Science Unit: *The Earth Around Us: Air, Water & Soil*

Lesson 10: *States of Water*

School Year:	2009/2010
Developed for:	L'École Bilingue, Vancouver School District
Developed by:	James Day (scientist), Elisabeth Sones and Fabienne Goulet (teachers)
Grade level:	Presented to grades 1 - 2; appropriate for grades 1 - 7 with age appropriate modifications.
Duration of lesson:	1 hour and 20 minutes

Objectives

1. Recall that water can exist in three distinct states (gas/vapour, liquid, and solid).
2. Observe water change from a solid to a liquid (melting); observe water change from a liquid to a gas (evaporation); observe water change from a gas to a liquid (condensation).
3. Develop an intuitive feeling for what is happening at the molecular level in the three physical states of matter.

Background Information

Water is the most abundant molecule on Earth's surface, covering nearly 70% of the planet's surface. In the natural world, water exists as a solid, a liquid, and a gas. 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.

Vocabulary

Solid:	Matter that has a fixed shape and a fixed volume.
Liquid:	Matter that has a fixed volume but that takes the shape of its container.
Gas:	Matter that fills the volume and takes the shape of its container.
Water:	A clear, colorless, odorless, tasteless liquid. The water molecule is made of two hydrogen atoms and one oxygen atom.
Ice:	Water in the solid state; frozen water.
Water Vapour:	Water in the gaseous state.
Evaporation:	The process of a liquid becoming a gas.
Condensation:	The process of a gas becoming a liquid.
Melting:	The process of a solid becoming a liquid.
Freezing:	The process of a liquid becoming a solid.

Materials

- 3 pieces of lego (two of one colour, one of another colour)
- glass fish bowl
- coffee mug
- ice cubes
- clear plastic cups
- hair dryers
- hot water

In the Classroom

Introductory Discussion

1. Begin by wondering aloud about water.
    - What is water?
    - Is water always a liquid? When isn't it a liquid?
    - List different ways in which we use or encounter water vapour, liquid water, and ice.
    - Use the three pieces of lego to present to the students a 'model' of a water molecule. For example, explain that the two blue pieces of lego each represent one hydrogen atom, and that the red piece of lego represents on oxygen atom. Alone, they are atoms. Combined in the right way (snap the lego pieces), they form a molecule: a molecule with two hydrogens and one oxygen is a water molecule.
2. Briefly describe the two experiments and the physical activity. The students will first perform an experiment designed to have them notice water changing from one state to another (melting). Secondly, they will watch a demonstration in which a hot mug of water steams (evaporation), and in which the steam is collected on the surface of an inverted fishbowl (condensation). The third activity gets the students moving about and developing a conceptual understanding of what happens at the molecular level when matter exists in various states.
    - Melting of ice; evaporation of hot water; condensation of water vapour onto a glass surface.
    - Physical activity: states of water
3. For the first two activities, the students will be asked to focus on: making predictions, taking careful observations, recording results, and drawing conclusions. Students will be asked to communicate their results and conclusions, with hypotheses and results being recorded in their science worksheets.

Science Activity/Experiment

Experiment Title: Melting ice.

Purpose of Experiment: To determine how heat affects melting.

Experimental Treatments: There will be 4 groups of students. Each group will perform the two treatments below. The experiment will represent 4 replications (1 replication per group) and therefore confirmation of results.

Control treatment	Ice left at room temperature
Test treatment	Ice exposed to a heat source

Prediction or Hypothesis: Before making your prediction, it helps to start with a question; for example, will heat make the ice cube melt faster? Use your prior experience with snow and ice to predict what you think will happen when heat is applied to an ice cube. Record your prediction.

Methods and Instructions:
Each group of students should have an adult helping them with the hair dryer.

1. Each group is provided with two clear plastic cups, each containing one ice cube.

2. Keep the two plastic cups on the table, separated by about a foot.
3. Set the hair dryer to 'warm' and (have the adult) point it at only one of the two ice cubes. This is the ice cube receiving the 'heat treatment'; the other ice cube is our control, receiving the 'room temperature treatment'.
4. Observe the difference in melting between the two ice cubes.
5. Have the students verbally communicate their results and conclusions. Also be sure that student hypotheses and results are recorded in their science worksheets.

Science Activity

Experiment Title: Evaporation and condensation

Purpose of Experiment: To observe water changing states from liquid to gas and back to liquid.

Experimental Observations: Evaporation of hot water, and its subsequent condensation onto a glass fishbowl will be observed as a group.

Prediction or Hypothesis: Use your prior knowledge of water and steam to predict what you think will happen when the fishbowl is put over the cup of hot water.

