

Behind the Bottle: Investigating the Journey of a Bottle of Water

Overview

Tap water or bottled water: which is better for you and for the environment?

This lesson includes a set of activities that will help students think critically about the journey of a bottle of water -- from the factory where it is bottled, to our communities where it is purchased and consumed. Students will gather information about the bottled water being sold in their community and compare the price of bottled water with the price of local tap water. The accompanying student worksheets guide students in estimating the distance that bottled water from different sources has travelled to their community and how much energy was required for this transportation. Adding up the full costs of consuming bottled water will allow students to compare the ecological footprints of bottled water and tap water, and decide which is better both for themselves and for the environment.

The activities include an 8-minute video called "The Story of Bottled Water". The short film summarizes the path of a bottle of water. It also explores the role of marketing in increasing consumer demand for bottled water. The final activity encourages students to synthesize and reflect on their learning. Students will be able to present their stance once they have completed the previous activities, which focus on research and analysis.

Outcomes

Students will:

- be aware of the amount and variety of bottled water sold in their community and where it comes from;
- know the price of bottled water compared to the price of local tap water;
- Understand where bottled water comes from and how its extraction can negatively impact source waters;
- be able to calculate the distance a bottle of water has travelled to get to their community and the energy required to transport the bottle;
- appreciate the role of marketing in stimulating sales of bottled water and influencing consumer decision-making, and
- reflect on the ecological footprint of consuming bottled water and describe their personal perspectives on the environmental and health impacts of bottled water.

Materials Needed

- copy of student worksheets for each student
- map of Canada for each group
- a map of the world for the classroom
- computer with Internet and a projector (to show the film “The Story of Bottled Water”)

Suggested Approach

Introduction

- Introduce the topic of bottled water to students. Background information to help guide the discussion can be found in the information sheet "Behind the Bottle" and in the list of Additional Resources included as part of this teaching package.

Activity 1. Community Research: Investigating the bottled water that is sold in my community

- Have students (working either individually or in teams) visit a local store where bottled water is sold and complete Activity 1 of their handout.

Activity 2. Compiling the Class Data

- Using a whiteboard or blackboard, record results from the community research collected by all students.
- Students will then choose two or three types of bottled water from this list to focus on for further investigation. Help students to record the data for the bottled water types that are chosen for further study into the chart in Activity 2.

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Activity 3. Comparing different kinds of bottled water

- Lead students through the introductory paragraphs of this activity.
- Have students answer the three questions individually or in pairs.

Activity 4. How does the cost of bottled water compare to the cost of tap water?

- Have students work individually or in pairs to complete the table in Activity 4. Completing this table enables students to compare the cost of bottled water in their community with the cost of tap water.

Activity 5. How far has bottled water travelled to get to our community?

- Lead a short discussion / class reading of the introductory paragraphs for Activity 5 that explore the distance that a bottle of water has travelled to get to NWT communities.
- Following this, have students work in pairs or groups, with each pair or group focusing on one type of bottled water.

- Each pair or group will need a map of Canada, and it would also be helpful to have a world map available in the classroom.
- Students will use the map and chart of distances and common transport methods (page 8 of their handout) to estimate the distance the water bottle they are studying has travelled and predict the shipping method used. Students will record their results in columns 1-3 of the Transportation and Energy Data Sheet (on page 7 of their handout).
- In case of locations that do not appear on the distance charts provided, it may be useful to provide each group with a string and to explain to them how to trace the distance with the string, and hold the length up to the maps's scale.

Activity 6. How much energy do different modes of transportation use?

- Lead a brief class discussion about the concepts of transportation and energy use outlined in the introductory paragraphs of this section.
- Students will then apply what they have learned by calculating the amount of energy required to transport a bottle of water along the different segments of its journey from the bottling plant to their community.
- Questions and step-by-step instructions in the student handout will assist students in filling out the Transportation and Energy Data Sheet.

Activity 7. What does this all mean? Putting energy costs into perspective.

- These two questions can be answered by students individually or in pairs.
- These questions are intended to make students more aware of the energy cost of transporting bottled water.
- These questions have also been designed to provide practice in numerical problem solving.
- Answers to these questions are provided in this Teacher's Guide.

Activity 8. Who profits from the sale of bottled water?

