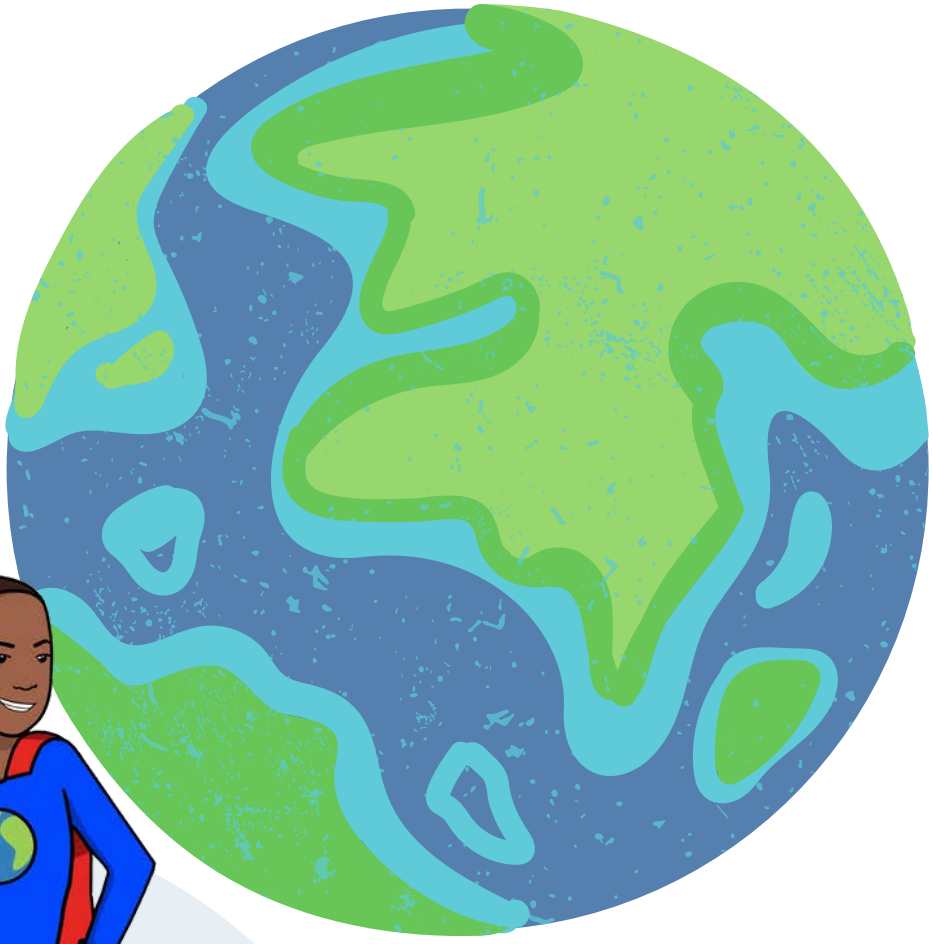
NEW JERSEY LEAVES NO BITE BEHIND

TEACHER HANDOUTS



Teacher's Guide to Basic Information on Climate Change & Food Waste

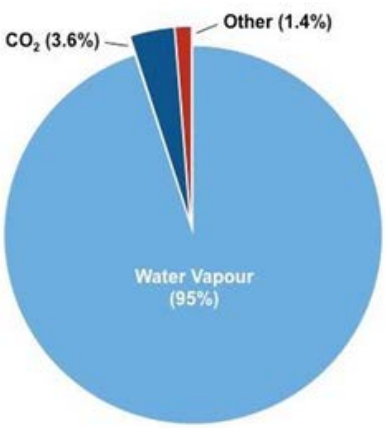
Climate Change

Climate Literacy Principles

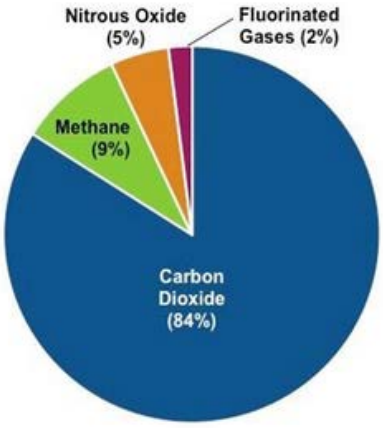
1. Principle 1: The Sun is the Primary Source of Energy for Earth's Climate System
2. Principle 2: Climate is regulated by complex interactions among components of the Earth system
    a. Interactions involve: oceanic, atmospheric, biologic, and geologic components
3. Principle 3: Life on Earth depends on, is shaped by, and affects climate
    a. Humans and animals impact on climate and the environment
4. Principle 4: Climate varies over space and time through both natural and man-made processes
    a. The main difference between climate and weather is that weather occurs over a shorter time scale (hours to days) when compared to climate (seasons and longer time spans)
