time required:1 class

*Key Concepts:*

**The Squamish estuary is where the Squamish River meets Howe Sound.**

*Objectives:*

*Students will:*

*-recognize the location of the Squamish estuary on a map;*

*-explain the physical characteristics of the Squamish estuary .*

**Key Words:**

**estuary, marine (salt) water, fresh water, brackish water, river delta, fiord, slough, estuarine flatlands**

**Skills:**

**Observing, gathering information, interpreting**

Background:

An estuary is a special place with some unique and important physical characteristics. Estuaries have distinct geographical locations, unique land formations, and are the place where seawater and freshwater mix. This physical setting supports a rich and diverse collection of plants and animals—the estuaries ecosystem—important in many ways.

The Squamish River Estuary has been under formation ever since the retreat of the glaciers from the last ice age some 10,000 years ago. It lies at the head of Howe Sound, approximately 40 kilometers north of Vancouver, B.C. The northern reach of Howe Sound

Materials:

- Map of B.C.
- Overhead of Major Estuaries of B.C.
- Squamish River watershed map
- Squamish Estuary map

# Our Estuary

**Background Continued**
is a typical British Columbian coastal fjord with steep mountain shores, a deep water channel, and a river at its head.

An estuary is the place where a river meets the sea. In Squamish, the Squamish River flows into Howe Sound at the Squamish Estuary. This estuary is one of the largest in south-western British Columbia and functions as important habitat provincially. In this estuary, we can find a generally steep-sided coastal basin with some as estuarine flatlands, sand and gravel bars, and sloughs. This type of estuary, called an estuarine fjord is different than the Fraser Estuary, for example, which has a river delta formation. Estuaries have been the cradle of human civilizations for thousands of years and to this day continue to be attractive places for human use and settlement.

In all estuaries, including the Squamish Estuary, an important feature is the mixing of freshwater and marine (salt) water. Freshwater is less dense than saltwater and will thus flow above the heavier saltwater. However, when the tide flows in at flood tide (high tide) there is a mixing of freshwater and saltwater creating zones of brackish water or diluted saltwater – a common physical feature of estuaries. For the Squamish Estuary, this mixing of freshwater and saltwater extends from the mouth of the Squamish River upriver to the Easter Seals Camp.

**Procedure:**

1. Explain to students that an estuary is the area where fresh water from a river meets and mixes with salt water from the sea. Study a map of the British Columbia and note all the rivers that flow into the ocean. Then ask students how many large estuaries they think might be found in B.C. There are only 18 major estuaries in all of B.C. – not a lot considering the total number of rivers that flow into the ocean!
2. Show the map of major estuaries of B.C. on the overhead and locate the Squamish (Howe Sound) estuary.
3. Explain how to identify features on a map: including ocean (marine), rivers and streams, roads, and estuary.
4. On the Squamish Estuary map, have students colour in green, the marine or salt water and in blue, fresh water from the river. Ask them to colour in blue/green, the areas where the salt water and fresh water mix over the estuarine flatlands (with the plant/wetland symbol).

**Extensions:**
1. Go outside to the playground and create a watershed model using a sloped hill and a watering can or hose. Have students observe and predict where the water will flow (river) and pool (ocean). Note the area where the river meets the ocean is the estuary.

**Evaluation:**

1. Have students:
    a. Label the physical parts of the estuary and watershed on the *Find the Estuary* diagram.
    b. Name two estuaries found in southwestern British Columbia.

**Community Connections:**
1. Have someone from the Squamish Estuary Conservation Society come in to speak to the class about the Squamish Estuary.

# Our Estuary

**Taking It Home:**
Take the word search home and discuss what all the words mean for the Squamish Estuary.

**Resource:**
This activity has been adapted from "What is an Estuary" from Discover Your Estuary (1992) and "Where do we find estuaries" from Squamish Estuary Explorations (no date).

**References:**
Kistritz, Ron. 1992. *Discover Your Estuary*. Environment Canada, Pacific & Yukon Region, North Vancouver, B.C.

Squamish Nation. 2007. *Conceptual Management Plan for Site A of the Squamish Estuary*. Prepared by Golder Associates, Burnaby, BC

Wells National Estuarine Research Reserve/ NOAA. 1997. *Estuary Net: A Water Quality Monitoring Project.* http://inlet.geol.sc.edu/estnet.html

USEPA. *The Water Sourcebook - 324 activities for grades K-12* www.epa.gov/OGWDW/kids/wsb/

**Glossary:**

**Brackish water:** water that contains a mixture of seawater and freshwater. Brackish water is somewhat salty.

**Estuary:** the area where a river empties into the ocean; a bay influenced by ocean tides resulting in a mixture of saltwater and freshwater.