- As a class, read through the introductory paragraphs of this section.
- Show the 8-minute film "The Story of Bottled Water" by Annie Leonard, and have students answer the reflection questions.
- The film is easily accessible on-line by visiting the website: www.storyofbottledwater.org

Activity 9. Synthesis, analysis and presentation

- Have students visit the website(s) of one or more companies that sell bottled water in Canada. Information and messaging on these websites will help students to answer the first question in this section.
- The second question is intended to guide students to synthesize and reflect on their learning about relative ecological footprints of bottled water and tap water. The question could be answered individually, or discussed in groups. If it is answered in groups, students could write their ideas down on a poster or flipchart paper and then present their ideas to the class.

Extension Activities

- Facilitate a final class discussion / journal writing activity to encourage students to describe what they learned through these activities, and if they were surprised by anything that they learned
- Lead a class discussion about the role and power of consumer decision-making: how does it affect the goods that are sold in our communities, and the quantity of waste we produce as a society? Set up a debate or panel discussion to address the topic: Should bottled water be banned? Yes or no?
- Have students present a short skit in groups, showing the journey that a bottle of water takes from the manufacturing of the bottle of water to the consumer to its disposal. The students could draw on what they learned from the “Story of Bottled Water Video” and/or their own additional research. Alternatively, students could be asked to depict this journey on a poster or represent it as a diorama.
- Set up an activity where students talk to the manager at a local store about how bottled water is purchased and the shipping methods used to transport the water to the store -- from the store manager's perspective.
- Have students design posters that compare the journeys of tap water and bottled water. These posters could be displayed in the school. Students could also design posters that encourage students to use re-usable bottles and drink from the water fountain.
- Have students research by interviewing their families, friends and/or neighbours in their communities to find out why community members do or do not choose to drink tap water and bottled water. Ask students to develop plans about how drinking tap water can be encouraged in their community, or how drinking bottled water could be discouraged.

LESSON 1

Curriculum Links

Grade 7 Science in Action

Unit A: Interactions and Ecosystems (Social and Environmental Emphasis)

Overview: Ecosystems develop and are maintained by natural processes and are affected by human action. To foster an understanding of ecosystems, this unit develops student awareness of ecosystem components and interactions, as well as natural cycles and processes of change. Building on this knowledge, students investigate human impacts and engage in studies that involve environmental monitoring and research. By reflecting on their findings, students become aware of the intended and unintended consequences of human activity, and recognize the need for responsible decision-making and action.

Focusing Questions: How do human activities affect ecosystems? What methods can we use to observe and monitor changes in ecosystems and assess the impacts of our actions?

Key Concepts

The following concepts are developed in this unit and may also be addressed in other units at other grade levels. The intended level and scope of treatment is defined by the outcomes below.

- interactions and interdependencies
- environmental monitoring
- environmental impacts
- producers, consumers, decomposers
- nutrient cycles and energy flow
- species distribution
- succession
- endangered species
- extinction
- environmental management

Grade 8 Science in Action

Unit E: Freshwater and Saltwater Systems (Social and Environmental Emphasis)

Overview: Earth is sometimes described as the water planet: over two-thirds of Earth's surface is covered by oceans and freshwater features. By exploring examples of aquatic systems, students come to appreciate the dynamic nature of these systems and learn about the interaction of landforms, sediments, water and climate. Students also investigate factors that affect the distribution and health of living things in aquatic environments and the supply and quality of water for human use.

Focusing Questions: How do water, land and climate interact? What are the characteristics of freshwater and saltwater systems, and how do they affect living things, including humans?

Key Concepts

The following concepts are developed in this unit and may also be addressed in other units at other grade levels. The intended level and scope of treatment is defined by the outcomes below.

- water quality
- water-borne materials
- erosion and deposition
- stream characteristics
- continental drainage systems
- ocean basins
- climate
- glaciers and icecaps
- adaptations to aquatic ecosystems
- human impact

Grade 8 - Math

General Outcome 4: Develop number sense

- SO-4: Demonstrate an understanding of ratio and rate.
- SO-5: Solve problems that involve rates, ratios and proportional reasoning.
- SO-6: Demonstrate an understanding of multiplying and dividing positive fractions and mixed numbers, concretely, pictorially and symbolically.

Dene Kede

The Land

- Use Dene names and show how people and animals use water in various ways.
- Field trip to local waterbody.

