A lesson from the Native Access to Engineering Programme

Water

Water: 1a: the liquid that descends from the clouds as rain, forms streams, lakes, and seas, and is a major constituent of all living matter and that when pure is an odourless, tasteless, very slightly compressible liquid oxide of hydrogen H_2O which appears bluish in thick layers, freezes at 0 ℃ and boils at 100 ℃, has a maximum density at 4 ℃ and a high specific heat, is feebly ionized to hydrogen and hydroxyl ions, and is a poor conductor of electricity and a good solvent

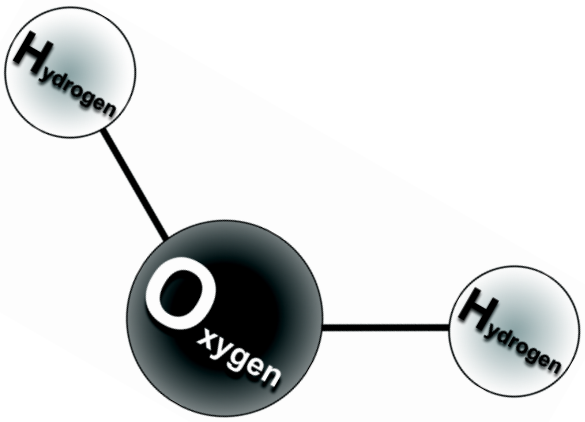
What is water?

Long, long ago, in the great past, there were no people on the earth. All of it was covered by deep water…
Haudenosaunee Creation Story

Some of the oldest stories we tell, the stories of how the world was created and how we came to be, begin with water. The Haudenosaunee or Iroquois peoples tell us that the universe was only water until Aientsik fell from the sky world. The Haida tell us that humans came to the world after the great flood when Raven coaxed them out of a giant clam shell.

What creation story do your Elders tell?
Why do you think water plays a role in many creation stories?

Water has great spiritual and cultural significance. Throughout all of our existence people everywhere, from the deep deserts to the rain forests to the frozen poles, have understood that water is life. It literally runs through our veins; 83% of our blood is water. Water helps us digest food, dispose of waste and regulate body temperature. We can live for weeks without food, but only days (about 3) without water. As much as we need water, so do all the plants and animals with whom we share Mother Earth.



What do you use water for?

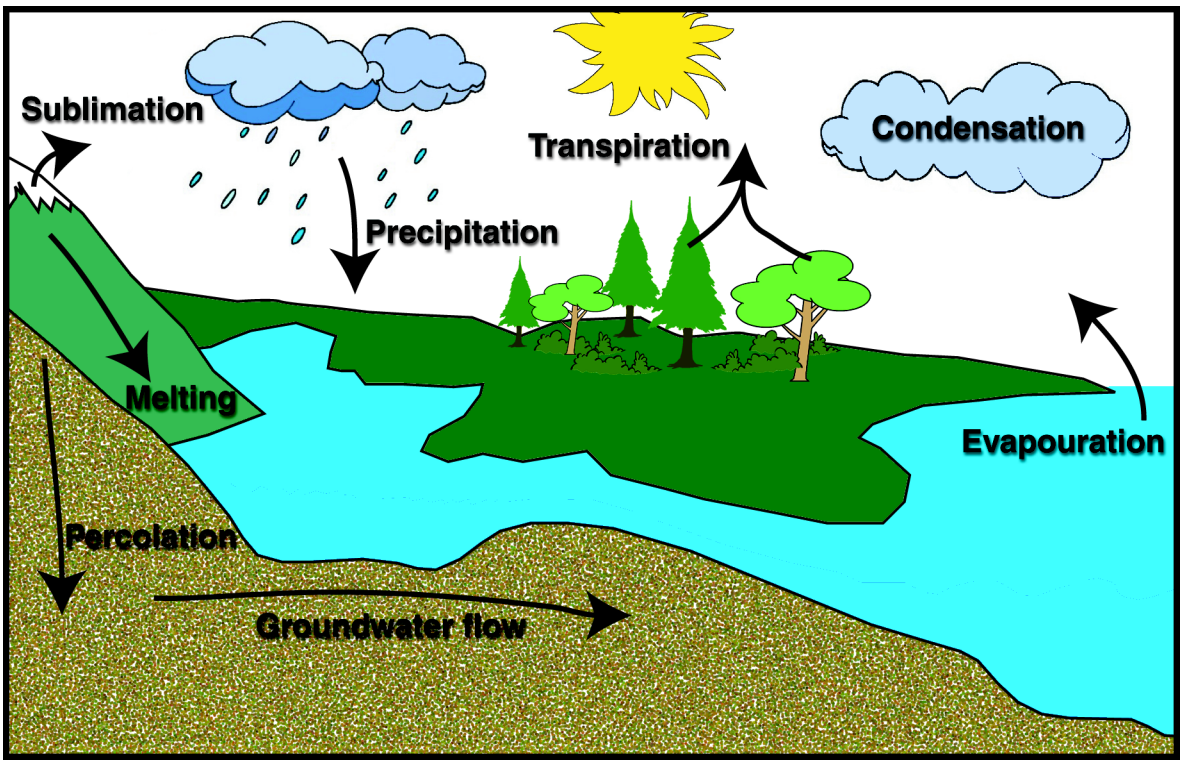
Water is life. It is also a means of transportation, a habitat for animals and plants, and a source of irrigation for crops. It is used for bathing, cleaning, cooking, drinking, and producing energy.

