

Today I Learned About What I Eat

Description:

Climate change affects food, but food also affects climate change. Students investigate causes of and solutions to food waste, plant-based recipes to get excited about, and the diversity and variety of heirloom foods.

Skills & Objectives

SWBAT

- Explain the link between food waste and climate change.
- Understand why some foods have a higher climate impact than others.
- Describe varieties of an heirloom food.

Skills

- Online research
- Communication

Students Should Already Know That

- There are many steps in the process that gets our food from where it is grown or raised to on our plates.

Standards Alignment:

HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller problems that can be solved through engineering.

HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

RST.11-12.9 Synthesize information from a range of sources into a coherent understanding of a process, phenomenon, or concept.

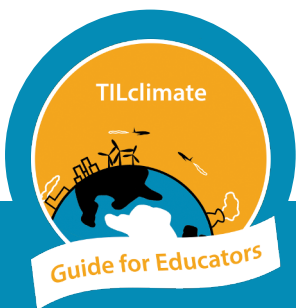
WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question

Disciplinary Core Ideas:

ESS2.D Weather and Climate

ESS3.C Human Impacts on Earth Systems

ESS3.D Global Climate Change



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How To Use These Activities:



Pages with the circular “TILclimate Guide for Educators” logo and dark band across the top are intended for educators. Simpler pages without the dark band across the top are meant for students.

Each of the included activities is designed to be used as a standalone, in sequence, or integrated within other curriculum needs. A detailed table of contents, on the next page, explains what students will do in each activity.

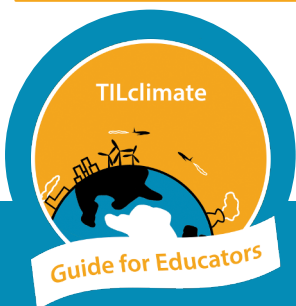
A Note About Printing/Materials

All student pages are designed to be printable in grayscale.

The worksheets do not leave space for students to answer questions. Students may answer these questions in whatever form is the norm for your classroom – a notebook, online form, or something else. This allows you, the teacher, to define what you consider a complete answer.

Podcasts in the Classroom: Throughout these Guides for Educators, we invite students to think about how they would share their learning with family and friends. One way to do this is to encourage your students to create their own podcasts - they're shareable, creative, and have multiple options for embedded assessment. We would love to hear any podcasts or see any other projects you or your students create! Email us at tilclimate@mit.edu, Tweet us @tilclimate, or tag us on Facebook @climateMIT.

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Social-Emotional Learning

Food is extremely personal. When talking about the intersection of food and climate, consider the differential needs of students who:

- may experience food insecurity, poverty, eating disorders, and/or a lack of control over what they eat at home. Discussions of food choice and food waste may impact these students differently than those from food secure households.
- come from families that grow food (especially beef cattle). These students may react to information about the climate impact of beef.
- have chosen to become vegan or vegetarian for climate-related reasons. They may require support to have constructive conversations with students who have not made these changes.
- are from Indigenous, enslaved, and/or immigrant backgrounds. These communities are often separated from their traditional and ancestral foodways.

The activities in this guide are designed to allow educators to differentiate and support students as they explore food waste, plant-based eating, and crop varieties. One way to do this is to allow students to choose which of these three topics they engage with.

Differentiation

The three activities in this Guide can take similar amounts of time, depending on the requirements for *Food and Climate* and *Heirloom Foods*. Educators may have student groups choose which of the three topics – food waste, food and climate, and heirloom foods – they engage with. To balance time if students are doing these activities *simultaneously*:

Remove USDA Data from *Food Waste*: Page 2 is a data activity that can slow students down. Include the page, but do not require students to graph the data.

Bonus Activity for *Food and Climate*: Climate change affects food production, too. Read about ways that farms are adapting to drought, flooding, and/or heat.

