

CLIMATE CHANGE FOOD STATION



Organization: Bishop Museum
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GENERAL DESCRIPTION

The Food Station is an activity in which visitors discover the carbon impact of their food choices. In a hands-on activity, participants learn how three food variables of local versus imported, fresh versus processed, and vegetable versus meat, can influence climate change by limiting greenhouse gas emissions. Visitors assess their personal carbon footprint by creating a meal from a selection of foods, each labeled with a number of CO₂e points, or emissions associated with their production. Additional carbon is added to imported versus locally produced food. Participants have the opportunity to make multiple meals as they learn about different food types and their hidden environmental costs. This experience empowers visitors with knowledge to reduce their personal carbon footprint by making responsible, and ultimately nutritious, food choices.

PROGRAM OBJECTIVES

Big Idea

Carbon dioxide emissions are widely associated with transportation and industry, yet relatively little attention is paid to the carbon footprint embedded in the foods we consume. The food station is designed to educate the public about environmentally responsible diet choices, promoting both personal and planetary health.

Learning goals

1. To understand why and how food production and transportation create greenhouse gas emissions.
2. To assess carbon emission differences between local vs. imported, processed vs. fresh, and vegetable vs. meat food products.
3. To empower with personal choices that make a difference in reducing individual contribution to climate change and simultaneously lead to healthy lifestyles.

Overall Program Messages

Food carries hidden carbon footprints both in its production and its transportation. Informed decisions about personal food selection can make a substantial difference in individual carbon footprints and global climate change. Key choices in reducing carbon footprints are to adopt a more vegetarian rather than meat-based diet, buy foods that are locally produced as opposed to imported, and fresh rather than processed. Diet is a choice and this choice is consequential.

TIME REQUIRED

Set-up: 5 minutes

Program experience: 5-7 minutes

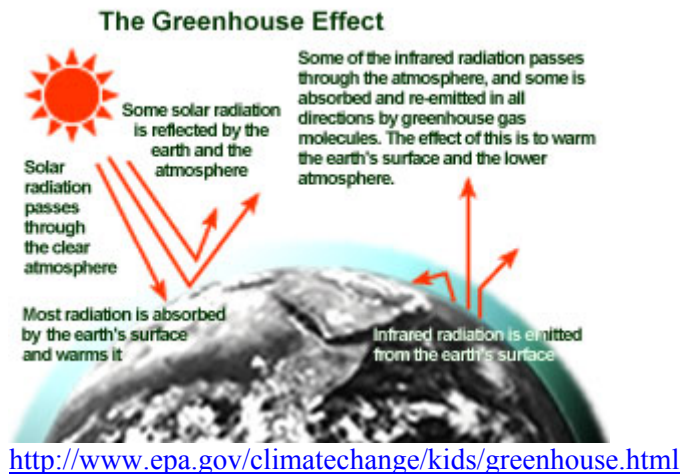
Clean-up: 5 minutes

BACKGROUND INFORMATION

Definition of Terms

Program-Specific Background Information

The earth's atmosphere is made up of gases, including nitrogen, oxygen, methane and carbon dioxide (CO₂). Light from the sun travels through our atmosphere and warms the earth, making life possible. Earth's land, oceans, and biosphere absorb the sun's energy and release heat back into the atmosphere as infrared radiation. Some of this infrared radiation travels back into space, but the majority is absorbed by greenhouse gases (such as carbon dioxide and methane) in the atmosphere that re-emit the energy as heat back towards the earth. Greenhouse gases act like a blanket, blocking infrared rays from leaving Earth's atmosphere and therefore trapping heat in a process called the greenhouse effect. The greenhouse effect has become dramatically intensified with human generated greenhouse gas emissions. The consequence is a dangerous process of global warming, or the increase in average temperature of the Earth's lower atmosphere, land, and oceans. This process is also referred to as climate change because the warming is not uniform and may actually produce an initial cooling in some areas. Climate change in the past one hundred years has escalated more rapidly than any other point in the Earth's geologic history, coinciding with the Industrial Revolution and ever increasing human population growth. Present and projected consequences of climate change include sea level rise, coral bleaching, the melting of polar ice caps, the displacement and mass migration of large numbers of environmental refugees, and the extinction of numerous plant and animal species.



