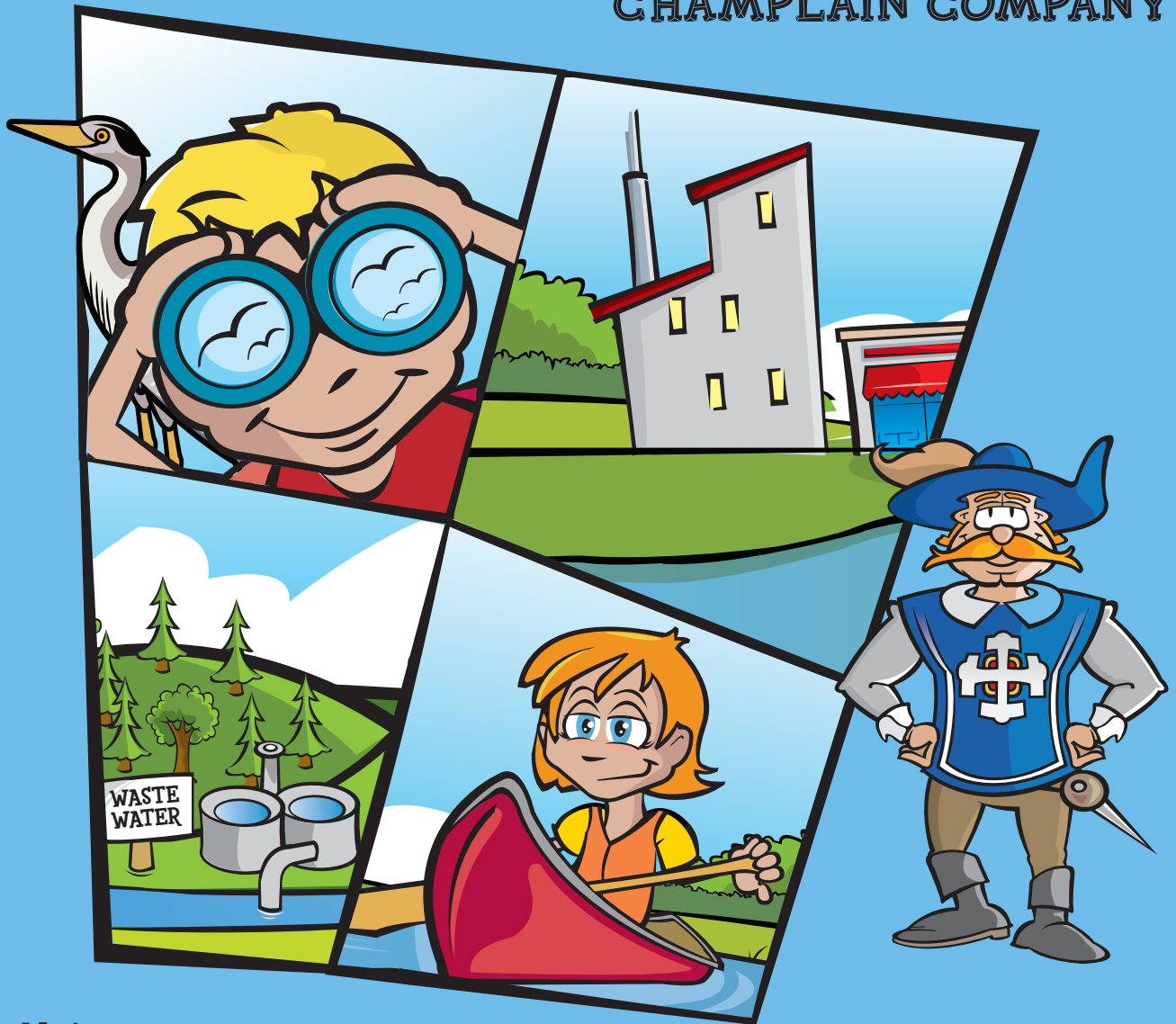


THE CLEAR WATER MUSKETEERS

CHAMPLAIN COMPANY



Guide for Mister
Athos' Musketeers

THE WATER
USAGE GRADE

Guide for Mister Athos' Musketeers

Water Usage Grade

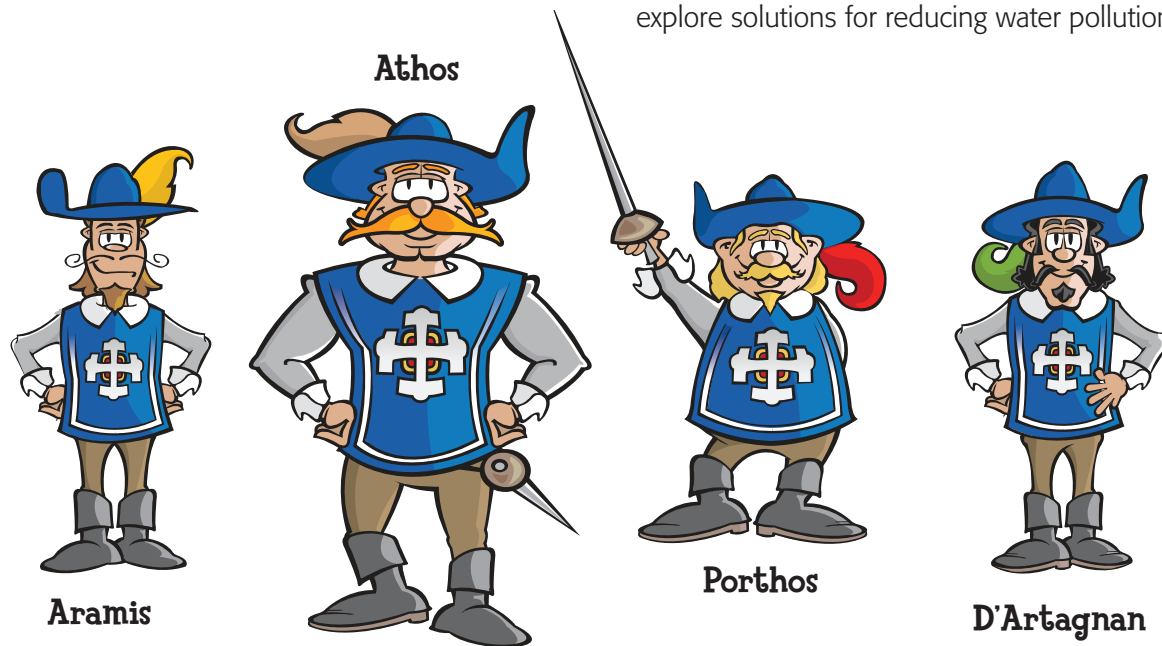
The Clear Water Musketeers are in charge of water protection in their community. With Mister Athos, the clear water musketeers will discover the various uses of water. Athos was a noble figure, with vast life experience. He gave the other musketeers advice and warned them of the consequences of their actions. Mister Athos' musketeers will learn how various kinds of human activity affect aquatic environments.

There are three other grades in the clear water musketeers program:

The Basin Grade: Mister Porthos' musketeers learn about the land through which the rivers flow.

The Aquatic Ecosystem Grade: Mister Aramis' musketeers discover the secret relationships between organisms living in various aquatic environments.

The Water Quality Grade: Mister d'Artagnan's musketeers explore solutions for reducing water pollution.



The four musketeers were featured in a story written by Alexandre Dumas in 1844: their names were **Aramis**, **Athos**, **Porthos** and **d'Artagnan**. They lived in the 17th century, from 1610 to 1670.

Name: _____

School: _____ Class: _____

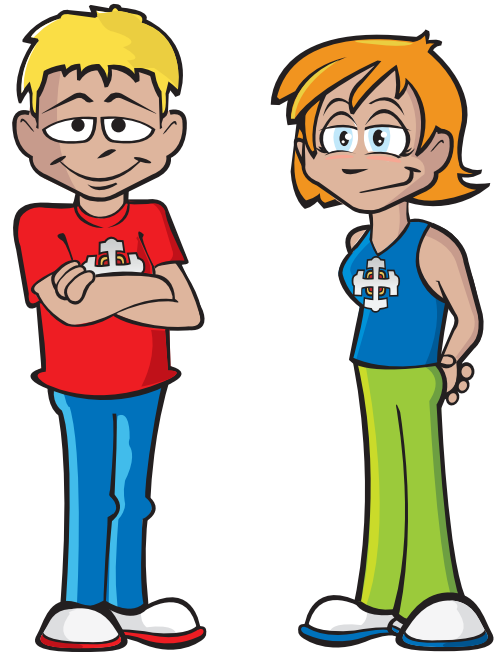
Water's many uses

Water is the source of life on Earth, and it is the essential component of all living things. It is as crystalline and as precious as a diamond. It has some very special qualities. Water (H₂O) is the only substance on Earth that is solid, liquid and gaseous in its natural state. Water can move mountains through its erosion of earth and rock, especially when it is in the form of a glacier. It has tremendous energy when it flows and is powerful enough to carry boats.

