WATER – Every Drop Counts
Science Project: Comenius 2011-2012

Skill 1. Use knowledge gained in other situations

Skill 2. Apply knowledge gained to solve problems

Skill 3. Conduct experimental or documentary research

Skill 4. Structure the results, communications, validations and summaries
1.1 Precious Water

What is Water?

Water is the most common substance on Earth but have you ever wondered what water is made of?

Water is the only substance found naturally in the three states of matter:

1. solid as ____________________
2. liquid as ____________________
3. gas as ____________________

Water is made of tiny molecules. These molecules are made of three atoms; two hydrogen (H) atoms and one oxygen (O) atom. These atoms stick together because of electrical energy. The molecular formula of water is \( \text{H}_2\text{O} \).

Water is also a solvent, which means that water dissolves things. Wherever water goes, it carries chemicals, minerals and nutrients with it.

There is a finite amount of water on Earth and it is constantly moving from one place to another place in a process called the water cycle.

The same water that existed on Earth millions of years ago is still here today!

1.2 Why is water important?

Water is important for all living things

The most important feature of water is that all living things need it to survive. Humans can’t survive more than 5 to 7 days without fresh water, although they can survive for about a month without food.

The supply of drinking water is limited

The total volume of water on Earth is about 1 360 000 000 km\(^3\). A cubic kilometre is a cube that is one kilometre long, one kilometre wide and one kilometre high. This sounds like a lot of water but not a lot of the water is useable or accessible.

Almost \( \frac{3}{4} \) of the Earth is covered by water
Water covers about ¾ of the Earth’s surface. Of this water:

- 97% is in the oceans and can’t be directly used by people, plants or animals because it is too salty.
- about 2% is frozen at the north and south poles, in glaciers and on snowy mountain ranges and can’t be used by people because it is too remote.
- about 1% of water is freshwater but not all of this water can be used because some of it is located underground, some is too polluted to use or difficult to transport and store.

Only about 0.5% of the water on Earth is freshwater that can be used directly by humans.

Exercise:

1. How long can people survive without water? _____________________
2. What is the total volume of water on Earth? _____________________
3. How much of the Earth’s surface is covered in water? _________________
4. What percentage of the Earth’s water is salty? _____________________
5. What percentage of the Earth’s water is fresh? _____________________
6. How much of the Earth’s water can be used directly by humans? _________________
Water affects health and development

Many people around the world cannot get access to clean water supplies and this can affect the development of countries and the health of their people.

Although water is a **renewable resource** (which means that we can keep reusing it), if the water is **polluted**, it becomes difficult and expensive to reuse.

Polluted water is a serious health hazard.

The way people get rid of their **wastewater** is also important for health and the environment. Wastewater is the water that has been used for things like flushing toilets, washing clothes or showering. This water can carry bacteria which can harm our health.

Wastewater should be piped from our homes, schools and industries to wastewater treatment plants where the water can be treated so that it can be piped safely into the rivers or reused.

Water has many uses

Water has many special qualities and so it is an important resource that can be used in many ways. Humans use water for:

- agriculture/animal husbandry
- processing food
- industry
- cleaning
- recreation
- transport
- __________________
- __________________
- __________________

Water is important for the environment

Water is also important for the natural environment. If people take too much water from rivers or pollute water, it can affect all the animals, birds, fish and plants that rely on the water for their survival.
1.3 Strategies for a Water Efficient School

1.3.1 Monitoring Water Use at School

Knowing how much water St Louis College uses and where it is used are important steps to improve water efficiency.

- We will calculate the school’s water efficiency or water usage per student per day in terms of quantity and cost. Then we will discuss and suggest water efficiency plans to feasibly improve water efficiency.

- We will conduct a water audit to determine how much water is used by location.

1.3.1.1 Calculating school water efficiency

School water efficiency can be shown in litres of water per student per day. Usually, a water efficient school uses less than 18 litres of water per student per day. There are factors that increase school water use such as after-school activities, swimming and other sports, accommodation units within the school and shared water meters.

Once the water efficiency has been calculated for 2010, we will know:

- Total volume water used
- Water use per student per year
- Water use per student per day
- Total yearly cost of water
- Average daily cost of water
- Average daily cost of water per student

So, next year we will be able to calculate the water efficiency for 2011. Then, we will compare the figures for 2010 and 2011 and hopefully we will have achieved an improvement in water efficiency; lower water usage and lower cost.

All the data will be collated on a database accessible in the CCM.

Refer to your worksheet.

To summarise:
1.3.1.2 Conducting a water audit

Why do a water audit?

A water audit will give us data that can be used to assess improvements in St Louis College’s water efficiency. A water audit is used to survey the quantity and quality of all the school’s water points, check where water is used and to find locations where water is lost or wasted through leaks.

