

DECISIONS, DECISIONS: *Tap or Bottled Water?*



KEY CONCEPTS

- SUSTAINABILITY OF WATER RESOURCES REQUIRES CONSERVATION AND BEST MANAGEMENT PRACTICES.
- RESPONSIBILITY FOR WATER IS EVERYONE'S CONCERN.

METHOD

Students will complete a series of “blind” tests on bottled and tap water, examining taste, water properties, and other factors.

ACTIVITY INFORMATION BOX:

TIME REQUIRED: 50-60 minutes

GRADE LEVEL: Grades 8-10

KEY WORDS: *water quality, tap water, bottled water*

MATERIALS:

- bottled water samples (various brands) and tap water
- paper bags
- elastic bands
- paper cups
- student worksheets

SETTING: indoors

SKILLS: data collection, observation, analysis, interpretation

SUBJECTS: Science 8-10

LEARNING OUTCOMES:

IT IS EXPECTED THAT THE STUDENT WILL:

- List properties of bottled and tap water;
- Compare “taste test” results of various types of water;
- Report on the pros and cons of bottled and tap water.



BACKGROUND

One of the fastest growing beverage choices in North America today is bottled water. People drink bottled water for many reasons. Some people drink bottled water because they think it tastes better or they think it is safer than tap water. But which is better: tap or bottled water? What are the similarities and differences between tap water and bottled water?

Safe drinking water is essential to good health. Tap water in the Greater Victoria area can come from surface water (Sooke Reservoir) or, in some cases, wells. Water is treated in all public water supplies to ensure that it meets water quality standards. Residents of Greater Victoria enjoy some of the best drinking water in the world. Our reservoir is fed by a pristine, protected watershed, which means our water supply is naturally clean and clear, and needs little treatment. Even so, the CRD's Water Quality Division keeps a close eye on our water, collecting samples from across the Greater Victoria Drinking Water System every day for testing. The CRD Water Quality and Aquatic Ecology Laboratories run daily tests on water samples to check for everything from bacteria and algae concentrations to pH, turbidity and conductivity. Dr. Richard Stanwick, Chief Medical Health Officer, Vancouver Island Health Authority, says that there is no need to buy bottled water for health reasons since the drinking water in Greater Victoria meets all health-based water standards.

Bottled water can come from wells, springs, artesian wells, or even public water supplies. For a listing and descriptions of different types of bottled water, see the accompanying table. In Canada, bottled water is considered to be a food and is regulated by Health Canada under the Food and Drug Regulations. All bottled water must be safe for people to consume. However, just like tap water, it can vary in taste and quality. The taste and quality of both tap and bottled water depends on the source water's natural mineral content, how (or if) it is treated, and the container used when drinking. The taste of tap water versus bottled water is a very personal thing. The differences between tap water and bottled water that are noted by people are due mainly to the source water and the way the water is disinfected.

Other considerations when deciding on the pros and cons of tap water versus bottled water include: cost, environmental impacts, and bottle maintenance. The cost of bottled water is considerably more than tap water – in Greater Victoria for example, bottled water costs up to 1,000 times more than drinking water! Then there is the environmental impact of all those discarded plastic water bottles. Water bottles often end up in landfills, contributing many millions of additional tons of long-lasting materials to our ecosystem. Production of the plastics the bottles are made of also consumes many millions of litres of oil during the manufacturing process. Finally, consideration must be given to "maintenance" of water bottles. Bacteria can grow in the water once the seal has been broken in an unrefrigerated bottle of water. This can produce unwanted health risks.



DIFFERENT TYPES OF BOTTLED WATER

SPRING AND MINERAL WATER

SPRING WATER	Bottled potable water derived from an approved underground source that contains less than 500 mg/L total dissolved solids. Spring water may be treated to remove unwanted chemical and microbiological components but may not be labelled as “natural” (see below).
NATURAL SPRING WATER	Same as “spring water” and in Europe must meet the collection requirements of “natural mineral water” (as below) without any treatment to remove bacteriological components.
MINERAL WATER	Bottled potable water obtained from an approved underground source that contains 500 mg/L or more of total dissolved solids. In Europe, mineral water may be treated to remove unwanted chemical and microbiological components but may not be labelled as “natural” (see below).
NATURAL MINERAL WATER	Natural mineral water is mineral water (as defined above), but must meet the following conditions: it is collected under conditions which guarantee the original bacteriological purity; it is bottled close to the point of emergence of the source with particular hygienic precautions; it is not subjected to any treatments (other than removal of unstable constituents by decantation and/or filtration with the aid of aeration) that modify its essential mineral constituents; and it cannot be shipped in bulk.

OTHER BOTTLED WATER

ARTESIAN WATER	Bottled water from a well tapping a confined aquifer in which the water flows freely at the ground surface without pumping. It has been proposed that the collection of the water can be enhanced with the assistance of external pressure so long as such measures do not alter the physical properties, composition, and quality of the water.
BOTTLED WATER	Water that is placed in a sealed container or package and is offered for sale for human consumption or other consumer uses.
CARBONATED OR SPARKLING WATER	Bottled water containing carbon dioxide.
DISTILLED WATER	Bottled water that has been produced by a process of distillation and has an electrical conductivity of not more than 10 $\mu\text{S}/\text{cm}$ and total dissolved solids of less than 10 mg/L.
DRINKING WATER	Bottled water obtained from an approved source that has undergone special treatment or that has undergone minimum treatment consisting of filtration (activated carbon and or particulate) and ozonation or equivalent disinfection process
DEIONIZED WATER	Bottled water that has been produced through a deionization process to reduce the total dissolved solids concentration to less than 10 mg/L.
FLUORIDATED WATER	Bottled water containing added fluoride in such an amount that the total concentration of added and naturally occurring fluoride does not exceed 1 mg/L.



