Energy Audit

Food Miles and How We Eat

The distance that food travels from where it is grown and processed to where we buy it has an impact on our environment largely because of the greenhouse gas emissions involved in the transportation. This audit provides options for how to assess food choices, and includes calculations for the different ways that food travels to our stores.

Option 1: 10 Things I Buy Each Week

Create and agree on a set grocery list of 10 food items that each student in the audit will research/buy, or does buy on a regular basis. Ideally you want to include items that are consumed in your homes each week. Pick individual food items like carrots, yogurt, chicken, frozen juice, etc. rather than categories like meat or fruit. For this option, the **pre audit** will involve finding out where the items come from, how they travel, and recording the number of kilometers each travels to the grocery store. Based on the weight of the items you are buying each week, you can calculate the greenhouse gas emissions related to the travel. **The action will be to try and find similar or reasonable substitutes locally, and set a reasonable goal for students to choose those items instead.** The **post audit** will be to calculate the difference in greenhouse gas emissions between the pre audit food items and those that don't travel as far.

Option 2: Our Favourite Meal

As a group, agree on a complete meal you like, and list all ingredients separately. For example, bacon and eggs with toast, and fruit sauce in a cup. The **pre audit** will involve finding out where the items come from, and recording the number of kilometers each travels to the grocery store. Based on the weight of the items in the meal, you can calculate the greenhouse gas emissions related to the travel. **Your action would be to try and make the favourite meal more sustainable in as many ways as possible. I.e. where the individual food items come from, and how each is grown or made.** The **post audit** will be to calculate greenhouse gas reductions from the changes to the meal.

Option 3: Change it Up – Food Substitutions

Choose some food items or meals that you plan to substitute with other items or meals. For example, having a meal based around lentils instead of hamburger, or making homemade fruit sauce instead of buying fruit sauce in a cup. The **pre audit** will involve finding out where the items come from, and recording the number of kilometers each travels to the grocery store. Based on the weight of the items in the meal, you can calculate the greenhouse gas emissions related to the travel.

As well, how the food is grown or processed contributes to the greenhouse gas emissions. This website includes greenhouse gas emission comparisons for common proteins and vegetables. http://www.ewg.org/meateatersguide/a-meat-eaters-guide-to-climate-change-health-what-you-eat-matters/climate-and-environmental-impacts/ **Your action would be to set reasonable goals for meal substitutions with local, less resource intensive production, more sustainable methods of food production or reduced packaging.** The **post audit** will be to calculate the difference in greenhouse gas emissions between meals made before and after food substitutions.

Option 4: Good Food Box Comparison

For this audit, start by getting the Good Food Box (GFB), either the Sunshine box, Basic or Regular box every two weeks for the period of your project. (Cost approx $20 - $30 each box) Make use of the food in a variety of ways, by testing recipes, preparing shared school meals, or by distributing the food to students. Compare items in the GFB with similar items from grocery stores. Compare for cost as well as for food miles. For the **pre audit**, create a chart to keep track of where the grocery store foods come from, and calculate the greenhouse gas emissions related to the travel. Do the same, for the GFB items and their emissions. **Your action would be to have as many students and families as possible find alternative ways to bring local foods into their diet on a regular basis, such as by getting the GFB.** The **post audit** will be to calculate the difference in greenhouse gas emissions between the foods purchased from grocery stores and the foods in the GFB. As more families get the GFB, more greenhouse gas emissions will be reduced.

Calculating Greenhouse Gas Emissions

Use the forms below to calculate the greenhouse gas emissions from travel by comparing food that travels by truck, rail, ship, or by air. Each vehicle produces different amounts of carbon dioxide emissions because of the energy needed to run it, and how much it can carry. This is called an **emissions factor** and it is the amount of carbon dioxide emitted from each kind of transport per tonne of food, for each kilometer it travels.

Use your best guess for how the food has traveled to your store, research how foods travel, or ask someone in the store if they can help you:

- If it is grown in North America, it will likely be coming by truck, or rail;
- If it is hardy, and comes from outside of North America, it will travel by ship;
- If it is perishable and delicate, and comes from outside of North America, it will likely arrive by airplane.

- Use the emission factor that fits the method of travel to make your calculation.
  Truck 0.18 $kgCO_{2e}$/tonne.km
  Air 0.68 $kgCO_{2e}$/tonne.km
  Rail 0.018 $kgCO_{2e}$/tonne.km
  Ship 0.014 $kgCO_{2e}$/tonne.km

Source: Christopher Weber and Scott Matthews. Food-Miles and the Relative Climate Impacts of Food Choices in the United States. Environmental Science and Technology. 2008, 42 (10) pp 3508-3513. Accessed on-line 14 Jan 2016.