Water is also the most precious substance because it is essential to our survival. Although we can survive 30 days without food, we cannot survive more than three days without water. But water is not easy to carry because it leaks everywhere. Imagine having to carry a pail of water from the store to your home on foot, every day, without spilling too much. Yet that is what many young people must do in countries where there is no water distribution system.

Water is crystalline and sparkles brilliantly in the sun. Unfortunately, when it is polluted, it no longer glitters, and it loses all its beautiful qualities. In the Missisquoi Bay basin, the water in the lakes and rivers is mostly of very poor quality. That is damaging to all types of uses. Because the water is contaminated, it is very expensive to treat. Good quality water is therefore a resource that is becoming more and more rare. In some parts of the world, it is so rare that people are extremely thirsty. The land is extremely dry and can no longer grow food. Conflicts over water are emerging around the world.

Athos, who is the wisest of the musketeers, knows that water is precious. The clear water musketeers will learn the consequences of our various usages of water. Then they will carry out their mission: to assess water usage at home and at school.



Aqualine and Riviero will guide you on your expedition to discover the various types of water usage, and will help you find ways to save water and avoid contaminating it. In this way, we will all have access to clear water, for a long time. It's as clear as rock water!

Residential usage

Drinking water is an essential need because our body cannot go without water. The human body loses 2.5 litres of water each day. We compensate for some of this loss with food (1 litre of water), but that's not enough. We therefore have to drink 1.5 litres of water a day, and even more in the summer or after heavy physical activity.

