Food Up!
URBAN AG CURRICULUM

Module 7: Heating Up—Why a Changing Climate Matters to You

Goals and Objectives:

Climate change is widely considered the greatest threat to global health in the 21st century. In addition to an increase in the frequency of extreme (and dangerous) weather events and the spread of infectious disease, climate change is and will continue to have a dramatic impact on agriculture. Concurrently, conventional agricultural practices are driving climate change by burning fossil fuels to generate synthetic fertilizers and operate machinery, as well as releasing carbon dioxide via deforestation and poor land management. The connection between climate change and food is a paramount, personal reality that will impact all consumers during their lifetimes. In this lesson, students will refresh their understanding of the difference between *climate* and *weather*, explore the basics of climate change and greenhouse gasses, consider the relationships between climate change and agriculture, and make connections to their own diets and the garden.

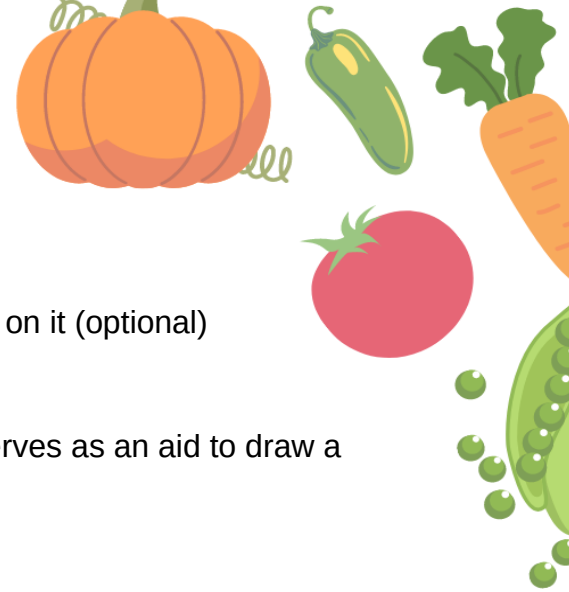
Students should walk away from this module with a better understanding of how agriculture shares a bidirectional relationship with climate change, as agriculture is both impacted by climate change and driving it forward. New agricultural strategies and a greater awareness of this relationship is needed to generate meaningful change. This module is slightly longer than some others and is best for bigger groups.

Time: 1 hour 25 minutes

Optional additional activities: 30 minutes

Materials:

- ☐ Module 1 Teacher Print Kit
- ☐ Module 1 Student Handouts
- ☐ Post-It Notes
- ☐ Open area for physical activity
- ☐ Whiteboard and markers (or large sheet of paper and markers)
- ☐ 4 large pieces of paper
- ☐ Blank paper (1 per student)
- ☐ Tape
- ☐ Pens or pencils and colored markers (if available)
- ☐ Chalk for paved spaces **or** stakes and string for grassy/field spaces
- ☐ 12 dodgeballs OR newspaper and masking tape
- ☐ 2 thermometers (for taking air temperature outside)
- ☐ A clear, jar, or vase and something to cover it (plastic wrap or a dark t-shirt)



Optional:

- ☐ A Small bag with “What are Humans doing?” written on it (optional)
- ☐ Technology to play a YouTube video
- ☐ 2 pieces of string (~ 1 foot and ~7.5 feet)
  - Note: you can do this activity without string; it serves as an aid to draw a large circle for the game

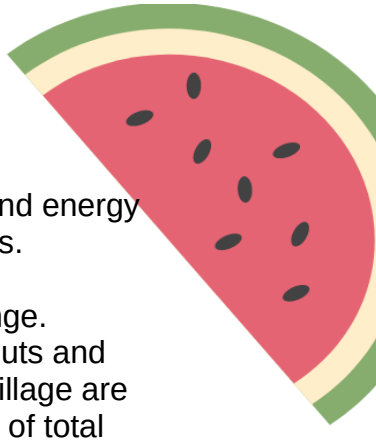
Teacher Background:

The United Nations describes climate change as “long-term shifts in temperatures and weather patterns.”[1] Importantly, these shifts may be caused by natural events, such as variations in the solar cycle. However, beginning in the 1800s, human activities have been the main driver of climate change, driven by our energy use through burning fossil fuels like coal, oil, and gas. The process of burning fossil fuels produces greenhouse gas emissions that act like a blanket around the Earth, trapping the sun’s heat and raising global temperatures significantly faster than in the past. In this lesson, climate change refers to long-term shifts in temperatures and weather patterns, mainly caused by human activities, especially due to the burning of fossil fuels.

