

Food Miles and Embodied Energy: The Journey of Food from Field to Table

Grade 10 – Biology: The Sustainability of Ecosystems

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How much of the food you will eat today will be locally produced? And how much will travel hundreds, if not thousands, of miles before it is delivered to your plate?

The embodied energy of a product is the energy used throughout the product's entire life cycle, from production to disposal, including fuel for machinery used in production and transportation, energy required to make chemical pesticides and fertilizers, not to mention processing and packaging. The term "food miles" refers to the distance food travels from where it is grown to where it is ultimately purchased or consumed by the end user. The greater the food miles of a food, the less desirable that product is in terms of social and environmental sustainability. The term food miles has become part of the lingo among food system professionals when describing the farm-to-consumer pathways of food.

Our study of food will deal primarily with the aspect of transportation – the link in the food industry cycle which uses the greatest amount of energy. This transportation most often requires the use of fossil fuels, a limited energy resource that pollutes our air. As part of this activity, we will identify the environmental, social and economic benefits of buying and eating locally produced food as opposed to food grown in far away places and transported over great distances.

Your Assignment

The local Farmer's Market has hired you to design and create a display explaining to shoppers about the environmental impact of choosing foods with greater embodied energy, due to having traveled greater distances. The *promotional information* will be displayed at neighbourhood grocery stores. It should encourage customers to choose *locally grown produce* whenever possible in order to make environmentally and socially conscious consumer decisions. Share what you have learned about the energy required to transport food great distances and the impact this transportation has on the environment. Use this information to encourage the public to buy locally and seasonally. Provide examples of locally grown foods, and tips for eating local even during the winter months (i.e. storing, preserving, greenhouses etc.).

The display *will be in the form of a poster*, using a variety of visual representations of the issue (i.e. maps showing where food comes from) and

clearly stating what individuals can do to be environmentally responsible food shoppers.

Purpose Of Assignment

As well as providing you with the opportunity to learn about your own consumer choices, during the assignment, you are expected to:

- 1) Pose questions about the *ecological relationship* between humans and today's food production system.
- 2) Investigate the environmental and social issues of our current food industry model.
- 3) Examine the factors that affect the human population's ability to remain within its *carrying capacity*. Do our current food production and transportation systems exceed our carrying capacity? If the whole world lived and ate the way people do in the developed world, would there be *enough energy to meet demands*?
- 4) Use a *variety of materials*, including the internet, magazines, community resources and publications and interviews (if possible) to help you answer these questions.
- 5) Be sure to state different opinions on the issue, show how *popular views have changed* over the past fifty years, and take a side on the issue making sure to *defend your opinion*.

Evaluation

This assignment will be evaluated in three parts:

- 1) Journal Entry – individual (15 marks)
After we have had two classes discussing this topic, write a half-page journal entry about the issue of food sustainability and food miles. Include:
 - 3 things you have learned...
 - 2 things you want to find out more about...
 - & 1 thing you will make sure to communicate in your poster.
- 2) Food Miles Map - individual (35 marks)
Choose a multi-ingredient food (i.e. a fruit salad, or a hamburger) that people regularly eat, and create a visual representation of where component ingredients (at least four) have been transported from. You will be provided with an outline world map for this assignment.
- 3) Farmer's Market Poster – with a partner (50 marks – *See rubric attached*).
Will also include self and peer-assessment after presentation.

Teacher Information

Potential Cross-Curricular Links:

Listed below, are curriculum expectations that are associated with this culminating activity. These, however, are only the ones in the Science curriculum (Grade 10, Academic and Applied). Ideally, this culminating activity would be carried out in conjunction with two other courses at this grade level. There are obvious connections to the Grade 9/10 Food and Nutrition course, where students learn about the Canadian food industry, seasonal foods, and consumer food choices. Also, in the Grade 9 Geography course, issues of regional diversity, sustainable resource use and Canada's global connections are discussed. With this in mind, the chosen activity does reflect humans as members of an ecosystem and the impact we are having due to the patterns of our food consumption, and therefore fits the following curriculum expectations of the Biology component of Grade 10 Science.

