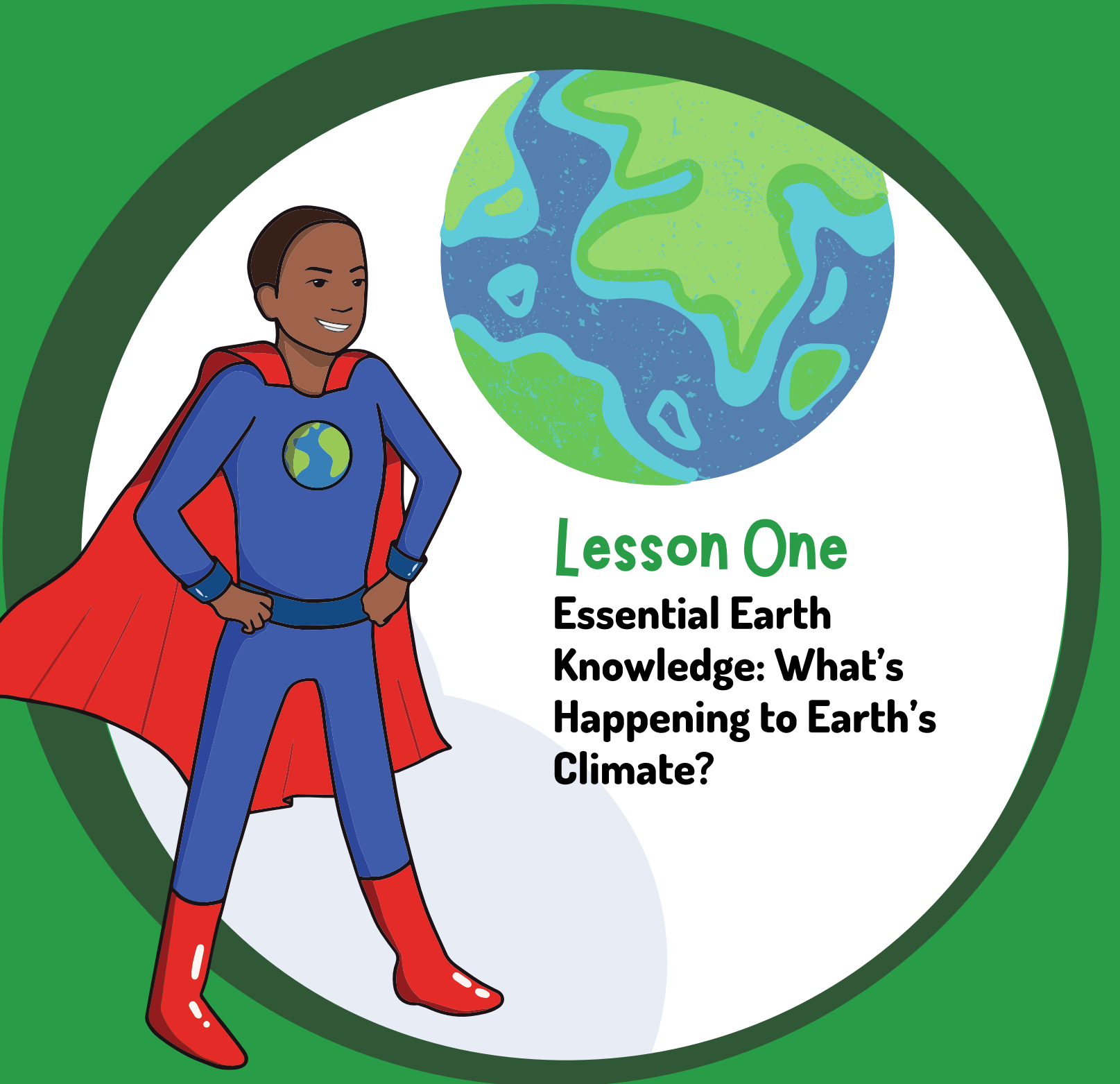
RUTGERS–NEW BRUNSWICK
School of Environmental and Biological Sciences



Lesson One

Essential Earth Knowledge: What's Happening to Earth's Climate?

USDA NIFA
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
Robert Wood Johnson Foundation

Lesson One

Lesson Overview

Understanding why and how earth's climate is changing due to society's use of non-renewable energy sources that are rich in carbon (coal, oil, and natural gas) and other activities like food waste, industrial agriculture, and deforestation, begins with an understanding of the components of the earth's climate system, especially the earth's atmosphere, as a component of an inter-connected climate system. This lesson grounds students in an understanding of the different gases in the air/the atmosphere and how greenhouse gases trap the sun's heat. It begins with an observation of a time lapse of global temperature anomalies over time. Students should notice and remark on "What data is represented in this video model?" (e.g. changes in color, movement, time, and years). Students should notice and remark on "What data is represented in this video model?" (e.g. changes in color, movement, time, and years).