Methods and Instructions:
Set-up prior to experiment: One mug containing water that has just been boiled. An electric tea kettle works best to heat the water and pour it into the mug.

Students will observe collectively as the teacher/scientist works with the demonstration equipment.
Remind the students that the water is very hot and that they need to keep their hands and faces back.

1. Begin by placing a mug of room temperature water on the table. Have the students record their observations, nothing special happens here, but encourage the students to make a record of their observations all the same. They might notice bubbles in the water or drips of water on the outside of the mug. What is important is that they learn to observe carefully even if nothing unusual seems to be occurring. This skill can help students then notice when something unusual is happening.).
2. Now place the fishbowl (upside-down) over the mug. Again, have the students record their observations (again, nothing special happens here).
3. Get the students to predict what might be different if hot water were used instead.
4. Now put a mug of hot water on the table. Ask the student to record their observations (they should notice the steam coming out of the cup and they might notice a greater number of bubbles in the mug).
5. Again, place the fishbowl (upside-down) over the mug. Have the students record their observations (they should notice condensation form on the inside of the fishbowl. Once sufficient condensation has collected, maybe after a few minutes, drops of water should be forming and may even be running down the surface of the fishbowl.).
6. As always, get the students to communicate their results and conclusions: student hypotheses and results should be recorded in their science worksheets.

Science Activity

Activity Title: The states of water

Purpose of Activity: To provide students with a deeper conceptual understanding of the difference between a solid, a liquid, and a gas.

Methods and Instructions:

1. Begin by confirming that students understand that water is made up of molecules (re-define this word for them).
2. Explain that the students are to pretend that they are each one molecule of water and that, all together, they represent a small amount of water.
3. Get students to jump around (carefully) in whichever direction they are inclined. The only rule is that they do not leave the classroom/playground/area. Explain that this is similar to how gas molecules behave when they are in the form of a gas – bumping and jiggling and full of energy!
4. Now get the students to stand in a group with their arms outstretched, so that they are all touching at least one other person's arm. Let them walk around in whichever direction they feel like, provided that they are always maintaining contact with the other students. Explain that this is like how molecules behave when they are in the form of a liquid – freely mobile, but closer together than a gas and with less energy.
5. Finally, get the students to lock arms at the elbows. Tell them that they can take the tiniest little steps, but that they must not unlock arms with their neighbours. Explain that this is how molecules in a solid behave – very little motion and very little energy.

Closure Discussion

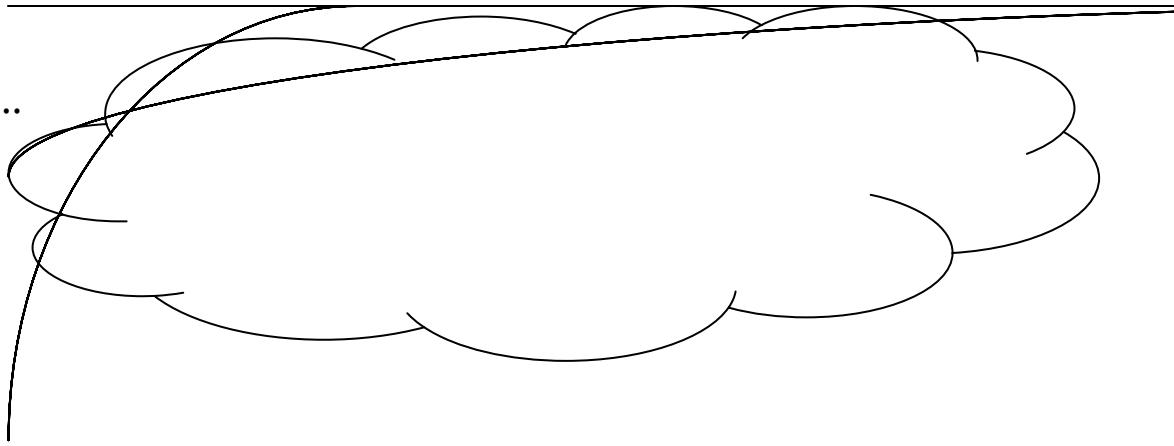
1. What are the three states of water?
2. Introduce the next lesson on “what happens to water before we use it”

References

1. Parker, Steve (translated by Claude Cossette). 2004. L'eau. Pp. 6-7. Broquet Inc.
2. Edited by Pan-Canadian Science Place © Scholastic Canada Ltd. (translated by Pierre Brault, Agnès, Lin Burman, and Karima Afchar). 2005. L'air et l'eau: Guide de l'enseignant. Pp. 55-57. Les Éditions Duval, Inc. and Scholastic Canada Ltd.

