Chapter 2: Energy Entering and Leaving Earth's System

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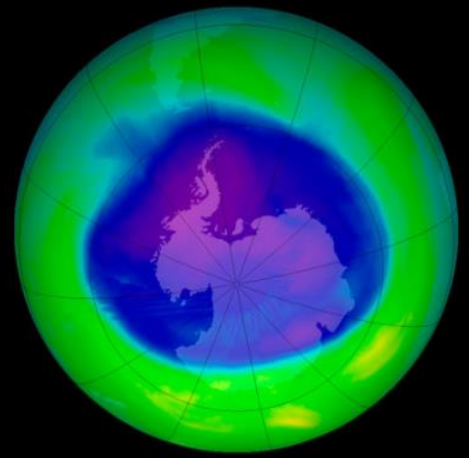
7 Lessons



1 WARM UP
Warm-Up

ECC: 2.7.1 WARM-UP

HAND IN

Students think about the information they feel people should know in order to understand climate change. (5 min)

Warm-Up

From: Irene Lee
To: Student Climatologists
Subject: Helping Others Understand Climate Change

World Climate Institute

What are some important ideas you'd want to share with people who don't know very much about climate change?

and support laws that will help with this serious problem.

Your report is a valuable part of WCI's mission to educate the public so they can better understand this topic. We appreciate your help!

2 **MODELING TOOL**
Explaining Climate Change with the Modeling Tool

ECC: 2.7.2 EXPLAINING CLIMATE CHANGE WITH THE MODELING TOOL

Students use the Modeling Tool to explain Earth's current warming trend. (15 min)

Using the Sim, we discovered, Carbon dioxide and methane stop energy from leaving by redirecting energy that would have exited the system. This leads to less energy exiting the Earth system, so more energy enters than exits. We also know that when more energy enters than exits, there is more energy in the system and more energy can be absorbed by the surface, so temperature increases.

Vocabulary

redirect: send to a new or different place

2 MODELING TOOL
Explaining Climate Change with the Modeling Tool

ECC: 2.7.2 EXPLAINING CLIMATE CHANGE WITH THE MODELING TOOL

Students use the Modeling Tool to explain Earth's current warming trend. (15 min)

You will be writing a report that answers the Chapter 2 Question, *Why does temperature increase when carbon dioxide or methane increases?* You will be writing this report for an audience who doesn't know as much as they do about climate change.

From: Irene Lee
To: Student Climatologists
Subject: Helping Others Understand Climate Change

World Climate Institute

Thank you for all your hard work on the subject of climate change these last few weeks. Being able to explain why our climate is changing and why Earth's ice is melting is vital.

Today, I'd like you to create a report that explains these climate change ideas to a general audience. Be sure your writing is clear and includes visuals so people who don't know much about this topic will find it meaningful. WCI hopes that if people understand, they will take action and support laws that will help with this serious problem.

