MSOSW Curriculum
Lesson Two: Why Should We Conserve Power?

Why does saving energy matter?

Overview: In this lesson, students will learn about how energy use affects our planet, including the science of global climate change.

Objectives:

The student will:

- Define carbon footprint.
- Define global climate change.
- Explain how the greenhouse effect warms our planet.
- Identify evidences for global climate change.
- Understand possible causes of global climate change.
- Identify possible future effects of global climate change.

Standards Addressed:

- Science as Inquiry: Think critically and logically to make the relationships between evidence and explanations; Recognize and analyze alternative explanations and predictions; Understandings about scientific inquiry
- Physical Science: Transfer of energy
- Life Science: Populations and ecosystems; Diversity and adaptations of organisms Earth Science: Structure of the Earth system; Earth's history; Earth in the solar system
- Science and Technology: Design a solution or product; Understandings about science and technology
- Science in Personal and Social Perspectives: Natural hazards; Risks and benefits; Science and technology in society
- History and Nature of Science: Science as a human endeavor; Nature of science

Suggested Grade Levels: Middle School (6^{th}-8^{th})

Timeline: 3.5 class periods

Materials:

Day 1:	Global Climate Change Presentation and Notes (GCC)	
	3 small tanks or large jars	plastic wrap
	3 thermometers	1-3 heat lamps
	Vinegar	baking soda
Day 2:	Computer access	Student Definition Worksheet
	GCC presentation	Getting to the Core activity sheets
Day 3:	GCC Presentation	
Day 4:	GCC presentation	

Procedure:

Day 1: The Greenhouse Effect

- Ask students if they have heard of or know about the greenhouse effect. Ask them to describe it or relate it to their lives. At this point, all answers are fair, just get them talking.
- Set up the greenhouse effect model (you could also have students do this in groups if you have the materials available and the time):
    - Tape a thermometer to the side of each tank (if you put them on the bottom of the tank, the third thermometer needs to be elevated)
    - Cut two pieces of plastic wrap for the second and third tank.
    - In the bottom of Tank 3, pour 200mL of vinegar and 2 Tbsp. of baking soda (the amounts may vary if you're using a smaller or larger tank size – you want to produce a fair amount of CO2 to fill at least half the container).
    - After combining the baking soda and vinegar, wait 1-2 minutes – the CO2 produced is denser than the air in the tank and so will push it out. During this time, discuss the lab set up with the students and have them start discussing what they think will happen.
    - Cover the second and third tanks with plastic wrap.
    - Place a heat lamp above the tanks, positioned high enough to be more or less equally spaced from all three tanks.
    - Record the initial temperatures and turn on the heat lamp.
    - Ask students to predict what will happen over the next 15 minutes.
- Teach the mini-lesson on the greenhouse effect (first section of the Global Climate Change presentation).You may choose to stop every few minutes and record the temperature or wait a full 15 minutes and then observe the temperature in each tank.
- Assessment: Each student should sketch the lab set up and explain how the different parts of the lab relate to Earth's atmosphere. (See Resources for an example and the grading rubric.) You could choose to have students draw or write for the assessments, or explain in a short video.

Day 2: What is Global Climate Change?

- Defining carbon footprint and climate change:
    - Hand out the Student Definitions Worksheet and, in pairs, have students spend 10 minutes researching and creating their own definitions for carbon footprint and global climate

changes. They need at least two sources and should focus on having a complete definition.
    - Have pairs share their answers to create a class definition of each on the board.
- Begin next section of the Global Climate Change presentation (What is It section, then stop on the "Well, What Do the Data Say?" slide.)
- Begin the "Getting to the Core: The Link Between Temperature and Carbon Dioxide" activity from the EPA. (http://www.epa.gov/climatestudents/documents/temp-and-co2.pdf)
- You may choose to introduce it and complete it tomorrow or introduce it, have students start working, and then complete the graphs for homework.

Day 3: What is Global Climate Change?

- Complete the "Getting to the Core" graphing activity from yesterday.
- Watch "Climate Change – A Report from Antarctica: WAIS Divide Ice Core – (10 minutes – a good feature on polar scientists) https://www.youtube.com/watch?v=TDOQIkiIL9Q&feature=related (The link is also in the presentation on the "Well, What Do The Data Say slide in the "Meet an Ice Core Scientist" and in the notes)
- Ask students to compare what they learned from the modeling activity two days ago to the information they have now on CO2 levels on Earth.
- Complete the section on Well, What Do the Data Say in the GCC presentation.

Day 4: The Future of Climate Change

- Go over the possible future effects of climate change (final two sections), and then lead into the "What Can We Do About It?" section)
- Ask students to brainstorm some things that could be done to reduce our greenhouse gas emissions, after looking at the slide with information on where our emissions come from.
- Lead into the section on electrical energy production.

Assessment Options for this Lesson:

- Student Definition Worksheet
- Modeling the Greenhouse Effect Rubric

Extension Options for this Lesson:

- Modeling the Greenhouse Effect – this is a simple demonstration that models the greenhouse effect a little more interactively than simply

showing a diagram. You'll need objects to represent the Earth, the sun, a light particle, a heat wave, oxygen, nitrogen, and carbon dioxide.

- Model a light wave traveling at relatively high frequency from the sun to Earth. In a wavelike motion, walk the light wave (e.g., a yellow balloon) from the sun to Earth. Do not include any effects of atmospheric gases.
- Model absorption of the light energy, its conversion to heat and its departure from Earth to outer space. For example, exchange the yellow balloon for a red balloon. Walk the heat wave away from planet Earth, again using a wavelike motion but this time of a lower frequency (fewer up and down motions; longer wavelength). Do not include any effects of atmospheric gases.
- Describe what you have done as modeling the flow of energy into and out of the Earth system.
- Now include the atmospheric gases nitrogen, oxygen and carbon dioxide. Model a light wave traveling from the sun and show that it does not interact with any of the atmospheric molecules. Model the heat wave leaving Earth and that it interacts with carbon dioxide but not with oxygen or nitrogen.
- Model the interaction of the heat wave with a carbon dioxide molecule as an absorption of energy and a re-radiation of that heat energy back to planet Earth where it is absorbed and re-radiated back out. This can be repeated several times.
- Describe the greenhouse effect as a natural phenomenon that currently helps keep Earth at a comfortable temperature. Describe the effects of human actions in increasing the current greenhouse effect, thereby threatening to change the global climate.