

Lesson #13

Back to the Future

Subject Areas

Social Studies, Science, Math

Student Skills

Critical thinking, reflection, sequencing, research

Developing Vocabulary

Containership, containerization, dogsled, dugout, freight, kayak, migrants, network, Northwest Passage, resilient, retrofit, snowshoe, trade route, Voyageurs

RELATED BACKGROUNDERS



**Energy
Needs**



**Energy and the
Environment**



**Taking
Action**

Students explore how the movement of goods has changed over time. They examine different means of transporting freight, which makes up 46% of transportation emissions in Canada. Students take on the task of historically sorting a set of Moving Goods Cards. In analyzing the cards, they also consider speed and pollution to weigh the sustainability of different modes of transportation. After working with the Moving Goods Cards, students also examine one of three case studies to identify transportation solutions and then create their own ideas for transporting goods. They reflect on options for the future and consider how decisions today impact the future.

Learning Objectives

- ◆ Students investigate how their food reaches them via modes of transportation.
- ◆ Students explore the pros and cons of historical, present day, and future alternatives to how we move freight.
- ◆ Students consider how to revitalize older modes of transportation in ways that could reduce our impact on the environment.
- ◆ Students envision a different future and explore sustainable ways to transport freight.

Materials You Need

- ◆ copies of the Moving Goods Cards provided at the end of this lesson
- ◆ answer keys for the Moving Goods Cards provided at the end of this lesson
- ◆ copies of three case studies from the Sustainable Transportation Case Studies: Go Fly a Kite, Building Bikes and Bearing Food, and Getting Charged About Electric.

Time Estimate

Lead In

Main Activity

Wrap Up

40 minutes

2 hours

20 minutes

3
HOURS

“Nature does not hurry, but everything is accomplished.” —Lao Tzu

Teacher Tip

You may wish to prepare the Moving Goods Cards a few days in advance. If you make colour copies and have them laminated, you will have a lasting resource.

What You Do

Lead In

40 minutes

Lead In

1. Ask students to bring in one favourite processed food snack or lunch item. Ask them to list all ingredients, and then create a mind map showing three or more steps of how three or more ingredients travelled from their source to students' homes.
2. Ask students to consider questions like:
 - ◆ *How might people have accessed their snacks or lunch in Canada 100 years ago?*
 - ◆ *How does the environmental impact of transportation differ for whole and processed foods?*
 - ◆ *How does the transportation of goods differ from personal travel?*
 - ◆ *What do you think has contributed to changing the way goods move and where they come from? [cheap fuel and trade policy have both had a large influence]*
3. Explain or discuss the differences and connections between personal travel and the travel of the goods and services we use. The impact of personal travel is direct while the impact of transporting goods and services is indirect.
4. Tell students they will explore how the transportation of goods has changed and that knowing about the movement of goods we use can help inform the choices we will make in the near future.
5. As a class, enjoy a sample of local food and ask students how they would define *local*?

Main Activity

2 hours

Main Activity

Part A—30 minutes

6. Put students into groups of three and provide each group with a complete set of the Moving Goods Cards. Tell the students they will be sorting the cards in three different ways. They will have five minutes to complete each sorting task, and they will have five minutes afterwards to make some observations. Using the information provided at the end of this lesson, review what information they will find on the cards, explain the concepts of distant versus recent past, and

Main Activity (continued)

assign roles within each group. Each group will need a timekeeper to track time; a recorder to record the final sequence; and a gatekeeper to ensure that everyone gets to participate.

7. **Sorting historically:** Ask students to organize the cards into three categories—*distant past*, *recent past* and *present*—to generally capture their historical sequence. You can ask the recorders to quickly jot down the card number sequence or to use a cell phone or digital camera to snap a picture of the cards in sequence.
8. **Sorting by speed:** Next, ask students to sort the cards according to speed by placing the cards in order from the slowest mode of transportation to the fastest.
9. **Sorting by impact:** Ask students to sort the cards again, this time by considering the amount of pollution associated with each type of transportation.
10. Encourage students to make observations and discuss their results using prompt questions:
 - ◆ How have modes of transportation changed over time?
 - ◆ Which modes are fastest? Slowest?
 - ◆ Which pollute most? Least?
11. Spend ten minutes with the class revealing the correct sequences on the board. To do so, see the answer key included at the end of this lesson. Lead a discussion with the class, using general questions:
 - ◆ What patterns did you see in the card values you explored?
 - ◆ What, if anything, surprised you about the sequences?
 - ◆ What modes have outlasted others? Do older modes still have use?
 - ◆ What do you think this says about the future of transporting goods?