Listen to Elders's stories about a local waterbody

Further Resources

- *Bottled and Sold: The Story Behind Our Obsession with Bottled Water*, Peter H. Gleick, 2010. Published by Island Press, Washington D.C. 213 pages.
 - *Bottlemania: How Water Went on Sale and Why We Bought It*, Elizabeth Royte, 2008. Published by Bloomsbury, New York. 266 pages.
 - *Blue Covenant: The Global Water Crisis and the Coming Battle for the Right to Water*, Maude Barlow, 2007. Published by McClelland & Stewart. 248 pages.
 - *Blue Gold: The Battle Against Corporate Theft of the World's Water*, Maude Barlow and Tony Clarke, 2003. Published by McClelland & Stewart, Toronto. 278 pages.
 - *Clean Your Water Tank*, Health and Social Services Government of Northwest Territories. Short Video. 9.25 minutes. (included in the resource package).
 - *Eau Canada: The Future of Canada's Water*, Bakker, Karen, 2007. Published by UBC Press, Vancouver and Toronto. 417 pages.
 - *Inside the Bottle: An Exposé of the Bottled Water Industry (2nd edition)*, Tony Clarke, 2007. Published by Canadian Centre for Policy Alternatives. 216 pages.
 - *Privatizing Water: Governance Failure and the World's Urban Water Crisis*, Bakker, Karen, 2010. Published by Cornell University Press, Ithaca and London. 303 pages.
 - *Reclaiming Public Water book: Achievements, Struggles and Visions from Around the World*, Brennan, Hoedeman, Terhorst, Kishimoto, 2007. Published by Transnational Institute. 286 pages. Available on-line: <http://www.tni.org/sites/www.tni.org/archives/books/publicwater.pdf>
 - *The Story of Stuff*, Anne Leonard and Ariane Conrad, 2010. Published by Simon and Schuster. 317 pages.
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Behind the Bottle: Investigating the Journey of a Bottle of Water

Buying a bottle of water from a local store or vending machine... it seems like a simple action. Yet the journey that a bottle of water takes is long and energy intensive. From the factory where the bottle is manufactured and filled, to communities in the NWT where we buy it, to the landfill where it ultimately rests, a bottle of water contains a lot of hidden costs.

Where do the bottles of water that we purchase here in the NWT come from?

How far have they travelled and how much energy does it take to bring the bottles here?

Who profits from the sale of bottled water?

These are a few of the questions that we will be exploring as we investigate and follow the journey of a bottle of water... from where it is manufactured to the moment when we buy it in our communities.



Activity 1

Community Research: Investigating the bottled water that is sold in my community

Visit a store in your community where bottled water is sold. List the kinds of bottled water that are sold, and fill in the table for each kind of bottled water. All of this information, apart from the price, can be found by reading the label on the bottle.

Observer (Your name): _____

Date: _____

Store Name: _____

Characteristics of the bottled water sold in _____ (insert name of community)

Name of bottled water	Amount of water in bottle (L or mL)	Price (\$)	Where does the bottled water come from?	Is the water labelled as spring or mineral water?	What company bottles the water?

Notes:

- Where does the bottled water come from? For mineral or spring water, the location of the spring or source of the mineral water must be given. When bottled water has come from a municipal water system, the community where the water has come from is given.

Additional observations:

Activity 2

Compiling the Class Data

After results from each student's community research have been compiled, please choose two or three types of bottled water that you will study further as a class. Then record the data for these bottled water types in the table below.

Types of bottled water sold in _____ (name of community) that our class will investigate further.

Name of bottled water	Amount of water in bottle (L or mL)	Price (\$)	Where does the bottled water come from?	Is the water labelled as spring or mineral water?	What company bottles the water?

Were you surprised by any of this information? If so, how?

Activity 3

Comparing different kinds of bottled water

There are two types of bottled water in Canada:

- 1) “Mineral or spring water”: water that has been taken from a natural spring or other underground source that is not part of a community water supply and does not need to be treated to make it safe to drink.
- 2) Water from any other source that has been treated to make it safe to drink and then bottled. This includes tap water that has been taken from a community water supply and bottled.

According to Canadian regulations, water that has been bottled from a spring or other natural source must be clearly labelled with the location of the water source. If the bottled water you are examining does not say “spring water” or “mineral water,” then it is most likely tap water that has been taken from the community water system where it was bottled.

3a. Is the bottle of water you are investigating labelled as spring or mineral water? (Yes or No)

3b. If yes, what is the name of the spring or mineral water source?

3c. If no, what community was the water bottled in?