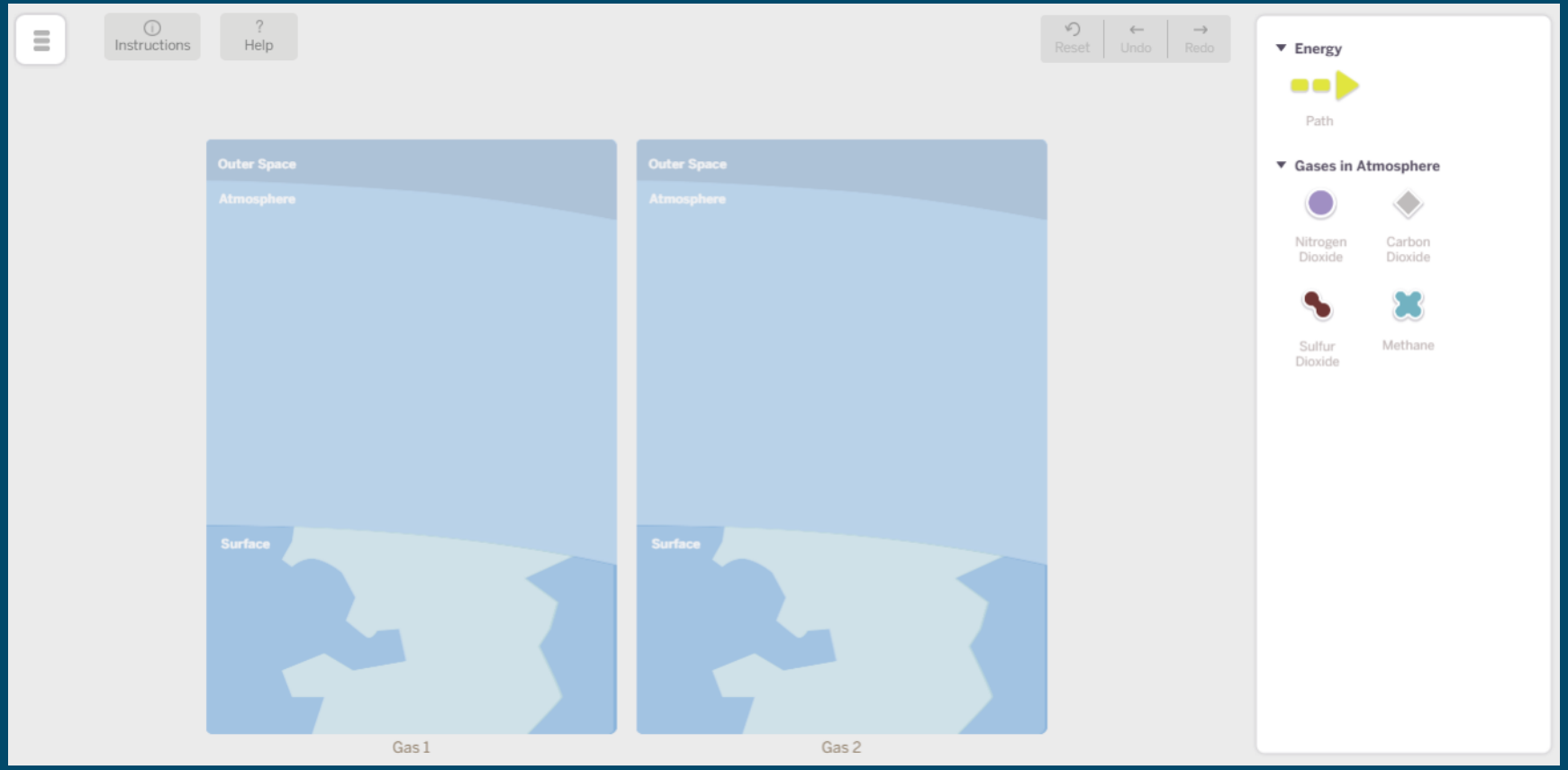
Your report is a valuable part of WCI's mission to educate the public so they can better understand this topic. We appreciate your help!