Before conducting the water audit we will need;

- the school water efficiency results for 2010.
- a map of St Louis College
- groups of water monitors with measurement and recording skills
- to organise a date and access into all areas of the school

On the day of the Water Audit;

- make sure that each group knows their assigned area
- draw on the map the location of the water points
- label and number the water points
- complete the water audit handouts
- note the water efficiency features of the fixtures and fittings
- note broken, dripping and/or leaking fixtures and fittings

After the Water Audit

- collate each group’s data to determine the total school result
- monitor fixtures and fittings

Next year we will undertake another water audit!

All the data will be collated on a database accessible in the CCM.

Refer to your worksheets.

To summarise:
1.3.1.3 Monitoring fixtures and fittings

The water monitors will assess the school’s fixtures and fittings each month to:

• regularly check for broken, dripping and/or leaking fixtures and fittings
• note repairs needed
• note repairs completed

All the data will be collated on a database accessible in the CCM.

Refer to your worksheets.

To summarise:

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

1.3.2 Drinking Water Quality

Water supply and sanitation in Belgium

In Belgium, water supply and sanitation is provided by a large variety of organisations. Most municipalities in Belgium have delegated the responsibility for water supply and sanitation to regional or inter-municipal utilities. There are more than 62 water supply utilities including 2 regional, 30 inter-municipal and 30 municipal utilities.

Water supply is not scarce in Belgium and water supply is generally continuous and of very good quality. Wallonia provides 55% of Belgium’s drinking water needs. An interesting aspect of the water supply and sanitation sector in Belgium is the recognition of people’s basic right to water. This means that people who have difficulty paying their water bills are given financial support by the Regions.

Ensuring drinking water purity is essential for our health as well as for the health of the environment. Drinking water must be ‘wholesome’ and this is defined in law by standards for a wide range of substances, organisms and properties of water. The drinking water standards are strict and they include wide safety margins. They cover:

• micro-organisms
• chemicals such as nitrates and pesticides
• metals such as lead and copper
• the way water looks and how it tastes
The water in St Louis College has four easily measurable properties that are commonly used to characterise water purity and are detailed in the European Union drinking water standards. The four characteristics are the pH, alkalinity (KH), general hardness (GH) and the presence of contaminant nitrates.

pH is a measure of the hydrogen ion (acid) concentration in water and helps determine if water will damage plumbing. Alkalinity (KH) is a measure of water’s ability to neutralise acids and is directly related to the pH. The general hardness of water is mostly caused by dissolved calcium and magnesium in the water and high concentrations can cause lime build-up (scaling) in the fixtures and fittings. Nitrate is a common contaminant from fertilisers and waste and if present in high concentration can be a threat to general health.

During the water audit, the water monitors will collect water samples from key locations. On site, the water monitors will measure the temperature of the water. Then, in the science laboratory, the water monitors will test the water samples pH, nitrates, nitrites, hardness and under supervision.

All the data will be collated on a database accessible in the CCM. The data will be analysed and compared to the EU drinking water standards. The results will be reported in a water purity document.

Refer to your worksheets.

To summarise:

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
1. 4 The Water Cycle in Nature

Have you ever wondered why, with billions of people using water every day, that we don’t run out of water? It’s simple! It’s because of one of nature’s best inventions – the **water cycle**.

Our Earth has exactly the same amount of water it had thousands of years ago. It is being continuously recycled in a process called the water cycle. In the water cycle, water goes around the Earth through a number of processes.

Look at the picture below.

Water falls from the sky as rain, hail or snow. This is called **precipitation**. When water falls on the ground it can soak into the ground. This is called **infiltration**. The water that does not soak into the ground is called **runoff** and it flows into streams, rivers or oceans.

During the **evaporation** stage, water turns into a gas called water vapour and rises invisibly into the air. **Condensation** is when the invisible water vapour turns back into a liquid in the sky. When this falls as precipitation, **the cycle starts again**.

Water can also be released into the air by plants during the process called **transpiration**.

The entire process is called the water cycle.

**Exercise:**

What are the four stages of the water cycle?

Stage 1: ________________________________

Stage 2: ________________________________

Stage 3: ________________________________

Stage 4: ________________________________
1.5 Managing the Water Cycle

A large city, such as Liège, can’t rely on the natural water cycle to provide us with all the water we need or to remove all our wastewater.

Although rain (precipitation) from the water cycle provides us with most of the water we use, it doesn’t always rain when or where we need it. Rainwater must be stored and transported to where it can be used by people.

The population also produces a lot of wastewater which could affect our health if it is not removed and treated.

The supply of fresh water and the removal of wastewater, must be done in a sustainable way, and protect the environment and our health.

Managing the water cycle is how we ensure that we have enough water for the future.