From a scientific perspective, water is a chemical compound called H_2O because it is made from 2 hydrogen (H) atoms and 1 oxygen (O) atom.

Moving and changing: The hydrologic cycle

Water is always moving and changing from solid, to liquid, to gas and back again. The movement of water from one place to another and from one state to another is one of life's great cycles, sometimes called the hydrologic or water cycle. The hydrologic cycle shows the many ways that water flows and changes from one form to another. We give names to each of the processes in the cycle.

Where have you seen water as a liquid?
How about as a gas or solid?



The Water Cycle

Precipitation: Water in liquid (rain) or solid (snow or ice) form falls from clouds to the ground or other bodies of water.

Percolation: Water in liquid form seeps through the ground into the Earth and underground water sources such as aquifers.

Transpiration: Water travels up through the bodies of plants in liquid form and is evaporated through pores, called stomata, on the underside of leaves.

Evaporation: Liquid water on the Earth's surface (rivers, lakes, oceans) changes to gas as it enters the atmosphere.

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Sublimation: Solid water (ice and snow) on the Earth's surface changes to gas as it enters the atmosphere.

Melting: Solid water (snow, ice) melts into liquid form and flows into the Earth and surface waters (rivers, lakes, oceans).

Freezing: Liquid water solidifies and is held on the surface as snow or ice. In glaciers and ice caps this water can remain solid for thousands of years.

Condensation: Gaseous water in the atmosphere forms clouds, then precipitates as liquid (rain) or (solid) snow.

The water cycle is the ultimate in recycling.
As far as we know, all the water present today, has been here since the beginning of time.

Do you know any other natural cycles?

How much water?

Water is all around us. More than 70% of the planet's surface is covered by it. Water is found in places where it is not easily seen - in the atmosphere, in plants, under the land, in our bodies. Scientists, who like to count things, estimate our planet has about 1.39 billion cubic kilometres of water.

Take a look at the tables below.
What conclusions can you make about the water available for plants, animals and humans?

Table 1. Salt water and freshwater

	Volume (1000 km^2)	% of total water
Salt water	1 350 955	97.5
Fresh water	35 029	2.5
Total	**1 385 984**	**100**

Table 2. Freshwater distribution

	Volume (1000 km^2)	% of fresh water	% of total water
Ice	24 364	69.5	1.76
Ground water	10 530	30.1	0.76
Lakes	91	0.26	0.007
Soil	16.5	0.047	0.001
Atmosphere	12.8	0.036	0.0009
Swamps	11.5	0.033	0.0008
Rivers	2.1	0.006	0.0002
Biological water	1.1	0.003	0.0001
Total	**35 029**	**100**	**2.5**

While there is lots and lots of water on the planet, most of it is difficult to get at or full of salt. Salt water makes up 97.5% of all water, and while some fish, mammals, plants and microscopic creatures can live in it, humans and most animals need unsalted, clean, freshwater to survive.