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

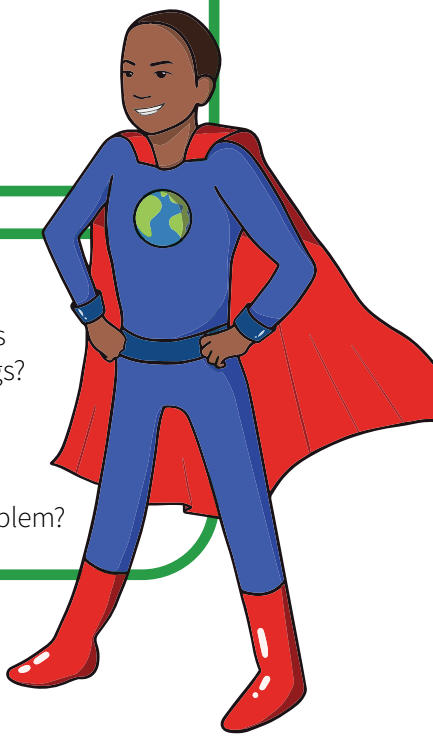
Systems and system models

Disciplinary Core Ideas

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

Driving Question(s)

- How does The Greenhouse Effect regulate the temperature of the Earth's atmosphere, and why does this matter for humans and other living things?
- What is causing the earth's global temperature to rise (increase)?
- What data are scientists collecting to know about this?
- What are communities and individual people doing to help with this problem?



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Lesson One

Observable Phenomena

NASA imagery of global temperature over time.
SVS: Global Temperature Anomalies from 1880 to 2021 (nasa.gov).
See slides in trying to understand the phenomenon.

Learning Objectives

Students will be able to:

- Understand the idea of the climate as a system shaped by multiple components.
- Describe how greenhouse gasses help to regulate the climate.
- Understand how increasing greenhouse gasses in the atmosphere changes conditions for life on Earth.

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

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***

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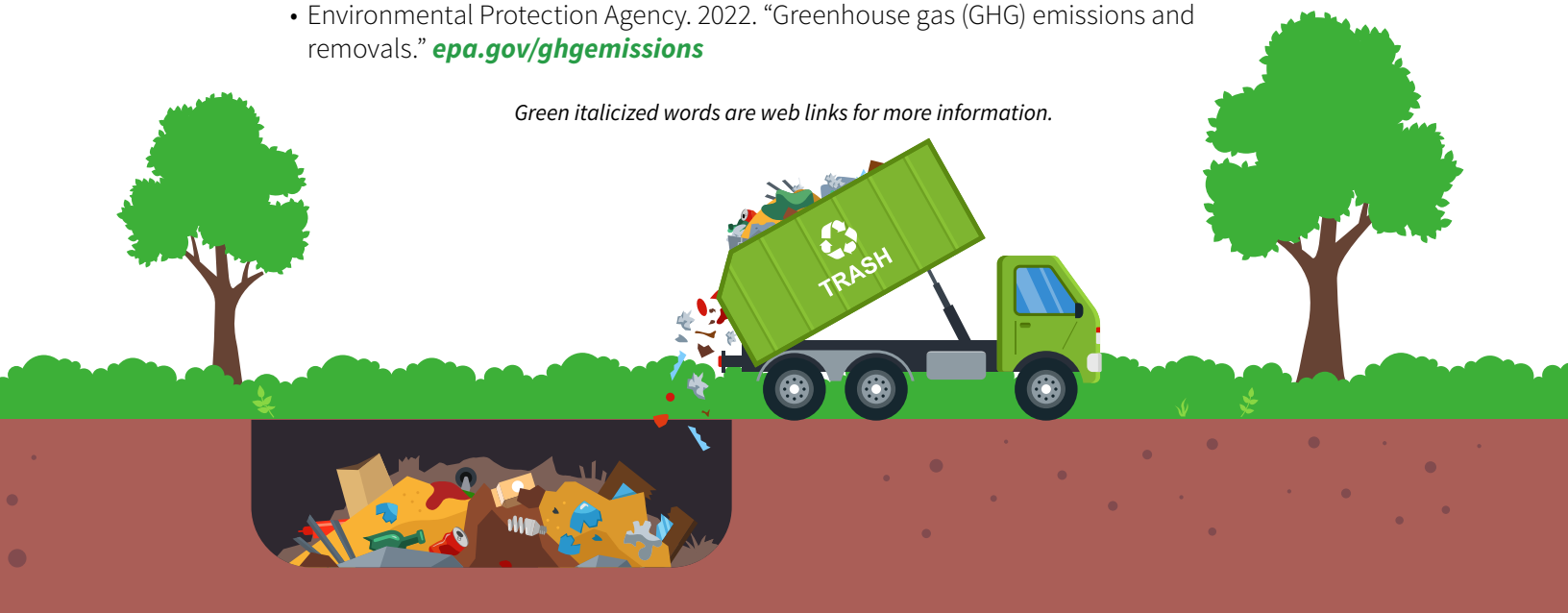

Procedure

Before You Begin

- Review the *Notice and Wonder* protocol to determine if scaffolding will be needed for some students.
- Review the Jigsaw activity procedure below. Determine who will be the Leader of each group, based on differentiation (suggested).
- Prepare to show slides to class.
- Make enough copies of handouts.