5. Principle 5: Our understanding of the climate system is improved through observations, theoretical studies, and modeling
6. Principle 6: Human activities are impacting the climate system
    a. Human activities include increased levels of CO2 and greenhouse gases in the atmosphere, burning of fossil fuels, land use towards deforestation, and more
7. Principle 7: Climate change has consequences for the Earth system and human lives
    a. Consequences include but are not limited to rising sea levels, extreme weather, decline in ecosystem and human health, and increased absorption of carbon dioxide
8. Principle 8: Humans can take actions to reduce climate change and its impacts

Earth's Greenhouse Gases

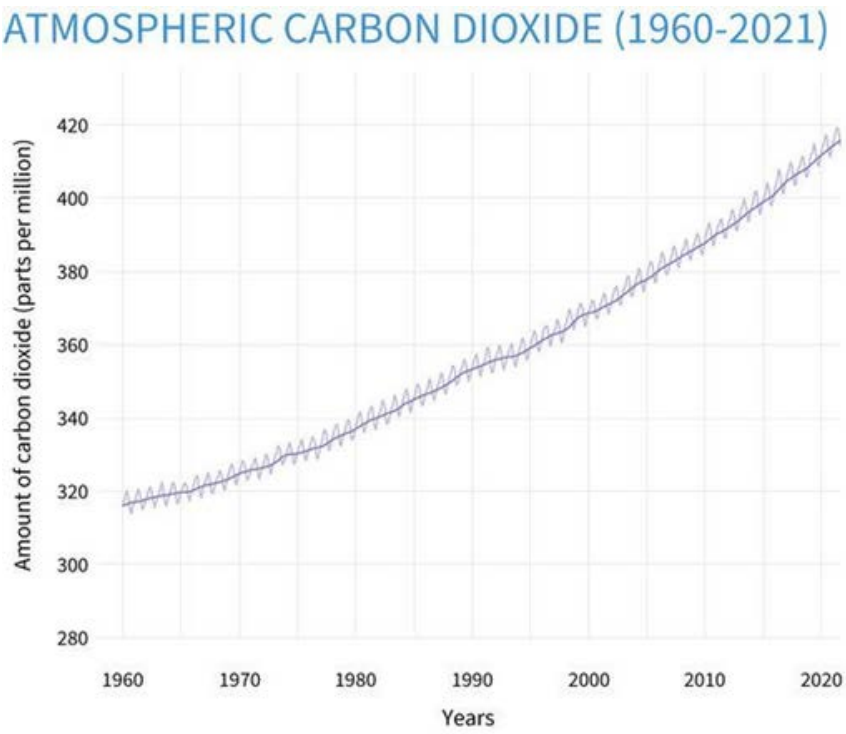
- Greenhouse gases include carbon dioxide, methane, nitrous oxides, and water vapor
- Reference the figures below to understand the breakdown of greenhouse gases in the atmosphere and man-made greenhouse gases on the rise (ie. burning of fossil fuels)