Two major greenhouse gasses causing climate change include carbon dioxide and methane. These are emitted when we burn gasoline to drive cars, and coal to heat buildings. Clearing land and forests can also release carbon dioxide that was stored in soil and trees. Landfills for garbage and food waste, as well as livestock production (cattle, buffalo, sheep, and goat production) are also major sources of methane emissions. Industries and activities including energy, transportation, agriculture, and road construction are among the main emitters.[1]

Although our planet’s forests and oceans absorb greenhouse gasses from the atmosphere through photosynthesis and other processes, these natural carbon sinks are not able to keep up with our rising emissions. The resulting buildup of greenhouse gases causes alarmingly fast warming worldwide. It is estimated that the earth’s average temperature rose by about 1 degree Fahrenheit during the 20th century. If that does not sound like much, consider this: When the last ice age ended and the northeastern United States was covered by more than 3,000 feet of ice, average temperatures were just 5 to 9 degrees cooler than they are now. The last decade—2010 2019 — was the hottest decade in the last 1,300 years.[2]

Climate change will impact all industries to some extent, but perhaps the most visible impact will be on agriculture. Climate change on the food system is already being felt locally, regionally, and globally. Warmer temperatures influence agricultural pests, diseases, food storage, and causes food safety issues.[3] Overall, climate change will have a negative impact on food production, with less availability and affordability for food. Globally, the risks will be the greatest in tropical regions and for the poor. The risks go beyond agricultural production, with impacts to the highly integrated food



system infrastructure. Transportation systems, equipment manufacturing, and energy access will be impacted by extreme weather conditions and rising sea levels.

However, some agricultural management practices are driving climate change. Industrial and conventional farming systems, reliant on energy intensive inputs and practices, such as synthetic fertilizer, heavy fossil-fuel run equipment, and tillage are major culprits. Livestock production alone accounts for a significant percent of total greenhouse gas emissions globally, and clearing land to feed livestock is especially problematic. New farming strategies are needed to help us adapt to a changing climate and reduce the implications of agriculture on the environment.

Opening Discussion:

Before jumping into details about climate change, agriculture, and health, start with a discussion on personal experiences relating to weather and climate change.

- *Has your life ever been directly impacted by a weather event or climate change? How so?*
  - Flooding of property, evacuation due to a fire, loss of farm revenue, car accident in a snowstorm, hailstorm damage to a car or house, missing school due to heatwave or polar vortex…
- *In the examples you just gave, do you think other people in your community were negatively impacted by the event? How so?*
  - Higher costs for goods and insurance due to variability in the weather
  - Loss of wages due to closures
  - Missed school with academic consequences
  - Negative health impacts

Thanks for sharing your experiences with weather and climate change. In today's lesson, we will investigate the connection between climate change, agriculture, and the food we eat.

Activity #1: What is climate? Reviewing your closet

Time: 10-15 minutes

Materials:

- ☐ Teacher Print Kit
  - ☐ Includes: Weather vs Climate Graphics (pages 4-5)
- ☐ Student Handouts (print 1 copy per 2 students)
  - ☐ Includes: Weather vs Climate Graphics (page 2)
- ☐ White board (or a large sheet of paper) and markers
- ☐ Post-it Notes

Optional:

- ☐ Technology to play YouTube videos

Prep: Gather materials and make sure you have a clean writing space

Lesson:

Start by helping students differentiate climate from weather.

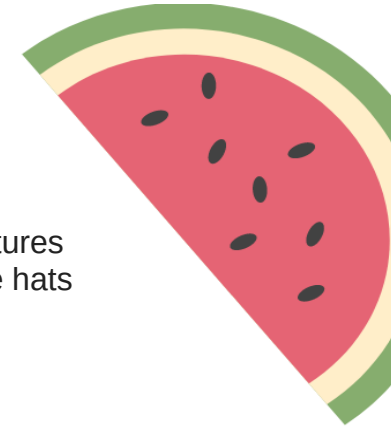
1. Draw two columns on the white board or on a large piece of paper. Title one column 'WEATHER' and the other 'CLIMATE.'

2. Discuss: *What is the difference between climate and weather?*
   - Note: The difference between weather and climate is a measure of *time.* Weather is the conditions of the atmosphere over a short period of time, while climate is how the atmosphere "behaves" over relatively long periods of time.[4]

   - Another way to think about this difference is as follows: Weather occurs on a local, small-time horizon, and includes forecasts. Climate happens at regional or global scales, over a long-time horizon (decades to centuries). We use models and big data to make climate predictions.

3. Once the students understand the basic difference, write the word TIME in between the two columns, or draw a symbol of time, like a clock.