OTHER BOTTLED WATER (continued)	
GLACIAL WATER	Bottled water from a source that is direct from a glacier. Glacial water shall meet the requirements of natural water.
NATURAL WATER	Bottled water (such as spring, mineral, artesian or well water) obtained from an approved source that is from an underground formation and not derived from a municipal or public water supply system. This water has undergone no treatment other than physical filtration, iron removal, and that has not had any significant change occur in the total concentration of the major ions in comparison with the concentrations occurring in the approved source water.
PURIFIED WATER	Bottled water produced by distillation, deionization, reverse osmosis, or other suitable process that contains not more than 10 mg/L of total dissolved solids. Water that meets this definition and is vaporized, then condensed, may be labelled distilled water.
WELL WATER	Bottled water from a hole bored, drilled, or otherwise constructed in the ground, which taps the water of an aquifer. Well water shall meet the requirements of natural water.

Source: Health Canada <http://hc.gc.ca/>

PROCEDURE

1. Ask students whether they use the school's drinking fountains or drink bottled water. What do they think might be the pros and cons of bottled or tap water? List pros and cons on the board.
2. Tell students that they are going to research the properties of both types of water and their investigation will include a "blind" taste test.
3. Set up the blind taste test: divide students into small groups, giving each group a set of three or four bottles of water placed in labelled paper bags (sample 1, 2, etc.; use elastic bands to keep the bags closed); paper cups; and student worksheet.
4. Ask students to pour a sample from each bag into a cup and record their observations on the student worksheet.
5. After all samples have been observed and the observations have been recorded, combine the results of all groups to find out how each samples ranked compared to one another. You should have data on:
 - Taste
 - Odour
 - Visual Description
 - Rank
6. After "unveiling" the water samples, find out more about each water sample. Begin by reading the label on the water bottles and go to the CRD Water website (see Background) to find the annual report on water quality of treated water for the tap water sample. Ask students to find out:
 - What is the water's source? (Many students may be surprised that their favourite bottled water is actually from a public water supply!)
 - How is the water treated (if at all)?
 - How much calcium (Ca) and magnesium (Mg) is in the water? (These are minerals we want in our diet.)
 - How much does the bottled water costs per litre? How much does tap water cost?



7. Discuss the results. Refer to the students' initial list of pros and cons of tap versus bottled water – would students now change their lists? Which type of water is “better”?
8. Wrap up by writing on the board: “For me, healthy drinking water is...” and have students write a paragraph beginning with this statement.

EVALUATION

Have students:

1. Give examples of water characteristics such as taste, odour, cost per litre, and mineral content.
2. List the pros and cons of bottled and tap water after completing the blind taste test.

EXTENSIONS

1. Test the water samples for pH, alkalinity, and hardness using a water quality test kit (see additional resources). Graph the results.
2. Ask students to research the how the increased use of bottled water may be contributing to climate change. What happens to plastic water bottles in their community? How many metric tons of plastics are used in water bottles in Canada each year? What might be some alternatives to using plastic water bottles?

COMMUNITY CONNECTIONS

1. Find out how bottled water is delivered to homes and stores in Greater Victoria. What might be transportation costs associated with delivering bulk water – either tap or bottled?
2. Find out if water bottles are recycled in Greater Victoria and what happens to them after they leave the recycling depot. Discuss.

ADDITIONAL RESOURCES

CRD Water Services. *Refreshing Information About Drinking Water* Quality Brochure available from <http://www.crd.bc.ca/water/>

Poison Pump. Project WET Curriculum and Activity Guide, Montana State University. p.93.

Operation Water Drop. Safe Water Foundation. Water quality test kits are available for \$50-100 per kit cost recovery basis. <http://www.safewater.org>

CRD Water Quality. <http://www.crd.bc.ca/water/waterquality/reports.htm>

Test Your Knowledge of Bottled Water. Brochure from Kairos Canada.

<http://www.kairoscanada.org/e/action/waterBottledWaterBackgrounder.pdf>

Inside the Bottle: Exposing the bottled water industry (2nd edition). by Tony Clarke. Canadian Centre Policy Alternatives. <http://www.policyalternatives.ca/Reports/2007/07/InsideTheBottle/>

REFERENCES

2007 Annual Overview of Greater Victoria's Drinking Water Quality. CRD Water Services

Welcome to Water Services. CRD Water Services Website: <http://www.crd.bc.ca/water/>

Cruising Chemistry: Tap vs. Bottled Water. Duke University.

http://www.chem.duke.edu/~jds/cruise_chem/water/wattap.html

Bottled Water Basics. USEPA Water Health Series. <http://www.epa.gov/safewater/dwh/index.html>

Questions and Answers on Bottled Water. <http://www.hc.gc.ca/fn-an/> Click on bottled water



NAME:

BLOCK:

BOTTLED OR TAP: THE TEST

INSTRUCTIONS: Using the samples provided, pour a sample from each bag into a cup and record your observations on the worksheet. Provide as much detail as possible. Finally, rank the samples from 1 (best) to 4 (least favourite).

	sample 1	sample 2	sample 3	sample 4
Taste				
Odour				
Describe the Water				
Water Rank				