Part B—1 hour and 30 minutes

12. Show students that the total emissions from shipping goods continue to rise despite more efficient modes of transportation. There are two main factors that cause emissions to rise: the increasing quantity of goods and the increasing speed at which they move. This is not a sustainable approach to transporting goods. With more efficient and less environmentally harmful technology, people around the world are finding better ways to transport goods.
13. Tell students that they are going to learn about some success stories that reduced emissions for moving goods, which will prepare them to explore their own ideas.
14. Form groups of three students and provide each group with a copy of one of these three case studies (from the Sustainable Transportation Case Studies):
 - ◆ Go Fly a Kite—Sailing Ships With Power
 - ◆ Getting Charged About Electric—Vehicles for Now and the Future
 - ◆ Building Bikes and Bearing Food—A School Where Food and Transport Meet
15. Ask the groups to identify (a) how their case study relates to moving goods, (b) what solution is suggested in the case study, and (c) what they liked about the story.

Main Activity (continued)

16. After 15 minutes, ask the class as a whole to share their insights and any other thoughts on how we move goods.
17. After debriefing, tell students that their final task is to form a design team to find or invent a way to make ONE mode of transporting goods (e.g., ship, rail, truck, zeppelin, airplane, bike) less harmful to the environment and more efficient. In their design teams, they will create a short case study of their own, using the list of solutions in Figure 1 for inspiration.
18. Ask students to use the same basic format for their case study as they found in the sample case study. Tell them to be prepared to provide a brief class presentation that includes:
 - ◆ two benefits and one challenge of moving goods this way
 - ◆ a diagram, drawing or photograph of the technology/idea/design in use
 - ◆ an explanation of how this idea is being used, or could be used, far and wide
 - ◆ what they are most proud of in their design and why
 - ◆ the advice they would give to someone trying to create a solution for this mode of transportation
19. Plan a period in the library and/or computer lab and allow at least one day out of class time for the groups to prepare their case.
20. Ask the groups to make their presentations in class during the first half of class, keeping to the requested two-to-three minute time limits, and allowing time for one or two questions from students. With groups of three, there will be eight to ten presentations of case studies if all groups present.

Wrap Up

20 minutes

Wrap Up

21. After the case study presentations, lead a class discussion to debrief the students' experiences and perspectives. Sample questions to explore include:
 - ◆ Of the designs you heard about, which ones sounded most promising? Why?
 - ◆ How do you think transportation patterns are changing now and will change in the future?
 - ◆ How do you predict our needs and wants as consumers may change as a result?
 - ◆ What is the importance of putting less demand on transported goods? (i.e., by buying less or buying locally, you conserve energy and reduce emissions).
 - ◆ How has your thinking on the transportation of goods changed from this exercise?
22. Collect the class case studies. As a class, you may wish to share your case studies in school or with GreenLearning. Contact us at info@greenlearning.ca for more information about sharing your case studies with us.

Ways to Reduce Transportation Emissions From Moving Goods	
	Avoiding Transportation
1	Reduce volume and/or weight in product design.
2	Reduce the volume and/or weight of product packaging (i.e., less containerization).
3	Concentrate products by removing some components (e.g., fruit juices).
4	Exchange data electronically rather than in print (e.g., via the internet rather than newspapers).
5	Relocate production or assembly closer to the point of consumption.
	Operations
6	Provide training in eco driving.
7	Reduce truck idling, especially overnight and at pickup/drop-off.
8	Reduce speed and generate less empty mileage (via ship, train or truck).
9	Use longer trains and double stacking containers or larger ships.
10	Minimize ship use of diesel power in ports.
11	Use collaborative transport networks.
	Technological Solutions
12	Retrofit: Add devices to remove engine emissions (e.g., diesel particulates filter).
13	Repower: Replace existing engines with new engines with lower emissions levels.
14	Refuel: Use cleaner alternative fuels (e.g., second generation biodiesel).
15	Repair/Rebuild: Better maintain engines to keep them at maximum performance.

