



### Subject:

Biology, Chemistry,  
Environmental Science

### Time:

45 minutes

### Grades:

7-10

### What to know before getting started:

August is National Water Quality Month, a time for Canadians to reflect on the importance of water and sustainable water use practices while they enjoy outdoor summer activities out on the water. There are many different ways that pollution can enter our waterways and it is important to keep them clean, not only for the general health of surrounding ecosystems but also because we rely on freshwater reservoirs for our drinking water. This activity covers some of the common strategies Canadian cities follow to purify drinking water for residents and businesses, and it includes instructions on how to test pH levels in water. **It takes more than just turning off the tap to ensure we have clean, potable water—follow this activity to improve your own personal water conservation habits!**

### Materials you will need:

- Red cabbage leaves
- Standard grade filter paper or coffee filters
- Blender (optional)
- Microwave (optional)
- Dropper/toothpicks (optional)
- Paper
- Writing materials
- Device with access to the internet for additional research

### Activity time!

According to the World Health Organization, one in three people around the world do not have access to clean drinking water. Drinking water sources, including lakes, rivers and reservoirs, are susceptible to contamination and before we can drink it, the water needs to be treated to remove things such as bacteria and dirt, which can cause illnesses. There are two parts to keeping our freshwater sources clean—one is wastewater management (cleaning the sewage or wastewater before it is released into our waterways) and the second is water purification (cleaning the freshwater that is taken in from our waterways for drinking purposes).

Most Canadians depend on municipal sewage systems or household septic systems to manage their wastewater, and, as of 2009, only about three per cent of Canadians have no way to treat their sewage. Usually, the waste we flush down the toilet or the dirty water that goes down the drain in our sinks is processed and cleaned before it is discharged. For Canadians who live in cities and towns, their municipality has sewers and treatment plants that collect waste, filter out solids from liquids, and use a variety of methods to remove contaminants. This means that when the wastewater is released into our waterways it doesn't pollute the environment. People who don't live on a municipal sewer system might have a septic tank or a collection tank for their sewage, which is then cleaned out when needed. Although the quality of wastewater management varies from place to place, these systems and strategies help to reduce pollution in our waterways.

Those same waterways are often sources of drinking water. Before the water is clean and safe to drink, it has to be purified. The most common steps involved in the water purification process are as follows:

**Step 1:** Water is directed from the waterway to a treatment plant via pipes, which are outfitted with screens to remove large objects such as weeds and garbage.

**Step 2:** Chemicals are added to the water to further separate out the dirt and other dissolved particles in the water. The particles bind with the chemicals forming larger solid masses, which are called "floc" (short for flocculation).

**Step 3:** Because the floc is denser than the water, it settles to the bottom of the water supply, and is then collected and removed.

**Step 4:** The water then passes through a number of special filters which remove the remaining finer particles.

**Step 5:** Chlorine, a common disinfectant, is added to get rid of microscopic organisms, such as bacteria and viruses.

**Step 6:** The pH level of the water is adjusted to make sure it is neither too basic or acidic, which helps protect water pipes and household plumbing from being damaged by corrosion.



**Step 7:** A second disinfectant, chloramine, can be added, which keeps the water fresh and clean as it moves through a network of water pipes.

**Step 8:** The mineral fluoride can be added to drinking water to help prevent dental cavities.

**Step 9:** Tests are performed at various locations and stages of the water treatment process to ensure water quality continues to meet national standards.

**Step 10:** The water is stored in city reservoirs and distributed to consumers via water mains (i.e., a system of pipes).

Now that you have a better understanding of the drinking water purification process and testing performed by water treatment plants, why not perform your own test using your drinking water at home? You can start by measuring the pH level of your water, which is fun and easy to do. But what does pH mean? The potential of hydrogen, or pH, indicates the acidity or basicity of a liquid (i.e., it indicates the concentration of hydrogen ions in your solution). A lower pH value (or a higher concentration of hydrogen ions) corresponds to a more acidic solution (e.g., lemon juice), while a higher pH value (or fewer hydrogen ions) corresponds to a more basic solution (e.g., laundry detergent). The pH scale goes from 0 to 14; at room temperature, pure water is considered neutral and has a pH of 7. Anything below 7 is considered an acid, and anything above 7 is considered a base.

Litmus paper is often used to test the acidity/basicity of a solution, but it can be hard to find outside of science laboratories. But don't worry, you can follow the steps below to learn how to make your own pH paper test strips, using red cabbage leaves. The cabbage juice that you will make changes to red in the presence of an acid (pH less than 7), to blue at a neutral pH (pH around 7), or to purple in the presence of a base (pH greater than 7).

Follow these steps to make your own cabbage-based pH paper test strips. Consider asking an adult for help!

1. Cut the red cabbage leaves into pieces that will fit into a blender. Blend the cabbage using the blender, adding a minimal amount of water needed to blend it. If a blender is not available, use a vegetable grater or carefully chop the cabbage into very fine pieces using a knife. (Safety is important in any lab experiment, so ask an adult for help with this step.)
2. Microwave the cabbage mixture until the liquid boils or until steam is coming off of the cabbage.
3. Allow the cabbage to cool down.
4. Using a coffee filter, filter the liquid from the cabbage into a bowl. This should have lots of pigment/colour.
5. Soak another coffee filter in the liquid that has just been filtered and allow it to dry.
6. Cut the dry coloured paper into test strips.
7. Using a dropper or a q-tip, apply a small amount of your tap/drinking water to a test strip.



8. Repeat step 7 using a variety of different solutions found in your home (examples provided below). Record your results in the table. Note: only use solutions that are safe to handle and non-toxic to humans or the environment.

SOLUTION	ACIDIC	NEUTRAL	BASIC
Tap water			
Apple juice			
Vinegar			
Laundry detergent			

Now, consider the questions below and discuss them with family and friends:

1. Why is it dangerous to drink untested/unpurified water?
2. What kind of microorganisms can live in water that pose a threat to humans?
3. Do all Canadians have access to clean drinking water? Why would some people have access and not others?
4. Why shouldn't we drink untreated water from lakes and rivers while we're camping?
5. Can you name any diseases that are transmitted through water?
6. Water purification is costly and puts a strain on the environment. What can you do to conserve more water and ensure you are not wasting it?



To extend your learning, research and compare how water treatment practices and standards differ in other countries. Make a Venn diagram comparing water quality and access in Canada to different countries around the globe. Consider some of the following countries:

- Mozambique
- Chad
- Somalia
- Ethiopia
- Uganda
- Papua New Guinea
- Cambodia
- Mexico
- Nepal
- Haiti

### Share your learning adventure with us!

What did you learn by completing this activity? Do you have any questions? Tag [@CanGeoEdu](#) on Facebook, Twitter or Instagram and let us know using the hashtag [#OnlineClassroom!](#)

### Other ways to complete this activity:

- There are a number of other plants that produce pigments that can be used as pH indicators. Repeat the project with other common home and garden indicators such as beets, red roses or purple pansies. Which one produces the strongest result?
- Using your pH test strips, test and compare the water quality of different waterways in your area and/or collect rainwater and compare it to tap water. Which is more acidic/basic?
- Create an infographic highlighting facts on proper water sanitation or water-related diseases (more information can be found on the [World Health Organization website](#)).