Unsustainable levels of greenhouse gas (primarily CO₂) emissions are commonly associated with the burning of fossil fuels from our transportation methods, coal-generated power plants, cement production, and the deforestation of tropical rainforests. However, until recently, little attention has been paid to the food we eat and their associated carbon footprints. A 2006 United Nations Food and Agriculture Organization report concludes that our diet is responsible for more greenhouse gas emissions than either transportation or industry!

The foods we consume all carry hidden environmental costs from transportation, refrigeration, and fuel for farming, to methane emissions from plants and animals. All of these factors lead to a build-up of greenhouse gases in our atmosphere. The food station of climate change family science night focuses on the three considerations of local vs. imported, fresh vs. processed, and meat and dairy vs. vegetable in assessing the carbon footprints of various foods.

1. Local vs. Imported

Food miles, or the distance that our food travels from all over the world to reach our plates is a tremendous source of greenhouse gas emissions due to both transportation and refrigeration. It is estimated that the food system generates 1/3 of global greenhouse emissions (www.eatlowcarbon.org). Food that was grown, raised, or produced within a relatively short distance of the place from which it is purchased by the consumer is both kinder to our environment and healthier for our bodies. Imported foods are picked early and arrive tasting bland and degraded in their nutrient content. They also require an enormous amount of energy to transport. According the Maui County Farm Bureau, for every one calorie of food we must factor in ten calories of petroleum, electric and other energy, which in turn generate carbon emissions. Hawaii, for example, imports 80 – 90% of its food yet 1.9 million acres (or 47% of total land area) is agricultural. Buying local not only provides fresher foods of a higher nutrient value while decreasing greenhouse gas emissions, buy supporting local farmers also boosts the local economy.
Seasonal, organic

2. Fresh vs. Processed

Fresh food carries a higher vitamin and nutritional content than processed foods. Processed foods often include food additives, such as flavorings and texture-enhancing agents that can actually be detrimental to our health. Furthermore, whole foods, which include unprocessed and unrefined produce, grains, nuts, and beans produce fewer greenhouse gas emissions than processed and packaged foods, which require a great deal of energy to produce. Canning, freezing, drying, and packaging are all energy-intensive. Buying organic, when possible, is also healthier for both the people and the planet. Organic foods have been produced without synthetic pesticides and fertilizers, growth hormones, and antibiotics. Fertilizers are chemicals that when applied to farmland, emit a greenhouse gas called nitrous oxide. In addition to killing marine life and emitting methane, fertilizers and pesticides also cause water pollution and erosion, processes that create more carbon dioxide.

3. Vegetable vs. Meat

Meat, particularly beef, is the primary cause of global warming in our agricultural system. Producing a half pound of hamburger meat for one person's lunch releases the same amount of greenhouse gas as driving a 3,000 pound car about 10 miles. Furthermore, for every pound of beef they produce, cows emit between 2.5 and 4.7 oz of methane, which equates to between 3.6 and 6.8 pounds of CO₂. Meat production also contributes to global warming through cleared land for grazing and the subsequent loss of carbon dioxide absorbing trees (Fiala, 2009). In addition, animals are sprayed with over 2 millions pounds, and their cages over 360,000 pounds of pesticides annually. They are fed 84% of all antimicrobials (which

include antibiotics) and eat half of all the grains grown in the United States every year. (www.gourmet.com/foodpolitics/2009/09/carbon-footprint-101). One sobering statistic is to compare carbon emissions in the production of a vegetable like asparagus and beef production; one pound of beef generates 14.8 pounds of CO₂, which is 36 times the CO₂ equivalent of one pound of asparagus. Other meats are also far lower in their carbon footprint (a pound of pork generating 3.8 pounds of CO₂ and chicken 1.1 pound) One researcher's estimation of America's beef consumption equates to between 941 and 1023 pounds of greenhouse gas per person, per year, which is the carbon output equivalent of 7,500-15,000 SUVs (Cascio, www.openthefuture.com/cheeseburger).