4. Next, ask your students to think of climate vs. weather as a **closet filled with clothes and accessories.** Write the following under each column for the students to see:
   - **WEATHER** → Tells you what to wear each day.
   - **CLIMATE** → Tells you what type of clothes to have in your closet.



5. Pass out several sticky notes per student and ask them to draw pictures of all items they might have in their closet: clothing, accessories like hats and gloves, umbrellas, boots, etc.

6. Next, have student volunteers come up to the board and stick their drawings in the appropriate columns. Students will post clothing appropriate for the current day in the WEATHER column. Other clothes appropriate for your climate, but not necessarily today's weather, will be posted in the CLIMATE column.
    - For example, on a hot summer day in Wisconsin, students might post their sandals under the WEATHER column, but their sweatshirt or winter boots would go under the CLIMATE column. Note that items can certainly go in both columns! Keep the discussion flowing as students post on the board.

    - See page 5 of the Teacher Print Kit for an example closet from NOAA National Centers for Environmental Information.

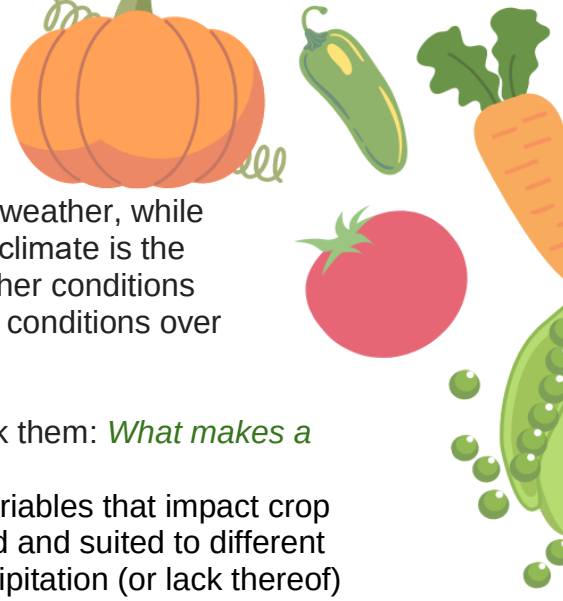
7. Next, repeat the CLIMATE column of the closet activity for a location as far away as you can think of… perhaps Iceland, Egypt, or a tropical island. Help the students think about what a closet might look like in this location. For example, in Egypt and across the middle east, you are likely to find lots of lightweight clothing, such as *kaftans* (a long lightweight garment with wide sleeves and often a sash), and fewer winter coats and boots.

8. Discuss: *What are the major differences between these two climates? Why does the climate matter?*
    - Example: The differences between these climates can mean different lifestyles, industries, crops, plants, and animals. Extreme climates (dry, wet, hot, or cold) are more difficult for human existence and farming than more moderate climates.

9. Optional (5 mins): Write the following statements on the board.[5]
    - *The temperature in New York City averaged 82 degrees Fahrenheit on July 20, 2010.*

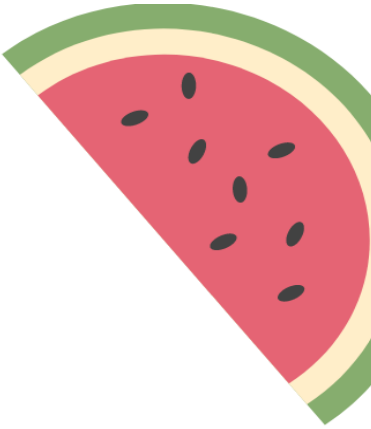
    - *The temperature in New York City averaged 77 degrees Fahrenheit for the month of July between 1981 and 2010.*

    - Ask students to reflect on the difference between these two statements. *What is similar about the measurements? What is the difference?*



- If needed, explain that the first statement describes weather, while the second statement describes climate. A region's climate is the temperature, precipitation, humidity, and other weather conditions over a long period, whereas weather refers to those conditions over a short period of time, usually hours or days.

10. Lastly, to prepare students for later lesson sections, ask them: *What makes a climate good for growing food?*
    - Note: This is an opportunity to bring up the many variables that impact crop growth and mention that different plants are adapted and suited to different climates, but that extremes in temperature and precipitation (or lack thereof) make it harder to farm… think deserts and Antarctica.



Activity #2: What is climate *change?* Meeting the greenhouse gases; a game

Time: 30 minutes

Now that your students know what "climate" means, help them understand, in basic terms, what "climate change" means.

[NOTE: this lesson is not intended to make an *argument* for why climate change is real. This is settled science; 97-99% of climate scientists agree that climate change is happening because of human activities. If you have students with questions about the evidence of climate change, the resources listed at the end of this module and provided in the teacher print kit will help you respond.]

