**Transportation 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:

1. options for how to assess food choices, and
2. calculations for the different ways that food travels to our stores.

## How to assess food choices

### Option #1: 10 Things I Buy Each Week

As a group, list 5-10 common food items that families buy at the grocery store on a regular basis. Try to come up with a list that is common to most students in the group. Pick individual food items like carrots, yogurt, chicken, frozen juice, etc. rather than categories like meat or fruit.

- ➔ **Pre audit**: find out where the items come from, how they travel, and record 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 find similar or reasonable substitutes locally, and set a reasonable goal for students to choose those items instead.**
- ➔ **Post audit:** will 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.

- ➔ **Pre audit**: find out where the items come from and record the distance (kilometers) that each food 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 is to make the favourite meal more sustainable in as many ways as possible. How could the ingredients be more sustainable? I.e. investigate where ingredients come from and how they are grown/made.**
- ➔ **Post audit:** calculate greenhouse gas reductions from the changes to the meal.

## 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.

**How do we know what vehicle transported the food?** Use your best guess for how the food has travelled to your store by researching or by asking someone at the store for help:

- 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 or delicate, and comes from outside of North America, it will likely arrive by airplane.

| | |
|---|---|
| Truck | 0.18 $kgCO_{2e}$/tonne.km |
| Airplane | 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 was transported by each method.

**Pre Campaign Audit**

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

- food items
- Date range or week of food purchase
- weight of each quantity of food
- where food comes from/is grown (distance travelled to the store in kilometers)
- how it travelled – 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.

(Optional) **Mid Campaign Audit** (helps to see how things are going)

During the action period, do the same as the pre audit. This data will help students know if they are reducing food miles and give ideas for 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.

**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.<br>**Mathematics: Outcome: N8.5** Demonstrate understanding of multiplication and division of integers concretely, pictorially, and symbolically.<br>**SP8.1** Analyze the modes of displaying data and the reasonableness of conclusions. |
| **Grade 9 Health Education AP9.12** Design, implement, and evaluate three eight-day action plans that demonstrate responsible health promotion related to comprehensive approaches to safety, non-curable infections/diseases, romantic relationships, healthy food policies, addictions, tragic death and suicide, chronic illness, and sexual health. |

## Explanation of Chart Abbreviations and Calculations

| Information you have | Abbreviation | How you read it |
|---|---|---|
| Mass (weight of food item) | kg | Kilogram |
| Distance travelled (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 | Kilogram kilometers divided by 1,000 equals tonne kilometers |
| 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.<br>**Truck 0.18** $kgCO_{2e}$/tonne.km<br>**Rail 0.018** $kgCO_{2e}$/tonne.km<br>**Air 0.68** $kgCO_{2e}$/tonne.km<br>**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:<br>Make your best guess of what transport vehicle(s) transported the food. Multiply the emission factor for that transport type by the tonne kilometers for that food. | Eg truck 0.18$kgCO_{2e}$ /tonne.km x tonne.km = $kgCO_{2e}$ | |

**FORM A: Individual Student food tracking - No calculations**
This form is used by each individual student to track what food they bought, its weight, and the transportation details.

**Date range of food purchase:** **Name:**

| **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. | | |

**EXAMPLE**
**Date range of food purchase:** Jan 25-29 **Name:** 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 | Ecuador/6600km/ship |
| 4.blackberries | 0.2kg | Chile/10,500km/air |
| 5. rice | | |
| 6. potatoes | | |
| 7. | | |
| 8. | | |
| 9. | | |
| 10. | | |

**FORM B: Master List - Combined group food tracking - No calculations**
This form is used by your group to combine all the details from each student's Form A. Each table should be for one food item. You can recreate these tables for however many food items you tracked.

**Date range of food purchase:** **Group members:**

| **Food Item #1** | **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. | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

| **Food Item #2** | **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** |
| 2. | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**EXAMPLE**
**Date range of food purchase:** Jan 25-29 **Group members:** Angie, Pam, Joe

| **Food Item #1** | **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 |
| | | | |
| | | | |


**FORM C - Individual emissions calculations**

Each student can use this form to calculate the emissions from their food items.

**Date range of food purchase:** **Name:**

| **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 travelled (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** | **= D/1000** | **=F x emission factor** |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |
| 4. | | | | | |
| 5. | | | | | |
| 6. | | | | | |
| 7. | | | | | |
| 8. | | | | | |
| 9. | | | | | |
| 10. | | | | | |
| Total | | | | | |


**FORM C**

**EXAMPLE**

**Date range of food purchase:** Jan 25-29 **Name:** 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 travelled (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** | **= D/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$kgCO_{2e}$ |


**FORM D - Master List - Combined emissions calculations**

Use this form to calculate the total emissions for each food item using the table. Use one table per food item. Finally, sum the totals in column G for all food items to calculate total combined food emissions.

**Date range of food purchase:** **Group members:**

| **Food Item #1** | **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 travelled (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** | **= D/1000** | **=F x emission factor** |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | Total: |

**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 students' decisions to purchase foods differently.


**FORM D**

**EXAMPLE**

**Date range of food purchase:** Jan 25-29 **Group members:** Angie, Pam, Joe

| **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 travelled (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** | **= D/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$kgCO_{2e}$ |