Greenhouse Gases in Atmosphere



Anthropomorphic (Man-Made) Greenhouse Gases

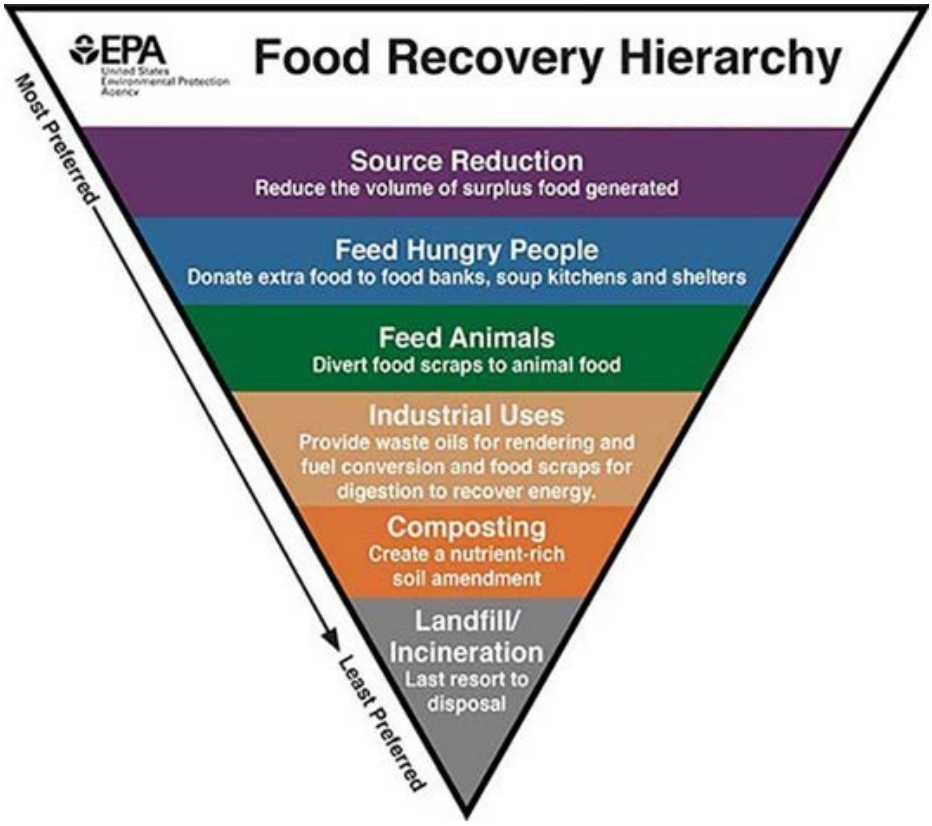


- The figure on atmospheric carbon dioxide shows the record breaking increases each year of carbon dioxide in the atmosphere which started its rise after the industrial revolution.

Food Waste

- 30-40% of the food supply in the United States is thrown away as food waste which equates to 1.3 billion tons of food wasted each year
- In 2018, 37.2 million Americans including 11.2 million children were living in food insecure households
- Food waste is not only wasting food but resources as well

- Food waste is hurting our environment through the emission of methane in landfills
- Reference the Food Recovery Hierarchy below to learn more about how best to divert food waste



References

Elnakib, S., Rowe, A., & Shukaitis, J. Food Waste 101: Understanding the Basics. NJAES and Rutgers Cooperative Extension.

Global Climate Change NASA website. What is the greenhouse effect?

Guide to Teaching about Climate. CLEAN Committed to Climate and Energy Education. Climate Literacy Principles.

Lindsey, R. & Dlugokencky, E. (June 2022). Climate Change: Atmospheric Carbon Dioxide. Climate.gov

United States Environmental Protection Agency website. Sustainable Management of Food: Food Recovery Hierarchy.

Teacher's Guide to Handouts and Figures for Lesson One

Lesson One

Phenomenon -- Time Lapse Video showing Temperature Anomalies from NASA Scientific Visualization Studio

This phenomenon helps students to see the changes to earth's global temperature over the last century (1880 – 2021) using changes in color to indicate changing global surface temperature anomalies. Anomalies are when temperature deviates from the average – so are above or below the annual global average surface temperature. Students only need to understand that the images show a warming planet over time. With the warmest years of the past century all occurring in the last 20 years.

"Collectively, the past eight years are the top eight warmest years since modern record keeping began in 1880. This annual temperature data makes up the global temperature record – and it's how scientists know that the planet is warming." (from the NASA SVS website: https://svs.gsfc.nasa.gov/4964)

A thorough explanation of the figure is provided by NASA here: https://svs.gsfc.nasa.gov/4964

You may want to play the video more than once. Guiding questions are provided in the handouts for this phenomenon to help guide the "Notice and Wonder".

This is done as a whole class.

Main Activity/Jigsaw Activity

Divide students up into six groups.

Two groups will work with Figure 1, two groups with figure 2, and two groups with figure 3.

Follow the procedure provided in the lesson plan for the activity. Students will spend about 10 minutes in their "expert groups" using the Guiding Questions provided in the handouts for each figure to help them understand and discuss the figure, and understand what it is showing them. They then return to their "home group" to learn about the other figures from their peers, and share what they learned about their figure. Every student will get a copy of all three handouts. A leader from each "expert group" should be assigned. They will make sure that everyone in their "expert group" understands which figure their group is working on, and help the group use the Guiding Questions to understand the figure. Someone else in the group can be the "Recorder". Everyone in the group should try to take some notes on their handout, so they can go back to their "home group" and talk a little about what the figure they looked at means or shows to the peers in their "home group".

Interpretive information about each figure in this activity.

Figure 1a and 1b. Arctic Sea Ice Extent from 1978 to 2016.

