Climate Change Lesson 2: *The Make*

Educator's Resource Guide

Objective

In *The Make*, students are provided with a scenario and must:

1. Build greenhouse gas models to measure the impact of trapping heat on temperature.
2. Collect, graph, and analyze data.
3. Communicate their findings.

Time Required: 90 minutes

Materials Required	Safety Considerations	Science & Engineering Practices
For each group of students: ● 2 clear plastic containers with a lid for one of the containers Great options include plastic to-go cups that have a hole for straws at the top. Other options include soda bottles or deli soup containers. For soda bottles or deli soup containers, you'll need to cut a hold through the lid for the students before the experiment begins. ● 2 glass thermometers per group (Optional: Vernier temperature probes) ● Masking tape or modeling clay ● Lamp with bulb (100 to 150 watts) ● Stand to support lamp setup ● Scissors, timer, water ● Graph paper (Optional: graphing app)	None	● Developing and Using Models ● Planning and Carrying Out Investigations ● Analyzing and Interpreting Data

Inquiry Scale

Level 1: Most teacher-driven

Create the models and use them as a demonstration. Discuss the greenhouse effect with the students, using the models as reference. Have students complete the discussion guide in small groups or as a class.

Level 2

Give students the list of materials and the procedure to build the greenhouse models (located in the Student Guide). Have students complete the discussion guide in small groups.

Level 3

Have students work in small groups to design models to demonstrate the greenhouse effect. Check in with groups at specific time periods throughout the class. During this time, groups will share their progress and set up with the class. Take this time to clear up any misconceptions. Allow students to

select their own materials (see Student Guide) and approve selected materials before construction begins. Students will be required to explain how their model demonstrates the greenhouse effect.

Level 4: Most student-driven

Have students work in small groups to design models to demonstrate the greenhouse effect. Students can use any materials available in the classroom or lab (see Student Guide). Students will be required to explain how their model demonstrates the greenhouse effect.

Agenda

I. Show PowerPoint to introduce *The Make* Activity (10–15 minutes)

The PowerPoint will review essential concepts learned in *The Solve* and provide context for the students' upcoming *Make* challenge.

In the presentation, students will be provided with a scenario:

> Because of your great work solving the mystery in Lesson 1, your local town hall has taken notice. And now, council members need your help.
>
> In two days, council members will discuss investing in new solar panels for your school as a way to reduce greenhouse gas emissions. The problem? A handful of vocal protestors don't want the panels installed because they do not believe that greenhouse gases affect the global temperature. "Because greenhouse gases don't affect the global temperature," the protestors say, "there's no reason to waste money on solar panels!"
>
> Your task? Teach everyone at the meeting how greenhouse gases affect temperature by using a model. You'll need to make your explanation as simple as possible. People of all ages will be attending the meeting, and you'll need to make your presentation apply to all ages. Luckily, a good model can do just that.
>
> The town has provided you with certain materials to help you with your model. If you succeed, you will be rewarded by the town!
>
> Good luck!

II. *The Make* Activity (80 minutes)

As guided by the organizer, students will:

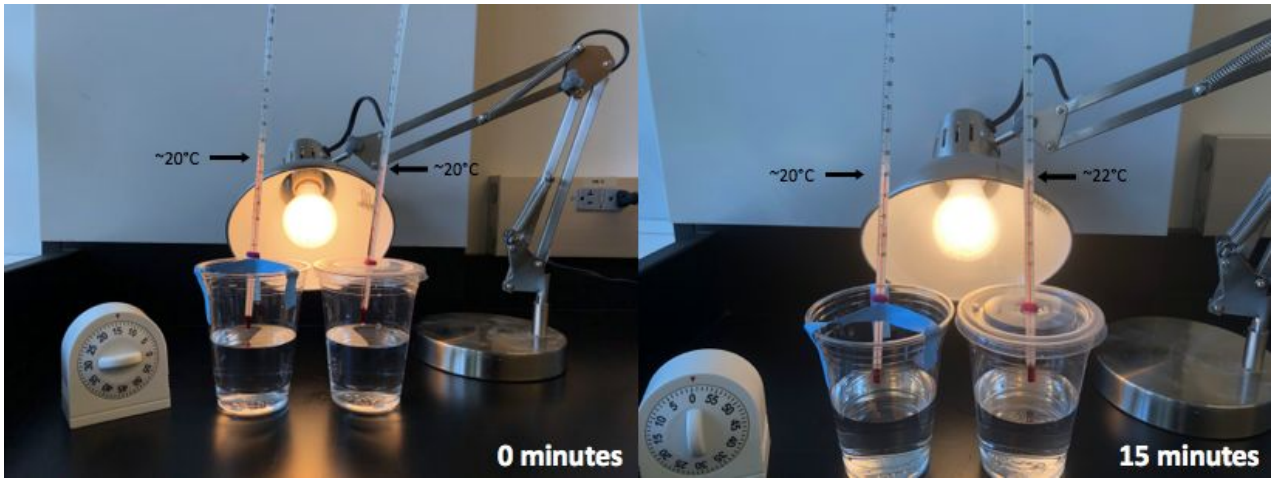
1. Assemble their greenhouse models. (Note: For remote learning, students can view the experiment here) If assembling the models in-person, students will follow the instructions below:

   Assemble the Models

   a. Pour the same amount of water into two separate containers so that it is approximately 4 cm in depth.
   b. Cover one container with a lid, and place the thermometer through a pre-cut hole in the lid. The bottom of the thermometer should be suspended in the container so that it is **not** touching the water.
   c. Suspend a thermometer in the second container using masking tape. The bottom of the thermometer should be suspended in the container so that it is **not** touching the water.
   d. Place the lamp with the 100–150 watt bulb so that it is approximately 6 inches above both containers. (Note: If you do not have access to lamps, you can place the containers in a well-lit window area).

