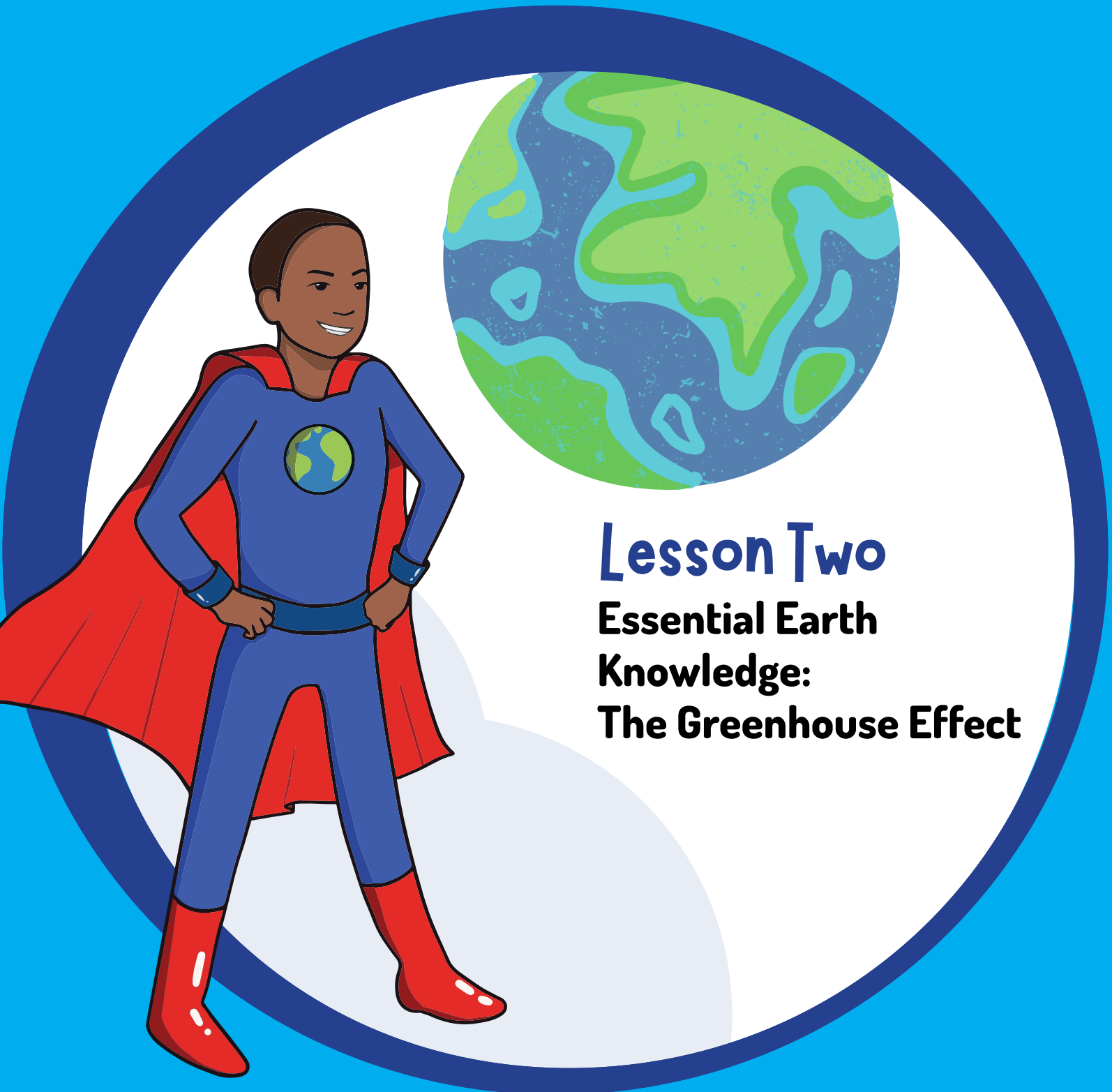
RUTGERS–NEW BRUNSWICK
School of Environmental and Biological Sciences



# Lesson Two

## Essential Earth Knowledge: The Greenhouse Effect

USDA NIFA
New Jersey Department of Environmental Protection
Robert Wood Johnson Foundation

# Lesson Two

## Lesson Overview

As a foundation for thinking about the relationship between food and climate change, students will develop a basic understanding of how human activity, through the greenhouse effect, is influencing the climate system. Lesson 1-3 grounds students in an understanding of the greenhouse effect, components of the climate system, the origins of different greenhouse gasses, and how human activity, by adding greenhouse gasses to the atmosphere, is affecting the conditions for life on Planet Earth.