<https://www.climatehubs.usda.gov/hubs/topic/adaptation-resources-agriculture-case-studies-using-adaptation-workbook>

Bonus Activity for *Heirloom Foods*: Many of the crops you might investigate are originally from another continent. Find out the name of the Indigenous people whose traditional lands you live on and research their foods and stories. <https://native-land.ca/>



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Detailed Table of Contents

Page	Title	Description	Time (min)
	Podcast Episode	Students listen to TILclimate: TIL about What I Eat, either as pre-class work at home or in the classroom. https://climate.mit.edu/podcasts/til-about-what-i-eat	10-15
1-5	Food Waste	Students investigate the causes and impacts of food waste, and then invent a solution.	30-45*
6	Food and Climate (internet required)	Students research a plant-based recipe that they could introduce to their family or friends.	20-30*
7-8	Heirloom Foods (internet required)	Students research heirloom varieties of a chosen food crop, to see the diversity of foods available.	20-30*

*See *Differentiation*, previous page



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Food, Food Waste, and Climate

This Educator Guide includes three investigation activities. Educators may pick and choose among the pieces of the Guide, as suits their class needs.

Parts of this Guide may align with the following topics:

- Physical science: Production of heat-trapping gases such as methane and nitrous oxide.
- Engineering: Challenge to develop a solution to food waste.
- Life/environmental science: Impacts on ecosystems from agriculture, agricultural practices.
- History/social science: History of food, colonial impacts on Indigenous foodways
- ELA/literature: Connections to stories about farming, farms, and foodways.

MIT Resources

We recommend the following as resources for your own better understanding of climate change or as depth for student investigations. Specific sections are listed below:

- Climate Science, Risk & Solutions, an interactive introduction to the basics of climate change. <https://climateprimer.mit.edu/>
 - Chapter 02 The greenhouse effect and us
 - Chapter 06 Predicting climate
 - Chapter 08 What are the risks?
 - Chapter 10 What can we do?
- MIT Climate Portal Explainers are one-page articles describing a variety of climate topics. New Explainers are posted monthly. <https://climate.mit.edu/explainers>
 - Food Systems and Agriculture
 - Fertilizer and Climate Change
 - Soil-based Carbon Sequestration



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Wrap-Up Discussion Questions

- What are some technologies, laws, or practices that can reduce food waste and loss? Explain the relationship between food waste and climate change.
- Why do some foods have a larger climate impact than others? How does eating more plants generally have a lower impact?
- Looking at where crops were before European colonization – which ones surprised you?
- How many varieties of your chosen food did you find? Did that surprise you? What were some of the best names you found?
- In the podcast, Dr. Rosenzweig talks about the importance of healthy food being “available, affordable, nutritious, reliable”. What programs and practices have you seen that make the variety and choice we’ve been talking about accessible to people experiencing food insecurity? (Think about programs that give extra food assistance for people shopping at farmers’ markets, etc.)

Climate Solutions

Climate solutions can be thought of as falling into four categories outlined below. Across all categories, solutions at the community, state or federal level are generally more impactful than individual actions. For example, policies that increase the nuclear, solar and wind mix in the electric grid are generally more effective at reducing climate pollution than asking homeowners to install solar panels. For more on talking about climate change in the classroom, see “How to Use This Guide”.

• Energy Shift

How do decision-makers make the switch from carbon-producing energy to carbon-neutral and carbon-negative energy?

• Energy Efficiency

What products and technologies exist to increase energy efficiency, especially in heating and cooling buildings?

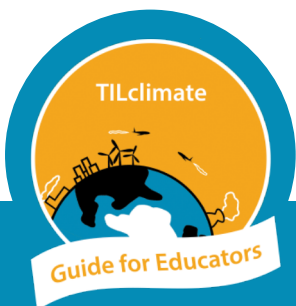
• Adaptation

How can cities and towns adapt to the impacts of climate change?

• Talk About It

Talking about climate change with friends and family can feel overwhelming. What is one thing you have learned that you could share to start a conversation?

What solutions are the most exciting in your classes? We would love to hear from you or your students! Images, video, or audio of student projects or questions are always welcome. Email us at tilclimate@mit.edu, Tweet us @tilclimate, or tag us on Facebook @climateMIT.



Today I Learned About What I Eat

"If less food is wasted, then we don't have to grow as much food. If we're wasting ... food, that's just all these greenhouse gas emissions that are going up."

Dr. Cynthia Rosenzweig, Climate Impacts Group, NASA

TILclimate podcast: Today I Learned About What I Eat

Food Waste

Earth's atmosphere acts like a blanket, trapping heat from the Sun. Without this blanket, there would be no life on Earth. As we burn fossil fuels like coal, oil, and natural gas, and cut down trees, we release carbon dioxide (CO₂) into the atmosphere, which makes the blanket trap even more heat. Other gases, such as methane (CH₄), nitrous oxide (N₂O) and others add to the blanket, as well. This trapped heat is warming up our Earth, air, and ocean, changing weather and climate patterns all over the world.