Many Aboringal people, in the north, in the south,
and in the southwest live in very dry areas.
How do people get water - for drinking, for irrigation,
for cleaning - when it isn't readily available?

Not all deserts have cacti.

Freshwater

Only 2.5% of water on earth is freshwater. And very little of it is actually available to us. Nearly 70% of fresh water is frozen or in places where it is difficult to access, like the atmosphere or deep underground. Only about 1% of water is available for us to use, and some of that water is polluted and unsafe.

Because fresh water is so rare we must be careful how we use it.

Fresh water - how renewable is it?

What is a renewable resource?

Fresh water is a renewable resource. Renewable resources are those which can replace themselves over time. The key is time, freshwater is renewable only if we respect the natural cycles of Mother Earth. If we drain a lake faster than water flows into it, that water in that lake is no longer a renewable resource. If we dump sewage or industrial and agricultural waste into a lake so fast that the lake cannot naturally filter itself, the water in that lake is no longer a renewable resource.

Because water flows and changes through the hydrological cycle, we must always remember that it is a resource for everyone. We may take good care of our own local water resources, but if we then dump waste or divert the natural flow of water, we may seriously impact the water resources of other people.

Mi'kmaq and Maliseet grandparents tell the story of a long ago drought, when the people of one village dammed a river. While they had enough water, people in villages further down stream suffered because they had none. The Gitchee Manitou sent them a great spirit named Koluscap who broke the dam so everyone one could have access to the water again.

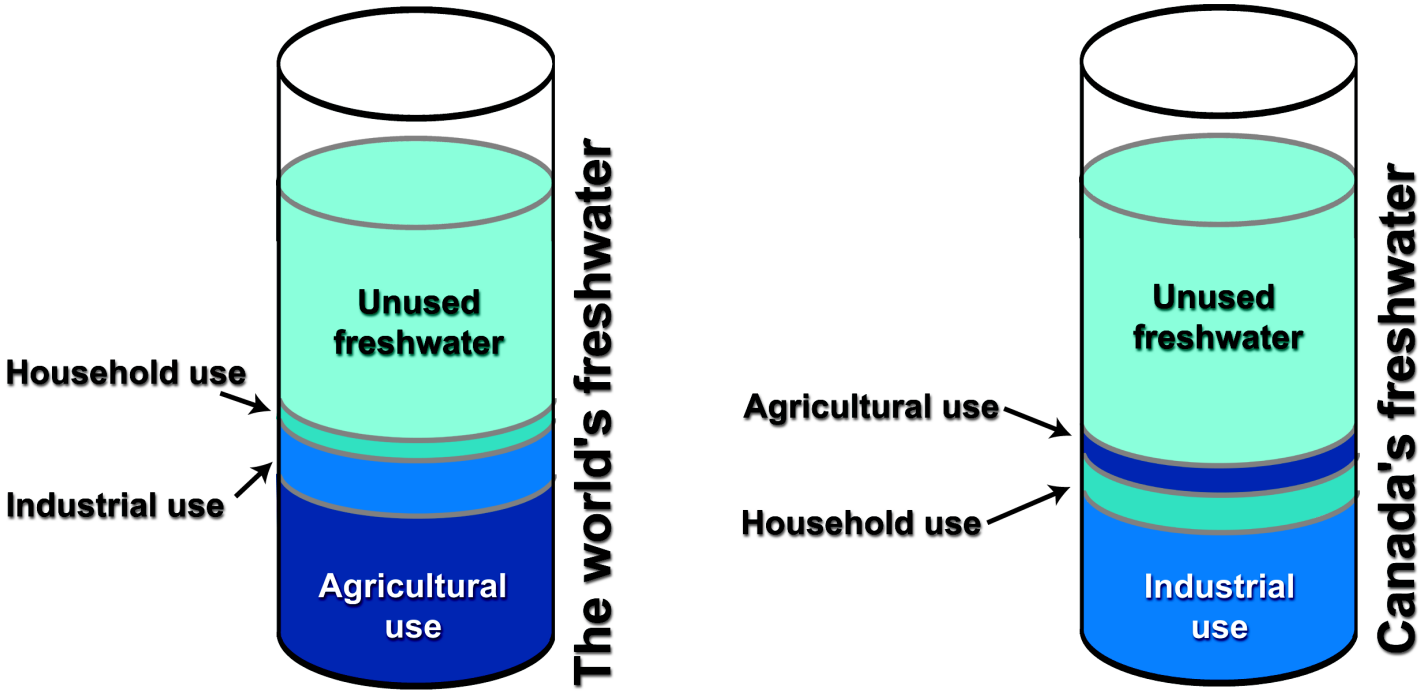
Water is for everyone, and it is only renewable if we are careful in how we use it.