   Collect Your Data

   a. Measure and record the starting temperature in both containers before turning on the lamp.
   b. Predict which condition(s) will result in the fastest increase in temperature. Record your prediction in the space provided [in the Student Guide].
   c. Measure and record the temperature change every minute for the next 15 minutes. Use the table [in the Student Guide].
   d. Record your observations.



III. Exit Ticket (10 minutes)

Students complete the exit ticket that summarizes their understanding of *The Make* and connects students to the upcoming *Engineering* challenge.

Note: In collaborative classrooms, this serves as the individual accountability in an otherwise group project.

Exit Ticket Answer Key

1. Which container heated fastest and why? *The one with the lid heated faster because the lid trapped the heat in the container.*

2. How do your models demonstrate the greenhouse effect? *As the sun's rays hit the Earth, some of the heat is absorbed into the water and some bounces back. Some of that heat that bounces back is trapped by greenhouse gases in the atmosphere, which warms the Earth. The lid on the model represents the greenhouse gases trapping the heat. The model without the lid is a point of comparison so we can see how the greenhouse gases affect temperature.*

3. How do your models relate to Mosa Mack's discovery in Lesson 1? *Mosa Mack discovered that glacial ice was melting because of increased temperatures. When she investigated, she found that there were increased greenhouse gases in the atmosphere, which trapped heat, causing the increase in temperature. This is exactly what happened in the model!*

4. How is the greenhouse effect in your model similar to or different from Earth's greenhouse effect? *It is similar in that trapping heat leads to an increase in temperature. One difference is that our model is a physically closed system and does not show the impact of specific greenhouse gases.*

5. Now that we know what is causing climate change, come up with two possible solutions for dealing with it. *Answers will vary. Answers include reducing the amount of greenhouse gas emissions. Further exploration of this question will continue in Lesson 3: The Engineer.*

The Make Project Grade and Rubric Score Sheet – Climate Change

Climate Change *The Make* Checklist: Content Concepts and Practices

Project Completeness

- ❑ All aspects of the activity are complete:
  - ❑ Experiment was set up
  - ❑ The Student Guide Planning Organizer is organized and neat
  - ❑ Data table is complete
  - ❑ Graph accurately includes both data sets in different colors

Disciplinary Core Ideas

- ❑ Experiment design questions are accurately answered and demonstrate understanding of controlled variables
- ❑ Experiment design questions are accurately answered and demonstrate understanding of independent variables
- ❑ Experiment design questions are accurately answered and demonstrate understanding of dependent variables
- ❑ Diagram of equipment setup has labeled arrows that accurately show what each part represents for the Earth-Sun system
- ❑ This data analysis is connected to the concept of climate change

Science & Engineering Practices Rubric

Assign numbers based on the rubric on the following page. **1–4**

Developing and Using Models	
Planning and Carrying Out Investigations	
Analyzing and Interpreting Data	

Teacher Comments:

Final Score: Final Grade:

Climate Change Science & Engineering Practices Rubric

	Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Developing and Using Models	Drawings, diagrams, or visual models include major misconceptions or have missing parts. Explanation of the model is minimal or not present.	Drawings, diagrams, or visual models include minor misconceptions or have missing parts. Explanation of the model is minimal.	Drawings, diagrams, or visual models are complete, but contain a minor misconception. Explanation of the model is complete but lacking complexity.	Drawings, diagrams, or visual models have no misconceptions and contain all details. Explanation of the model is complete and complex.
Planning and Carrying Out Investigations	Investigation does not produce the relevant data to align with the research question. Or no procedure is detailed.	Investigation minimally produces the relevant data to align with the research question. Procedure is lacking the necessary detail to be carried out.	Investigation identifies dependent and independent variables, and will produce the relevant data to align with the research question. Procedure is detailed enough to be carried out, but has some clarity issues.	Investigation identifies dependent and independent variables, as well as controls and will produce the relevant data to align with the research question. Procedure is concise.
Analyzing and Interpreting Data	Constructs data tables or graphs that do not display all data. Analyzes data with major misconceptions or omissions.	Constructs data tables or graphs that display all data, but does not analyze relationships. Analyzes data with minor misconceptions.	Constructs data tables or graphs that display all data and makes simple connections between variables. Analyzes data to provide evidence for a phenomena.	Constructs data tables or graphs that display all data and makes complex connections between variables. Analyzes data to provide evidence for a phenomena and acknowledges limitations.