Table 1

Percentage of water in food

Can you match the following foods with the percentage of water they contain? beef, spinach, lettuce, fish, apple (answers on page 18)

Tomato -----	95%
Milk -----	90%
-----	85%
Potato -----	80%
Egg	75%
-----	60%

It is vital to have drinking water at home each day. Some municipalities have a water supply system to provide drinking water to each home. The water is drawn from a river, lake or groundwater aquifer. In this last case, the municipality has to drill a very deep well.

Some homes are not connected to a municipal water supply system. In these cases, groundwater is drawn by means of a residential well. This water is naturally purified in the ground, although it is necessary to periodically check the quality. A home water treatment system can be added to soften the water (remove limestone), clarify the water, improve its taste, etc.

Drinking water supply



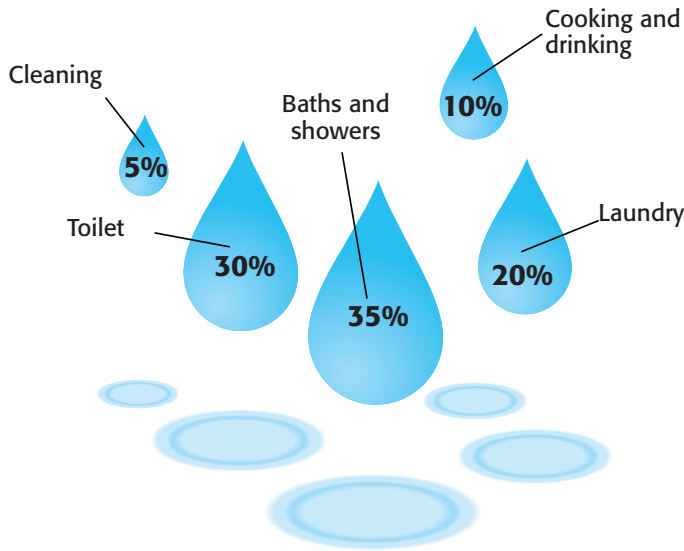
Once drawn from its source, the water must be purified in a drinking water treatment plant. Drinking water must not contain any contaminants that could harm human health. After it has been treated, the water is chlorinated to preserve its good quality throughout its trip through the water supply system up to the home.

Water in the home must be potable, so that you can drink it and use it to cook food. However, this type of usage represents only a small part of the possible uses of water in the home. More than 50% of water is used for washing activities.

We use water to wash our food (to remove soil, bacteria and pesticides) and to cook it (boiling, steaming). Water is also used in many recipes (sauces, pie crust). We have to wash our hands frequently while preparing meals and, of course, before eating!

Graph 1
Percentage of domestic uses of water

Water is a good cleaner throughout the house. With the help of soap, water dissolves and carries things away, especially dirt and grease. It quickly and cleanly evacuates our bodily waste. But with all these polluting substances accumulating in our wastewater, this water has to be cleaned before being poured back into a river or lake.



Using the graph below, can you calculate the exact percentage of water used for washing activities?
(Answers on page 18)



Can soapy water help clean rivers and lakes?

No, because in aquatic systems, soap decomposes in the water and is absorbed by the plants and animals, which is not good for their health.

Total for washing activities:

Cyanobacteria



The phosphate contained in soap is a nutrient that causes overgrowth of aquatic plants and cyanobacteria. That's why you should always use phosphate-free soap. Cyanobacteria are also called blue-green algae. The term "cyan" means blue. You can see the blue traces left by cyanobacteria on the shore of the Missisquoi Bay.

Outdoors, we use water for plants (watering the lawn, flowers, shrubs and trees, vegetable gardens), for pools or to cool off in the summer, and to wash buildings or the car. On average, Quebeckers use 400 litres of water per person in and around their homes each day. By saving water at home, a family can reduce its water consumption by at least 40%. People can also watch their water consumption at school and at work.

Once water has been used in the home, a good part of it returns through the sewer pipes to the wastewater treatment plant. For homes that are not connected to a sewer system, wastewater from the house goes into a septic system. A septic system is like a mini water treatment plant. In a tank buried in the ground and connected to the home's sewer outlet, contaminants settle on the bottom or float to the surface. The water is thus clarified before being sent through perforated pipes buried in the ground, which let the water out bit by bit. The water finishes its filtration process in the ground, by means of bacteria.

Wastewater treatment



Wastewater has to be cleaned before being released into the lakes and rivers—otherwise, the entire aquatic system will be contaminated. By reducing our water consumption, we also reduce the amount of wastewater that needs to be treated. That's two in one!

Municipal usage

Municipalities also use large amounts of water. Just think of municipal pools, street cleaning, watering grass and flowers in parks, and fire hydrants for the fire department. Several actions, however, can be taken to save water. Pierced or old pipes let water leak, representing a 15 to 30% loss in drinking water. What a waste!

Drinking water is very expensive to produce. At the moment, we don't pay for all the costs of water as in other countries. One thousand litres of tap water costs us only \$1.15! Compare this to the costs of other drinks: 1,000 litres of bottled water costs \$1,500. The same volume of cola costs \$850, and of milk, \$985. We have good quality tap water: all you have to do is put a pitcher in the refrigerator for it to be as refreshing and tasty as bottled water. If we paid for all the costs of water production, including the infrastructures and waste, the bill would be much higher.

Given that we use 400 litres of water per person per day at home, how much would it cost if we had to pay the same price as for bottled water, for a family of four people, for seven days?