Source: National Oceanic and Atmospheric Administration
http://www.photolib.noaa.gov/coastline/images/big/line2354.jpg

Freshwater use

How do people use water in your community?

The Food and Agriculture Organization (FAO) of the United Nations monitors the use of fresh water by all the countries in the world. In 2000, it estimated that human beings used 54% of the available fresh water on the planet. Only 8% of that fresh water went to household uses like drinking and sanitation, the rest was used for agriculture (69%) and industry (23%). FAO estimates that by the year 2025, human beings will use 70% of all available fresh water each year.



World vs. Canadian fresh water use, 2000

If world water consumption continues to increase, what could happen?

In 2000, people in Canada used almost half of the fresh water available to us: 69% for industry, 20% for household uses and 12% for agriculture.

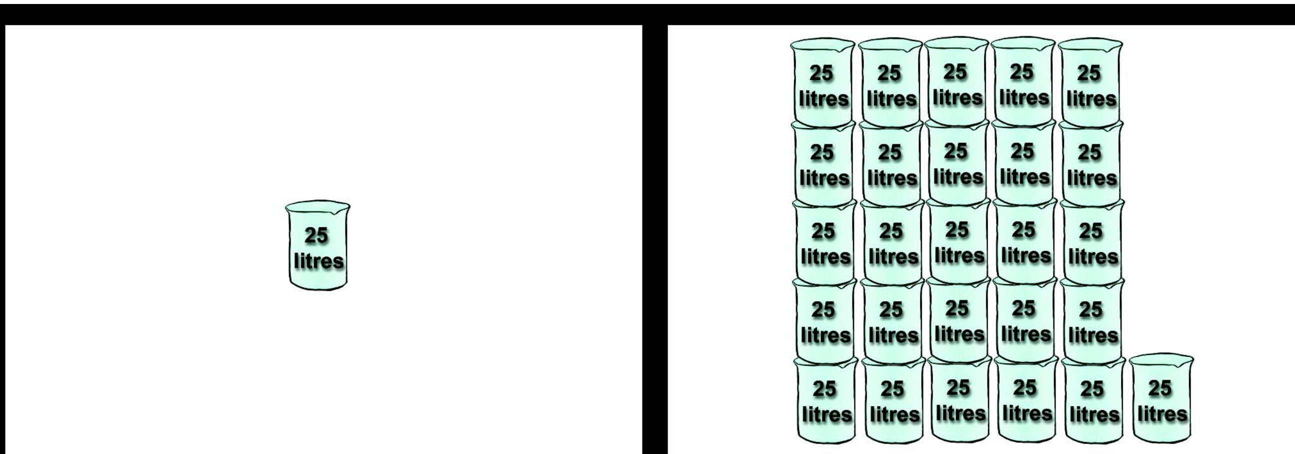
Why do you think that our water usage is so different from overall world usage?

Canada actually has about 20% of all the world's fresh water, and about 7% of the renewable fresh water. Even though more than half of the fresh water in Canada is nonrenewable, we still have access to more fresh water than people in most other countries.

Water and health

In order to remain healthy, every person needs to have access to between 20 and 50 litres of uncontaminated, freshwater every day.

If there are 6 billion people living on Mother Earth, how much freshwater is needed everyday to keep everyone healthy?



This is approximately the amount of water each person on the planet needs each day to stay healthy.

This is the amount of water an average person in North America uses each day.