Materials:

- ☐ Student Handouts
  - ☐ Includes: The Greenhouse Gas Effect: A Car Example (page 3-4)
  - ☐ Includes: Human Action Cards (Pages 6-7)
- ☐ Scissors

For Greenhouse Effect Game (for 8+ participants):

- ☐ Open area for game
- ☐ 2 pieces of string ~ 1 foot (30 cm) and ~7.5 feet (230 cm) long
  - Note: You can do this activity without string; it just serves as an aid to draw a large circle for the game
- ☐ Chalk for paved spaces **or** stakes and string for grassy/field spaces
- ☐ 12 dodgeballs **or** newspaper and masking tape
  - Ask students to make simple balls by balling up newspaper and using a bit of masking tape to bind the paper into balls.

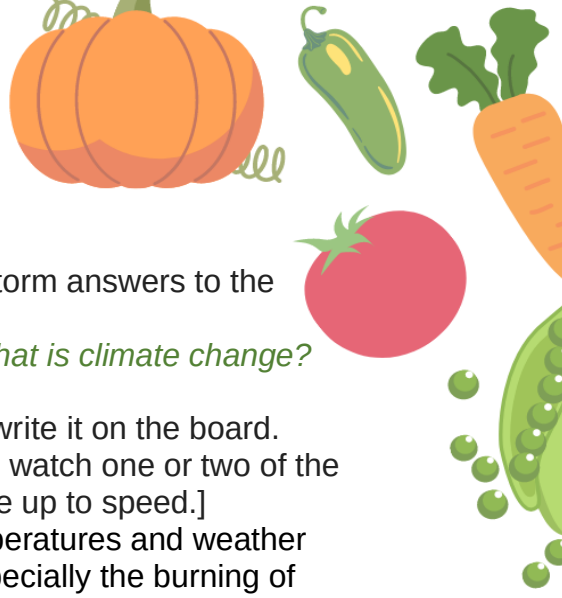
Optional:

- ☐ Technology to play YouTube videos
- ☐ Small bag with "What are Humans doing?" written on it

Note: This game requires 8+ participants; it works best with even more people, up to 20-25.

Prep:

Draw a 2-foot (60cm) circle on the ground by holding one end of the short string in one place and using chalk attached to the other end to make the circle.
This circle represents the Earth. Draw a larger, 15-foot (460cm) diameter circle around it using the longer string. This circle represents the Earth's atmosphere.



Lesson:

1. Begin by discussing *climate change* as a group. Brainstorm answers to the following question and write some ideas on the board:
    - *Now that you understand weather vs. climate, what is climate change?*

2. Suggest the following definition of climate change and write it on the board. [NOTE: If this feels like a difficult starting point, you can watch one or two of the optional background videos listed below to get everyone up to speed.]
    - Climate change refers to long-term shifts in temperatures and weather patterns, mainly caused by human activities, especially the burning of fossil fuels.

3. Discuss: *What are some examples of climate change visible today? Why do such changes matter?*
    - More frequent and extreme weather events, including more frequent heat waves, more intense droughts, changes in atmospheric and ocean circulation, ocean acidification, sea level rise, changes in pest and disease presence.

    - Consider: social, environmental, health (including mental health), and economic impacts

4. Now ask your students, *what causes climate change?*
    - This is your opportunity to discuss **greenhouse gases** and the **greenhouse effect**.

    - In very simplified terms, certain gases in the atmosphere—often called greenhouse gases—block heat from the sun from escaping, which leads to warming. Similarly, a greenhouse is full of windows that let in sunlight. That sunlight creates warmth, which cannot escape those same windows.

    - Human activities, such as burning fossil fuels, have dramatically **increased** the concentration of greenhouse gases in Earth's atmosphere, warming the planet. However, our planet would have been in cooling period today without human intervention.[6]

    - Explain (and reiterate) that greenhouse gases are gases that trap heat. **Carbon dioxide (or CO_2)** is the most discussed greenhouse gas. It is also often used as a metric for estimating the impacts of all greenhouse gases: water vapor, methane, ozone, nitrous oxide, chlorofluorocarbons.

Note: Human activities are causing climate change. It is true that the climate has changed in the past, and throughout the history of the Earth. What is most striking about our current situation is the **accelerated speed at which the climate is changing**.