Curriculum Expectations Addressed:

Science, Grade 10, Academic (SNC2D)

Biology: The Sustainability of Ecosystems

Understanding Basic Concepts

- Examine the factors (natural and external) that affect the survival and equilibrium of populations in an ecosystem (e.g., resource limits of an ecosystem);

Developing Skills of Inquiry and Communication

Through investigations and applications of basic concepts:

- Formulate scientific questions about observed ecological relationships, ideas, problems, and issues
- Select and integrate information from various sources, including electronic and print resources, community resources, and personally collected data, to answer the questions chosen;
- Relating science to technology, society, and the environment
- Identify and research a local issue involving an ecosystem; propose a course of action, taking into account human and environmental needs; and defend their position in oral or written form;
- explain changes in popular views about the sustainability of ecosystems and humans' responsibility in preserving them.

Science, Grade 10, Applied (SNC2P)

Biology: Ecosystems and Human Activity

- Relate issues to environmental sustainability with a particular focus on issues in Ontario and Canada.

Understanding Basic Concepts

- Show the relationship between the resources available and the equilibrium of a natural population in an ecosystem;

Developing Skills of Inquiry and Communication

Through investigations and applications of basic concepts:

- Identify a current local concern or issue involving an ecosystem
- Select and integrate information from various sources, including electronic, print, and community resources, to answer the questions chosen;
- Analyse the data and information gathered to clarify aspects of the concern or issue (e.g., Identify costs and benefits from a social, cultural, and/or environmental perspective; predict the consequences of action or inaction; propose possible solutions);
- Communicate the results of the investigation using a variety of oral, written, and graphic formats (e.g., Write a letter to the mayor or organize a public debate);

Relating Science to Technology, Society, and the Environment

- Assess the impact of technological change on an ecosystem.

Implementation Plan:

The discussion of food miles and the local food movement could take 2 weeks, three classes (50 minutes each) per week.

Potential for Extensions

This activity and unit lends itself well to extensions (especially in the fall season). A field trip to a local farmers' market could provide opportunities to meet food producers and sample local, seasonal foods. Similarly, students could learn to prepare seasonal, local foods or culturally significant foods of Canadian First Nations people and host a celebratory autumn harvest feast.

Assessment of the Process

Journal Entry:

After Day 2 class, write one page journal entry:

- 3 things I have learned...
- 2 things I want to find out more about...
- 1 thing I will make sure to communicate in my poster

	Lesson / Activity	Assessment
DAY 1	Introduction of topic: - Where has the food we've eaten today come from? - What foods grow seasonally in Ontario? - How would our diet be different if we ate only what grows in Ontario? - Why can't we grow all the foods we eat in Canada? * Introduce culminating task (poster)	
DAY 2	Environmental perspective - Fossil fuels used in transportation - Climate change and pollution that result - Links between organic and local food movements	<i>Journal Entry</i>
DAY 3	Social & Economic Perspective - Fair trade, developing local economies - Exports and cash crops in developing countries that struggle to meet their own food needs - Food security Seasonal eating in Ontario	
DAY 4	Tracking a food item (i.e. yogurt) - Identify main ingredients and source countries (Suggestion: Brainstorm as a class some foods that could be chosen and the source countries for some of the main ingredients.)	<i>Food Miles Map</i>
DAY 5	- Detailed discussion of poster project - Brainstorm as a class what information will be on the poster. - Class time to work on poster with partner	
DAY 6	- Campaigning in other classrooms (short presentations as if at grocery store). - Hand-in poster after presentation	Self- and Peer-Assessment of Presentation <i>Rubric for poster</i>

JOURNAL ENTRY EVALUATION

Student Name: _____

Complete → 1 2 3 4 5

Insightful → 1 2 3 4 5

Sets goals for poster → 1 2 3 4 5

Total: /15

Food Miles Map:

Students choose a common multi-ingredient food (fruit salad, hamburger) and create a visual representation of where component ingredients (at least four) have been transported from. Not only does this activity require students to find out the distances items and ingredients have traveled from their site of production, but also to consider all the component parts and steps in production of a simple product.

For example:

Yogurt requires:

- o **Strawberries** – grown in California, transported to factory in Mississauga, Ont.
- o **Yogurt Culture** – processed in Quebec, transported to factory in Mississauga, Ont.
- o **Milk** – milked from dairy cows in Quebec, pasteurized, transported to factory
- o **Sugar** – grown in Jamaica, processed, transported to factory
- o **Plastic Container** – made in plastics factory, transported to yogurt factory
- o **Aluminum Cover/Lid** – mined aluminum, foil made, transported to factory

Provide an outline world map.

Background Information:

Local food (also known as *regional food*) is based on a principle of sustainability placing a priority on consumption of food products that are locally grown as opposed to food products grown great distances away. It is part of the concept of local purchasing, a preference to buy locally produced goods and services.