- Extension: some foods travel in more than one way to where we buy them For example, bananas may travel by ship from South America and then by rail and truck to stores in Saskatchewan. To calculate greenhouse gas emissions in more detail, estimate the distance the food travels by each method from where it was grown, to where it was purchased.

Pre Campaign Audit
For any of the above options, create a form, or use one of the forms below, that includes:

- food items
- date or week of food purchase
- weight of each quantity of food
- where food comes from/is grown (distance traveled to the store in kilometers)
- how it traveled – by truck, rail, ship or air

Each student keeps track of his or her own food items. As a group, combine the information onto one form in order to calculate greenhouse gas emissions from travel. If students won't be doing the calculations themselves, they can use the simpler FORM A and FORM B. If they will be doing the calculations, use FORM C and FORM D.

Mid Campaign Audit (optional, helps to see how things are going)
During the action period, record the same information as for the pre audit, on each food purchasing date. This data will show if students are changing purchasing behaviour to reduce food miles, and give some information about how to promote more change.

Post Campaign Audit
After the action period, have students record the same information as for the pre audit, to see if they have successfully reduced greenhouse gas emissions related to changes they have made to the foods they buy.

Curriculum Connections

Grade 4 Social Studies RW4.2 Investigate the importance of agriculture to the economy and culture of Saskatchewan. **Health Education AP4.1** Design and apply, with guidance, two four-day action plans that require communication related to healthy eating and physical activity, prevention/management of health challenges, negotiating disagreements, safety and protection, personal identity, and stressors.
Grade 5 Science HB5.1 Analyze personal and societal requirements for, and impacts of, maintaining a healthy body. **Health Education USC5.1** Analyze personal eating practices.**AP5.1** Design and implement, with guidance, two five-day action plans that embrace health opportunities or address health challenges related to personal eating practices, changes of puberty, impact of illness/disease, identity and well-being, violence, peer pressure, and self-regulation. **Grade 5 Mathematics: Outcome N5.2**Analyze models of, develop strategies for, and carry out multiplication of whole numbers.**N5.3** Demonstrate, with and without concrete materials, an understanding of division (3-digit by 1-digit) and interpret remainders to solve problems.**N5.6** Demonstrate understanding of decimals to thousandths**P5.2** Write, solve, and verify solutions of single-variable, one-step equations with whole number coefficients and whole number solutions.**SP5.1** Differentiate between first-hand and second-hand data.**SP5.2** Construct and interpret double bar graphs to draw conclusions.
Grade 6 Social Studies RW6.2 **Contribute to initiating and guiding change in local and global communities regarding environmental, social, and economic sustainability.** **Mathematics: Outcome: N6.3** Demonstrate understanding of the order of operations on whole numbers (excluding exponents) with and without technology. **N6.4** Extend understanding of multiplication and division to decimals (1-digit whole number multipliers and 1-digit natural number divisors). **P6.1** Extend understanding of patterns and relationships in tables of values and graphs. **SP6.1** Extend understanding of data analysis to include: line graphs; graphs of discrete data; data collection through questionnaires, experiments, databases, and electronic media; interpolation and extrapolation.
Grade 7 Social Studies RW7.3 Assess the ecological stewardship of economies of Canada and the circumpolar and Pacific Rim countries. Health Education DM7.8 Examine and demonstrate personal commitment in making health decisions related to blood-borne pathogen information, safety practices, harmonious relationships, food choices, interpersonal skills, and morality.DM7.9 Examine health opportunities and challenges to establish personal commitment goal statements related to blood-borne pathogen information, safety practices, harmonious relationships, food choices, interpersonal skills, and morality.AP7.10 Design, implement, and evaluate three six-day action plans that demonstrate personal commitment to responsible health action related to blood-borne pathogen information, safety practices, harmonious relationships, food choices, interpersonal skills, and morality. **Grade 7 Mathematics: Outcome: N7.2** Expand and demonstrate understanding of the addition, subtraction, multiplication, and division of decimals to greater numbers of decimal places, and the order of operations. **SP7.1** Demonstrate an understanding of the measures of central tendency and range for sets of data.**SP7.2** Demonstrate an understanding of circle graphs.