(Answer on page 18)



Storm drains



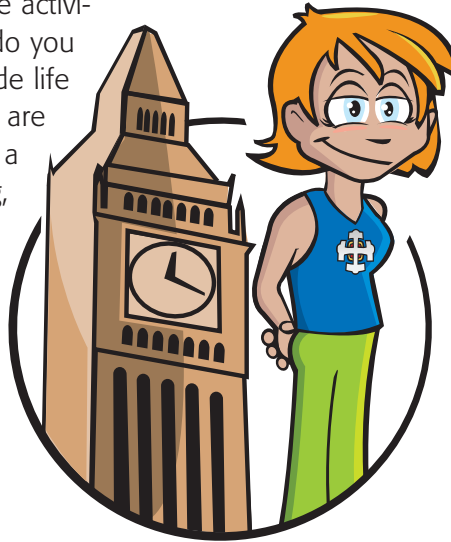
Where does the water used outside the home and in the municipality go? If this water seeps into the ground, it is filtered by the soil and goes back into the groundwater. If it runs over the ground and in the streets, either it reaches a ditch and then a river, or it falls into a storm drain and goes into the storm water pipe system under the streets. In most cases, the water in this network is released into a river or lake without being treated. It is therefore very important to avoid contaminating surface runoff.

FOR PROPER MANAGEMENT OF MUNICIPAL AND RESIDENTIAL WATER, IT IS IMPORTANT TO:

- Treat drinking water to protect people's health
- Save water to reduce the cost
- Reduce water contamination indoors and outdoors
- Treat wastewater before releasing it into aquatic environments
- Reduce contaminants in storm drain water

Recreational usage

When you think of summer, what kinds of leisure activities do you think of? Swimming, of course. But do you prefer going to the pool or to the beach? Lakeside life is highly appreciated in Quebec, because there are many recreational activities. You can swim, have a picnic, go underwater diving, camping, canoeing, kayaking, windsurfing or even surf on a board pulled by a kite! For those who don't have a house on a lake, it is important to have public access to water in the municipality. All citizens can then take advantage of the water, as well as visitors.



Why do Europeans use less water than we do?

It's because they have a lot less water on their territory. They also have programs to encourage people to save water in order to pay less.

Aquatic landscape



The presence of water enhances the landscape with its movement and its music. However, if the water is of poor quality, or if there is garbage in the lakes and rivers or along the banks, then all recreational activities are affected. Even fishing is affected, because if the water is polluted, the fish and mussels become contaminated.

It's important to think about saving water when travelling as well. If we compare per capita water consumption in the world, it is 425 litres in North America, 400 litres in Quebec, 200 litres in Europe and 30 litres in Africa.

Of course, all animals living in aquatic and terrestrial ecosystems use water, even in winter! In order to enjoy all the pleasures offered by our aquatic environments, we have to protect water at all times.

Recreational fishing



In Quebec, 15% of the population enjoys. In the rivers and lakes of the Missisquoi Bay basin, you can learn to fish by catching panfish, yellow perch and brown bullhead, and then improve your skills by fishing walleye, largemouth bass and northern pike. It's both relaxing and exciting!

Winter activities



Let's not forget about all the winter water-related activities, too. Snow and ice are water! You can skate on frozen lakes and rivers, go ice fishing, cross-country skiing or snowshoeing. But be careful of thin ice. A frozen bath is not only unpleasant, it's dangerous! Here's a fisherman who is very proud of his catch at Lake Selby: a smallmouth bass.

In winter, how come the fish living in ice-covered lakes and rivers don't freeze?



Ice is lighter than water and floats. Beneath the ice, the water is 4°C and the fish continue to swim. They are less active than in summer but they survive very well, even though it's as cold as a refrigerator!