What effect does heat have on ice (frozen water)?

I think...

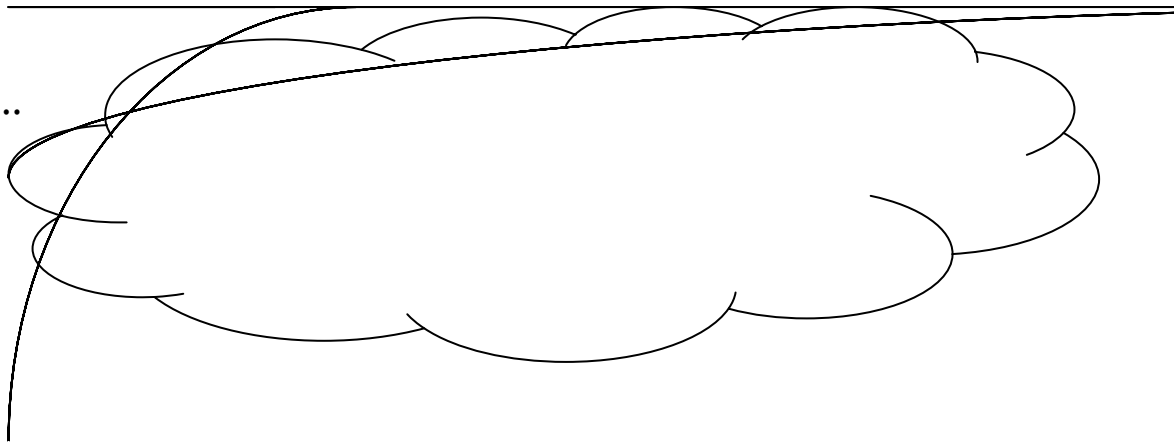


I observe...

<u>Conclusion:</u> Heat makes the ice melt _____.

The states of water

I think...



I observe:

Conclusion:

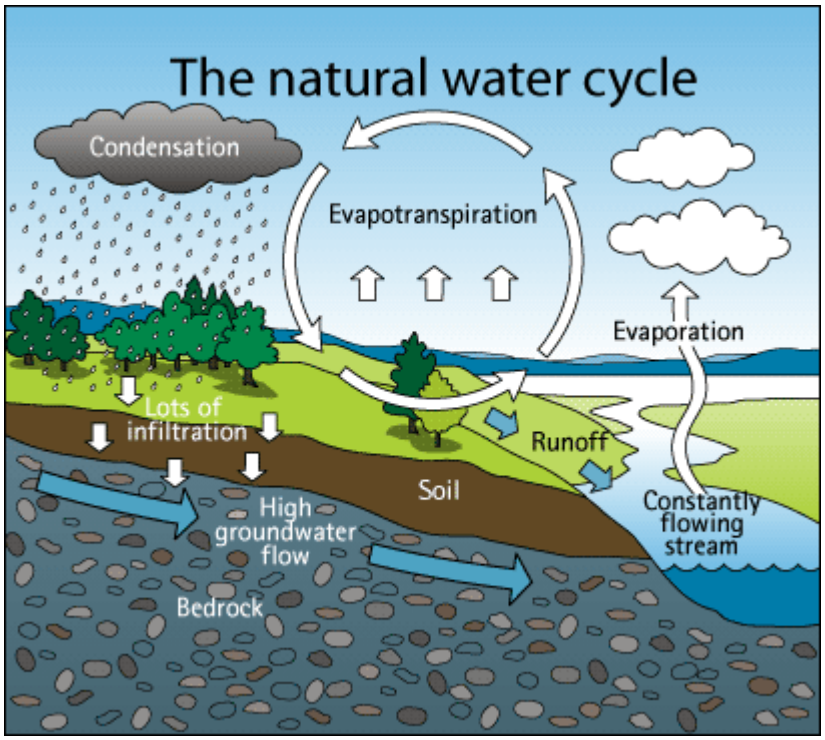
Conclusion:

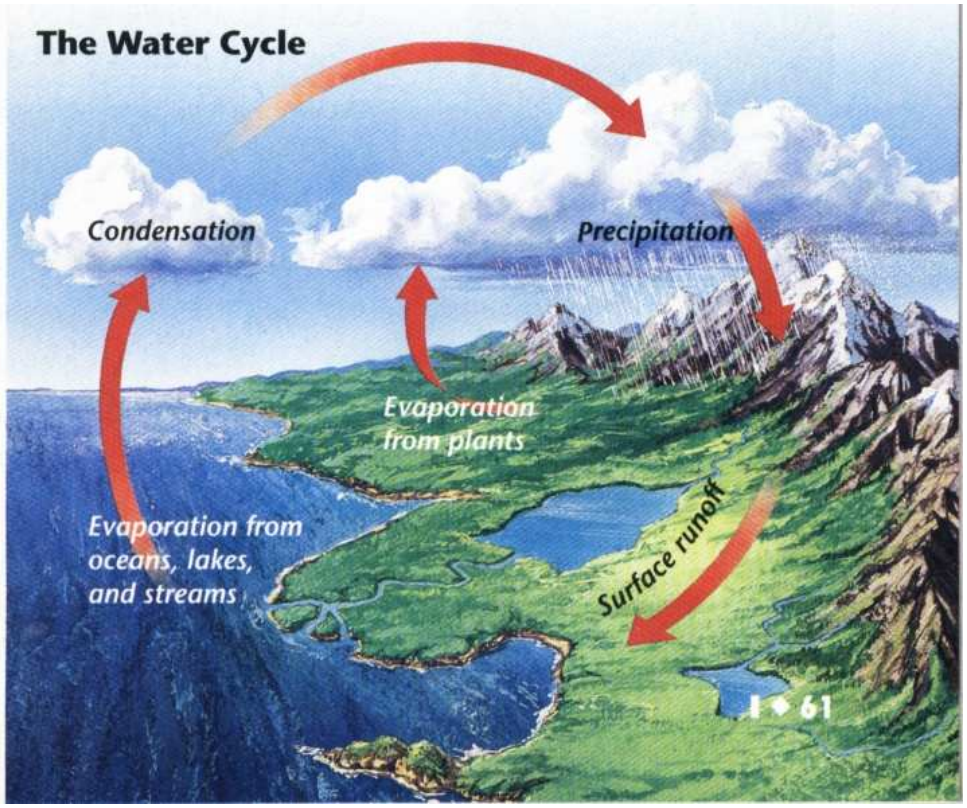
Drawing of water molecules in the liquid state:

Drawing of water molecules in the gas state (vapour):

Drawing of water molecules in the solid state (ice):

Drawing of the water cycle


The natural water cycle
Condensation
Evapotranspiration
Evaporation
Lots of infiltration
Runoff
Soil
High groundwater flow
Constantly flowing stream
Bedrock


The Water Cycle
Condensation
Precipitation
Evaporation from plants
Evaporation from oceans, lakes, and streams
Surface runoff

Quel est l'effet de la chaleur sur la glace ?

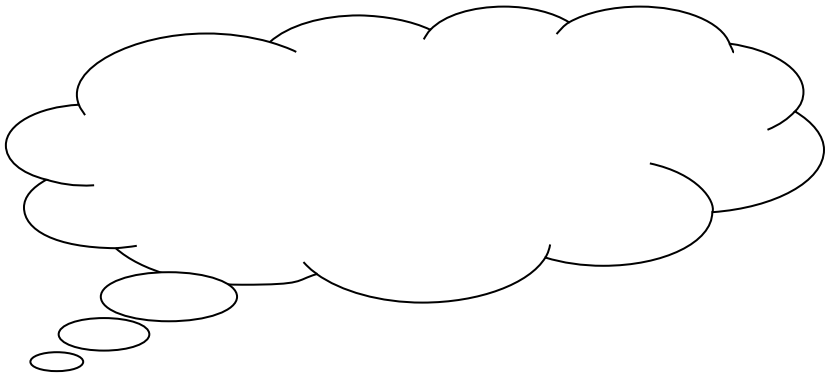
Je pense : 

J'observe : 👁 👁

<u>Conclusion</u> : La chaleur permet à la glace de fondre _____.

Les états de l'eau

Je pense :