Materials

- Presentation Slides and Worksheets
- Computer/Chromebook/Technology
- Video What Is the Greenhouse Effect ***youtube.com/watch?v=SN5-DnOHQmE***
- Exit Ticket

Lesson

1st **Phenomenon: A notice and wonder of activity observing changes to earth's average temperature using the NASA video** ***svs.gsfc.nasa.gov/cgi-bin/details.cgi?aid=4964***

1. Students are told that they are about to watch a video made by scientists who study climate change that shows how earth is changing. Ask them to think about the Guiding Questions (below) as they watch. They are asked to pay close attention to the video used by NASA scientists in the Scientific Visualization Studio and describe what the data is showing or telling them. (Have students use the corresponding handout in their workbook. Use the Notice and Wonder Protocol. "I wonder why…", "I wonder if…").
2. Suggested Guiding Questions for students: What information is being shown? What do you think is happening? What is causing the changes? What do you notice? What more do you need to know to be able to understand what you see here? The video can be shown two-three times to them until enough students have developed some "I wonder" and "I notice" statements to share.
3. Use the slides provided to record the Notice and Wonder responses from students. Identify trends and narrow down to two-three questions for "I wonder". These are then highlighted, and the class will re-visit these throughout the unit to see if they are being answered by the lessons.
4. Students are told that they are going to learn about the earth's climate system and that a system is made up of components or parts that interact, influencing each other. What does that mean? That changes to one part or component of the system, affects the other parts of the system and the system as a whole. Give an example,

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Procedure

(continued)

such as, if one person in your family is sick, it might affect what another member of the family can do (maybe mom or dad has to stay home from work) and that affects what the whole family is doing or feeling that day. Or if the school cafeteria has a leak and has to shut down, that is one component of the school system, how would it affect the rest of the school? Or if the buses, the transportation part of the school system were not able to run, how would that affect the school system overall? Slide of a system is shown. Today, we'll be talking about the Global Climate System, and are going to start with watching a short video on what greenhouse gases are and the role they play in the climate system.

2nd Video Teacher introduces the video What Is the Greenhouse Effect

youtube.com/watch?v=SN5-DnOHQmE

1. Show students the *What Is the Greenhouse Effect* video.

   During the video prompt students with questions: Can anyone tell me what a greenhouse is?

   How does the earth's atmosphere act like a green house? "In the video they mention that earth is surrounded by a jacket of gases called the atmosphere that acts like the glass in a greenhouse."

2. Have students fill out the video guide and discuss their answers.

3rd Jigsaw Activity with Data

1. Break students into their Expert groups and assign each group one of six possible handouts with figures:

   A. Figures showing changes to sea ice extent in the Arctic over time;

   B. a graph of the amount of carbon dioxide in earth's atmosphere over time, and

   C. a chart of activities that generate different greenhouse gases in New Jersey.

   D. a bar graph of emissions from different foods and where in the food supply chain those emissions come from

   E. a pie chart showing the different types of greenhouse gases generated from human activities from the US EPA, "***A student's guide to global climate change***" website.

   F. Global greenhouse gas emissions from different parts of the food supply chain or the process of getting food from the land to disposal.

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Procedure

3rd Jigsaw Activity with Data (continued)

2. Using the Jigsaw Method, students start in their Expert Groups, discussing their assigned figure. Have them decide on their answers to the questions assigned and then bring back their answers to their Home Groups.
3. Students move back to their Home Groups and take turns sharing what each figure tells us. As a group they should decide on a big idea, or the main takeaway from the figure. They should talk about what they are learning and if they have any questions.
4. Have each group share out their big idea. Place these on the board or chart paper to go with the unit.

Exit Ticket

4th **Teacher passes out Exit Ticket. The teacher collects exit tickets and reviews student answers. Make minor adjustments to the next lesson based on data received.**

Lesson Extension

Using Global Data to Understand Climate Change Students examine two important figures from ***NOAA showing how temperature and precipitation have changed in the United States since the early 1900s***. Students study the first figure and answer the following: - What has happened in the United States to the temperature from 1920 to 2020? - How has the amount of rain and snow (precipitation) in N.J. changed from 1940 to 2020? - What does this mean for your neighborhood? This can also be done as a Jigsaw Activity.

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