**Estuarine flatlands:** the lowland marshes and tidal areas associated with an estuary.

**Fjord:** a long, narrow arm of the sea bordered by steep cliffs: usually formed by glacial erosion.

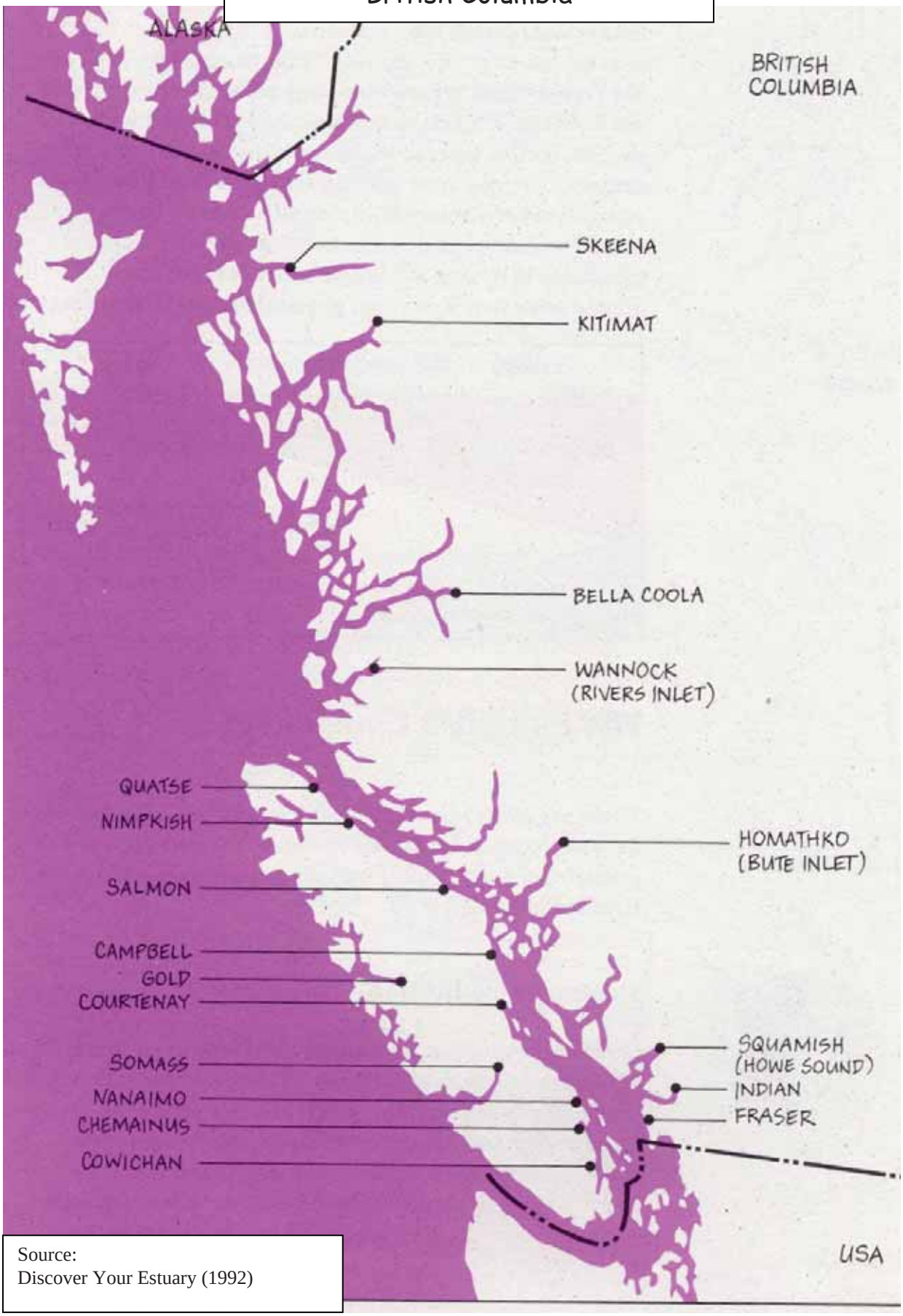
**Freshwater:** water containing little or no salts, such as inland rivers and lakes.

