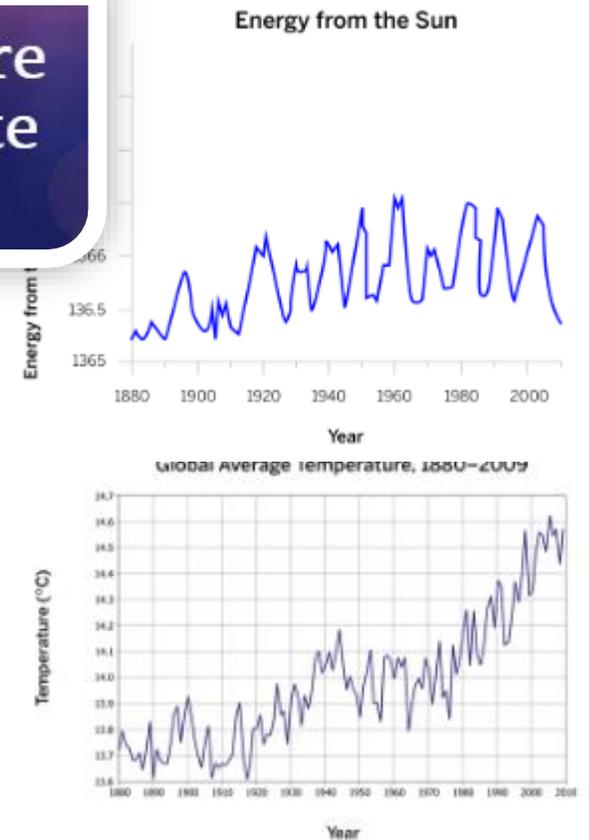


## 2.2: Reading "Past Climate Changes on Earth"

## 2.3: Learning More About Past Climate Changes

### Chapter 2: Energy Entering and Leaving Earth's System

7 Lessons



AmplifyScience > Earth's Changing Climate > Chapter 2 > Lesson 2

AmplifyScience > Earth's Changing Climate > Chapter 2 > Lesson 3

1 WARM-UP  
Warm-Up



2 READING  
Active Reading: "Past Climate Changes on Earth"



3 STUDENT-TO-STUDENT DISCUSSION  
Discussing Annotations



4 HOMEWORK  
Homework



1 WARM-UP  
Warm-Up



2 READING  
Second Read of "Past Climate Changes on Earth"



HAND IN

3 MODELING TOOL  
Modeling an Increase in Temperature Due to Gases



4 CLASS  
Revisiting the Anticipation Guide





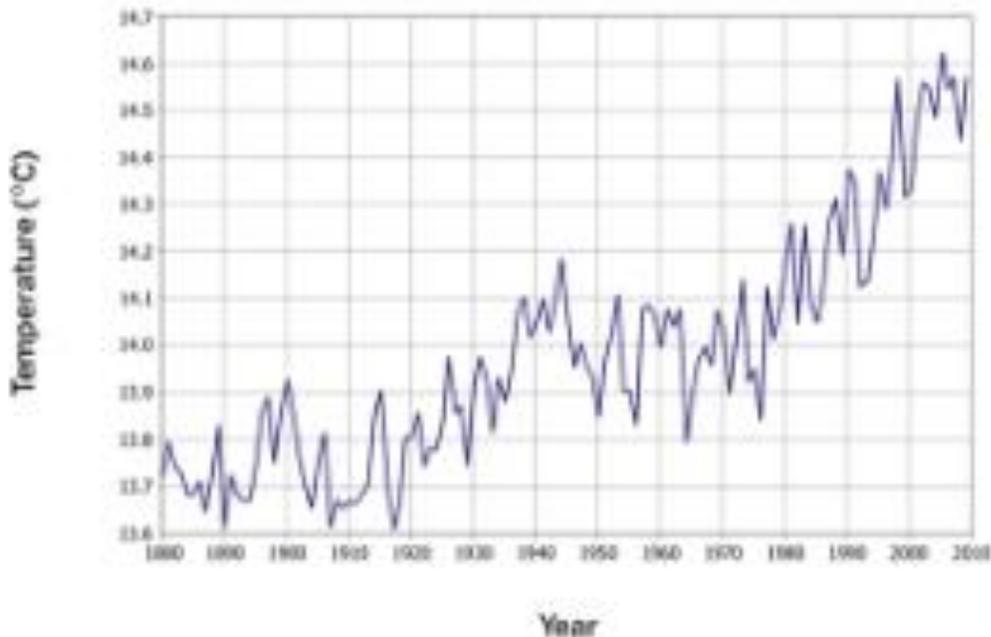
# ECC: 2.2.1 WARM-UP

Students analyze a graph showing that the amount of energy from sunlight has not had an increasing trend. (10 min)