2 **MODELING TOOL**
Explaining Climate Change with the Modeling Tool

ECC: 2.7.2 EXPLAINING CLIMATE CHANGE WITH THE MODELING TOOL

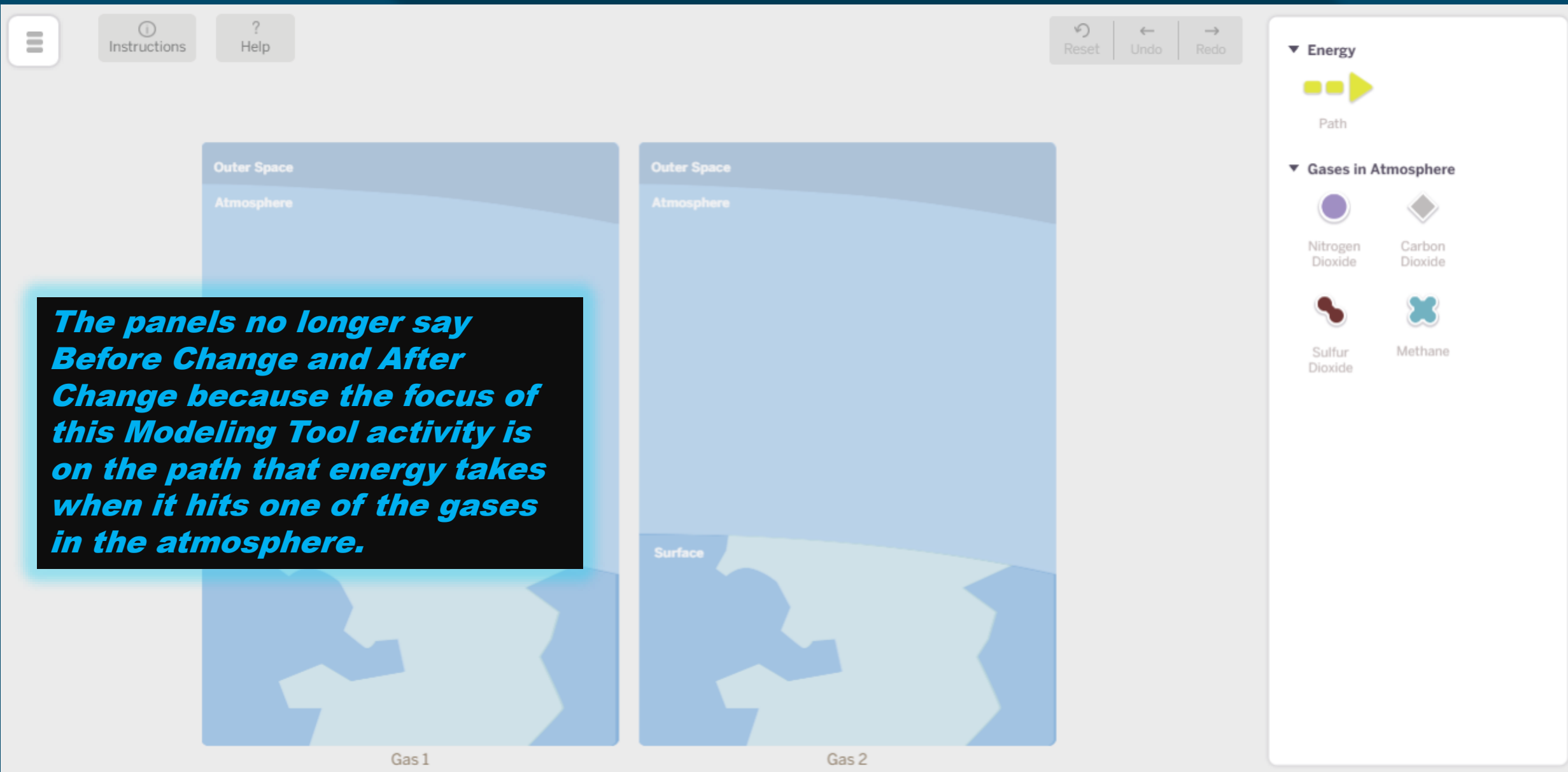
Students use the Modeling Tool to explain Earth's current warming trend. (15 min)

Showing science ideas with a graph, model, or other visual is an extremely valuable and important way to convey information in science. Visuals are also good for helping anyone understand your ideas, which is why you will include a screenshot of your model with the report you write.

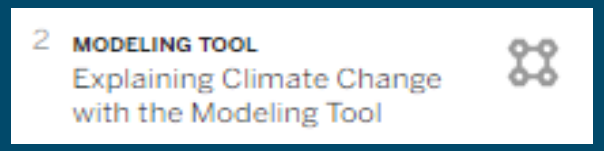


2 **MODELING TOOL**
Explaining Climate Change with the Modeling Tool

ECC: 2.7.2 EXPLAINING CLIMATE CHANGE WITH THE MODELING TOOL



The panels no longer say Before Change and After Change because the focus of this Modeling Tool activity is on the path that energy takes when it hits one of the gases in the atmosphere.