**Marine (salt) water**: water that is found in the ocean with high salinity (salts)

**River delta:** Usually a triangular mass of sediment, especially silt and sand, deposited at the mouth of a river. Deltas form when a river flows into a body of standing water, such as a sea or lake, and deposits large quantities of sediment. They are usually crossed by numerous streams and channels and have exposed as well as submerged areas.

**Slough**: a marshy or reedy pool, pond, inlet, backwater, or the like.

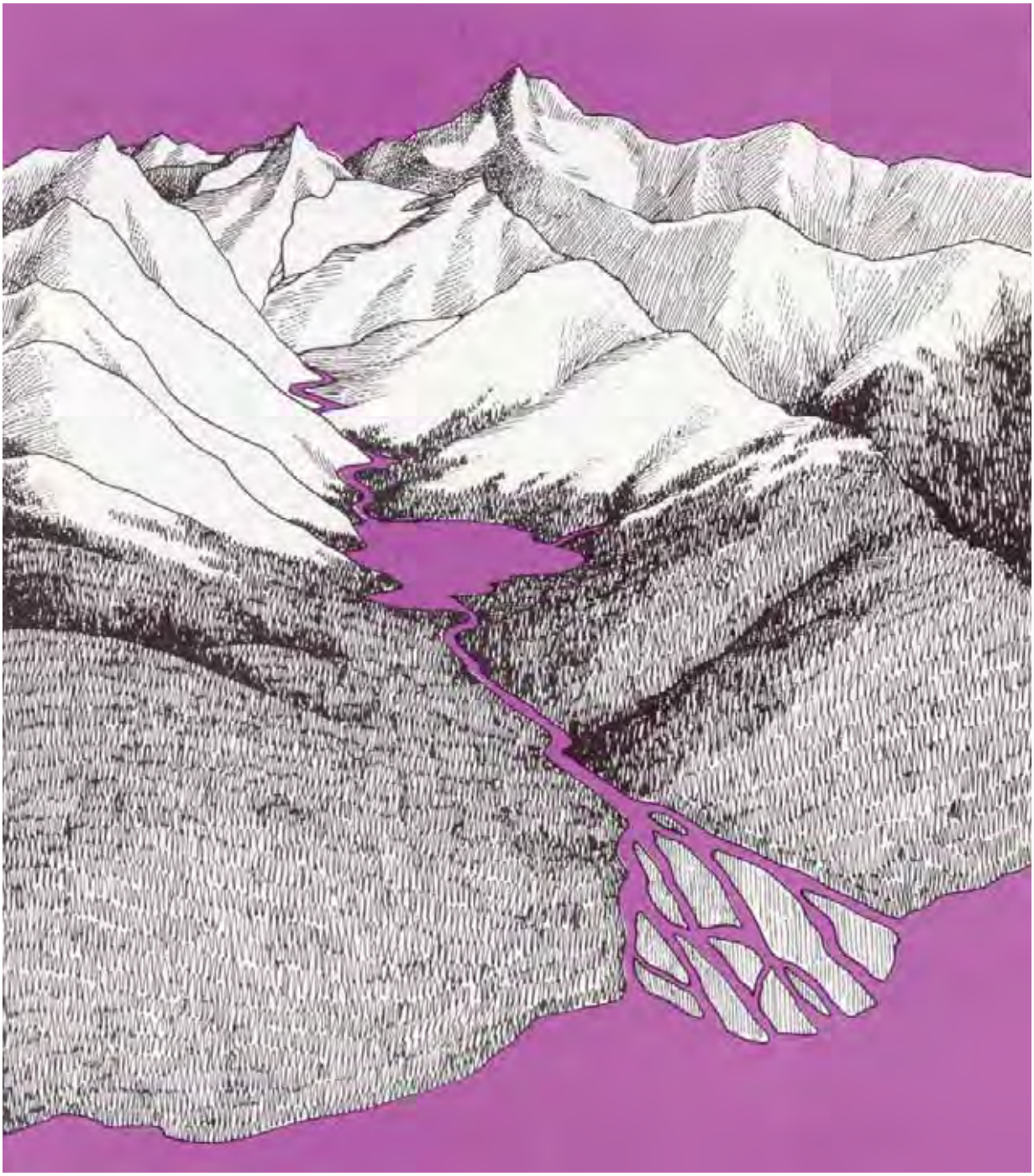
# Map of the Major Estuaries of British Columbia




Source:
Discover Your Estuary (1992)

Name:_____

# Find the Estuary!



Source:
Discover Your Estuary (1992)