There are two figures here. Figure 1a. Is meant to be a guide, because it shows the geographic location of Arctic Sea Ice (at the Arctic Circle or "North Pole" between Russia, Canada, and Alaska, generally). It also shows the meaning of the different colors associated with Sea Ice Concentration (how much sea ice is present or "extent" of sea ice). White is a high percentage of sea ice, light blue is a lower percentage or concentration of sea ice, and dark blue is little or zero percent of sea ice, basically, open ocean.

The instructions in the handout ask students to use Figure 1a and the Guiding Questions provided to have a conversation, together, trying to understand what the figure is showing us

about the changes to the planet at the Arctic Circle. *They do not have to record responses to every question. The goal is to use those questions to guide a conversation in which the "expert group" tries to interpret the figure. This is true for all groups.*

A timelapse video of this data can be viewed here: https://svs.gsfc.nasa.gov/5002

FIGURE 2. Amount of carbon dioxide in Earth's Atmosphere Over the Time (also known as, the Keeling Curve)

This figure is perhaps one of the most used and recognizable of all climate change data. Called the "Keeling Curve", named for the American Scientist, Charles David Keeling, who in 1958, developed a method, still used today to measure the amount of carbon dioxide in the earth's atmosphere in Parts Per Million (PPM), it is an important one for students to understand and get familiar with.

For Parts Per Million on the Y-Axis of the graph, we provide a "text bubble" that explains that this simply means, "how much carbon dioxide is in the earth's atmosphere". This is adequate, however if a student wants to know more about this unit of measurement, you can explain that scientists use this to measure small amounts of one type of matter in a much larger type of matter. In this case, CO2 molecules in air. Here is a link to a more in-depth explanation.

Again, the instructions in the handout ask students to use the Guiding Questions provided to have a conversation, together, trying to understand what the figure is showing us about changes to the amount of carbon dioxide in the earth's atmosphere from 1958 (when we began to measure it as PPM in the atmosphere) until now. Here is a link to a daily measurement of PPM CO2 in the atmosphere if you think students may enjoy seeing this: https://keelingcurve.ucsd.edu/

They do not have to record responses to every question. The goal is to use those questions to guide a conversation in which the "expert group" tries to interpret the figure. This is true for all groups.

Clearly, CO2 levels have steadily increased since 1958. The seasonal variation every year (CO2 drops in the spring and increases in the fall) is due to the onset of spring in the Northern Hemisphere every year, which triggers photosynthesis and thus decreases CO2 in the atmosphere until the fall, when plants become dormant and stop growing/photosynthesis. For more information about Keeling Curve, go to https://keelingcurve.ucsd.edu/

To understand CO2 levels in the atmosphere for the past 800,000 years, the longest record we have, you can go to: Climate.gov https://www.climate.gov/teaching/resources/co2-ice-core-record

FIGURE 3. Figure showing NJ Greenhouse Gas Sources and Sinks.

The total amount of greenhouse gas emissions in NJ in 2018 data is shown by what percentage of those emissions come from different types of activities. Transportation includes all types of automobiles and air travel, emissions from manufacturing and industrial activities, waste, and other activities that are SOURCES of Greenhouse Gas emissions to the atmosphere. It is important to note that these activities generate emissions because FOSSIL FUELS are used to power them or directly combust for the activity (like when driving a combustion engine car or burning natural gas for electricity).

SINKS of Greenhouse Gases are things that subtract, rather than add, emissions to the atmosphere. A Negative number is used to show this in the figure. A text bubble is included in the handout to explain this as well.

This figure can be found in the NJ Scientific Report on Climate Change (2020): https://www.nj.gov/dep/climatechange/docs/nj-scientific-report-2020.pdf#page=34

Students can see that the greatest contributor to Greenhouse Gases is transportation in NJ. "As a result of its continued dependence on gas- and diesel-powered vehicles and increased vehicle miles traveled, New Jersey has seen an increase in greenhouse gas emissions from transportation despite a modest increase in fuel efficiency of the overall United States motor vehicle fleet." (NJ Scientific Report on Climate Change, 2020).
Students can notice that "Residential" emissions contribute 16% of emissions. That means things that use fossil fuels at home, such as heating and air conditioning, electricity or television and computers and the refrigerator for example.
Students will use the Guiding Questions Provided to think about and discuss what the figures are showing us. They do not have to record responses to every question. The goal is to use those questions to guide a conversation in which the "expert group" tries to interpret the figure. This is true for all groups.