ECC: 2.7.2 EXPLAINING CLIMATE CHANGE WITH THE MODELING TOOL

Students use the Modeling Tool to explain Earth's current warming trend. (15 min)

- Drag an arrow into the model. Show students that they can connect either end of the arrow to outer space, the atmosphere, or the surface.
- Demonstrate how to connect more than one arrow to show where energy changes direction. Model this by connecting an arrow from outer space to the surface, and then connect another arrow from the surface (where the first arrow ends) to outer space.
- Explain what connected arrows mean. This shows energy coming in and bouncing off the surface, or energy being absorbed and then reemitted, and then exiting to outer space.
- Drag gas molecule into the model. Show students that they can connect either end of an arrow to a gas.

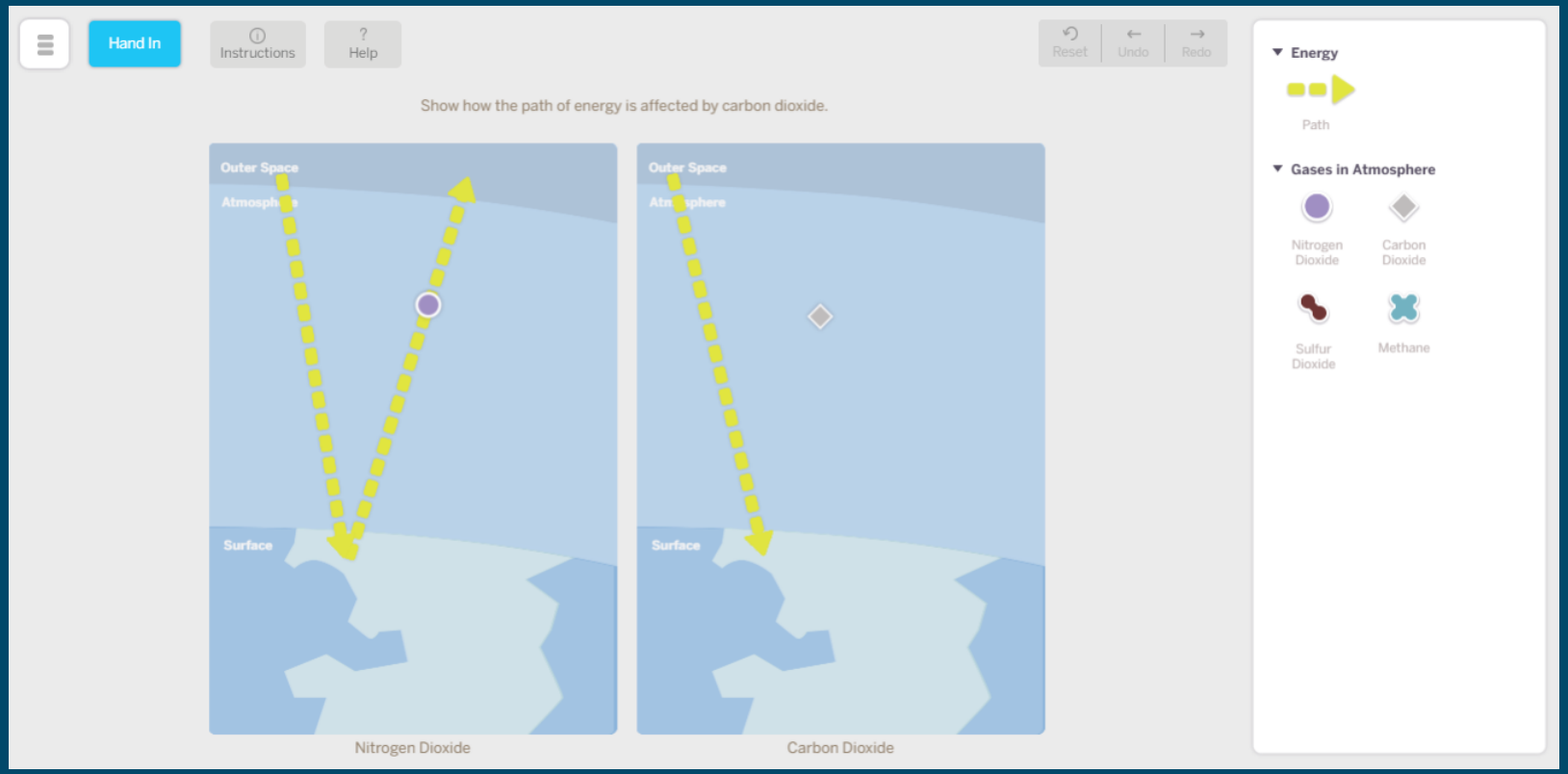
You will only be able to show part of your answer with this Modeling Tool, but you can add more details to your explanation later in the lesson when you talk with your classmates and make a written explanation.