5. Display the “The Greenhouse Effect: A Car Example” image (page 3 in the Student Handouts). *Have you ever gotten into a car on a warm day and found the car to be much, much hotter than the air outside? This is actually a great example of the greenhouse effect!* Walk through the graphic using the Greenhouse Gas Effect Notes on page 4 of the Student Handouts.
    - *That’s exactly how greenhouse gases act. They let sunlight pass through the atmosphere, but they prevent the heat that the sunlight brings from leaving the atmosphere. Overall, greenhouse gases are a good thing. Without them, our planet would be too cold, and life as we know it would not exist. But there can be too much of a good thing. Scientists are worried that human activities are adding too much of these gases to the atmosphere, which is leading to warming of the Earth over time.*

6. *Now you are ready to play the **Greenhouse Effect Game!***
    - This game demonstrates the greenhouse effect by showing how carbon dioxide in the atmosphere traps some of the sun's heat, insulates the Earth and allows life to survive. It also shows what happens when human actions affect the concentration of greenhouse gases in the atmosphere.

    - Allow about 20 minutes for the game and explanations. Follow the instructions above to prepare to play. This game is played in 3 rounds or more. Each round takes about 30 seconds.

7. **Round 1**. Two students are the keepers of the CO_2 molecules, represented by the dodgeballs. Provide one ball each to the keepers. These students should stand anyone inside the ‘atmosphere’ circle, outside the Earth.
    - They must not move their feet during the game. (**Note**: this is optional based on the size and activity level of your group).

    - All other students are the sun's rays. They start outside the atmosphere and must try to reach the "Earth" (to touch it with a hand or foot) and then escape through the atmosphere without being touched by a CO2 molecule. The CO_2 keepers will throw the dodgeballs to tag rays within the bounds of the atmosphere. (Another option is to have students tag on another with a ball.)

    - Rays that are touched by a CO_2 molecule (dodgeball) while in the atmosphere must stay standing still in the "atmosphere".

    - Rays must only try to reach Earth once.

    - Rays that have escaped into space then make a circle around the atmosphere. *You can time this for 30 seconds.*

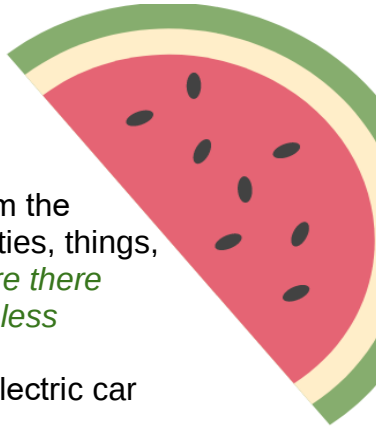
- Discuss: How many rays have been trapped in the atmosphere by CO2 molecules? This represents the amount of heat energy from the sun that has been trapped in the atmosphere, which is called the greenhouse effect. Discuss how this affects the temperature of Earth. Remember that a certain amount of CO2 is required to keep the planet warm enough to support life.

8. **Round 2**. What happens if the amount of CO_2 in the atmosphere is increased?
    - Firstly, remove any sun's rays that were trapped in Round 1.
    - Place 4 Human Action Cards (pages 6-7 in Student Handouts) in the bag. [Cards are color coded: Red cards add carbon dioxide to the atmosphere and Green cards reduce CO_2 (sequester or remove it).]
    - Take a Human Activity card out of the bag and read the card. Add the appropriate number of CO_2 molecules (dodgeballs) to the two that are already in the atmosphere by handing them to the CO_2 keepers.
    - Play the game again and discuss what happens.

9. **Round 3** and following rounds. Add all the Human Action Cards to the bag. Repeat the game, picking a Human Action card out of the bag. As you repeat the game, do not remove CO_2 molecules between rounds unless indicated by a human action card (this will allow illustration of CO_2 concentrations in the atmosphere to go up and down), however do remove rays between each round so that the number of CO_2 molecules can go up even more, or go down. If the numbers of CO_2 molecules become too much for the keepers to handle, a teacher or two can come in to help.

Note: The game should illustrate that when the amount of CO_2 increases, more of the sun's heat energy gets trapped, and the temperature of the Earth goes up. Burning fossil fuels is one of the main ways humans increase the amount of CO_2 in the atmosphere. When human actions reduce the amount of CO_2 in the atmosphere, the greenhouse effect is less strong.

10. Debrief: Create two columns on the board, and head one column with “Adds CO_2” and the other with “Removes CO_2.”
    - Start with “Adds CO_2.” Brainstorm: *What actions do humans take to add CO2 and other greenhouse gases to our atmosphere?* Encourage students to think of anything they do that requires energy and think of how that energy is made. Think of items they own, or places that they go. How are these items made and delivered? How are these places heated and cooled?