In most areas of Turtle Island people have access to enough freshwater. On average, we each use more than 650 litres a day!

In many other parts of the world, people are not so fortunate. Many of them do not have enough water to drink, to produce crops or to maintain the sanitary conditions necessary for good health. In 1999, the United Nations Development Program estimated that approximately 1 in every 6 people did not have access to clean drinking water. It also said that early in the twenty-first century, 1 in every 4 people will suffer from chronic water shortages.

What consequences do you think this imbalance in access to freshwater might have?

In some places people have to walk great distances to get water from wells.

The need for water resource scientists and engineers

Where does your community get its water?

Even through the Creator has blessed North America with lots of fresh water, many Aboriginal communities do not share in the bounty. Some communities do not have the piping or delivery infrastructure required for running water in homes. In communities that do have piping, the water may contain high concentrations of bacteria which make it unsafe to drink without boiling. In order to remedy these problems, these places need water scientists and engineers who understand the community and the people.

Water resource engineers help protect water supplies and make sure that development of new resources (like forestry or mining) do not disrupt natural processes and water sources. They help in the assessment of pollution sources, the control of flood damage and soil erosion, and the resolution of conflicts over water reserves. They monitor water quality and build, design and manage water treatment plants to ensure proper water filtration. In places with unique problems, they look for unique solutions, developing new technologies such as desalinization equipment to make salt water drinkable for ocean-side communities

Source: National Oceanic and Atmosphereic Administration
http://www.photolib.noaa.gov/nerr/images/big/nerr0068.jpg

Native water resource engineers give our people the expertise needed to understand government reports about contamination sources and move forward on recommendations. With an understanding of modern science and respect and knowledge for the land, water resource engineers from our communities can help avoid ground-water contamination and play an integral role in ensuring that everyone in the community stays healthy.

What could a water resource engineer do in your community?

Resources

1. AAAS Atlas of Population and Environment
http://atlas.aaas.org/index.php?part=1&sec=waste
2. Earth Observatory - The Water Cycle
http://earthobservatory.nasa.gov/Library/Water/water_2.html
3. Environment Canada - Clean Water
http://www.ec.gc.ca/water_e.html
4. Environemnt Canada - Fresh Water
http://www.ec.gc.ca/water/e_main.html
5. Indigenous Peoples Kyoto Water Declaration
http://www.indigenouswater.org/IndigenousDeclarationonWater.html
6. International Year of Fresh Water
http://www.wateryear2003.org
7. Managing our freshwater ecosytems
http://www.eco-pros.com/managingfreshwater.htm
8. Six Nations of the Grand River, Creation Story
http://www.geocities.com/Athens/Olympus/3808/mohawk_creation_story.htm
9. United Nation Food and Agriculture Organization - Aquastat
http://www.fao.org/waicent/faoinfo/agricult/agl/aglw/aquastat/main/index.stm

Connecting to Math

A 2003 study examined community water systems in 740 First Nations communities. The water systems were rated according to the following the categories:

Category A:
System has few or no problems;

Category B:
System requires some repair;

Category C:
System has potential safety and health concerns, e.g. untrained personnel, inadequate monitoring, unreliable/poor water source etc. (This category does not mean there is an immediate risk to water users, but that there are serious issues to be addressed in order to maintain the system's safety.)

Results in each region are shown in the table below.

Region	Category A	Category B	Category C
Atlantic	0	4	13
Quebec and Cree	20	15	2
Ontario	35	35	61
Manitoba	28	32	6
Saskatchewan	31	51	16
Alberta	30	29	14
British Columbia	41	155	94
Yukon	0	16	12

National Assessment Of Water And Wastewater Systems In First Nations Communities, Summary Report, Indian and Northern Affairs Canada, May 2003
http://www.ainc-Inac.gc.ca/ps/hsg/cih/ci/ic/wq/wawa/asse_e.html

As the community water resource engineer, you have to present the result of this study to your band council members. Can you use the information in the table to ...

1. Tell them what percentage of community water systems have few or no problems? Have many have some problems?

2. Produce a graph which shows how many communities fall into each category?

3. Build a graph which will let you visually compare the risk category by region?

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