Materials

- Laminated photographs or plastic pieces of various food types, with their carbon footprint indicated on the bottom.
- Laminated information signs.
- Toy truck, cargo ship, airplane or other shipping method relevant to your geographic area (or use laminated photographs).
- Plastic lunch trays for visitors to use in choosing their meals.
- 8 Trays to hold laminated pictures, organized by food group (Meats, legumes, produce, seafood, dairy, starch, deserts, beverages)

Material Sources:

- Plastic food can be purchased widely but an alternative is to print out photographs from the internet and laminate them. Good sources for this include Microsoft Clip Art: <http://office.mircosoft.com/en-us/clipart/default.aspx>
Flickr Creative Commons: <http://flickr.com/creativecommons/>

A useful source for calculating carbon footprints of food components and sample meals is www.eatlowcarbon.org

CO2e food footprints

MEATS	CO2e
Bacon	450
Beef (roasted deli slices)	1163
Beef (steak, grilled)	4793
Beef (Tenderloin, grilled)	7641
Chicken (baked)	436
Hot Dog	357
Lamb	2034
Pork chop	753
Pork short ribs	1489
Salami	352
Turkey	613
LEGUMES	
Beans	24
Lentils	56
Hummus	196
Nuts	20
Edamame	64
Tofu	1095
PRODUCE	
Grilled vegetables (Seasonal)	95
Grilled vegetables (hot house)	767
Seasonal fruit	84
Tropical fruit	380
Raw vegetables (Seasonal)	80
Raw vegetables (Hot house)	752

(www.eatlowcarbon.org)**SEAFOOD**

Clams, mussels, oysters	160
Pacific Cod (baked)	393
Salmon farmed (baked)	1229
Salmon wild far away	1017
Salmon wild regional	101
Shrimp	777
Tuna far away	1175
Tuna regional	259
Tuna frozen	295

DAIRY

Boiled egg	661
Butter	320
Cheese domestic	1140
Yoghurt	148

STARCH

Baked potato	112
Bread	132
Pasta	180
Rice	109

SIDES

French fries	122
Onion rings	107

BREAKFAST

Whole wheat pancakes	636
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Breakfast cereal and milk	1224
Fried egg	336
Omelet with veggies	783
Omelet with meat and cheese	1573
Omelet with veg and cheese	1326
Oats	144
Toast and jam	103
Yoghurt with fruit	306

SALAD

Garden Salad	401
Chicken Caesar salad	863

BEVERAGES

Bottled water	125
Black coffee	284
Coffee, cream, sugar	304
Glass of milk	296
Smoothie (seasonal fruit)	381
Smoothie (imported fruit)	540
Soda	168

