Science 10 – lesson 3

Behind the Bottle – What's in the Bottle?

Objective: To illustrate the energetic cost of drinking bottled water.

Introduction: To get to the NWT a bottle of water must often travel thousands of kilometers. Besides the energy required for this transport, other energy is expended to create and store these bottles. As tap water quality is strictly monitored in the NWT this energy may not be of best use. The goal of this lesson is to generate awareness amongst students about the true energetic costs of bottled water.

Curriculum Connections:

Unit B – 1: existence of energy in a variety of forms; select and integrate information from various print and electronic sources or from several parts of the same source

Unit D -4: assess risks and benefits of human activity

Supplies / Materials:

- 10-15 bottles from bottled water, either brought in by students or recovered from recycling
- Calculators
- Copies of reference tables: *distance between NWT communities* and Table 1 in **resources** below or access to Google Maps; Table 2 below

SCIENCE FOCUS

Lesson Subject

Science 10

Topic

Energy Flow in Tech Systems

Location

Classroom

Length

50 mins

Hook: Show students a controversial bottled water ad. such as:

http://www.coloribus.com/adsarchive/prints/archipelago-bottled-water-3166605/. Ask students if this is truly the case (Note: if a bottle doesn't say spring or mineral water it is tap water), where energy may be being wasted in bringing it to another community (bottle manufacturing, transport, cooling, recycling). What forms of energy are involved? (Chemical, mechanical, thermal and electrical)

Intro Activity: Have students look at the bottles and determine where they came from. Ask them to make an educated guess about the modes of transport required for the bottle to make it to their community? (Rail, ship, plane, transport truck)

Main Activity:

1. Review and/or introduce the Joule. Have students hypothesize how many Joules (or Megajoules) transportation of bottled water requires.
2. Have students calculate how much energy their bottle needed for transport (1 L of water = 1 kg).
3. Either have students read the Gleik and Cooley article (Resource 3) about energy required to make water bottles or use Gleik's and Cooley's data to calculate the energy of producing bottles:
    a. Bottles weigh approx. 38 grams and lids 2 grams
    b. Resin production requires approximately 76 MJ/kg
    c. Final production (into a bottle) requires approximately 20 MJ/kg

Conclusion / Review: Were students surprised by the energy required by the process? What might make it worth it/not to use this energy?

Resources:

1.

Distances and Common Transport Methods for Bottled Water

From	To	Approximate distance (kilometres)	Most common transport method for bottled water between these locations
Within Canada			
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
International			
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

(Ecology North, 2013)

2.

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

3. Gleik, PH and Cooley, HS. 2009. Energy implications of bottled water. In: Environmental Research Letters 4:1. Online at: http://iopscience.iop.org/article/10.1088/1748-9326/4/1/014009/fulltext/;jsessionid=98982E2AFDD6B0E37F12F7C1CDB30865.c2

Extensions:

1. Have students research the energy of cooling and recycling to get a complete picture of energy costs.
2. Have students do an energy comparison for the process of bottling water to common household energy uses.
3. Have students create awareness about how much energy is required to bring bottled water to communities.