Figure 1. Adapted from Erik van Agtmaal's "Ways of Evaluating and Mitigating CO₂ emissions in Goods Transport at Firm Level," Green Logistics Consultants Group, *Transport and Energy: The Challenge of Climate Change*, www.internationaltransportforum.org/Topics/Workshops/WS3vanAgtmaal.pdf

Adaptations & Extensions

- **See *The Story of Stuff* as a class.** Watch the movie *The Story of Stuff*, available online at www.storyofstuff.com. In twenty well-spent minutes, this animated film by Annie Leonard explores consumer society and the life cycle of material goods.
- **Collaborate on solutions.** Explore emissions reductions strategies with students at the Victoria Transportation Policy Institute: <http://www.vtpi.org/ster.pdf>.
- **Conduct life-cycle analyses.** Ask students to conduct a life-cycle analysis of a product or products that they use regularly and to focus particularly on transportation. This exercise could be tied to and would enrich the exploration of ecological footprints in EnerAction Lesson #4, *Walk a Mile in My Shoes*.
- **Teach “Living Within Earth’s Means.”** Explore students’ needs and wants using Barbara Duncan’s lesson “Living Within Earth’s Means” (see p. 140–144 in *Teaching Green—The Middle Years*, edited by Tim Grant and Gail Littlejohn, Toronto, 2004). To view the table of contents or purchase the book, visit www.greenteacher.com.
- **Design a game.** Invite students to design a game using the Moving Goods Cards (or portions of them). Ask them to devise a game that can be played with the Grade 3 class down the hall or shared at an information booth for families during a school open house. Students write out rules and present them to the class. They may make multiple copies of the cards and/or design their own to expand upon the themes.
- **Explore the benefits of local food.** Invite a local farmer to speak to the class or at an assembly on the benefits of local food. Include an opportunity for students to taste-test samples of local produce. Alternatively, arrange a field trip to a local farm or to a community garden.

Assessment Rubric

These criteria can be expanded or adapted to emphasize different aspects of the lesson. You can use the rubric to help students self-assess their participation and experience, and then pose follow-up questions to the class encouraging them to reflect further on their challenges and insights.

Knowledge and Understanding	1	2	3	4
Describe ways in which human activities and technologies alter balances and interactions in the environment.	Demonstrates limited understanding of content	Demonstrates some understanding of content	Demonstrates considerable understanding of content	Demonstrates thorough understanding of content
Thinking and Investigation	1	2	3	4
Evaluate the importance for individuals, society, the economy, and the environment of factors that should be considered in designing and building structures and devices to meet specific needs.	Uses critical/creative thinking processes, skills and strategies with limited effectiveness	Uses critical/creative thinking processes, skills, and strategies with some effectiveness	Uses critical/creative thinking processes, skills, and strategies with considerable effectiveness	Uses critical/creative thinking processes, skills, and strategies with a high degree of effectiveness
Application	1	2	3	4
Make connections within and between various contexts (e.g., past, present, and future; environmental; social; cultural).	Makes connections within and between various contexts with limited effectiveness	Makes connections within and between various contexts with some effectiveness	Makes connections within and between various contexts with considerable effectiveness	Makes connections within and between various contexts with a high degree of effectiveness

Using the Moving Goods Cards

The Task

Each Moving Goods Card profiles a mode of transportation and tells a story of how goods are moved. Each card includes an image and a number of variables for each mode of transportation. As they study the cards, students explore the transportation of goods from different perspectives. The cards are intended to stimulate thinking and to support students in identifying and exploring patterns.