Activity 4

How does the cost of bottled water compare to the cost of tap water?

Bottled water is sold in bottles of various sizes. To compare the price of different kinds of bottled water with the cost of tap water, it is helpful to convert all the different kinds of water to the same unit: litres.

Note: 1000 mL = 1 litre

Please complete Table C below for the kinds of bottled water your class has chosen to investigate.

The information you need to complete the last column of the chart is found in the box Tap Water Costs in the NWT below.

Type, size and price of various types of bottled water compared to the price of tap water.

Name of bottled water	Size of bottle (L) (see calculation example on next page)	Price of bottled water	Price (\$ / litre) (see calculation example on next page)	How much more expensive is the bottled water than tap water? (see calculation examples on next page)	
				As a simple difference	As a ratio of the difference

Tap Water Costs in the NWT NWT communities provide safe, clean drinking water to residents. Communities draw water from a local waterbody, clean the water so it meets safe drinking water standards, and then transport the water to community buildings, including homes, schools and workplaces. People then turn on the tap and use the water. On average, tap water in NWT communities costs residents less than \$0.01 / litre. For these calculations, use \$0.01/litre.

Calculation Examples

Calculating the size of your bottle in litres.

Example: A small bottle of orange juice contains 150 mL and costs \$2.25. What is the cost of this bottle as dollars per litre?

First, we need to convert millilitres (mL) to litres (l). We can do this conversion knowing that there are 1000 millilitres in a litre.

$$= 150\text{mL} \div 1000 \text{ mL/L} = 0.15 \text{ litres}$$

= The bottle contains 0.15 litres of orange juice

Calculating the cost of your bottle of water as \$ per litre.

Now we need to know what the cost of this orange juice would be if we had a whole litre. We know that the cost is \$2.25 for 0.15 litre, so we can calculate how many times 0.15 litres can go into 1 litre by dividing 1 by 0.15 litres. We then multiply that number by \$2.25.

$$= (1/0.15 \text{ litre}) * \$2.25 = \$15/\text{litre} \text{ (we round up } \$14.9999\dots)$$

= The orange juice costs \$15 per litre

Calculating the differences between costs of water.

Example: A large bag of popcorn costs \$3.00 whereas a small popcorn costs \$2.00. How much more expensive is the large popcorn than the small popcorn? Calculate both the difference between the two costs and the difference between the two prices as a ratio of difference.

Simple difference between two costs

$$= \$3.00 \text{ (price of the large popcorn)} - \$2.00 \text{ (price of a small popcorn)}$$

= \$1.00 The large popcorn costs \$1.00 more than the small popcorn.

Ratio of difference

$$= \$3.00 \text{ (price of large popcorn)} / \$2.00 \text{ (price of small popcorn)}$$

= 1.5 The large popcorn is 1.5 times more expensive than the small popcorn.

Now, your turn! (Teacher response guide)

For your bottle of water:

1a) Calculate the size of your bottle of water in litres.

Note: The label probably gives a size in millilitres (mL).

Example using a standard bottle of water size of 500mL that costs \$2.00.

$$= 500mL \cdot \frac{1l}{1000ml} = \frac{500}{1000}l = 0.5l$$

The size of the bottle is 0.5 litres.

1b) Calculate the cost of your bottle of water as dollars per litre (\$/l)

$$= \frac{1}{0.5l} \cdot \$2.00 = \frac{\$2.00}{0.5l} = \$4.00/l$$

The bottled water costs \$4.00 per litre.

1c) Which is more expensive? The water in this bottle or tap water?

Use the average cost of tap water as \$0.01/litre for comparison.

How much more expensive is it? Calculate both a simple difference and a ratio of difference.

$$\text{Simple difference} = \$4.00/l - \$0.01/l = \$3.99$$

The bottled water costs \$3.99 more per litre than tap water.

$$\text{Ratio of difference} = \frac{\$4.00}{1\text{litre}} \div \frac{\$0.01}{1\text{litre}} = \frac{\$4.00}{1\text{litre}} \cdot \frac{1\text{litre}}{\$0.01} = 400$$

The bottled water is 400 times more expensive than the tap water.

1d) Now write your answers into the table provided at the beginning of Activity 4.

Activity 5

How far has bottled water travelled to get to our community?

How do you feel after having walked a long distance or played a game of basketball? Do you feel tired? Just as it takes energy to move your body when doing physical activity, it also takes energy to move objects from one place to another.