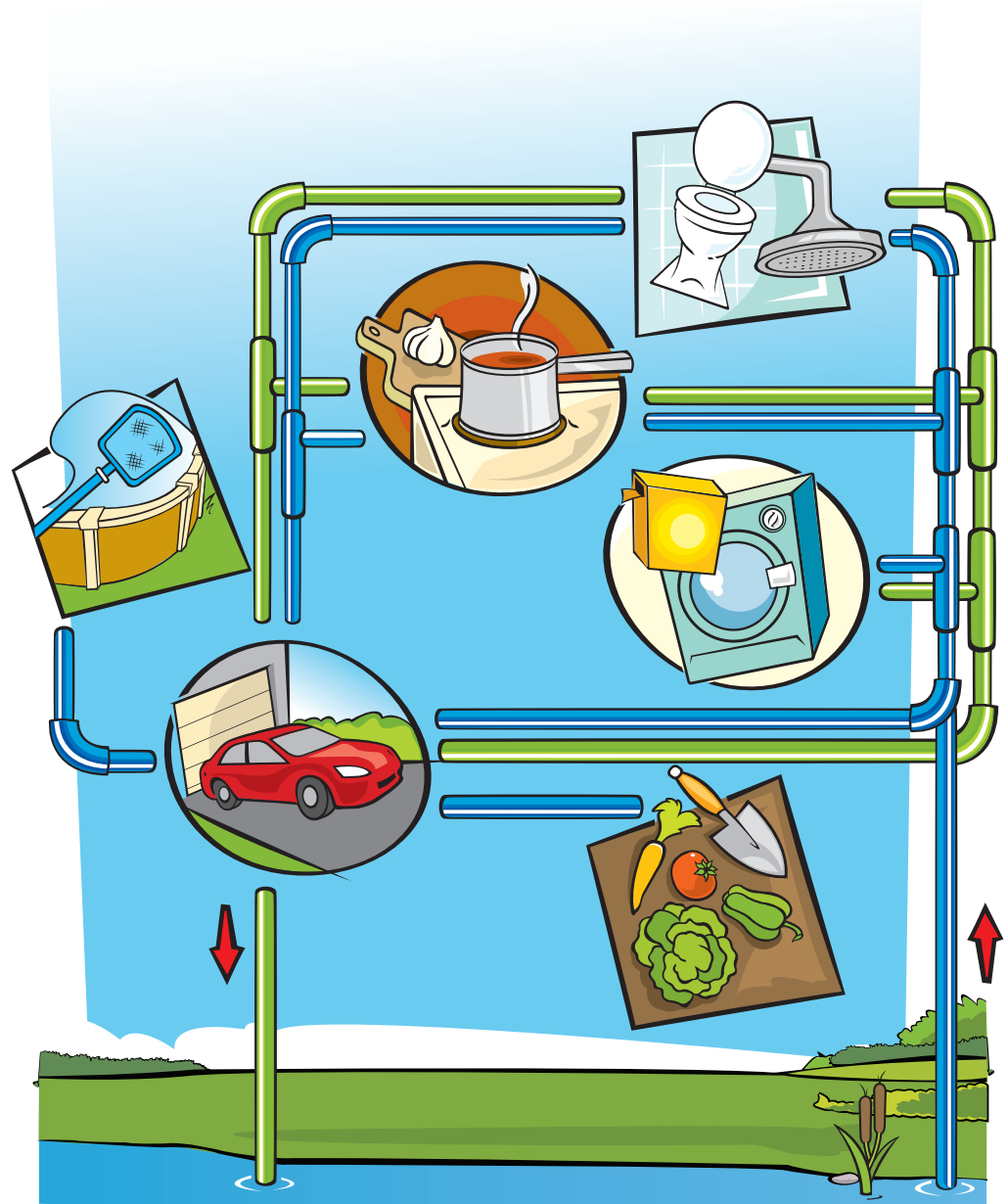
TO PROTECT THE AQUATIC ECOSYSTEM WHEN ENGAGING IN RECREATIONAL AND TOURISM ACTIVITIES, IT IS IMPORTANT TO:

- Avoid contaminating the water during activities on, in and near the water
- Avoid damaging public access ways and paths along the water
- Avoid leaving behind garbage, worms or dead fish when fishing
- Respect the rules for water sports, fishing and swimming

The drinking water route

Analyze the drawing of the drinking water route to find out more on the residential uses of water. This exercise will help you carry out your clear water musketeer mission on page 19.

On average, Quebeckers use 400 litres of water per person for domestic uses, each day. Imagine if you had to carry 400 one-litre bottles of water each day! In the summer, consumption can go up 50%, which amounts to 600 litres per person. It is estimated that half this water is wasted as a result of plumbing problems, over-watering and too much washing. That's why municipalities have very strict rules on summer watering. The lawn may be thirsty, but people are a priority. We can reduce the amount of waste, however, by changing our outdoor water usage habits. It's much more useful to water plants than asphalt, don't you think?





Bathroom

A bath uses between 150 and 200 litres of water. Taking a shower uses 15 to 20 litres per minute, which means that a short, five-minute shower uses 75 to 100 litres. Installing a low-flow shower head cuts the amount of water in half, saving even more hot water as well as money on your energy bill.

Old toilets (more than 15 years) require 18 litres of water or more to flush. Modern, ultra low-flush toilets use only 6 litres of water, a savings of at least 60%. It is preferable to throw solid garbage into a wastebasket rather than the toilet, so as to avoid flushing water.

Turning off the tap while brushing your teeth or shaving saves 8 litres of water. Otherwise, it takes 13 litres per minute.



Kitchen

Letting the water run to get a glass of water uses 13 litres of water per minute. By letting the water run just a few seconds, filling up a pitcher and putting it in the fridge, you can save at least 8 litres of water.

Dishwashers use up to 95 litres of water per cycle, but that's less than washing the same amount of dishes by hand. New models use up to 30% less water. Using the dishwasher only when it's full saves even more. And for better energy performance, run the dishwasher outside of peak times.



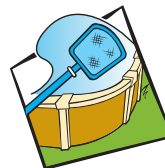
Laundry room

Using the washing machine only when it's full can save 130 litres per cycle. Recent models use up to 70% less water. A dripping faucet loses 140 to 680 litres of water per day.



Garage

Washing the car by hand with a pail instead of a hose uses 10 litres of water and allows you to save 300 litres of water. Sweeping the entranceway instead of spraying it with a hose saves an average of 200 litres of water.



Pool

Filling the pool at the beginning of summer uses about 48,000 litres of water. Leaving about 15 cm at the top instead of filling it to the edge prevents losses from splashing. Installing a solar tarp reduces the amount of water lost through evaporation.



Garden

Avoid watering in full sun: not only is it not good for the plants, but up to 60% of water will be lost through evaporation. The lawn needs 2 to 3 cm of water a week, not more. A garden hose discharges up to 1,000 litres of water an hour. A sprinkler loses up to 50% of water to evaporation. A drip watering system is much more efficient. Adding compost to the soil and mulch at the foot of plants helps to retain water. You can also collect rainwater in a barrel.