The concept is often related to the slogan “Think globally, act locally”, common in environmentalism and sustainable economics. Those supporting development of a local food economy consider that since food is needed by everyone, everywhere, everyday, it would only require a small change in the way it is produced and marketed in order to have a great effect on health, the ecosystem and preservation of cultural diversity. It is argued that shopping decisions favoring local food consumption directly affect the well-being of people, improve local economies and may be ecologically more sustainable.

In general, local food is in opposition to the ideas of global free trade. Critics argue that by convincing consumers in developed nations not to buy food produced in the third world, the local food movement damages the economy of third world nations, which often rely heavily on food exports and cash crops. The response to this would be that third world nations’ dependence on cash crops and exports is a major cause of food insecurity and hunger in those nations.

Critics also say that local food tends to be more expensive to the consumer than regular food and could never provide the variety of foods currently available (such as having summer vegetables available in winter, or having kinds of food available which can not be locally produced due to soil or climate conditions). However, proponents indicate that the lower price of regular food (which is sometimes called *cheap food*) is often due to a variety of governmental subsidies, including direct ones such as price supports, direct payments or tax breaks, and indirect ones such as subsidies for trucking via road infrastructure investment, and often does not take into account the true cost of the product (in terms of environmental and social costs). They further indicate that buying local food does not necessarily mean giving up all food coming from distant eco-regions, but rather favoring local foods when available. Encourage students to imagine what an entirely local diet would look like here in Ontario. Significant lifestyle changes and attention to food preservation and preparation would be required, as it was in the past.

Transport distance

A goal of a local food system might be to minimize food transport distance, known as *food miles*. A consumer report published in 2003 by The Guardian newspaper in the UK found that a selection of 20 fresh food items purchased from British supermarkets had traveled an average of 5,000 miles each; in North America, an average fresh food transport distance of 1,000-1,500 miles is often cited.

Food quality

Locally grown fresh food can be consumed almost immediately after harvest, so it may be sold fresher and usually riper (e.g. picked at peak maturity, as it would be from a home garden). Also, the need for chemical preservatives and irradiation to artificially extend shelf-life can be reduced or eliminated.

Sustainable Farming

A major potential effect of local food systems is to encourage multiple cropping, i.e., growing multiple species and a wide variety of crops at the same time and same place, as opposed to the prevalent commercial practice of large-scale, single-crop monoculture.

With a higher demand for a variety of agricultural products, farmers are more likely to diversify their production, thereby making it easier to farm in a sustainable way. For example, winter intercropping (e.g. coverage of leguminous crops during winter) and crop rotation may reduce pest pressure, and so the use of pesticides. Also, in an animal/crop multi-culture system, the on-farm by-

products like manure and crop residues may be used to replace chemical fertilizers, while on-farm produced silage and leguminous crops may feed the cattle instead of imported soya. Manure and residues being considered as by-products rather than waste, will have reduced effects on the environment, and reduction in soya import is likely to be economically appealing for the farmer, as well as more secure (because of a decrease of market dependence on outside inputs).

Local Economies

Local food production would seem to strengthen local economies by protecting small farms, local jobs, and local shops, thereby increasing food security.

One example of an effort in this direction is community-supported agriculture (CSA), where consumers purchase advance shares in a local farmer's annual production, and pick up their shares, usually weekly, from communal distribution points. In effect, CSA members become active participants in local farming, by providing up-front cash to finance seasonal expenses, sharing in the risks and rewards of the growing conditions, and taking part in the distribution system. Some CSA set-ups require members to contribute a certain amount of labor, in a form of cooperative venture.

Particularly in the developed nations, the move away from local food to agribusiness over the last 100 years has had a profound socioeconomic

effect, by redistributing populations into urban areas, and concentrating ownership of land and capital. In addition, the traditional farming skill set, which by necessity included a diverse range of knowledge and abilities required to manage a farm, has given way to new generations of specialists. When farming for local consumption was a cornerstone of local economies, the farmer was an integral, leading member of the community, a far different position from today. Support for local food is seen by some as a way to rediscover valuable community structures, values and perspectives. Discuss with students the decreasing percentage of Canadians who are employed in the agriculture industry.