How much energy do you think it takes to move a 1-litre bottle of water from the factory where it is bottled to our home communities? How can we calculate this?

To start with, we will need to determine where a bottle of water has come from, and how far this location is from our community. Let's investigate...

Choose one of the types of bottled water that was found in your community. If there is more than one type of bottled water sold in your community, work with classmates to decide who will investigate each of the types of bottled water. At the end of the activity, share your results.

5a. Where does the bottled water you have chosen come from?

Name of bottled water type: _____

Location where bottled: _____

5b. How far has the bottled water travelled from the factory where it was filled to your community? What methods of transport were likely used to move the bottled water from the factory to your community?

This information will be recorded in **columns 1 to 3** of the Transportation and Energy Data Sheet.

Using a map of Canada and/or a map of the world, trace the path you think the bottle of water took to get to your community.

Use the distance chart on the next page and the laminated NWT communities distance chart to assist you in calculating the distance that the bottle of water has travelled and to determine the mode of transport that was most likely used to move the bottle of water during the various parts of its journey.

Notes and observations:

Distances and Common Transport Methods for Bottled Water

From	To	Approximate distance (kilometres)	Most common transport method for bottled water between these locations
<i>Within Canada</i>			
Edmonton, AB	Yellowknife	1,500	large diesel transport truck
Edmonton, AB	Hay River	1,100	large diesel transport truck
Vancouver, BC	Edmonton	1,100	large diesel transport truck
Hope, BC	Edmonton	1,000	large diesel transport truck
Cranbrook, BC	Edmonton	700	large diesel transport truck
Toronto, ON	Edmonton	3,400	Rail
Montréal, QC	Toronto, ON	500	Rail
<i>International</i>			
Evian, France (Alps)	Le Havre, France (shipping port)	700	Rail
Le Havre, France	Montréal, QC	5,500	Ship
Fiji	Vancouver, BC	9,400	Ship

Notes:

- Kawkawa Springs, British Columbia (B.C.), is near Hope, B.C
- Mississauga, Ontario, is near Toronto, Ontario

Use the table of distance between NWT communities to help calculate distances.

5c. How are goods such as bottled water usually transported to your community? Does the method of shipping depend upon the time of year?

Activity 5a

Transportation and Energy Data Sheet: (Example responses)

How far does a bottle of water travel to our community and how much energy is used to transport it?

Name of bottled water type: Evian Location where bottled: Evian, France

Column 1		Column 2	Column 3	Column 4	Column 5
Segment of the Journey		Distance (km) Activity 5	Shipping Method Activity 5	Energy used by this shipping method (J/kg * km) Activity 6	Transportation energy used for this segment of the journey (J) Activity 6
From	To				
Evian, France	Le Havre, France	700	Rail	235	164,500
Le Havre, France	Montreal, QC	5,500	Ship	432	2,376,000
Montreal, QC	Toronto, ON	500	Rail	235	117,500
Toronto, ON	Edmonton, AB	3,400	Rail	235	799,000
Edmonton, AB	Hay River, NT	1,100	Large diesel transport truck	2400	3,640,000
Hay River, NT	Trout Lake, NT	401	Winter Road	3100	1,243,100
TOTALS		11,601 km			7,340,100

5d. What is the total distance the bottled water travels between the bottling factory and your community?

The bottle of water has travelled 11,601 km from Evian, France to Trout Lake, NWT.

5e. What is the total energy used to manufacture the bottle of water and transport it to your community?

11.34 MJ of energy is used to manufacture the 1 litre bottle of water and to transport it to my community.

Activity 6

How much energy do different modes of transportation use?

Different methods of transportation require different amounts of energy to move an object from one place to another.

Energy is the ability to do work, and it is measured using the unit Joules (J). The most common forms of energy are heat, motion and electricity.

Natural Resources Canada, a department of the Canadian federal government, monitors how much energy it takes to transport goods across the country. The following table shows the amount of energy required to move an object with a mass of 1 kg (such as a 1-litre bottle of water) a distance of 1 km. The unit used to measure this is a Joule per kilogram kilometre (J / kg • km).