According to the United States Department of Agriculture (USDA), the US wastes 31% of food at the retail and consumer levels. This means that almost one third of all food that is available at grocery stores, restaurants, and markets does not end up getting eaten. Every step of our food system releases heat-trapping gases: from gasoline used in tractors, methane from cows' digestive systems, natural gas in a food processing factory, refrigerants used for cooling, and much more. If we can reduce food waste, we don't have to grow as much food. Every step of our food system could release fewer heat-trapping gases, which would have less of an impact on Earth's climate.

Where Does Food Waste Come From?

On the following pages, you will find:

- Data from the USDA on food waste.
- USDA investigation into causes of food waste.
- A few stories of solutions to food waste.

Read the data, causes, and solutions. Then, in groups:

1. Choose one food type and one related cause of food waste.
2. Imagine or invent a solution to this food waste issue. Try to create a solution at the system level – a technology, law, or process that makes it easy for restaurants, grocery stores, and households to reduce food waste.

Today I Learned About What I Eat

USDA Data: Food Waste

United States Department of Agriculture, 2010. Totals are in billions of pounds. *Retail* includes grocery stores, farmers' markets, supermarkets, etc. *Consumer* includes food eaten at home, in restaurants, or as takeout.

Food Type	Total US Food Supply	Food Loss: Retail	Food Loss: Consumer
Grain products	60.4	7.2	11.3
Fruit - Fresh	37.6	4.4	9.5
Fruit - Processed	26.7	1.6	2.9
Vegetables - Fresh	53.5	5.2	12.8
Vegetables - Processed	30.4	1.8	5.3
Milk	53.8	6.5	10.5
Other Dairy Products	29.1	2.8	5.7
Beef & Pork	31.6	1.4	7.2
Poultry	22	0.9	3.9
Seafood	4.8	0.4	1.5
Eggs	9.8	0.7	2.1
Tree Nuts & Peanuts	3.5	0.2	0.3
Sugar & Sweeteners	40.8	4.5	12.3
Fats & Oils	26	5.4	4.5

Total

1. Total each column.
2. Calculate the percent food loss at the retail and consumer level for each food type.
3. Which food types experience the most loss, by percentage?
4. What other patterns do you notice?

The Estimated Amount, Value, and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States. USDA Economic Research Service, 2014. https://www.ers.usda.gov/webdocs/publications/43833/43680_eib121.pdf

Today I Learned About What I Eat

How Does Food Waste Happen?

The United States Department of Agriculture (USDA) investigated the situations under which most food loss happens at the retail (grocery store, market, etc.) and consumer (home, restaurant, etc.) levels. This study did not include loss before the retail level, either in manufacturing, transportation, or on farms.

In your group, come up with an example for each line. A few have been completed for you.

Retail Level Food Waste

Type of Food Loss	Example
Dented cans and damaged packaging.	
Packaging that damages produce.	
Speciality or holiday foods that aren't purchased.	
Foods being spilled, damaged, or bruised.	
Cutting off too much from a vegetable, fruit, or meat when it is being prepared.	<i>Grocery store kitchen makes fruit salad, but cuts off too much so it's prettier.</i>
Foods not being kept at a safe temperature	<i>The freezers failed at the store, so they had to throw out all the frozen foods.</i>
Overstocking or overpreparing due to difficulty predicting number of customers.	<i>There was a big snowstorm on New Years' Eve, so people didn't buy as much food as the store had prepared.</i>
Removing blemished, misshapen, or wrong-sized ("ugly") foods.	

The Estimated Amount, Value, and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States. USDA Economic Research Service, 2014. https://www.ers.usda.gov/webdocs/publications/43833/43680_eib121.pdf

Today I Learned About What I Eat

Consumer Level Food Waste

Type of Food Loss	Example
Speciality or holiday foods that aren't eaten.	
Foods being spilled, damaged, or bruised.	
Cutting off too much from a vegetable, fruit, or meat when it is being prepared.	
Foods not being kept at a safe temperature.	
Overpreparing due to difficulty predicting number of customers.	
Only using food that looks nicest (even if other food tastes just as good.)	
Confusing labels on food.	<i>What does 'best by' or 'use by' mean? Is it still safe to eat if past its 'best by' date?</i>
Lack of knowledge about how to prepare foods, or portion sizes.	
Industry and government standards.	<i>Food left on your plate at a restaurant can't be re-used.</i>
Fresh food aging.	<i>Potatoes sprout, apples get mealy, etc.</i>

