Science Unit: ***Pacific Salmon and their Environment***

Lesson 11: ***The Water Cycle***

Summary:	Students work together to create a **visual demonstration** of the amount of salt and **freshwater** on the Earth (using coloured tape covering a basketball) and discuss the importance of freshwater for humans and salmon. They then conduct **experiments** with ice, water and steam to observe the **water cycle**.
School Year:	2014/2015
Developed for:	Dr. Annie B. Jamieson Elementary School, Vancouver School District
Developed by:	Dominic Tollit (scientist); Beverly Grant and Melanie Dorchester (teachers)
Grade level:	Presented to grade K-2; appropriate for grades K-4 with age appropriate modifications
Duration of lesson:	1 hour and 20 minutes
Notes:	This lesson uses and adapts parts of both Scientist in Residence Program Unit - Aquatic Ecosystems Lesson #1 and Air and Water Lesson #10. Boiling water is used and requires adult supervision.

Objectives (Objectives refer to the science topic and/or the process of science.)

1. Recall that water can exist in three distinct states (gas/vapour, liquid and solid).
2. Learn about how much water covers the Earth and the various forms of water (gas, liquid, solid).
3. Discuss why water conservation and keeping water catchment areas pollution free is important.
4. Observe 3 water cycle experiments. Observe water change from a liquid to a gas (evaporation), from a gas to liquid (condensation) and observe liquid fall as rain (precipitation). Observe how the water cycle turns saltwater into freshwater.
5. Learn to understand the cyclical nature of the water cycle and how and where evaporation, condensation and precipitation occur within the water cycle using a simple puzzle template.

Background Information

The Earth has been called the water planet, as water covers 70% of its surface. Water is what makes the Earth look blue from space. Fresh water is found in rivers, lakes, ponds, and groundwater, and also floating above the Earth as clouds. Fresh water is also found, frozen in the icecaps of the Arctic and Antarctic regions and in glaciers (this accounts for 2% of all water). However, the oceans (salt water) account for 97% of all water on Earth. Less than 1% of all the Earth's liquid water is fresh water, available for humans, plants and animals. Water is an essential resource for life; it is a fundamental building block of life, and nearly 70% of our bodies are made up of water. Water conservation and protecting the local watershed catchment area are very important for both humans and a multitude of plants and animals, including Pacific salmon. Excess fertilizer from agricultural operations, oil spills, dumping garbage like plastic, tree removals and river bank erosion activity can all seriously harm our fresh water resources.

The water cycle describes the presence and movement of all water on earth, and above it, in the atmosphere. The earth has a limited amount of water and it is constantly changing states from liquid (water) to vapour (gas) to solid (ice) and back again. Most of the water on earth is found in the oceans.

When the sun heats up the top layer of water in the oceans (or lakes or rivers), some of it evaporates as water vapour and is dispersed in to the air. This water vapour rises until it hits cooler air and then it begins to condense into clouds. The cloud water droplets grow bigger by colliding with other droplets, until, when conditions are right, the droplets will fall back to earth as rain or snow. It is the sun's energy which drives the water cycle via evaporation. Without the sun there is no cycle.

Vocabulary

Water Cycle: Describes the existence and movement of water on, in and above the Earth.
Solid: A substance that has its own shape (keeps its form); a solid usually feels firm; the shape of solids can change but the solid material takes up the same amount of space.
Liquid: A substance that flows easily and takes the form of its container; liquids take up the same amount of space regardless of the size and shape of the container.
Gas: A substance that does not have its own shape; it can expand indefinitely or be contained in a container.
Evaporation: The process by which a substance (water) is changed from liquid to a gas (vapour)
Precipitation: The release of water in liquid or solid state (rain, snow, hail) from the atmosphere on to the earth.
Condensation: The process by which a substance (water) is changed from a gas to a liquid.

Materials

- Basketball
- Scissors
- 2 trays
- hair dryer
- salt (4-5 table spoons)
- Butchers paper
- Blue and white electrical tape
- Tray of ice cubes
- 2 large glass bowls
- 20g weight (large marble)
- Water cycle puzzle pieces
- Plastic spoons
- Tape measure
- 3 glass cups
- Kettle
- Cling film
- Coloured pens
- Glue

In the Classroom

Introductory Discussion

1. Short description of 'hook' to capture student's attention.

   Is all water the same? Can we drink seawater? Have we got enough fresh water for everyone, is there lots and where does it come from? How does the world recycle its water? Brainstorm about where we find water on Earth (e.g., Rain, ocean, puddles, ponds, clouds, lakes, snow, etc.). Introduce the water cycle and how today the class will observe 4 experiments to understand how the water cycle works.

2. Short description of other items to discuss or review.
   - Re-introduce concept of solid water (ice), liquid (most common form of water) and gas (water vapour, steam) states.
   - Introduce and explain evaporation, condensation and precipitation

3. Briefly describe science experiment/activity.
   - Hands on activity using different colour and lengths of tape wrapped on a basketball to represent the amount of saltwater in our oceans, as well as freshwater as ice and in lakes, rivers and groundwater. Discuss fresh water conservation and pollution.
   - Class observation of 3 different water cycle experiments that show evaporation and condensation as well as precipitation. Class will experience (taste) salt water being converted to fresh water through these state change processes.

     Each individual will cut and glue simple images of the water cycle and the individual words evaporation, condensation, precipitation and ground water onto a puzzle template to understand the order and water state changes required in the water cycle

4. Briefly describe the processes of science that the students will focus on: Students will be asked to make observations during the water cycle activity. Students will show they have understood where and how these water state changes are occur within the water cycle.
5. Briefly describe safety guidelines.