- Next, address the "Removes CO_2 column." Using your list from the "Adds CO_2" column, brainstorm ways to enjoy the same activities, things, and places, without emitting as much CO_2 from fossil fuels. *Are there alternatives to some activities that would work well but create less greenhouse gases?*
  - Examples: Car emissions→Ride the bus→Ride in an electric car plugged into a solar grid
  - Methane emissions from cows→Choose to eat chicken instead of beef

11. Discuss: *Why is more CO_2 in the atmosphere bad?*
    - While CO_2 is both a natural, necessary substance in our atmosphere, it is also a pollutant in high concentrations.

    - High levels of CO_2 are trapping heat and warming the planet, which means more extreme weather events, more acidic oceans impacting fish, global ecosystem shifts that may impact exposure to allergens, infectious disease spread, more mental health burden from heat waves and ecoanxiety.

12. *What change can you make this week that will reduce your greenhouse gas footprint?*

Optional Background Videos:

- *What's the Big Deal With a Few Degrees?* By Global Weirding with Katharine Hahoe – 9:04 mins. https://www.youtube.com/channel/UCi6RkdaEqgRVKi3AzidF4ow

- *How Global Warming Works in Under 5-minutes* by the University of California. https://www.howglobalwarmingworks.org/in-under-5-minutes-ab.html

- *Climate Change 101 with Bill Nye* by National Geographic - 4:06 mins. https://www.youtube.com/watch?v=EtW2rrLHs08

- *The Greenhouse Effect* by the U.S. Environmental Protection Agency – 1:55 mins. https://www.youtube.com/watch?v=VYMjSule0Bw

Optional Alternative Activities and Versions of the Game:

- Climate Centre. (2017). Greenhouse Gas Game.

- UCAR Center for Science Education. (2018). Greenhouse Gas Game.

Activity #3: No Rain, No Gain – How a changing climate is stressing our farms

Time: 20 minutes

Materials:

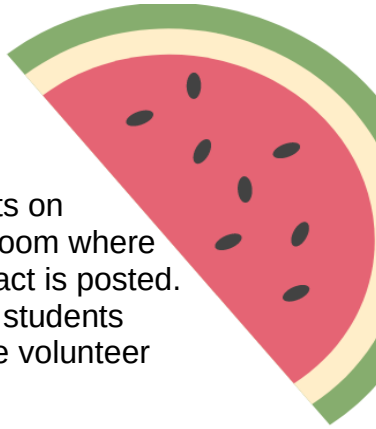
- ☐ Student Handouts
  - ☐ Includes: Drought Image (page 8)
- ☐ Teacher Print Kit
  - ☐ Climate Change Impacts Teacher Guide (page 8)
  - ☐ Climate Change Impacts on Agriculture (page 9)
- ☐ Large Paper
- ☐ Markers
- ☐ Tape

Lesson:

1. Display or pass around the Drought Image (page 8 in the Student Handout or page 7 in the Teacher Print Kit). Ask: *What happened to these crops? How might climate change have been responsible?*
   - These Texas corn crops were killed by drought—one extreme weather event that occurs *more frequently* because of climate change. Ask students to brainstorm other climate change-related events.
     - Rising sea level
     - Extreme heat
     - Changes in rainfall patterns
     - More frequent and intense extreme weather events (e.g., droughts, hurricanes, flooding)

2. Next, help students explore how different aspects of climate change impact agriculture. Write each aspect of climate change (listed in blue above) on large pieces of paper and post them around the room.

3. Then display and read the **Climate Change Impacts on Agriculture Slide** (page 9 in the Teacher Print Kit) or write the following impacts on the board:
   - Loss of topsoil
   - Fungus invasion in corn crop
   - Saltwater contamination of freshwater supply
   - Increased cost to fight weeds
   - Increase in a crop's water needs
   - Higher food prices
   - Depletion of freshwater sources for irrigation



4. Next start the movement activity. Read each Climate Change Impacts on Agriculture aloud and direct the students to move to the area of the room where the aspect of climate change they believe is responsible for that impact is posted. Once students have made their choice, give each group of gathered students one to two minutes to discuss why they selected this aspect. Ask one volunteer from each group to share with the class.

5. Use the **Climate Change Impacts Teacher Guide** to respond to students' explanations and facilitate discussion. For example, for the impact "Loss of topsoil," students could move to "Extreme heat" because it dries out the soil and makes it vulnerable to being blown away.

6. Next, briefly discuss how students can adapt to these issues in the garden. For example, mulching can help soils retain water. Adding organic material like compost can help increase soil fertility and build topsoil. Planting perennial crops or trees can also help hold and build soil, preventing erosion.

Connecting to the Garden

Note: This optional activity requires you to be outside for a bit; it can be set up to run while you are working in the garden. The purpose of this activity is to demonstrate the greenhouse effect using temperature readings.