## Next Generation Science Standards

***5-ESS3-1***: Obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment.

***5-ESS2-1***: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

### Science and Engineering Practices

- Developing and using models.
- Obtaining, Evaluating, and Communicating Information.

### Cross Cutting Concepts

Systems and system models

### Disciplinary Core Ideas

**ESS3.C**: Human Impacts on Earth Systems
**ESS2.A**: Earth Materials and Systems

## Driving Question(s)

- How do different gases in Earth's atmosphere affect the temperature of the planet?
- Which human activities generate greenhouse gases & which activities can remove them?

## Observable phenomena

Glass thermometers & jar climate observation – Set up the thermometers with the procedures below. Provide students with the starting temperature for both thermometers. Then have students predict what they believe will occur with the temperatures as well as why they have made this prediction.

*Blue italicized words are web links for more information.*

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## Learning Objectives

Students will be able to:

- Recall that earth's atmosphere is a component of an inter-connected climate system.
- Identify 2 activities that currently cause the emission of greenhouse gases.
- Describe 2 things that can reduce GHG emissions.

## Behavior Change Objectives

As a result of the lesson, students will:

- Discuss two new habits they will try out to reduce the amount of greenhouse gases created from their activities.
- Students will suggest specific ways that greenhouse gas emissions connected to food can be reduced.

## Keywords

**systems | components | greenhouse gases | carbon dioxide | atmosphere methane | energy | global warming | climate system | fossil fuels greenhouse effect | interaction**


## Sources used in the development of this lesson


- Baede, A.P.M., et al. 2001. "The climate system: An overview," in Houghton, et al., eds., Climate Change 2001: The Scientific Basis, pp. 85-98. Intergovernmental Panel on Climate Change 2001. New York: University Press. ***ipcc.ch/site/assets/uploads/2018/03/TAR-01.pdf***
- Environmental Protection Agency. 2022. "Greenhouse gas (GHG) emissions and removals." ***epa.gov/ghgemissions***
- NJCTL 5th grade Human Impacts on Earth Unit – Greenhouse Effect Lab ***njctl.org/materials/units/human-impacts-on-earth/?open=Lab***
- The Concord Consortium Global Climate Change Model: Making Predictions About Future Climate ***learn.concord.org/resources/856/global-climate-change-model-making-predictions-about-future-climate***


## Before you Begin

- Review the Glass Jar Phenomenon demo and set up prior to students.
- Review the eLearning game and corresponding worksheet. Prepare to show slides to class.
- Make enough copies of handouts.

*Blue italicized words are web links for more information.*

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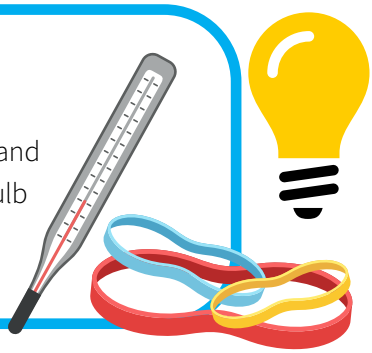
## Materials

- Presentation Slides and Worksheets
- Computer/Chromebook/Technology
- 2 Glass Thermometers
- 1 Glass Jar
- Plastic Wrap
- Rubber Band
- Lamp with adjustable stand
- 80 watt or higher light bulb
- Timer
- Exit Ticket



## Lesson

### 1st Review

1. As a class, review the image that demonstrates the greenhouse effect. Ensure that students understand what is going on in the image by having a brief class discussion.