Energy Use by Various Transportation Methods

Transportation Method	Amount of energy (Joules) it takes this transportation method to move 1 kg a distance of 1 km (J / kg • km)
Large diesel transport truck	2,400
Medium-sized diesel transport truck	6,660
Rail	235
Ship / Barge	432
Airplane	3,100

Source: Natural Resources Canada, Office of Energy Efficiency. Freight transportation secondary energy use by energy source and transportation mode - 2007. Available at www.nrcan.gc.ca

6a. Using the table above, please fill in Column 4 of the Transportation and Energy Data Sheet

6b. How much energy is needed to transport a 1-litre bottle of water? (column 5 of the Transportation and Energy Data Sheet)

Using the information we have gathered and calculated in columns 1 - 4 on our data sheet, it is possible to calculate the amount of energy required to move a 1-litre bottle of water along each segment of its journey from the factory where it is bottled to our community.

Note: 1 litre of water has a mass of 1 kg.

Let's explore an example

How much energy is required to use a medium-sized diesel transport truck to move a 1-litre bottle of water from Behchoko to Yellowknife? (distance = approximately 100km)

The transportation energy for one segment of the journey = distance travelled \times energy used by the shipping method for this segment.

$$\begin{aligned} \text{Energy} &= 100\text{km} \cdot 1\text{kg} \cdot 6600 \frac{\text{J}}{\text{kg} \cdot \text{km}} \\ &= 100 \cdot 6600\text{J} \\ &= 660,000\text{J} \end{aligned}$$

We will find that we are using very large numbers, so we can simplify them by converting Joules to Megajoules, and rounding to two decimal places.

Energy Conversion: 1 Megajoule = 1,000 000 Joules

$$660,000\text{J} = 0.67 \text{ Megajoules (MJ)}$$

Now, your turn! Use the space provided below to calculate the energy required for each segment of your bottle of water's journey.

Teaching example: Let's look at the example of a bottle of Evian water that travels from Evian, France to Trout Lake, NWT. We can suppose that it probably travels by rail to the port in France and then by ship to Montreal. From Montreal, it can travel by rail to Edmonton through Toronto where it will be transferred to a large diesel transport truck to make its way north to Hay River. From Hay River, it could be shipped on plane or by truck, depending on the time of year but let's say that it is winter and it is brought in by road.

Segment 1

Evian, France to Le Havre, France (700km), travel by rail, uses 235 J/kg*km

$$= 700\text{km} \cdot 1\text{kg} \cdot 235\text{J}/\text{kg} \cdot \text{km}$$

$$= 164,500\text{J} = 0.16 \text{ MJ}$$

Segment 2

Le Havre, France to Montreal, QC (5,500km), travel by ship, uses 432 J/kg*km

$$=5,500\text{km} \cdot 1\text{kg} \cdot 432 \text{ J/kg} \cdot \text{km}$$

$$=2,376,000\text{J} = 2.38\text{MJ}$$

Segment 3

Montreal, QC to Toronto, ON (500km), travel by rail, uses 235 J/kg*km

$$=500\text{km} \cdot 1\text{kg} \cdot 235 \text{ J/kg} \cdot \text{km}$$

$$=117,500\text{J} = 0.12\text{MJ}$$

Segment 4

Toronto, ON to Edmonton AB (3,400km), travel by rail, uses 235 J/kg*km

$$=3,400\text{km} \cdot 1\text{kg} \cdot 235 \text{ J/kg} \cdot \text{km}$$

$$=799,000\text{J} = 0.80\text{MJ}$$

Segment 5

Edmonton AB to Hay River, NT (1,100km), travel by rail, large sized diesel truck 2400 J/kg*km

$$=1,100\text{km} \cdot 1\text{kg} \cdot 2400 \text{ J/kg} \cdot \text{km}$$

$$=2,640,000\text{J} = 2.64\text{MJ}$$

Segment 6

Hay River, NT to Trout Lake, NT (401km), travel by airplane, uses 3100 J/kg*km

$$=401\text{km} \cdot 1\text{kg} \cdot 3100 \text{ J/kg} \cdot \text{km}$$

$$=1,243,100\text{J} = 1.24\text{MJ}$$

Segment 7

Segment 8

Now, let's add the segments. Write the segment totals and the total energy required for the whole journey into the transportation and energy datasheet.

$$=0.16\text{MJ} + 2.38\text{MJ} + 0.12\text{MJ} + 0.80\text{MJ} + 2.64\text{MJ} + 1.24\text{MJ} = 7.34\text{MJ}$$

6c. What is the total amount of energy required to produce a 1-litre water bottle, fill the bottle and transport it from the factory to our community?