Agricultural usage

In the Missisquoi Bay basin, forest in the east covers 60% of the land (sub-basin of the Missisquoi River), while agriculture in the west occupies 30% of the land (sub-basin of Pike River). Aren't we missing 10%? No! That's the land occupied by the municipalities, roads and waterways.

Growing food requires a lot of water. That's why agriculture is a great consumer of water, accounting for 70% of all the water consumed on the planet. Industries use 20% and municipalities 10%.

In Quebec, precipitation in the form of snow and rain is sufficient for our agriculture, in particular grain crops such as corn and wheat, as well as legumes such as soy beans and peas. In the Missisquoi Bay basin, corn accounts for 50% of crops. But if we wanted to grow rice or cotton, it would be a whole other story! Tremendous amounts of water are needed for these crops, which are grown in warmer climates.



For some vegetable crops such as lettuce, strawberries and broccoli, the soil has to be irrigated to water the plants more often than it rains. This water is usually drawn from a river, lake or groundwater aquifer. It's possible to save water by irrigating in a very limited way, using a drip distribution system at the foot of each plant. It's better than spraying or flooding the soil. These methods waste a lot because the plants cannot take advantage of all this water. If there is waste, then other people may not have enough water, which can lead to conflict.

Agricultural drainage



Some agricultural soils retain too much water. Drainage is therefore carried out using perforated pipes in the ground. The underground pipes can more quickly evacuate water that seeps into the ground during spring thaws or heavy rains.

Of course, animals must be given quality water, because it is essential to their health. The amounts of water needed vary according to the size of the animal, but also according to other criteria. For example, a dairy cow drinks three times more water than a beef cow. Do you find that surprising? Milk is one of the main products of livestock production. It is 90% water. In the Missisquoi Bay basin, pigs account for 50% of livestock production and cattle accounts for 40%.

We often see drain pipes at the edge of fields, with the water emptying into the ditch. Is that for the wastewater from the farm animals?



No, it's to evacuate the excess water from the fields.

Watering animals



Animals can no longer drink directly from streams, rivers or lakes. Drinking troughs must be set up and bodies of water fenced in so that the animals do not contaminate them with their fecal matter.

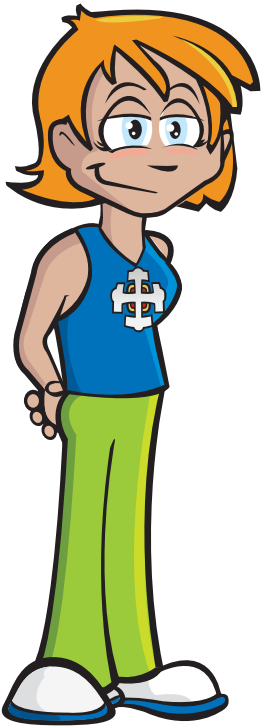
But in addition to being used to water the animals, a lot of water is used to wash the buildings that house the animals. This water ends up in the animal slurry and manure, which must be stored before being spread on the fields. In some farms, animal slurry is treated, just like municipal wastewater, before being spread. In other farms, it is treated in a way that produces energy (methane gas).

A NUMBER OF GOOD PRACTICES CAN HELP SAVE AND PROTECT WATER IN AGRICULTURE:

- ◆ Irrigate precisely, at the right time
- ◆ Reduce contaminants on the land, in ditches and in drains
- ◆ Improve animal watering systems
- ◆ Reduce the amount of water used for washing, and recycle the water
- ◆ Store wastewater at the farm

Industrial usage

The production of goods is divided into artisanal production, or cottage industries, and industrial production. In artisanal production, goods are made one by one, with tools. This is the case of work performed in sawmills, cabinet-making shops, pottery workshops, bakeries, etc. In industrial production, goods are made in large quantities with machinery that uses a lot of energy, especially in the manufacturing industries (food, drinks, textiles, pulp and paper) and extraction industries (mines, quarries, oil).



Whatever the product being made, water is required, and often in large quantities. For example, manufacturing a car requires 5 to 10 cubic metres of water (5,000 to 10,000 litres). To produce 1 kg of dyed fabric, between 80 and 200 litres of water are needed. And for 1 kg of candy? Three litres.

In the Missisquoi Bay basin, there are some chemical, metallurgical and textile industries, and a large number of artisanal or cottage industries. In open-pit mines, pumps extract the water from the subsurface in order to extract the minerals, withdrawing some 1,000 m³ per day. This water must then be treated before being released into a waterway because it contains various minerals as well as oil and grease from the machinery.

Several agrifood industries operate in the Missisquoi Bay basin. Once again, enormous quantities of water are needed to wash the food. Water is also required to wash the slaughterhouses and to prepare the meats in butcher's shops.