### 2nd Phenomenon: Glass thermometer & jar climate observation

1. Set up prior to class starting:
   - Use two identical glass thermometers.
   - Find a spot in the classroom to set up a heat lamp. Determine the length of time to let the heat lamp heat up the thermometers but wait until the beginning of class to place thermometers under the lamp so students can make their prediction.
   - Place one thermometer inside a glass vase or jar and cover it with plastic wrap, sealing the jar with a rubber band. Make sure the thermometer is fully enclosed in the glass and that the top of the jar or vase is sealed.
   - Place one thermometer in the open air, next to but not touching the first thermometer in the vase or jar.
2. Show students the two thermometers set up next to the lamp. Ask the students to think about what they think will happen to the temperatures of each thermometer once the lamps are turned on. Provide the students with the starting temperature to help with their prediction. Give students a chance to write down their prediction and to give a reason why they made this prediction by completing the Notice and Wonder handout in the workbook. Depending on time, teachers can lead a discussion of students sharing their predictions and why.
3. Let the class know that throughout their lesson they will check on the thermometers to take readings of their temperatures. You can have students pick how long they want to wait to check the thermometers but would suggest at least taking the temperate 2 times throughout the lesson. Depending on class time and instruction, teachers can choose to have students check on the thermometers every 30 to 60 minutes. Students should note both temperature readings and 1-2 observations.
4. Teachers can decide how long to leave the thermometers under the heat lamps or how long to continue this activity. Teachers can try days with noticeably different temperatures or study the changes over a week of school. Teachers led discussions on observations and related them to effects of greenhouse gases.

# Procedure

### 3rd eLearning Activity / Game: Earth's Climate System

1. Together as a class, demonstrate the eLearning Activity: Earth's Climate System. Allow students to review and play this eLearning Activity. Instruct students to complete the corresponding worksheet as they play. Tell students where to find the game online and that they can play it at home or during their free time if permitted.

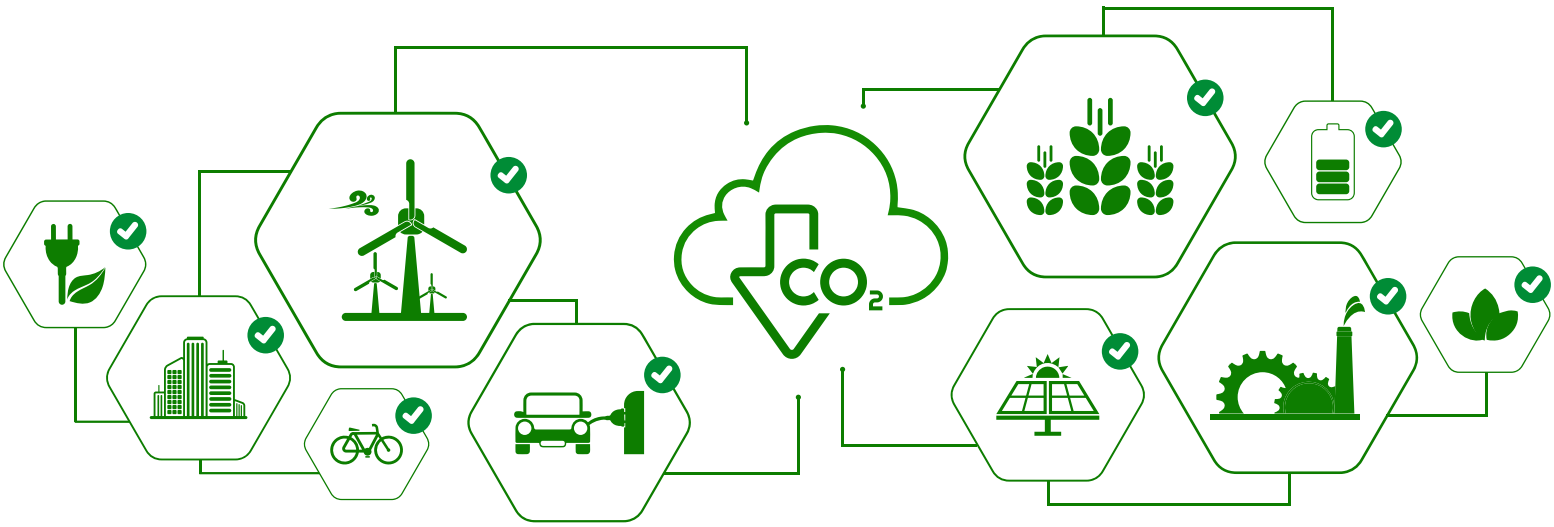
### Exit Ticket

**Learning Reflection**

1. Teacher passes out Exit Ticket
2. The teacher collects exit tickets and reviews student answers. Make minor adjustments to the next lesson based on data received.


### Lesson Extension & Extra Resources

- Meet the Greenhouse Gases! NASA Climate Kids. ***climatekids.nasa.gov/greenhouse-cards***
- 6 cards hand out to students one per student to read over and better understand their gas – share out as class after learning about their gas (can also do a student sheet to fill in information or have them use computer and look at them online).

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