In **Column 5** of the Transportation and Energy Data Sheet we calculated the amount of energy required to transport a 1-litre water bottle from the factory to our community. In addition to the amount of energy required for transportation, it takes approximately 4 Megajoules (MJ) of energy to manufacture the 1-litre plastic bottle that the water is transported in.

What is the total amount of energy required to manufacture a 1-litre water bottle and transport it to our community?

$$\text{Total energy required} = \underline{7.34\text{MJ} + 4\text{MJ} = 11.34\text{MJ}}$$

Activity 7

What does this all mean?

How much energy is needed to travel these distances?

If we are not accustomed to using the unit Joules to describe our everyday energy use, it may be hard to imagine how much energy a quantity such as 4 Megajoules is.

Let's compare the energy used to manufacture and transport a 1-litre bottle of water with two other common activities that require energy: driving a car and taking a hot shower.

Use your answer in 6c to respond to the following questions:

7a. It takes approximately 3.6 MJ of energy to have a three-minute hot shower¹. This is the amount of energy required to treat the water, transport it to your home and heat it for use in the shower. How many three minute showers could you take using the same amount of energy required to manufacture your 1 litre bottle of water and transport it to your community?

Example response using the bottle of water that traveled from Evian to Trout Lake.

$$= \text{energy used} \div 3.6 \text{ MJ/shower}$$

$$= 11.34\text{MJ} \div 3.6\text{MJ/shower}$$

$$= 3.15 \text{ showers}$$

7b. A mid-sized car with moderate fuel efficiency uses approximately 0.07 L of gasoline to drive 1.0 km on the highway. 0.07L of gasoline contains about 2.4MJ of energy.

How far could such a car be driven using the energy it took to manufacture a 1-litre bottle of water and transport it to your community?

We know that for every kilometre we are using 2.4MJ of energy.

Therefore, we can divide the total amount of energy used to manufacture and transport our bottle of water by 2.4 MJ.

$$= 11.34\text{MJ} \div 2.4\text{MJ/kilometer}$$

= 4.72 km For the energy it takes to manufacture a 1 litre bottle of water and transport it to my community, we could drive a mid-sized car 4.72 km.

¹ Estimated by Natural Resources Canada (2008). What is a kilowatt hour? See www.nrcan.gc.ca for more information on energy efficiency.

Activity 8

Who profits from the sale of bottled water?

Companies that bottle and sell water make billions of dollars per year in profits. As bottled-water sales have increased rapidly in the last decade, so have profits for the water bottling companies. Why do people purchase bottled water at a price hundreds to thousands of times more expensive than tap water, when clean, safe tap water is available?

On World Water Day (March 22nd), 2010, an 8-minute film “The Story of Bottled Water” was released by Annie Leonard on the website www.storyofbottledwater.org

This film explores the journey of a bottle of water, including a focus on the companies that have used intensive marketing techniques to persuade consumers that they should purchase bottled water instead of drinking it from the tap.

After watching this film, please answer the following questions.

The Story of Bottled Water by Annie Leonard

8a. The two most popular brands of bottled water in Canada are Dasani (sold by the Coca-Cola Company) and Aquafina (sold by the Pepsi Cola Company). From what source do these two companies get the water they sell?

Both of these brands of bottled water are made by filtering and bottling municipal tap water.

8b. Why do you think people choose to purchase bottled water?

This is a question to encourage personal reflection. Potential answers may include:

- convenience
- image: it is perceived as being fashionable
- dislike the taste of local water

8c. In your opinion, what role do you think brand names such as 'Coca-Cola' or 'Pepsi', and marketing campaigns play in encouraging people to drink bottled water?

This is a question to encourage personal reflection and discussion on the topic of branding, marketing and consumer decision-making.

Activity 9

Synthesis, analysis and presentation

Companies that sell bottled water in Canada.

Nestlé Waters: <http://products.nestle.ca/en/brands/waters.aspx>

Aquafina (Pepsi-Cola Co.): www.aquafina.com

Dasani (Coca-Cola Co.): www.dasani.com

Spend a few minutes looking at each website, and answer the questions below:

9a. What are the reasons these companies give for why we should buy bottled water instead of drinking tap water?

9b. The previous activities have allowed you to compare the environmental footprint and costs of bottled water vs. tap water. Considering what you've learned, is drinking bottled water a wise use of resources? What is your personal view on this issue?

In small groups, discuss your opinions about drinking bottled water and tap water. As a group, present your views to the rest of your class.