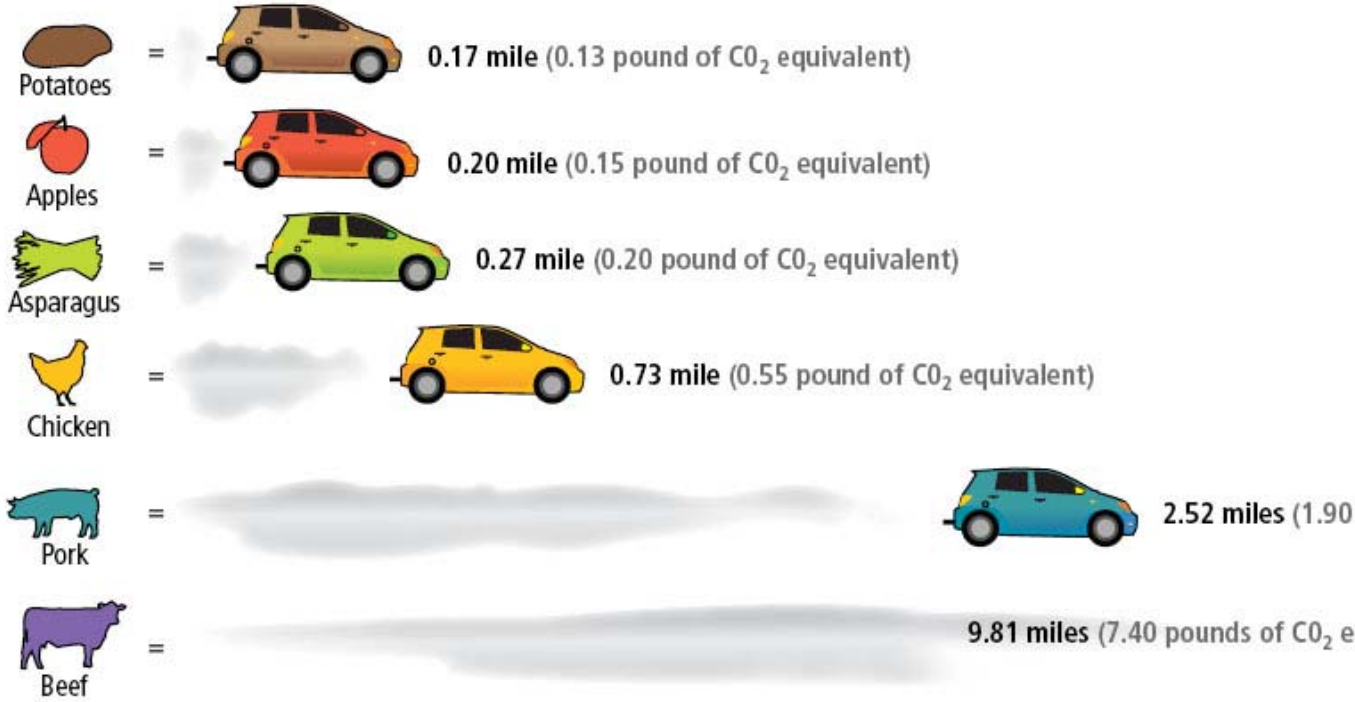
DESSERT

Cake	155
Chocolate chip cookies	153
Milk chocolate bar	277

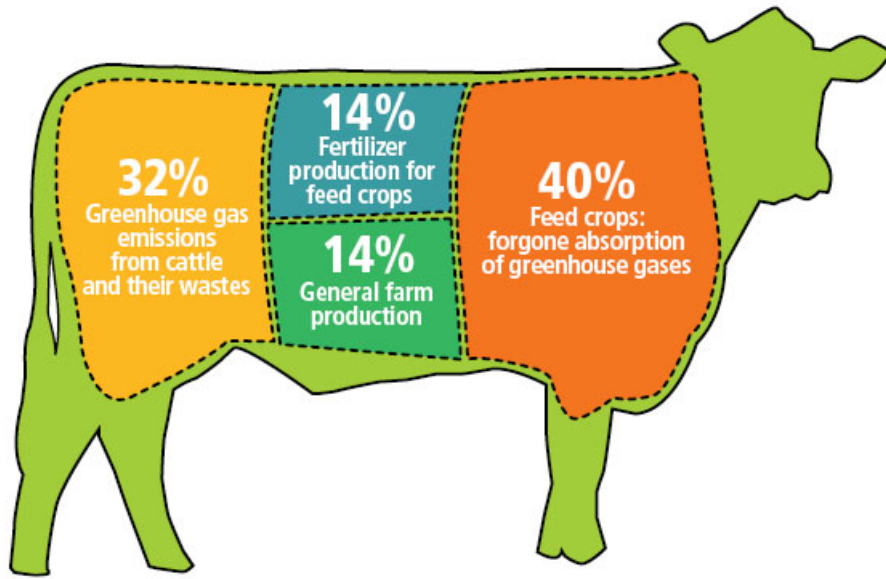
COMMON MEALS

The works beef cheese burrito	3840
Chicken and cheese burrito	741
Veggie burrito, cheese	448
Cheeseburger	2826
Hamburger	2541
Slice cheese pizza	556
Slice pepperoni pizza	644
Chicken sandwich	520
Falafel sandwich	300
Fish and chips	541
Macaroni cheese	906
Veggie lasagna	77
Italian sausage lasagna	1022
Meatloaf	2024
Philly cheese steak	3228
Beef stir fry	2629
Tofu stir fry	1340
Vegie stir fry	305
Grilled eggplant sandwich	310
Grilled cheese sandwich	929
Grilled salmon sandwich	393
Grilled veg hummus sandwich	270
Spaghetti marinara	352
Spaghetti meatball	1659
Beef taco	2797
Black bean taco	253
Chicken taco	784
Pork taco	1129

CO₂-equivalent emissions from producing half a pound of this food . . . are the same as emissions from driving . . .



<http://www.scientificamerican.com/article.cfm?id=thegreenhouse-hamburger>



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San Francisco Bay Cargo Ship

http://www.greencarreports.com/image/100180289_san-francisco-bay-cargo-ships-by-flickr-user-bernard-garon



Container Ship – Hawaii Freight

<http://www.hawaii-shipping.info/newsArchive.html>

Information to include on cargo information signs (depending on age level and appropriateness):

* SHIPPING IS DEMAND DRIVEN *

From an article titled “Health risks of shipping pollution have been ‘underestimated’” in The Guardian:

Vidal, John. Health risks of shipping pollution have been ‘underestimated’. The Guardian, Thursday 9 April, 2009.

- One giant cargo ship emits almost the same amount of cancer and asthma-causing chemicals as 50million cars.
- There are about 90,000 cargo vessels traveling the Earth’s oceans.
- Each ship expects to operate 24 hours a day for 280 days a year.
- 70% of all ship emissions are within 400Km of land
- Shipping is responsible for 3.5% to 4% of all climate change emissions, for 18-30% of the world’s nitrogen oxide pollution and 9% of global sulfur oxide pollution.

Icons for Carbon points on underside of food

Under 100:



Ie. 93 CO₂e

100-299



ie. 252 CO₂e

300-399



ie. 320 CO₂e

and so on.