2 **MODELING TOOL**
Explaining Climate Change with the Modeling Tool

ECC: 2.7.2 EXPLAINING CLIMATE CHANGE WITH THE MODELING TOOL

Students use the Modeling Tool to explain Earth's current warming trend. (15 min)

•**Left panel, nitrogen dioxide:** This panel is an example that shows the energy path going right through nitrogen dioxide, nothing happens when energy hits nitrogen dioxide. You don't need to make any changes to this left-hand panel.



Right panel, carbon dioxide. You should show what happens when an energy path hits carbon dioxide, then answer the questions on their devices

2 **MODELING TOOL**
Explaining Climate Change with the Modeling Tool

ECC: 2.7.2 EXPLAINING CLIMATE CHANGE WITH THE MODELING TOOL

NEXT >

Students use the Modeling Tool to explain Earth's current warming trend. (15 min)

Modeling How Gases Affect the Path of Energy

1. Open the Modeling Tool activity: Carbon Dioxide Energy Path. Create a model that you can add to your report for the World Climate Institute. If you have time, press NEXT and complete a model that shows the Methane Energy Path.

Goal: Show how the path of energy is affected by carbon dioxide (or methane).

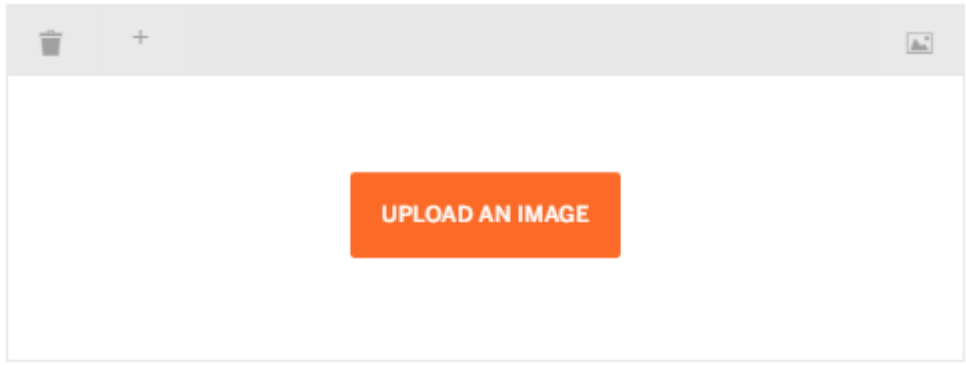
Do:

- Drag and drop an arrow on the Carbon Dioxide (or Methane) panel. Move it and resize the arrow to show what happen energy hits carbon dioxide (or methane).

Tips:

- The example on the left shows how nitrogen dioxide affects the path of energy.
- Arrows can be connected to other arrows or to gases.
- Incoming energy hitting the surface and carbon dioxide (or methane) have already been placed in the panel on the rig

Press HAND IN in the Modeling Tool to see a screenshot of your model below.