	Je pense	J'observe

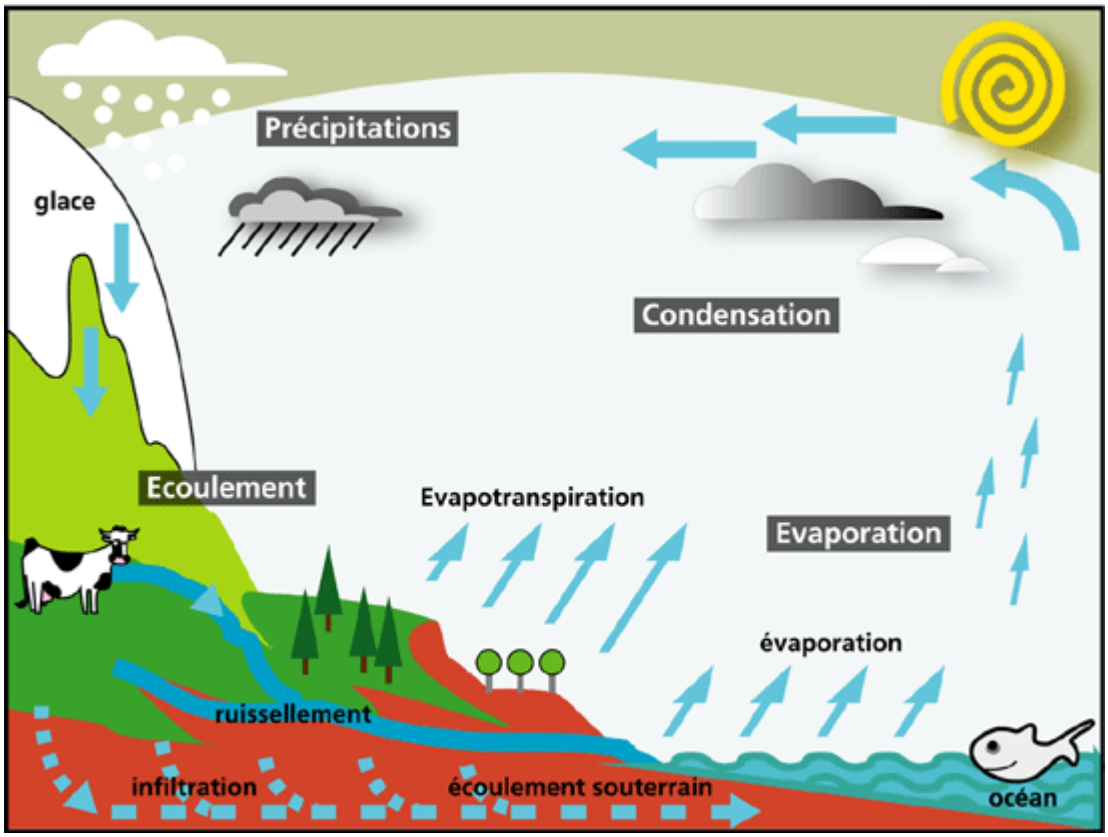
Conclusion :

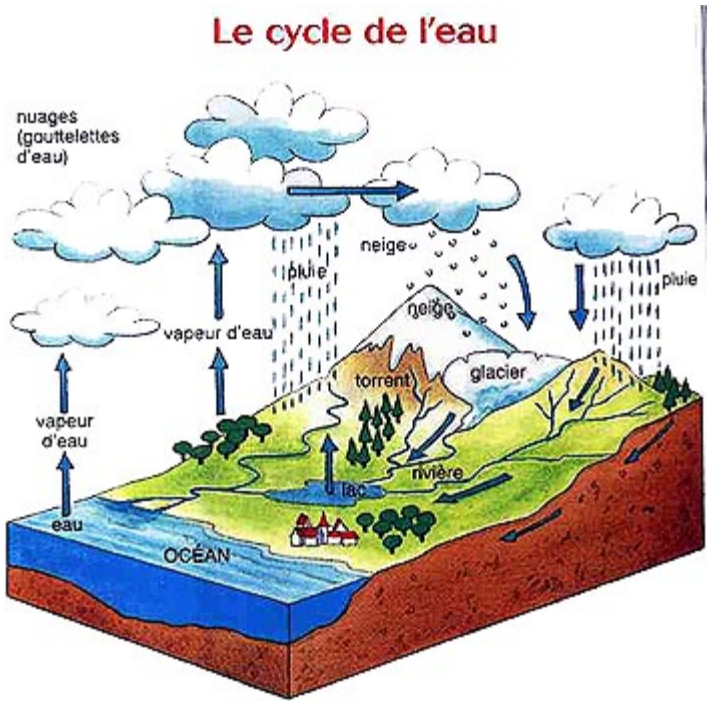
Dessin des molécules d'eau sous forme de **liquide** :

Dessin des molécules d'eau sous forme de **gaz** :

Dessin des molécules d'eau sous forme de **solide** :

Le cycle de l'eau


Précipitations
glace
Condensation
Ecoulement
Evapotranspiration
Evaporation
évaporation
ruissellement
infiltration
écoulement souterrain
océan


Le cycle de l'eau
nuages (gouttelettes d'eau)
pluie
neige
pluie
neige
vapeur d'eau
torrent
glacier
vapeur d'eau
rivière
lac
eau
OCÉAN