   Boiling/hot water should be handled by adults only!

   Bowls and cups need to be clean and spoons should be used to taste saltwater in bowl and freshwater in cup after the end of the observation period.

Science Activity/Experiment

Activity 1: How much water covers the Earth?

Purpose of Activity: To learn how much saltwater and freshwater exists on Earth and the need to protect our water reserves.

Methods and Instructions:

Set-up prior to experiment: Measure out 502 cm of blue tape in 5 sections, 12 cm of white tape, and 3 cm of white tape coloured light blue.

- This basketball will represent our Earth. We will use dark blue tape to represent the oceans or saltwater. Explain you have measured out 502 cm (97% of all water on Earth is in the oceans). Five students can wrap the blue tape and stick it on to the ball without the tape overlapping. Now if the white tape represents ice caps and glaciers, ask how long the tape should be? Get another student to place on 12 cm of white tape (2% of Earth's water is frozen as ice caps). Now if we use pale blue tape for freshwater how long should the tape be? Measure 3 cm. Less than 1% of all water on Earth if fresh water and usable to plants, animals and you and me. Only 0.1cm is in lakes and rivers. Show the students how small 0.1cm is.

- Briefly discuss where freshwater comes from (rain, snow, hail, dew) and water conservation (especially in low rainfall countries). Discuss that for high rainfall places like BC, keeping your water catchment healthy is very important. Discuss different forms of pollution (fertilizers, oil spills, and plastic garbage), highlighting how these sources might affect salmon. Discuss forestry practices and good habitat management.

Activity 2: Observing water state changes vital for the water cycle

Purpose of Activity: To observe evaporation, condensation and precipitation and to understand the water state change occurring in each.

Methods and Instructions:

Set-up prior to experiment: Boil up one kettle of water, set bowls and cups at 3 stations.

Introduce terms for liquid to gas (Evaporation), gas to liquid (Condensation) and Precipitation (condensed water falling as rain or snow). Highlight using a water cycle poster that these state changes are vital for the water cycle and are the only way the world recycles its water.

Students observe in small groups filling out an "I observed/learnt" worksheet.

Station A) Gas into a liquid: Compare 1 glass with ice in versus 1 glass with no ice. Note what happens within 2-3 minutes on the outside of the glass with the ice only. Ask where did the water on the outside of the glass come from? Condensation.

Station B) Liquid into a gas into a liquid (evaporation and then condensation): Boiled water in cup with flat bottomed glass bowl inverted over it. Observe steam evaporating from boiled water (ask what students think it is). Allow them to observe the condensation droplets that form very quickly on the underside of the glass bowl.

Station C) Boiling liquid saltwater: creating water vapour/gas through evaporation, condensing on cling film and falling as liquid water (precipitation) which is shown to be freshwater. Pour boiling water and salt into large bowl, quickly mix and place and empty cup in center of bowl. Quickly cover the bowl with cling film and place a marble in the middle on top of the cling film (heavy enough to make the cling film sag in the middle above the cup. Students will see droplets condensing on the cling film and then 'raining' into the cup. At the end of the session students will taste both the saltwater ocean in the bowl and the freshwater rain in the cup. Clean spoons might be used to taste the water.

Activity 3: Understanding the water cycle

Purpose of Activity: To show an understanding of the water cycle and where evaporation, condensation and precipitation occur within the water cycle.

Methods and Instructions:

Set-up prior to experiment: Photocopy pages 58-59 of the Water – Grades 1-3 book for each student. Cut out 6 individual images. Have sheet with the words WATER CYCLE, Sea water, Evaporation, Condensation, Precipitation (rain) and Ground water available for each student to cut out (see figure below). Put up a water cycle poster to help students complete the exercise.

- Provide each student a large piece of paper, scissors and glue. Ask the students firstly to cut out the individual words. Request that students place and glue the word Water cycle in the middle of the sheet and glue the picture of the sun and water above it.

- Ask them to think about the water cycle discussions and activities and place the 'puzzle' pieces in the right order – in a circle around the word water cycle. Ask students to draw arrows between each image. Check they have the right order before gluing them on. Repeat with the individual words, checking they are in the right spots before gluing then on.

- Ask Grade 2 students to describe the water state changes occurring at each stage or use a description of each within the puzzle template to help position each water cycle word. Students who finish early can also colour in the cycle.

Closure Discussion

Make a circle and ask students to talk about their observations and experiences. Review vocabulary and let students give examples of their knowledge of the water cycle.

- Ask what is the driving energy of the cycle is?
- Ask what other forms water falls to the earth?
- Ask what clouds are made of?
- Ask why mountains cause the clouds to rain?
- Ask how trees and plants fit into the cycle?
- Ask how we conserve water?

References

Science Works for Kid Series. Water, Grades 1-3 Teacher Resource Book. Collins Publishing.

Extension of Lesson Plan

1. Colour in the water cycle puzzle.
2. Use pH strips to learn about water pollution by testing water with vinegar, soap and bleach added to it.
3. Draw on the puzzle pictures of adult and juvenile salmon and salmon eggs.

I OBSERVED:	I LEARNT:
Write or draw below	Write or draw below

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SEA WATER	SEA WATER	SEA WATER
CONDENSATION	CONDENSATION	CONDENSATION
EVAPORATION	EVAPORATION	EVAPORATION
PERCIPITATION (RAIN)	PERCIPITATION (RAIN)	PERCIPITATION (RAIN)
GROUND WATER	GROUND WATER	GROUND WATER