Climate Change Lesson 2: *The Make*

Student Handout

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!

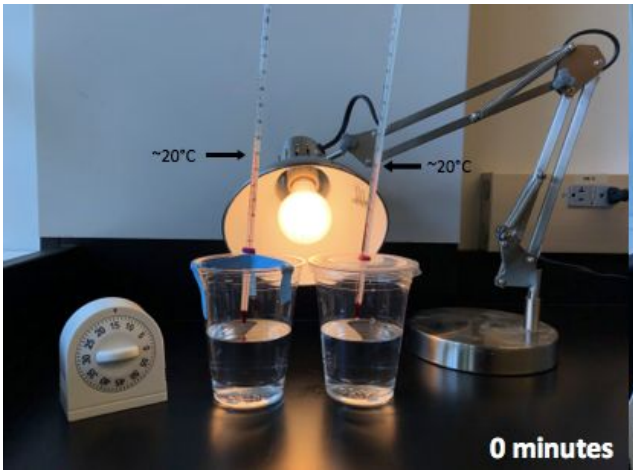
Good luck!

The Materials You're Given:

- 2 clear plastic containers, with a lid for one of the containers.
- 2 glass thermometers
- Lamp with bulb (100–150 w)
- Stand to support lamp setup
- Timer
- Water

You decide to make two models: one with a lid and one without. The lid, you decide, will imperfectly represent the layer of greenhouse gases around Earth. Since the vast majority of Earth is covered by water (more than 70%), add some water to the containers.

If you can measure the temperature of the air inside both models, showing how the air heats up more in the container with a lid, you will be able to demonstrate how greenhouse gases lead to an increase in air temperature.



Note: You can choose to print this Student Guide and write in your answers, or type your answers into a Word document or Google Doc. The directions below will guide you through writing your answers in this document. If you choose to create a new digital document, you can recreate the tables. For required images in the tables, draw on a piece of paper and upload into the table.

Plan Your Experiment

1. How will you measure the temperature of the air in the atmosphere?	
2. Why is it important for the amount of energy transferred to the containers to be the same?	
3. How will you ensure the same amount of sun energy is transferred to each container?	
4. How will you compare the temperature of the atmosphere in each container over time?	

Complete the sketch of your group's equipment setup. Label its key features and what they represent. Be sure to label: greenhouse gases, air temperature, ocean water.

Conduct Your Experiment

If you're doing this experiment online: **view the experiment here**.

Collect Your data:

1. Record the starting temperature in both containers.
2. Predict which condition(s) will result in the fastest increase in temperature. Record your prediction.
3. On the same sheet, record the temperature change every minute for the next 15 minutes.
4. Record your observations.

If you're doing this experiment in your classroom, record your group roles and assemble your models.

Group Roles: Assign one role per person in your group. Record your roles. (If you are a group of three, the **Materials Manager** and **Technician** can be the same person.)

Technician: Reads the thermometer aloud at specified times.
Name:

Materials Manager: Gathers the equipment; confirms the setup
Name:

Timekeeper: Keeps time and says “time” at every minute
Name:

Recorder: Records the temperature when recited aloud. Also writes general observations, as needed.
Name:

Assemble the Models

1. Pour the same amount of water into two separate containers so that it is approximately 4 cm in depth.
2. 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.
3. 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.
4. 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

1. Measure and record the starting temperature in both containers before turning on the lamp.
2. Predict which condition(s) will result in the fastest increase in temperature. Record your prediction in the space provided on the next page. .
3. Measure and record the temperature change every minute for the next 15 minutes. Use the table on the next page.
4. Record your observations.

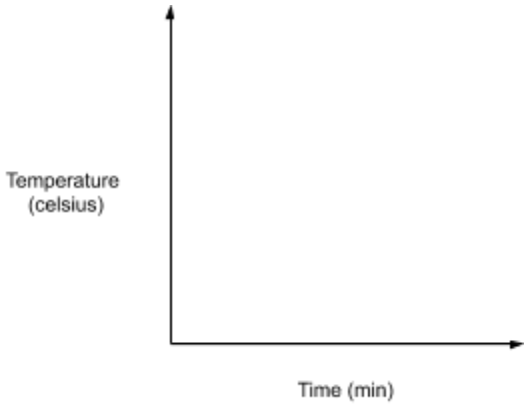
My Prediction:

Data Table

	Temp Above Water (°C): Lid	Temp Above Water (°C): No Lid
Starting Temp (°C)		
1 min		
2 min		
3 min		
4 min		
5 min		
6 min		
7 min		
8 min		
9 min		
10 min		
11 min		
12 min		
13 min		
14 min		
15 min (Final Temp)		
Temperature Change		

Observations: List all the observations you made while performing the investigation.

On a separate piece of graph paper, graph both data sets on the same graph using a different color for the lines. Each group member makes their own graph of the

data. Label the x-axis “Time (in minutes)” and label the y-axis “Temperature (Celsius)” as seen below:


How does your model of the greenhouse effect help us understand climate change? Based on your group’s discussion, write your conclusion here:

Name: _____ Date: _____

Exit Ticket: Connection to the Design

1. Which container heated fastest and why?

2. How do your models demonstrate the greenhouse effect?

3. How do your models relate to Mosa Mack's discovery in Lesson 1?

4. How is the greenhouse effect in your model similar to or different from Earth's greenhouse effect?

5. Now that we know what is causing climate change, come up with two possible solutions for dealing with it.

Assessment

Use the Checklist and Science & Engineering Practices Rubric to ensure you have addressed all aspects of *The Make* with quality work.

Climate Change *The Make* Checklist

Your Challenge: Make a greenhouse gas model to measure the impact that trapping heat has on temperature. Collect, graph, and analyze the data.

Project Completeness

- ❏ All aspects of the activity are complete:
  - ❏ The 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 Assessed

	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.