Time: 5-10 minutes (spaced over 1 hour)

Materials:

- ☐ Student Handouts
  - ☐ Includes: Two Thermometers Greenhouse Effect Recording Sheet (page 9)
- ☐ Two thermometers (for taking air temperature outside)
- ☐ A clear bowl, jar, OR vase and a cover (plastic wrap or a dark t-shirt)

Lesson:

1. Lay both thermometers outside for a few minutes in a sunny area. Mark down the time and the baseline temperatures of both thermometers on your record sheet.

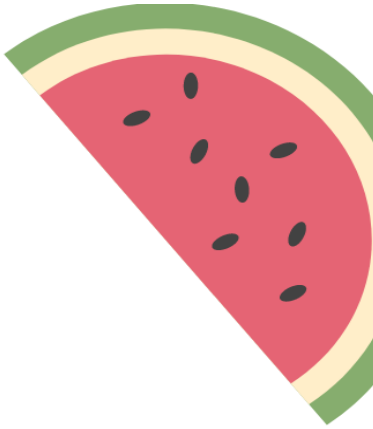
2. Place a vase in the sun with a thermometer in it. Cover it with a plastic wrap or a dark t-shirt.

3. Place the second thermometer next to the bowl (not in the shade). Ensure that the thermometer sensor is not touching a surface and is only exposed to air. Usually, laying a thermometer down on its side achieves this.

4. Record the temperatures on both thermometers every 5-10 minutes for about 1 hour. Ask two student volunteers to be “temperature checkers” in charge of recording these data. Use an audible timer to remind these students to return to the thermometers to record the temperature.

5. Look at the trend in temperatures and note which thermometer is typically reporting higher temperatures. Ask and discuss: *Why are the temperatures inside and outside of the vase different?*

   Note: Solar energy (light) enters the vase, becomes thermal energy (heat) and becomes trapped. As more and more light enters into the vase, it becomes warmer and warmer. This is like the greenhouse effect. The second thermometer is not trapped in a confined space. Because it is in the air, the thermometer is exposed to a mixture of both warm and cool air.[9]



Activity #4: Is your food warming the planet?

Time: 15-20 minutes

Materials:

- ☐ Blank Paper (1 per student)
- ☐ Markers
- ☐ Student Handouts (print 1 copy per 2-3 students
  - ☐ Includes: Food System Greenhouse Gas Emissions (page 10) and Food Waste (page 11)
  - ☐ Includes: Climate Food Flashcards (pages 12-20)

Lesson:

1. Start by asking your students how agriculture might be causing climate change. *Does growing food lead to greenhouse gas emissions? How do you think agriculture might contribute to climate change?*

   Yes, it does. Remind your students that historically, agriculture has been a major source of human caused CO2 and methane emissions—two greenhouse gases that are contributing to climate change. Farming practices like tilling the soil, manufacturing pesticides and fertilizers, and rearing cows who produce manure, all contribute to emissions.

2. Next, distribute 1 piece of blank paper and markers / pencils / pens to each student. Ask them to draw a plate depicting the dinner that they ate yesterday – including all beverages, desserts, and sides. Give them 5 minutes or so to draw.

3. Discuss: *All the foods on your plates originated on a farm. Do you think these foods may have different impacts on the environment or lead to different greenhouse gas emissions? Why?*

4. Display the “Food System Greenhouse Gas Emissions” slide (or distribute copies). Tell students to examine the charts and ask: *Which areas of the food system are responsible for the most GHG emissions? Are these statistics surprising? Why? What causes a food to generate more greenhouse gas emissions than another food?*

   Certain foods contribute more to climate change than other foods. Depending on the knowledge/age level of the group, engage in a conversation about the most carbon intensive foods and what goes into that number (growing feed for animals, using synthetic/chemical Nitrogen fertilizers, manufacturing pesticides, moving up the food chain, transportation, keeping cold or frozen, etc.).

5. Divide students into groups of 2-3. Distribute one copy of the **Climate Food Flashcards** to each group (pages 12-20 in the Student Handouts).

6. Ask the group to select one team member's meal to analyze. First, they should find cards with foods that closely remember the selected diet. For example, if the student drank a Coke, use the "Fizzy Drink" card. If they ate French fries, suggest they use "Potato" and "Vegetable Oil." Don't worry about the serving sizes for this activity, just use the portion listed on the card for each food eaten and include it once for each meal item containing that food.