Industrial wastewater

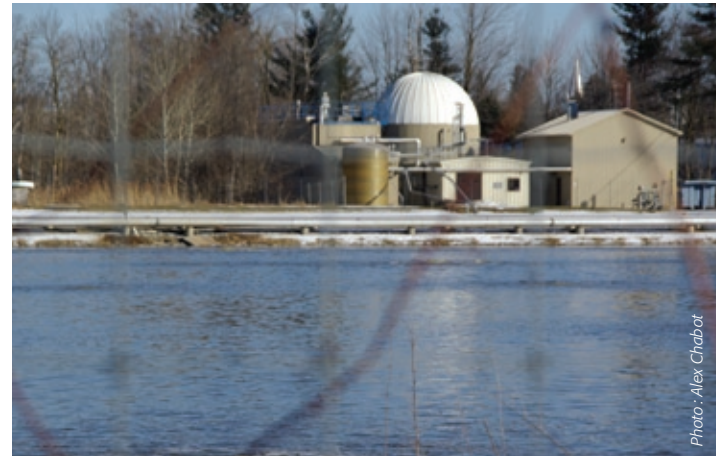


Photo : Alex Chabot

Previously, the water used to prepare food and clean factories was dumped directly into the rivers and lakes, which changed their colour and gave off bad odours! Today, all wastewater is treated either in the factory or by the municipality, and water can be saved by recycling within the factory.

Large companies often treat their water themselves to improve its quality. They reduce their consumption by recycling water within the factory and by treating their wastewater. Water is also often used to cool machinery down.

Energy

In wood production, tree-cutting and the construction of forest roads and bridges can contaminate streams and lakes. Up until very recently, pulp and paper plants were major industrial polluters that used enormous amounts of water to manufacture paper pulp, which contains 99% water. Today, they recycle 100% of their water within the factory, and wastewater is treated on site. Although there are no pulp and paper plants in the Missisquoi Bay basin, we all buy a lot of paper!

Does paper recycling save water?



Yes, because it takes 20 to 100 litres of water to manufacture one kilogram of paper (about 50 sheets). By recycling, the amount of paper pulp manufactured is reduced. Therefore, recycling saves water—as well as saving trees!

Water can be used directly as a source of mechanical energy. By means of a dam, we can use the power of the falling water to turn devices such as water wheels for watermills and turbines for hydroelectric dams.

Dams



In the Missisquoi Bay basin, while there are no hydroelectric dams per as such, about forty dams were once built to run factories in Bedford (electricity, grinding wheels to sharpen tools) and Notre-Dame-de-Stanbridge (wool-carding mills). Sawmills and flour mills that were located in several municipalities as well. This illustrates the importance of the water's energy for the development of municipalities and businesses in the basin.

Water can also provide energy when it is heated. At 100° Celsius it boils, and the steam can be used to power machines or to treat products. Water also transports heat. Hot water can be drawn from the ground in the winter to heat a house; this is called geothermal energy. In the summer, groundwater can be used to cool the house. Water is also used to circulate heat that comes from the sun.

Transportation

Water serves as a means of transportation. Boats are the perfect example. Most products that we buy come from other countries and have travelled by boat. Boat travel is economical, but it can lead to accidents, in particular with oil tankers.

Why does a hunk of plasticine sink to the bottom of the water, whereas if we shape the same hunk into a flat-bottomed boat, it floats?



Water has a consistency that pushes objects upward (water pressure). If an object is very dense, it sinks like a rock. An object of the same weight but with a larger surface touching the water enjoys a stronger upward push, better distributed across its entire surface.

Water is also used to transport materials and even dissolved substances. In the past, logs were floated down rivers as a means of transporting the wood. Today, this method of transport, called log driving, is prohibited, because it contaminates the rivers. Being a log driver was also a rather dangerous occupation!

Navigation



In the Missisquoi Bay basin, motorboat transportation is limited to the lakes and to the Missisquoi Bay. Up until 1920, hay was carried by boat (barge) to the United States to feed horses, which were much more numerous before the development of cars. Today, water transportation is limited to recreational activities.

SEVERAL GOOD PRACTICES CAN HELP SAVE AND PROTECT WATER USED FOR INDUSTRIAL, ENERGY AND TRANSPORTATION ACTIVITIES:

- ◆ Reduce the amounts of water needed to manufacture products
- ◆ Improve production processes
- ◆ Recycle water in the factory
- ◆ Reduce contaminants in the wastewater that is discharged
- ◆ Do not release contaminants while transporting products by boat
- ◆ Limit the construction of dams and let fish swim freely
- ◆ Do not heat the water in rivers and lakes

Glossary

Agrifood

Refers to all activities involved in the processing of agricultural products intended for human consumption.

Animal slurry

The liquid excretions of farm animals such as cows, pigs and poultry. Animal slurry is used as a farm fertilizer.

As clear as rock water

From old French, "Clair comme de l'eau de roche." Rock water was in fact spring water, renowned for its clarity and transparency. The expression is used to say that an action or word is "transparent," i.e. its meaning is obvious.

Chlorinate

To treat with chlorine, a disinfectant that is added to drinking water to reduce or eliminate the presence of microorganisms such as bacteria and viruses.

Contamination

Alteration of water quality that makes the water unsuitable for ordinary usage or creates a danger for public health.

Cyanobacteria

Aquatic bacteria that performs photosynthesis like plants by capturing solar energy and transforming carbon dioxide into living matter.

Drainage

Action of removing excess water from the soil using a system of pipes.

Drinking water (or potable water)

Water that can be consumed without any risk to human health.

Filtration

Action of passing water through a filter to separate and withhold the materials it contains.

Infrastructure

Permanent installations that meet the needs related to water, flood control and erosion, and environmental protection.

Manure

Mix of animal dung and straw, rich in mineral and organic matter.

Purify

To make pure by eliminating foreign elements.