For the cargo ship (or other form of transport) put one giant Earth Icon, since the actual amount cannot be qualified.



CONCLUDING TABLE: WHAT CAN I DO ?

Materials: laminated cards with pictures and suggestions on what individuals can do with their own food choices to reduce greenhouse gas emissions.

Ideas to include:

1. **Minimize food waste.** Save leftovers in re-useable storage containers and eat them the next day. It takes a tremendous amount of energy for food to travel from the farm to your plate and if you throw it away, all that embedded energy is wasted. In addition, if you throw food waste in a garbage bag destined for the landfill, rather than composting it, it releases methane, an extremely potent greenhouse gas (23 times more potent than CO₂). You can also minimize the plastic waste associated with foods by bringing your own reusable bags to the market and favoring minimal packing rather than buying foods that are wrapped in plastic, within plastic, within plastic.
2. **Buy locally and seasonally.** Foods that are in season and grown locally are lower in carbon and higher in nutrients.
3. **Minimize your consumption of meat and cheese.** Livestock production is responsible for 18% of the world's carbon emissions. If you eat meat and dairy, try to reduce frequency and portions, or substitute with other proteins like chicken and eggs.
4. **Do not buy air freighted food such as 'fresh' fish or out of season berries.** 'Fresh' seafood and out of season produce usually means it is flown by air, which is ten times more carbon intensive than container ships.
5. **Avoid processed and packaged foods.** Junk food, snack foods, most juices, snack bars, and even veggie burgers (prepared, boxed, frozen, and transported) carry enormous amounts of embedded energy and we eat these foods mindlessly. Substitute with more responsible treats like local fruit or nuts.
6. **Grow a garden.** Growing some of your own food eliminates the majority of emissions associated with transport and mass production. Raised bed gardens are available for urban areas. It is remarkable what you can grow in a small space.
7. **Be a conscious consumer.** SHIPPING IS DEMAND DRIVEN. If shoppers demand local foods over imported foods, the market will respond.