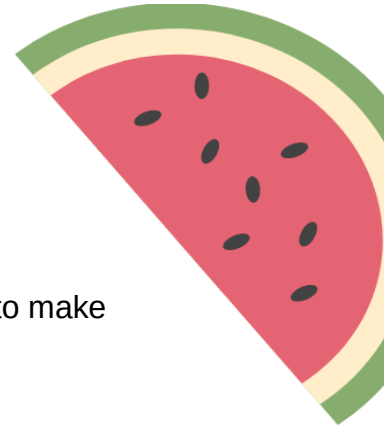
7. On a blank sheet of paper, ask the students to add up the total equivalent Driving Minutes (shown in the black circle of each card) for the meal. Ask the students to report the driving minutes summary to the class and discuss why the numbers may vary across groups / meals.

8. Next, ask the students to substitute items in the meal to reduce the emissions and driving time equivalent of their plate. They should write down any changes and add the driving time numbers again. Ask each group to report the driving minutes summary to the class of their revised meal and discuss why the numbers may vary across groups / meals.
    - *How did you reduce the emissions from your meal?*

9. Lastly, display the Food Waste images (page 11 in the Student Handouts) and discuss sources of emissions from food waste. Food gets lost or wasted all along the farm-to-fork supply chain. Food is lost on farms, during harvesting, processing, and storage. It's wasted in retail stores, school cafeterias, and in homes. Around one-third of it is lost or wasted in the US, from the time it is produced until it is consumed.
    - *What impact does food waste have on climate change? Why do we waste so much food? Where in the food supply chain is food lost or wasted?*

Optional: Show the below video which discusses diets and population size.

- The easiest ways to fix climate change is population control and going vegan - right? With Dr. Katharine Hahoe (7.5 mins) https://www.youtube.com/watch?v=KwejlpXK7ls
- Understanding Food and Climate Change - an interactive guide (Center for Ecoliteracy). https://foodandclimate.ecoliteracy.org/interactive-guide/cover.xhtml



Closing Discussion:

Aim to end on a positive note, letting students brainstorm their own power to make change.

- *What effects of climate change feel most important to you?*
- *What power do you have to reduce damage to the Earth in your everyday life?*
- *What power do others have to influence climate change? What are ways that you can influence others to act to mitigate climate change?*
- *What are some ideas or ways we could reduce our emissions or address climate change through how we grow and eat food?*

If you need ideas on potential solutions to discuss with your students, consider some ideas provided by the Center for Ecoliteracy (2018) outlined in their interactive guide, Climate Change Basics: Understanding Food and Climate Change. The final section titled *Promising Strategies for Addressing Climate Change* is particularly useful.

Optional:

- The Johns Hopkins Center for a Livable Future's original short film, Growing Solutions (42 minutes), shows how farmers are innovating to protect and regenerate the resources needed for a secure farming future, especially in the face of climate change. The film features a farmer who's growing topsoil; seed-saving high schoolers; a farmer training program for military veterans; a communal system for water conservation; and a perennial style of farming that mimics the prairie. A discussion guide is also provided.

References:

Teacher Background:

1. The United Nations, The Science: Climate Action Page (2022). https://www.un.org/en/climatechange/what-is-climate-change
2. The National Resources Defense Council, 2022. What is Climate Change?
3. Center for Ecoliteracy, 2018. Climate Change Basics: Understanding Food and Climate Change: An Interactive Guide.

Activity 1:

4. Definition from NASA (2005). "What's the difference between weather and climate?"
5. This part of Activity 1 was adapted from Unit 2 Lesson 5: *Our Changing Climate* from the *Foodspan* curriculum created by the John Hopkins Center for a Livable Future (2020).

Activity 2:

6. Global Climate Change. The Causes of Climate Change. NASA.

   The Greenhouse Effect Game adapted from The Saiga Resource Center, 2018. Activity: Greenhouse Effect Game.

Activity 3:

Adapted from Lesson 2, Module 5: *Our Changing Climate* from the *Foodspan* curriculum created by the John Hopkins Center for a Livable Future (2020)

Connecting to the Garden:

Adapted from Kids Mind, Lessons: The Tale of Two Thermometers. How to Explain the Greenhouse Effect to Kids (with printables).

Adapted from Section 9, Unit 6: *Systems for Survival* created by Michelle Romanelli of the Yale-New Haven Teachers Institute.

Activity 4:

Climate Food Flashcards borrowed from the Greenhouse Gas and Dietary choices Open-Source Toolkit.

Information on food waste from the Center for Ecoliteracy, 2018. Climate Change Basics: Understanding Food and Climate Change: An Interactive Guide.

Closing Discussion:

Center for Ecoliteracy, 2018. Climate Change Basics: Understanding Food and Climate Change: An Interactive Guide. Promising Strategies for Addressing Climate Change.