Curriculum Connections

Grade 8 Social Studies RW8.1 Analyze the social and environmental consequences of living in the Canadian mixed market economy based on consumerism. **RW8.2** Assess the implications of personal consumer choices.
Health Education USC8.6 Examine and assess the concept of sustainability from many perspectives, and develop an understanding of its implications for the well-being of self, others, and the environment.AP8.10 Design, implement, and evaluate three seven-day action plans that establish multiple supports for responsible health action related to family roles and responsibilities, non-curable infections/diseases, violence and abuse, body image, sustainability, and sexual health.
Mathematics: Outcome: N8.5 Demonstrate understanding of multiplication and division of integers concretely, pictorially, and symbolically.
SP8.1 Analyze the modes of displaying data and the reasonableness of conclusions.

Audit Forms A, B, C and D – example forms and blank forms included below

For each food item purchase date, including the pre audit, mid campaign audit (optional), and post audit, each student fills out a form with their foods, then data for all students is added to a Master list for calculations.

Emission factors (Column G): Each vehicle produces different amounts of carbon dioxide emissions because of the energy needed to run it, and how much it can carry. Emissions factors are the amounts of carbon dioxide emitted from each kind of transport per tonne of food, for each kilometer it travels.

Truck	0.18	$kgCO_{2e}$/tonne.km
Rail	0.018	$kgCO_{2e}$/tonne.km
Air	0.68	$kgCO_{2e}$/tonne.km
Ship	0.014	$kgCO_{2e}$/tonne.km

Source: Christopher Weber and Scott Matthews. Food-Miles and the Relative Climate Impacts of Food Choices in the United States. Environmental Science and Technology. 2008, 42 (10) pp 3508-3513. Accessed on-line 14 Jan 2016.

Explanation of Chart Abbreviations and Calculations

Information you have	Abbreviation	How you read it
Mass (weight of food item)	kg	Kilogram
Distance traveled (from where food is grown to where we buy it)	km	Kilometers
Mass x Distance: kg x km=	kg.km	Kilogram.kilometers
Converting kg to tonnes: 1000kg = 1 tonne. Mostly because food doesn't travel one kilogram at a time, it comes in large containers of 1 tonne or more.	kg.km ÷ 1000 = tonne.km	Kilograms per kilometer divided by 1000 equals tonnes per kilometer
Carbon dioxide emissions	CO_{2e}	Carbon dioxide equivalent emissions (the small $_e$ means equivalent because there are other greenhouse gas emissions that have been converted to amounts "equivalent to" the warming potential of carbon dioxide
Emissions Factors: Each vehicle produces different amounts of carbon dioxide emissions because of the energy needed to run it, and how much it can carry. A truck can't carry much but it doesn't use nearly as much fuel as an airplane. Ships use a lot of fuel but they can carry huge amounts of food (think of all the shipping containers you see stacked on a ship). Emissions factors are the amounts of carbon dioxide emitted from each kind of transport per tonne of food, for each kilometer it travels. **Truck 0.18** $kgCO_{2e}$/tonne.km **Rail 0.018** $kgCO_{2e}$/tonne.km **Air 0.68** $kgCO_{2e}$/tonne.km **Ship 0.014** $kgCO_{2e}$/tonne.km	$kgCO_{2e}$/ tonne.km	Kilograms of carbon dioxide, emitted per tonne of mass, per kilometer travelled

Calculating carbon dioxide emissions of food: Use the emissions factor of the vehicle that brought it from where it was grown to where we bought it. Multiply that by the tonne.km of the food you bought. Because the emissions factor and the food item are both recorded in tonne.km, they cancel each other out, and your answer is recorded as $kgCO_{2e}$	Eg truck $0.18kgCO_{2e}$ /tonne.km x tonne.km = $kgCO_{2e}$	

Individual Student FORM A example– No Calculations

Date of Food Purchase – Jan 25-29 **Student –** Angie

Food Item	**Total mass (kg)**	**Where did it come from?/ What distance did it travel?/ How did it travel (truck, ship, air)?**
A	**C**	**D**
1.carrots	0.2 kg	California /3000km/truck
2.hamburger	1 kg	Alberta/600km/truck
3.bananas	1.5kg	Equador/6600km/ship
4.blackberries	0.2kg	Chile/10,500km/air
5.rice		
6.potatoes		
7.		
8.		
9.		
10.		