Using the descriptive and visual clues provided, the cards can be sequenced by:

- ◆ **History:** The cards can be grouped into the categories *present*, *recent past* and *distant past*. Students can also attempt to sort the cards within those categories. Some cards clearly depict a time period and others are deliberately ambiguous.
- ◆ **Speed:** The cards can be sequenced from slowest to fastest or grouped into *low*, *medium* and *high speed*.
- ◆ **Pollution:** The cards can be grouped by low, medium or high levels of pollution.
- ◆ **Greenhouse gas emissions intensity:** The cards can be grouped by low, medium or high levels of greenhouse gas emissions.
- ◆ **Maximum load:** The cards can be sequenced by increasing or decreasing maximum load.

We recommend that students sequence or group the cards in three ways—by history, speed and pollution.

Card Legend

Maximum Capacity: The weight that can be carried at once (kg = kilograms). The technical term is Transportation Load Capacity.

Speed: The distance travelled in a day varies by mode. For ships, rail and airplanes, travel times of 12+ hours per day are possible and extend their daily range. For people-powered modes, travel times are shorter, reducing their daily range.

Greenhouse Gas Intensity: The greenhouse gas emissions for each kilogram transported. A large vessel can create a lot of emissions in total but if it carries a great amount, the level of emissions per item can be lowered.

Pollution: The amount of air and water pollution resulting from this mode of transportation. Pollution includes greenhouse gases, particulates (e.g., soot), as well as toxic materials that spill into water. This value indicates the typical impact a shipment of goods using this mode would have. Fossil-fuel-based modes and large-scale modes will have more overall impact.

Answer Keys

Historical Sequence

Both the date of origin for a mode of transportation and the end date of each mode (where relevant) is included in the answer key. The range in dates may create some variation in how students choose to sequence the cards. The range in their approach to the cards can serve as a useful discussion point on sustainable transportation solutions.



- 1** A steamship from Britain's White Star company arrives in New York full of goods and immigrants bound for Ontario and Quebec.



Maximum Capacity: 150,000 kg
Speed: 300 km/day
Greenhouse Gas Intensity: Medium
Pollution: High

- 2** A truck transports paper and stationary supplies from a plant in Calgary to Saskatchewan.



Maximum Capacity: 58,000 kg
Speed: 1,000 km/day
Greenhouse Gas Intensity: Medium
Pollution: High

- 3** Four horses haul a Conestoga wagon full of goods across the continent.



Maximum Capacity: 7,000 kg
Speed: 25 km/day
Greenhouse Gas Intensity: Near zero
Pollution: Near zero

- 4** A "Long John" freight bicycle delivers packages to homes and businesses in the city.



Maximum Capacity: 100 kg
Speed: 50 km/day
Greenhouse Gas Intensity: Near zero
Pollution: Near zero



5 The Skyhook airship/helicopter lifts heavy loads for construction in remote areas.



Maximum Capacity: 40,000 kg
Speed: 350 km/day
Greenhouse Gas Intensity: Low
Pollution: Low

6 Compagnie de Transport Maritime à la Voile (CTMV) charters sailing ships (e.g. the Belem) to transport fair-trade coffee, jam and wine.



Maximum Capacity: 250,000 kg
Speed: 150 km/day
Greenhouse Gas Intensity: Near Zero
Pollution: Near Zero

7 Coal-powered freight rail hauls lumber from the Pacific coast to Eastern Canada.



Maximum Capacity: 40,000 kg
Speed: 200 km/day
Greenhouse Gas Intensity: Medium
Pollution: High

8 Kwakiutl women haul gear with 23-meter long, cedar dugout, ocean-going canoes.



Maximum Capacity: 5,000 kg
Speed: 100 km/day
Greenhouse Gas Intensity: Near zero
Pollution: Near zero



9 An electric transport truck delivers school supplies.



Maximum Capacity: 4,000 kg
Speed: 150 km/day
Greenhouse Gas Intensity: Low
Pollution: Low

10 French Voyageurs near Québec travel by canoe with beaver pelts for North West Company.



Maximum Capacity: 3,000 kg
Speed: 150 km/day
Greenhouse Gas Intensity: Near zero
Pollution: Near zero