SET-UP

Time estimate for set-up: 5 minutes

- Set up the table with information signs and instructions pertaining to the activity.
- Separate food ingredients into trays of major food groups and spread out meals (either as photographs or plastic pieces) with the number of carbon points for each food stated on the back of each food item.
- Conclude the table with information signs on 'what you can do' and resources for finding locally produced, organic, fresh food.

PROGRAM DELIVERY

Procedure and Discussion

1. Visitors pick up a lunch tray and create their own meal by choosing food ingredients they like to consume (without any information about carbon points).
2. After the visitor has created their meal, instruct them to turn over the food pieces and add up the greenhouse gas emissions produced by their meal. Are they surprised?
3. Explain that CO₂e represents the Carbon dioxide equivalent, an internationally accepted measure to indicate the amount of global warming from greenhouse gases. In addition to carbon dioxide, CO₂e also includes other greenhouse gases such as methane.

One point equals one gram (g) or 0.35oz of carbon dioxide equivalent emissions (CO₂e) of greenhouse gases.

4. Encourage visitors to compare their choices with similar alternatives (ie. Cheese and beef burrito versus a vegetable burrito or hamburger versus a chicken sandwich).
5. Once the visitor has compared their chosen meal to alternatives of a lesser impact, suggest that they create a second meal using their new knowledge.
6. Re-calculate greenhouse gas emission points and congratulate them on any deductions.
7. Direct them to the transport cards (cargo ship, airplane). Reinforce that the carbon points associated with each food are estimated for the United States mainland production. Considering that 80-90% of our food in Hawaii is imported, we must add tremendous additional carbon for shipping and refrigeration across the Pacific Ocean.

NOTE: There is not ample research at this time to estimate actual numbers for this amount but the transport information display cards provide an idea of how much energy cargo ships or airplanes (depending on your location) require.

8. Reiterate important lessons from the activity:
 - daily choices we make impact climate change directly
 - the best ways to limit your food carbon imprint are to choose local, non-processed foods and minimizing consumption of meat and dairy products (particularly beef).
9. Direct the visitor to the concluding table where they may find a list of actions they may take personally and resources to find locally produced, healthy, fresh food.

DISCUSSION

Depending on your age group and knowledge base, below are some suggestions for further discussion.

1. Consider the components of food production that create greenhouse emissions, including
 - fuel for farming
 - transportation of food from farm to table

- refrigeration of food
- production and use of pesticides and fertilizers
- packaging
- water pumping for irrigation
- methane produced by plants and animals
- methane emissions for food that is thrown away
- deforestation as a result of clearing for livestock grazing
- nitrous oxide released from agricultural practices such as run-off from nitrogen based fertilizers

2. Compare carbon points to nutrition levels. Is there a correlation between low carbon foods and high nutrition? You might also consider color coding your food types according to food group so that visitors can create not only a low carbon meal, but also one that is balanced and nutritious.

TIPS AND TROUBLESHOOTING

This program can be adapted to many age-groups. Information can also be tailored according to your geographic location. Research how food is transported in your region (air, cargo ship, lorry) and find resources for obtaining locally produced food.

COMMON VISITOR QUESTIONS (www.eatlowcarbon.org)

What does a carbon point represent?

One point equals one gram (g) or 0.35oz of carbon dioxide equivalent emissions (CO₂e) of greenhouse gases.

For example, a 2,000 point meal equals 4.4 pounds of CO₂e.

The point value of a food is very similar to a carbon footprint but a true footprint would also take into account emissions from waste.

How is my carbon footprint food score, relatively speaking?

Based on conservative government statistics on what people in the United States eat and research data, the figure of 4500 represents high carbon. This amount of carbon, consumed every day equates to three tons of CO₂e, or roughly three roundtrip three-hour flights.