Individual Student FORM A – No Calculations

Date of Food Purchase – **Student –**

Food Item	**Total mass (kg)**	**Where did it come from?/ What distance did it travel?/ How did it travel (truck, ship, air)?**
A	**C**	**D**
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Master List FORM B example – No calculations - One page per food item

Food Item	Person	Total mass (kg)	Where did it come from?/ What distance did it travel?/ How did it travel (truck, ship, air)?
A	B	C	D
1. carrots	Angie	0.2 kg	California/ 3000km/truck
	Pam	1 kg	Rosetown/ 150km/truck
	Joe	5 kg	Washington/ 1500km/truck

Master List FORM B – No calculations - One page per food item

Food Item	Person	Total mass (kg)	Where did it come from?/ What distance did it travel?/ How did it travel (truck, ship, air)?
A	B	C	D

Individual Student FORM C example – Calculations

Date of Food Purchase – Jan 25-29 **Student –** Angie

Food Item	**Total mass (kg)**	**Where did it come from?/ What distance did it travel?/ How did it travel (truck, rail, ship, air)?**	**Mass (kg) x Distance Traveled (km)**	**Convert to tonnes x km Divide by 1000**	**$KgCO_{2e}$ = tonne.km x emission factor**
A	**C**	**D**	**E**	**F**	**G**
			= C x D	**= E/1000**	**=F x emission factor**
1.carrots	0.2 kg	California/3000km/truck	=0.2kg x 3000km =600 kg.km	= 600 kg.km ÷ 1000 kg/tonne =0.6 tonne.km	=0.6 tonne.km x 0.18 $kgCO_{2e}$/tonne.km = 0.108 $kgCO_{2e}$
2.hamburger	1 kg	Alberta/600km/truck	=600 kg.km	=0.6 tonne.km	=0.108 $kgCO_{2e}$
3.bananas	1.5kg	Equador/6600km/ship	=9900 kg.km	=9.9 tonne.km	=0.138 $kgCO_{2e}$
4.blackberries	0.2kg	Chile/10,500km/air	=2100 kg.km	=2.1 tonne.km	=1.42 $kgCO_{2e}$
Total					Total $kgCO_{2e}$ =0.108 + 0.108 + 0.138 +1.42 = 1.77$kgCO_{2e}$

Individual Student FORM C – Calculations

Date of Food Purchase – **Student –**

Food Item	Total mass (kg)	Where did it come from?/ What distance did it travel?/ How did it travel (truck, rail, ship, air)?	Mass (kg) x Distance Traveled (km)	Convert to tonnes x km Divide by 1000	$KgCO_{2e}$ = tonne.km x emission factor
A	C	D	E	F	G
			= C x D	= E/1000	=F x emission factor
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
Total					

Master List FORM D example – Calculations - One page per food item

Food Item	**Person**	**Total mass (kg)**	**Where did it come from?/ What distance did it travel?/ How did it travel (truck, rail, ship, air)?**	**Mass (kg) times Distance Traveled (km)**	**Convert to tonnes x km Divide by 1000**	**$KgCO_{2e}$ = tonne.km x emission factor**
A	**B**	**C**	**D**	**E**	**F**	**G**
				= C x D	**= E/1000**	**=F x emission factor**
1.carrots	Angie	0.2 kg	California /3000km/truck	=0.2kg x 3000km =600 kg.km	= 600 kg.km ÷ 1000 kg/tonne =0.6 tonne.km	=0.6 tonne.km x 0.18 $kgCO_{2e}$/tonne.km = 0.108 $kgCO_{2e}$
	Pam	1 kg	Rosetown /150km/truck	=150 kg.km	=0.15 tonne.km	=0.027 $kgCO_{2e}$
	Joe	5kg	Washington /1500km/truck	=7500 kg.km	=7.5 tonne.km	=1.35 $kgCO_{2e}$
Total						Total $kgCO_{2e}$ =0.108 + 0.027 + 1.35 = 1.48$kgCO_{2e}$

Master List FORM D – Calculations - One page per food item

Food Item	Person	Total mass (kg)	Where did it come from?/ What distance did it travel?/ How did it travel (truck, rail, ship, air)?	Mass (kg) times Distance Traveled (km)	Convert to tonnes x km Divide by 1000	$KgCO_{2e}$ = tonne.km x emission factor
A	B	C	D	E	F	G
1.				= C x D	= E/1000	=F x emission factor
						Total $kgCO_{2e}$

Calculating the carbon emissions saved:

The final calculation will be to subtract the post audit emissions from pre audit emissions results. To do this, take the total $kgCO_{2e}$ from the pre audit master list, and subtract the total $kgCO_{2e}$ from the post audit master list. This will give you the total $kgCO_{2e}$ saved by the changes to the way students purchased food.