2. Complete the following statement, using your model of carbon dioxide affecting the path of energy.

When there is an increase in carbon dioxide in the atmosphere, ▾, which causes temperatures to ▾.

2 **MODELING TOOL**
Explaining Climate Change with the Modeling Tool

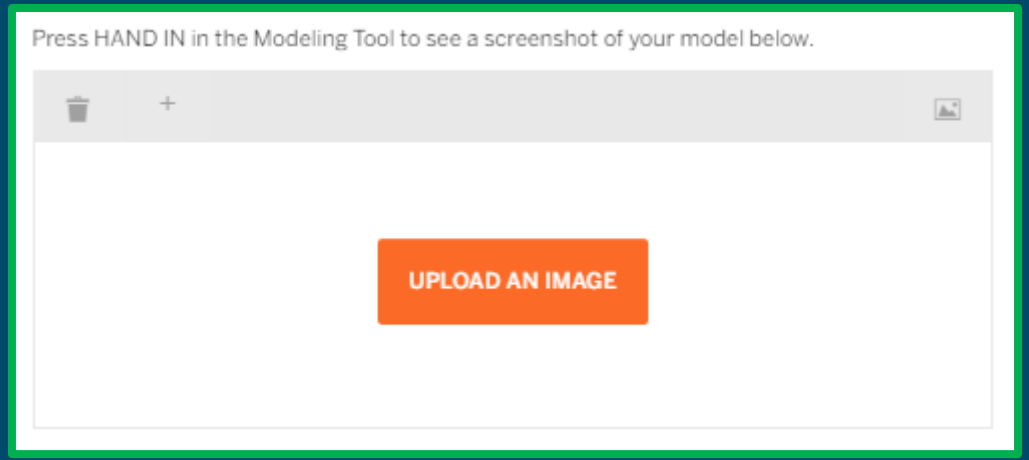
ECC: 2.7.2 EXPLAINING CLIMATE CHANGE WITH THE MODELING TOOL

HAND IN

Students use the Modeling Tool to explain Earth's current warming trend. (15 min)

Modeling How Gases Affect the Path of Energy

If you have time, create a model that shows the Methane Energy Path.



3 STUDENT-TO-STUDENT DISCUSSION
Discussing Causes of Climate Change

ECC: 2.7.3 DISCUSSING CAUSES OF CLIMATE CHANGE

Students work together to create one or two sentences, using key vocabulary words, that explain why temperature increases when carbon dioxide or methane increases. (15 min)

Word Relationships

Chapter 2 Question: *Why does temperature increase when the amount of carbon dioxide or methane in the Earth system increases?*

Word Bank: atmosphere, carbon dioxide, methane, energy, absorb, redirect

1. With your group, use the words above to discuss and answer the Chapter 2 Question.

2. After the discussion, work with your group and write one or two sentences on scratch paper that answer the question. Check to be sure you've included all the words.

3. Be prepared to share your sentences with the class.

4 WRITING
Writing About Climate Change for the Public

ECC: 2.7.4 WRITING ABOUT CLIMATE CHANGE FOR THE PUBLIC

NEXT >

Students write an explanation of what happens to the Earth system in a warming climate. (10 min)

As we discussed earlier, the model you just created in the Modeling Tool will help support your written explanation. Remember, science writing often uses both text and visuals to better explain things.

Part 1: Writing an Explanation of Climate Change

We know that the global average temperature on Earth is increasing and ice is melting. We also know that the amount of carbon dioxide and methane has increased. *Why does temperature increase when carbon dioxide or methane increases?*

To improve your explanation, you may find it useful to refer to your model and to use terms from the Word Bank.

Word Bank: atmosphere, carbon dioxide, energy, methane, redirect, surface, temperature

B I U

Word Count: 2

Write here...