Pollution

Introduction of waste and other harmful matter, in sufficient quantity to cause a deterioration of water quality.

Septic system

System for treating wastewater from a house or building.

Storm drain

Storm drains are connected to a network of pipes that carry rainwater and melted snow to nearby streams, rivers or lakes.

Wastewater

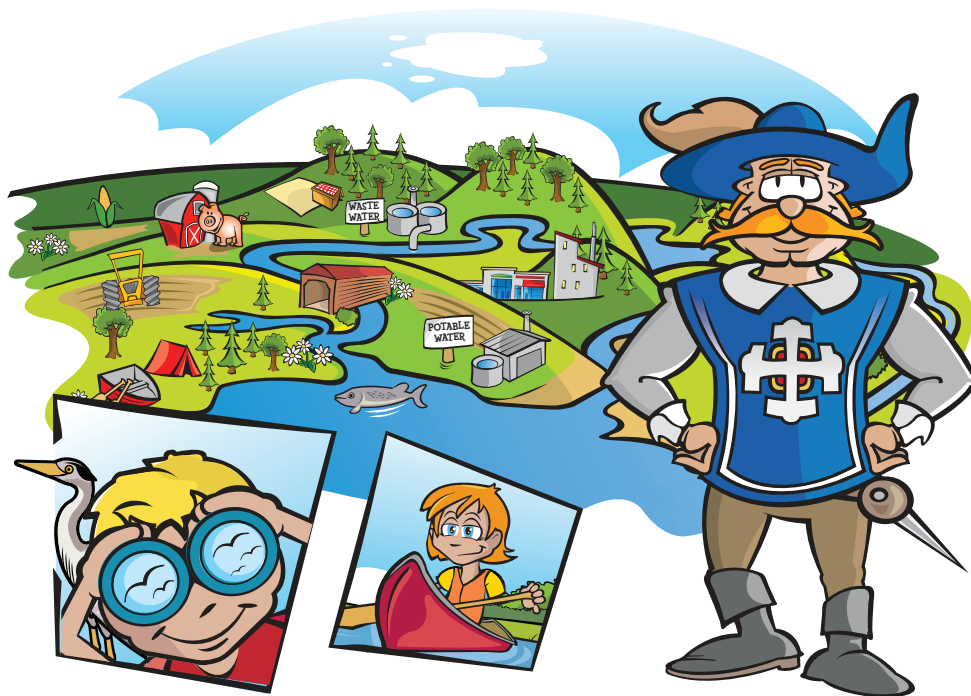
Water polluted by human activities.

Water sport

Recreational activity that takes place on the water.

Water supply system

An extensive series of underground pipelines that carry drinking water from one place to another.



Web Sites

Water Conservation Around the House
http://www.ecokids.ca/pub/eco_info/topics/water/water/index.cfm

The Water Heroes Story
<http://www.on.ec.gc.ca/greatlakeskids/heroes-story1-e.html#content>

Morphie's Great Water Ride Adventure
http://www.on.ec.gc.ca/greatlakeskids/morphie-story-title_e.html#content

Lake Champlain Basin Program – water links
<http://www.lcbp.org/kid.htm>

Question and Answer Game
http://epa.gov/safewater/kids/flash/flash_qagame.html

Books

A Drop of Water: A Book of Science and Wonder, Walter Wick, Scholastic Press, 1997.

Magic School Bus
 At the Waterworks, Joanna Cole, Scholastic Inc.,

Where Does Water Come From?
 C. Vance Cast, 1992, Barron's.

Answers to questions

Water in food
 beef 60%, spinach 90%, milk 90%, lettuce 95%, egg 75%, fish 80%,
 apple 85%, potato 80%, tomato 95%

Percentage of washing
 cleaning 5% + laundry 20% + baths and showers 35% = 60%

Price of water
 1,000 litres = \$1,500, 400 litres = \$600 per person per day
 For 4 people during 7 days: $\$600 \times 4 \times 7 = \$16,800$

Mission

Investigation into water usage at home

Identify and measure some of your water usage at home, using a table like the one below. Calculate the number of times you use water in each of these ways. Calculate the total number of litres used. Suggest some tips for saving water and other solutions for reducing contamination at the source.

Uses	Number of litres (a)	Day 1 Number of times (b)	Day 2 Number of times (c)	Total litres of water used = a x (b + c)
Taking a bath	150			
Taking a shower	80			
Flushing the toilet	15			
Brushing teeth	10			
Washing hands	10			
Pouring a glass of cold water	3			
Grand total				

The oath



We are *Mister Athos' Clear Water Musketeers* and our mission is to protect water, with honour and with pride. We promise to save water wherever it is found and to look after its good quality.

All for water and water for all!

Production

Corporation Bassin Versant Baie Missisquoi – 2008



Production team

Research and writing: Chantal d'Auteuil

Illustrations: Le Bipède

Graphic design: Ekorce Atelier créatif

Printing: Imprimerie Sisca

English version: Eve Krakow

Revision: Marie-Andrée Thériault

Financial partners

Lake Champlain Basin Program, Education and Outreach Committee

Rural Pact program of the MRC Brome-Missisquoi

Ministère des Ressources naturelles et de la Faune



This guide was designed in collaboration with the Direction régionale de l'analyse et de l'expertise de l'Estrie et de la Montérégie of the Ministère du Développement durable, de l'Environnement et des Parcs.