The managed water cycle

This involves:

- using dams to store water
- treating water at water filtration plants
- storing water in reservoirs
- building desalination plants to secure a future water supply
- providing water to our homes, schools and industries through pipes and pumps
- removing wastewater through the sewerage system
- treating wastewater at sewage treatment plants or water recycling plants
- returning effluent to waterways or recycling it for further use
- returning stormwater to local waterways

Vocabulary
There are three main areas managed in the water cycle:

1. Water supply system
2. Wastewater system
3. Stormwater system

1.5.1 Water Supply System

Catchments

A catchment is an area of land, usually surrounded by mountains or hills, where water flows and is collected. Within a catchment, water flows by gravity to the lowest point. The lowest point in a catchment is usually a stream, river, lake or wetland (swamp). In an unmanaged system, the water will eventually flow from the catchment to the ocean.

Dams

A dam stores water collected from a water supply catchment.

Water Filtration Plants

Water filtration plants improve the quality of our drinking water to meet the European health guidelines. Organic matter, sediment and minerals like iron and manganese are removed from the water. After filtration, fluoride is added to prevent our teeth from decaying and chlorine is added to clean the water and kill harmful micro-organisms.

Reservoirs

A reservoir is a large tank or body of water that stores water temporarily until it is needed. Filtered water from water filtration plants is transported through a system of pipes to reservoirs for storage before supply. Reservoirs are usually located on hills so that the water can flow to most places by gravity. Pumping stations can help supply water to elevated areas.
Desalination Plant

A desalination plant turns seawater into drinking water. Seawater is taken from the ocean and pushed through very fine filters in a process called reverse osmosis. This separates the ocean water into freshwater and a salty liquid. The freshwater becomes drinking water and the salty liquid goes back into the ocean.

1.5.2 Wastewater System

Sewage Treatment Plants

Sewage treatment plants treat wastewater before it is recycled or discharged into rivers (or oceans). Sewage treatment plants are usually located near rivers or on the coast. Treatment is either primary, secondary or tertiary depending on the number and type of processes used to treat the wastewater. Primary treatment is physically removing large waste materials such as toilet paper, human waste and sand from the wastewater. Secondary treatment involves biological and chemical processes that remove or breakdown smaller particles and dissolved pollutants in the wastewater. The secondary treatment produces nutrient rich solids that can be used to produce biosoils. Tertiary treatment is filtering and disinfecting the wastewater so that it can be safely released into rivers (and oceans) or be reused.

Recycled Water Plants

A recycled water plant receives effluent from a sewage treatment plant and cleans the water thoroughly so it can be used again for a variety of activities. Recycled water plants are usually built close to sewage treatment plants. Recycled water is often used in industry, irrigation and for watering municipal gardens and sports grounds.

1.5.3 Stormwater System

The stormwater system is a network of drains, pipes, canals and local waterways that remove stormwater from built-up areas after heavy rain and carry it to rivers (and oceans). As stormwater flows over hard surfaces (streets, footpaths) it picks up rubbish, grease, oil and other pollutants. These pollutants need to be removed to prevent them entering our rivers and oceans. There are usually grates, booms and nets installed at strategic locations to collect the pollutants in the stormwater.
1.5.4 Keep Our Waterways Clean!

By keeping rubbish and pollutants out of stormwater you can help keep oceans and rivers clean.

Actions to help keep waterways clean include;

- Put rubbish in the bin
- Wash cars on the grass instead of on hard surfaces (street, driveway) so the detergents don’t flow into the stormwater system
- Collect leaves, dirt and rubbish from driveways and gutters and dispose of it
- Put grass clippings and garden waste in the green bin or compost it
- Pick up your dogs droppings and dispose of it in a bin
- Keep your car serviced so it doesn’t leak oil
- Dispose of chemicals, paints and oils responsibly at the container park

1.5.5 Stormwater and Your Safety

Stormwater drains can be very dangerous places.

When it rains, huge amounts of water can suddenly wash into a drain. If you slip and fall into the water you could be swept away. The force of the water can be very very strong and you may not be able to get out and it is possible that you could drown. Even shallow water can be very powerful.

Drains can contain pollution such as broken glass, dangerous chemicals as well as disease causing bacteria from sewers or animal droppings. Animals like rats can be found in stormwater drains.

Stormwater drains are usually fenced and have warning signs telling people to stay out. It is also a good idea to keep your pets away from drains.

1.6 Encouraging Water Wise Behavior

Encouraging water wise behavior is an important way to improve St Louis College’s water efficiency.

We will try and get everyone involved by organising an awareness raising campaign to promote water wise behavior at school. The campaign will include the design and display of posters and signs around the school.

Some of the campaign messages could include:

- Don’t turn taps on too hard or leave it running when you are washing your hands.
- Have shorter showers after sport.
- Turn off taps properly when you have finished using them.
- Use the half-flush button instead of the full-flush button on the toilet.
- Report leaking taps and bubbling toilets to a teacher. Did you know that one drop per second wastes 7000 litres of water a year!
- Wash paint brushes, sports equipment, science instruments in containers or plugged sinks rather than under a running tap.