4 WRITING
Writing About Climate Change for the Public

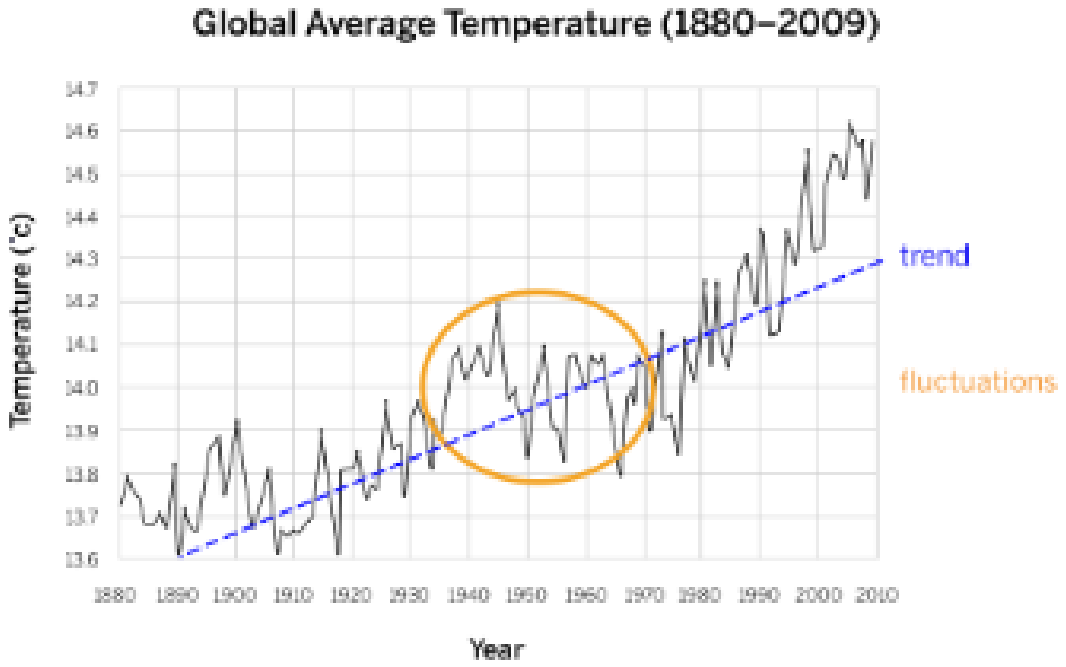
ECC: 2.7.4 WRITING ABOUT CLIMATE CHANGE FOR THE PUBLIC

HAND IN

Students write an explanation of what happens to the Earth system in a warming climate. (10 min)

Part 2: Explaining Trend and Fluctuation

This graph shows Global Average Temperature since around 1880. We know that globally, more and more ice is melting because the average temperature on Earth is increasing. Use this graph to explain why we are sure that the data over this time period is showing climate change, not just a temporary change in temperature. Use the terms ***fluctuation*** and ***trend*** in your explanation.



B I U

Word Count: 2

Write here...

ECC: 2.7.5 HOMEWORK

Students complete unfinished writing for homework.

Completing Your Explanations

Complete any unfinished work from today's lesson.

6 HOMEWORK
Self-Assessment (optional)

ECC: 2.7.6 SELF-ASSESSMENT

HAND IN

Students assess their current understanding of the Unit Question, What causes climate change?

Check Your Understanding

This is a chance for you to reflect on your learning so far. This is not a test. Be open and truthful when you respond.

Scientists investigate in order to explain their observations. You have been investigating why the climate has been changing. Are you getting closer to understanding what causes climate change?

1. I understand how the atmosphere is related to the ice melting. ▾

2. I understand what can affect energy entering and exiting the Earth system, and how this affects climate. ▾

3. I understand what can happen when energy hits gases. ▾

4. I understand what causes the amount of gases in the atmosphere to change. ▾

Explain your answer choice.

5. What about climate change are you still wondering?