11 Diesel-powered rail transports coal from Alberta-based mines to coastal ports.



Maximum Capacity: 12,000,000 kg
Speed: 500 km/day
Greenhouse Gas Intensity: Low
Pollution: Medium

12 Inuit transport seal meat by dogsled in Northern Labrador, Nunavut.



Maximum Capacity: 100 kg
Speed: 130 km/day
Greenhouse Gas Intensity: Near zero
Pollution: Near zero



13 Time sensitive goods are delivered by a 747 cargo plane.



Maximum Capacity: 250,000 kg
Speed: 14,000 km/day
Greenhouse Gas Intensity: High
Pollution: High

14 The ZIM Djibouti container ship arrives on the West Coast from South Korea with up to 10,000 shipping containers.



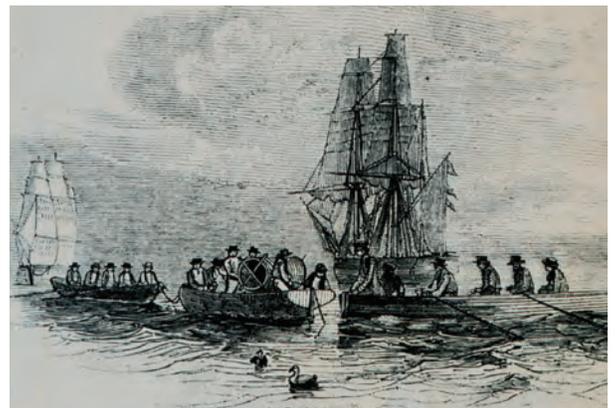
Maximum Capacity: 116,000,000 kg
Speed: 1,000 km/day
Greenhouse Gas Intensity: Low
Pollution: Medium

15 First Nations Lillooet traders travel by foot from south-central British Columbia to the interior, trading cedar and seashells for dried salmon and salmon oil.



Maximum Capacity: 40 kg
Speed: 200 km/day
Greenhouse Gas Intensity: Near zero
Pollution: Near zero

16 John Franklin's Expedition sailing ships Erebus and Terror set sail to explore the Northwest Passage.



Maximum Capacity: 30,000 kg
Speed: 200 km/day
Greenhouse Gas Intensity: Near zero
Pollution: Near zero

Answer Keys

Historical Sequence

Card	Description	Date	Until
12	Inuit dogsled	-12000	2010
8	Kwakiutl dugout canoe	1000	2010
15	Lillooet traders on foot	1000	1850
10	Voyageurs' canoe	1796	
3	Horses and wagon	1820	
16	Northwest Passage sailing ships	1845	
7	Coal-powered freight rail	1880	
1	British steamship	1900	
4	Freight bicycle	1900	2010
11	Diesel rail transport	1900	2010
2	Freight truck	1950	2010
13	Cargo plane	1970	2010
9	Electric truck transport	2000	2010
6	Sailing ship transport	2008	2010
14	Container ship	2009	2010
5	Skyhook airship/helicopter	2014	2014

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Other Card Values

Card	Description	Maximum Capacity (kg)	Speed (km/day)	GHG Intensity	Pollution
1	British steamship	150,000	300	Medium	High
2	Freight truck	58,000	1,000	Medium	High
3	Horses and wagon	7,000	25	Near zero	Near zero
4	Freight bicycle	100	50	Near zero	Near zero
5	Skyhook airship/helicopter	40,000	350	Low	Low
6	Sailing ship transport	250,000	150	Near zero	Near zero
7	Coal-powered freight rail	40,000	200	Medium	High
8	Kwakiutl dugout canoe	5,000	100	Near zero	Near zero
9	Electric truck transport	4,000	150	Low	Low
10	Voyageurs' canoe	3,000	150	Near zero	Near zero
11	Diesel rail transport	12,000,000	500	Low	Medium
12	Inuit dogsled	100	130	Near zero	Near zero
13	Cargo plane	250,000	14,000	High	High
14	Container ship	116,000,000	1,000	Low	Medium
15	Lillooet traders on foot	40	30	Near zero	Near zero
16	Northwest Passage sailing ships	30,000	200	Near zero	Low