The Estimated Amount, Value, and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States. USDA Economic Research Service, 2014. https://www.ers.usda.gov/webdocs/publications/43833/43680_eib121.pdf

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Solutions to Food Waste

Food waste has many causes – which means there are many potential solutions! The most effective innovations act at the system-wide or community level. We often see lists of actions individuals should take, but these usually require a lot of effort, planning, and energy from those individuals. We can change systems so that it is easier for stores, restaurants, and households to reduce food waste. The US Environmental Protection Agency (EPA) has a hierarchy of goals for food waste. Below are examples of programs and innovations for each level.

Priority 1: Source Reduction: What's Measured Can Be Managed



In restaurants, school kitchens, and grocery stores, data can be collected on what kinds of food are being sent back uneaten or thrown out unbought. Using this data, restaurants can change menus and stores can match what gets eaten.

Priority 2: Feed Hungry People: Apps to Rescue Food



At the end of the day, restaurants, caterers, and other food service businesses often have extra food that they cannot serve the next day. In cities around the US, there are apps and programs that pair businesses with nonprofits that can bring extra food to people who need it.

Priority 3: Feed Animals: Food Scraps as Animal Food



Food service at schools, colleges, and universities can partner with local farms to identify, separate, and deliver food scraps that are safe for animals to eat.

Disposal 1: Industrial Uses: Anaerobic Digestion



If food waste cannot be fed to people or animals, it can be fed to microorganisms that produce biogas (methane and carbon dioxide) that can be burned for energy, and solids that can be used as fertilizer.

Disposal 2: Composting: Curbside Composting



Many cities and towns offer curbside composting, so that food wastes are picked up alongside recycling and trash. Large-scale composting can often take meats, bones, and prepared foods that a backyard composter cannot manage.

Last Resort: Landfill and Incineration



Food that goes into the trash ends up in landfills or incinerators. Food waste in landfills decompose slowly. When they do decompose, they release methane, which is a strong heat-trapping gas. Incineration (burning waste) also releases heat-trapping gases and pollutants into the air.

USEPA Food Recovery Hierarchy <https://www.epa.gov/sustainable-management-food/food-recovery-hierarchy>

Images from The Noun Project by MylconFinder, BomSymbols, Eucalyp, Ian Rahmadi Kurniawan, ProSymbols, and Fantastic

Today I Learned About What I Eat

“What we choose to eat has a big effect, both on our personal health and planetary health. And this is in part because some foods emit a lot more greenhouse gases than others.”

Dr. Cynthia Rosenzweig, Climate Impacts Group, NASA

TILclimate podcast: Today I Learned About What I Eat

Food and Climate

Agriculture is the source of about 10% of US heat-trapping gas emissions.¹ Farms burn fossil fuels like oil and gas for machinery, use nitrogen-based fertilizers, cut down forests for land, and animals such as cows release methane when they burp. As these gases are released, they act like a heat-trapping blanket in the atmosphere. This trapped heat warms the air, Earth, and ocean. Warming is causing dramatic changes to Earth’s weather and climate patterns, such as extreme droughts and floods.

As you learned in the podcast episode, growing animals – particularly cows – for meat is a significant source of heat-trapping gas emissions in the US. But, as Dr. Rosenzweig says, the answer is not to suggest that everyone needs to be vegetarian or vegan. Instead, she suggests that people consider eating more plant-based meals.

Share Recipes



- 1. Brainstorm** In your group, think of search terms that could help you find plant-heavy and meatless recipes. Consider your favorite food types and what is generally available at the stores you already visit. Foods that are familiar and use ingredients that are easy to find are more likely to make it into your family’s meal planning.

Example: In the winter, I really like soups and stews to warm me up. I am going to search for “vegetarian winter soups”.



- 2. Research** Search internet recipe sites and cookbooks or talk to others in your community to gather recipes. Which ones are you the most excited about? Which have you tried before? If you already eat a plant-heavy diet, are there new recipes you would be excited to try?

Example: I found a recipe for curried butternut squash soup with roasted chickpeas. I already like to cook with coconut milk and curry powder, so this will taste familiar to my family. I can get frozen squash and canned chickpeas (also called garbanzos) at the grocery store.