Is there a certain number of points I should aim for?

Rather than aiming for a particular number, it is best to focus on reducing your carbon footprint wherever possible.

What is CO₂e?

Carbon dioxide equivalent is an internationally accepted measure to indicate the amount of global warming from greenhouse gases. In addition to carbon dioxide, CO₂e also includes other greenhouse gases such as methane.

Are CO₂e points the same as a carbon footprint?

CO₂e points are very similar to a carbon footprint in they are a measure of greenhouse gas emissions over the lifecycle of a product. A true footprint, however, would include emissions from waste, and CO₂e points do not. Wasted food is wasted energy!

How much lower in carbon is local than imported food?

There is presently not adequate scientific research to quantify this difference exactly due to variability in growing practice on farms with different climate and water conditions, the type of vehicle farmers use to deliver their produce and to a market at what distance, and how many trips the consumer may take to the market. Places like Hawaii, have a massive additional carbon footprint since 80-90% of food is imported across the Pacific Ocean via cargo ships.

Is organic food lower in carbon than conventional foods?

Although organic foods are not treated with pesticides, lowering their carbon points, organic does not necessarily mean lower carbon. Some organic farmers may have to travel long distances to transport their goods or require other inputs (such as transporting bees long distances to pollinate crops or importing grain to feed cattle). Choosing organic is important for personal and ecological health, but in terms of carbon footprints, it may be more important to consider other factors of local vs. imported, fresh vs. processed, and meat vs. dairy.

Are highly processed foods higher in carbon points than fresh foods?

Generally, yes. Processing and packaging require a lot of energy and also generate huge waste. Processed foods often contain ingredients such as sugar, salt, and high fructose corn syrup that are highly processed themselves. Juice, for example, is very highly processed. It takes about four oranges to make 6oz of orange juice that has to be transported in a chilled container over distance. Better to eat an orange!

Will eating a low carbon diet really make a difference?

The eating habits of people in the United States account for 5% of global greenhouse gas emissions. You can lower that amount by making informed diet choices.

Which foods are especially high in their carbon emission?

Meat and dairy are particularly high because ruminants (cows, sheep, and goats) naturally emit methane, a greenhouse gas that is 23 times more potent than CO₂. Other high carbon foods are out-of-season perishables or fish that is 'fresh' and therefore freighted by air.

Which foods are low in carbon?

Any fruits, grains, and vegetables grown locally are low in carbon. In terms of meat, chicken is lower in carbon than beef. Processed foods are also higher in carbon than home-made or non-processed foods.

GOING FUTHER

See the “Discussion” section above for suggested talking points and ways to delve further into the issue of climate change and diet.

Below are resources relevant to food choices and greenhouse gas emissions. Below, is a section of resources particular to HI.

General Resources

www.eatlowcarbon.org (Carbon calculator for various foods and meals)

www.localharvest.org (Listings of locally grown, organic food across the nation from farms, farmers' markets, restaurants, grocery stores).

www.circleofresponsibility.com

www.slowfood.com

Resources specific to the Hawaiian Islands

www.hawaii2050.org (The Hawaii 2050 sustainability plan)

<http://www.hawaiiorganic.org/organic-marketplace/certified-producer-directory?title=&letter=&chapter=Oahu> (Certified HOFA producers on Oahu)

www.kohalacenter.org

www.malamakauai.org

www.kanuhawaii.org

References

Maui County Farm Bureau

<http://www.scientificamerican.com/article.cfm?id=thegreenhouse-hamburger>

Vidal, John. Health risks of shipping pollution have been ‘underestimated’. The Guardian, Thursday 9 April, 2009.

www.eatlowcarbon.org

Merriman, Peter. “Support Local Farmers, Boost Sustainability”. Honolulu Advertiser, May 27, 2008.

<http://www.epa.gov/climatechange/kids/greenhouse.html>

<http://www.gourmet.com/foodpolitics/2009/09/carbon-footprint-101>

www.openthefuture.com/cheeseburger