Extra Resources:

- **Agriculture and Food Issues**
FarmIssues.com is a gateway to information on the web about farming and food. Play games, give your opinion on issues or search for pictures of your favourite farm animals. A totally interactive, informative and fun site for students & teachers to get the facts (and give them) on complex agricultural issues:
www.farmissues.com
- **All About Food: Agri-Food Facts**
Free document published by Ontario Agri-Food Order from OAFE (Ontario Agri-Food Education): www.oafe.org
- **The Food Safety Network (FSN)** at the University of Guelph provides research, commentary, policy evaluation and public information on food safety issues: <http://www.foodsafetynetwork.ca/en/>
- **Environmental Literacy Council Website:** <http://www.enviroliteracy.org/article.php/409.html>
- **Agropolis Museum Website:** <http://museum.agropolis.fr/english/index.html>

Excerpts from:

The Food Miles Report: the dangers of long-distance food transport, published by the SAFE Alliance, 38 Ebury Street, London SW1W 0LJ, October 1994. Available on-line: <http://www.mcspotlight.org/media/reports/foodmiles.html>

“Food production, distribution and consumption patterns have undergone a major transformation over the past 50 years. Retailers have continued to develop ever more extensive and sophisticated outlets and distribution systems and import an increasing volume of produce. Consumers have become used to convenient, comfortable shopping facilities, and a large range of quality produce.

“But the vast distances that food travels

FOOD MILES MAP

Student Name: _____

Title and labels..... / 3

Neatly coloured, attractive / 3

Clear routes of transport..... / 5

Accurate / well-researched..... / 8

Appropriate choice of food item..... / 8

Choice of four most significant ingredients..... / 8

Total: / 35

Rubric for Poster

Criteria	Level 1	Level 2	Level 3	Level 4
Evidence of understanding ecosystem resources and embodied energy.	- shows understanding of a few basic concepts - explanations show limited understanding and significant misconceptions	- shows understanding of some basic concepts - explanations show partial understanding and minor misconceptions	- shows understanding of most basic concepts - explanations show nearly complete understanding and no significant misconceptions	- shows understanding of all basic concepts - explanations show complete understanding and no misconceptions
Inquiry, questioning, and applying research skills.	- rarely applies research and questioning skills - gathers information from 1-2 sources	- sometimes applies research and questioning skills - gathers information from 3 sources	- often applies research and questioning skills - gathers information from 4-5 sources	- consistently applies research and questioning skills - gathers info from more than 5 sources
Communication of what has been learned to general public.	- communicates with little clarity, precision and conviction - rarely uses appropriate terms (embodied energy, reducing impact, life cycle)	- communicates with some clarity, precision and conviction - sometimes uses appropriate terms (embodied energy, reducing impact, life cycle)	- generally communicates with clarity, precision and conviction - usually uses appropriate terms (embodied energy, reducing impact, life cycle)	- consistently communicates with clarity, precision and conviction - consistently uses appropriate terms (embodied energy, reducing impact, life cycle)
Connection to community	- shows little understanding of connections between science and technology and the world outside the school	- shows some understanding of connections between science and technology and the world outside the school	- shows good understanding of connections between science and technology and the world outside the school	- shows thorough understanding of connections between science and technology and the world outside the school (social & environmental impacts)

Poster is worth 50 marks:

Level 1 = 0-15

Level 2 = 15-30

Level 3 = 30-45

Level 4 = 45-50

'from plough to plate' makes it vulnerable to oil supply, inefficient on a per calorie basis, and unsustainable in the long run. Combined with fair trade systems, many of these problems can be overcome by developing regional and local food systems that highlight and use local produce.

"Ten litres of orange juice needs a litre of diesel fuel for processing and transport, and 220 litres of water for irrigation and washing the fruit. The water may be a renewable resource, but the fuel is not only irreplaceable but is a pollutant, too.

"The problem is that fossil fuels, such as petrol and diesel are remarkably cheap. The price of the fuel itself does not reflect the cost of providing the roads on which the vehicles travel. Nor does it reflect the cost of the environmental damage that burning fossil fuel creates. Nor the cost of developing alternatives when the oil wells run dry. All these costs will have to be paid for sooner or later, but they are not added to the price of the food. If they were we might think very differently about whether we wanted to pay the true price for fresh lettuces from California, strawberries from Israel, and flowers from Kenya."

Self-Assessment

(to be completed after poster presentation)

While working on this assignment, I was proud of myself when...

Next time I work on a group assignment I will try to do a better job of...

Name: _____

Peer-Assessment

(to be completed after poster presentation)

While working on this assignment, my partner did a great job of...

One thing my partner could improve for next time would be...

Name: _____ Partner's Name: _____

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