- 3. Share** If you make the recipe, take pictures to share with your classmates, friends, and family. Ask the people who eat with you to give the recipe a rating. Post about it on social media or bring the recipe into class to add to a classroom cookbook.

¹ US EPA Inventory of US Greenhouse Gas Emissions <https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks>
Images from The Noun Project by Peter Lakenbrink, Tomasz Pasternak, and johartcamp

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“This idea is like - are we going to be going back to olden times in a certain way? Like food that we’ve grown to love are not going to be available? I actually feel - not at all. Even though we think we have a lot of choices ... there are 2,500 apple varieties grown in the United States today. And there are more than 4,000 varieties of potatoes in the Andes. [But] we know one or two or three, right? Indigenous and local food systems are often far more diverse than the diets of today.”

Dr. Cynthia Rosenzweig, Climate Impacts Group, NASA

TILclimate podcast: Today I Learned About What I Eat – cut for time³

Where Does Our Food Come From?

Visit an American grocery store today and you will find foods from around the world. We import food from other countries. (In fact, more than half the fresh fruit eaten in the US is grown outside the US.¹) Immigrant communities have always brought with them recipes and ingredients from their homelands that have integrated into American diets.

Even before our global shipping system made it possible to ship coffee from Chile and avocados from Mexico, foods have been exchanged between parts of the world. As Europeans colonized Africa, Asia, and the Americas, they brought their foods with them and brought foods indigenous to those areas back to Europe. Without this history, Italian food would not have tomatoes (originally from the Andes mountains) and no one outside Africa would have coffee.²

Visit <https://blog.ciat.cgiar.org/origin-of-crops/> to explore the original sources of some common foods. Apples may be as American as apple pie, but they first grew throughout Eurasia. Chilies and peppers are key ingredients in many South Asian dishes, but they are originally from Central and South America.

Heirloom Foods

Colonization also erased the food traditions of Indigenous nations as native people were forced off their land and removed from their cultural heritage. Modern agricultural systems have made it easier to grow a few varieties of the fruits and vegetables we know, and those are the ones we see in stores today. But Indigenous people grew hundreds if not thousands of varieties of these same foods.

Today there is a resurgence of interest in heritage or heirloom varieties of fruits, vegetables, grains, and more. Indigenous people are reclaiming the foodways of their ancestors. Farmers and gardeners of all cultural backgrounds are exploring the variety, color, and flavor of foods.

In groups, you will investigate the variety and diversity of indigenous and heirloom foods.

¹ New York Times, March 2018 <https://www.nytimes.com/2018/03/13/dining/fruit-vegetables-imports.html>

² Where Our Food Crops Come From, International Center for Tropical Agriculture <https://blog.ciat.cgiar.org/origin-of-crops/>

³ This quote was cut from the podcast episode because of time, but we wanted to encourage students to explore these themes.

Today I Learned About What I Eat

Heirloom Food Variety

Humans have been breeding, trading, and collecting thousands of varieties of foods for millennia – long before modern hybridization and genetic modification technology.



1. Brainstorm Discuss in your group what kind of food you are interested in investigating. It could be a favorite fruit, or a crop grown in your area. How many varieties/types of this food can you name without doing any research?

Example: You like to go apple picking in the fall. How many varieties of apple can you name?



2. Where Is It From? Use <https://blog.ciat.cgiar.org/origin-of-crops/> to find out where in the world this food type came from. If your crop is not listed, assign one member of your team to research its origins.

Example: Apples were originally from Europe, Central Asia, and East Asia.



3. Initial Search Using search terms such as *heirloom*, *heritage*, and *antique*, find websites that list varieties of your chosen product.

Example: Search “heirloom apples”, “heritage apples”, and/or “antique apples”.



4. Divide the Work Have each member of your group read one site.

Example: Sites may be retail stores selling seeds, blogs or articles about heritage/heirloom foods, or resources aimed at farmers.



5. List Varieties List as many varieties of your chosen product as you can. What kinds of variation are there? Color, flavor, growing season?

Example: There are thousands of varieties of apples – they vary in color, size, flavor, best use, growing season, etc.



6. Share What excites you about these varieties? Are there any you particularly want to try? Are there farms, gardens, or orchards in your area that are growing any heirloom/heritage varieties?

Example: There is a kind of heirloom apple that was developed in my area. My local orchard even grows it!