CLIMATE HERO CHALLENGE

This activity is a way for students to take the information home and put it to use in their lives, to empower them to reduce emissions and think about how the choices they are presented with can limit how much they can cut their emissions. They can use the guide for ideas and record their actions on the point sheet provided. Teachers will keep track of the class's total.
Space is provided for students to add other actions that reduce emissions to their point sheet as well.

TEACHER NAME: _____ **DATE:** _____

CLASS NAME/NUMBER: _____

5th Grade Climate Change Hero Challenge!

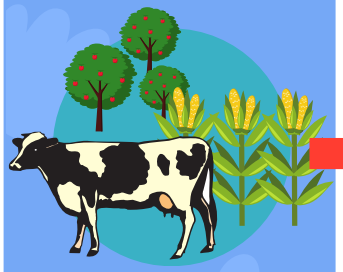
Teacher Point Sheet

Welcome to your Climate Change Hero journey!
Keep track of your students Climate Change Hero Action points.
Students are allowed to complete any of the listed actions but can only log them once.
Fill out the following page at the end of the program.

Student Name	Total Points
Total Points for Class:	

Lesson 2: Teacher Key

Production



Produce is grown and animals are raised

Harvesting

Produce is harvested by hand and machine

Food Processing

Produce is processed (washed, cut, cooked)

Packaging

Packaging depends on how the produce or animal products are processed.

Labelling

Produce is labelled with a sticker

Transporting

Food can travel up to thousands of miles by truck, plane, or boat

Retail Stage

Produce is sold in a variety of stores

Consuming

Dinner time! This is when food is eaten.

1

Disposing

2

Rolling Armadillo

Landfill or compost

1

FOOD MILES DETECTIVE: KEY

Students must uncover which food item has travelled the most Food Miles and caused the most Greenhouse Gas Emissions. Use the following clues to determine the name of your food item and calculate the total Food Miles .

HANDOUT #1

Food Suspect: Pineapple

Total Number of Food Miles: 2,964

HANDOUT #2

Food Suspect: Mango

Total Number of Food Miles: 1,237

HANDOUT #3

Food Suspect: Honey

Total Number of Food Miles: 8,637

HANDOUT #4

Food Suspect: Pork

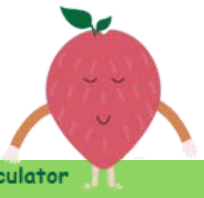
Total Number of Food Miles: 7,288

After all groups have finished, have students put the 4 food items in order from least to most Food Miles.

Extra Challenge (optional): Have students guess which food item would produce the most Greenhouse Gases BASED ON FOOD MILES (generally the highest amount of miles produces the most Greenhouse Gases)
Key: HONEY

Extra Challenge (optional): Have students guess which food item would produce the most Greenhouse Gases BASED ON FOOD ITEM (meat products produce more Greenhouse Gases due to production needs)
Key: PORK

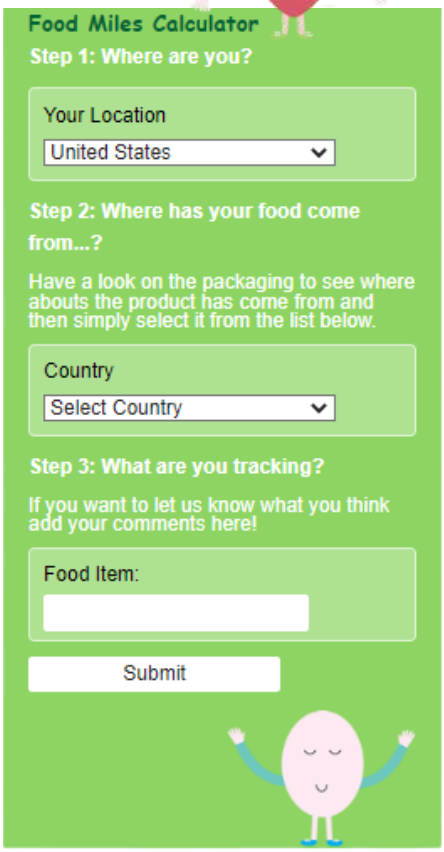
Food Miles and Shrinking our Food's Carbon Footprint:
Teacher Handout



Separate students into four groups and assign each group one of four possible handouts. Students will analyze a produce sticker to find out the country of origin and use the food miles calculator to write down how many miles it has travelled to get to the US.

After 5-10 minutes write down answers on the board and have groups work together to put food items in order (least to greatest miles).
Then, have students rank them from smallest to biggest carbon footprint.

**Idea is that students know to leave them in the same order.



Mango

Banana

Avocado

Pears