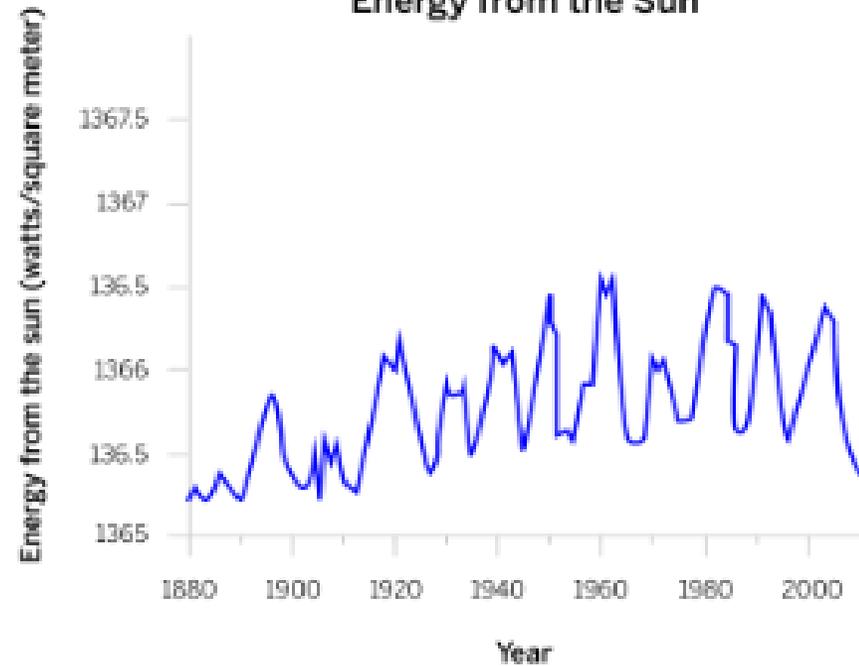
***Could an increase in energy from the sun be the cause of the most recent climate change?***

Compare these two graphs from the same time period: one with data about global average temperature and the other with data about energy from the sun, and then answer the question.

Global Average Temperature, 1880–2009



Energy from the Sun



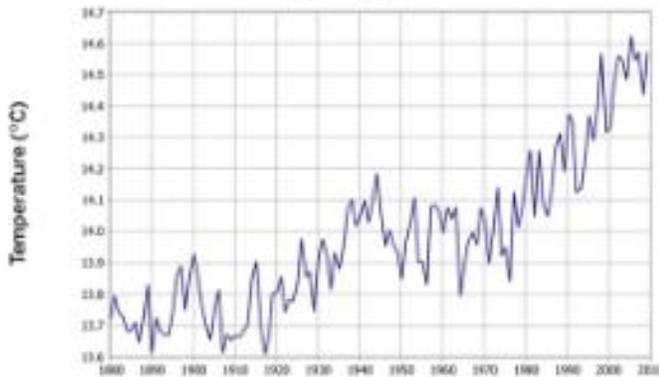


# ECC: 2.2.1 WARM-UP

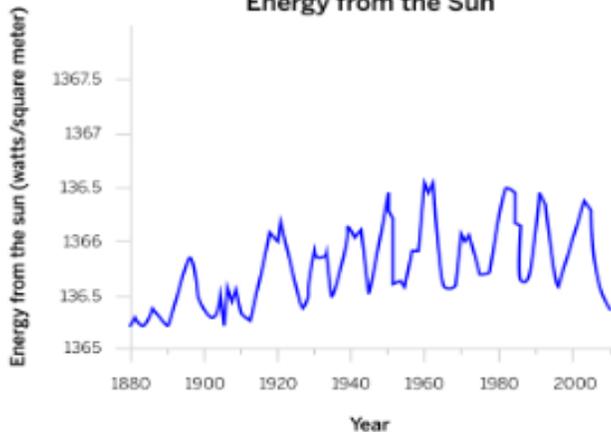
***Could an increase in energy from the sun be the cause of the most recent climate change?***

Compare these two graphs from the same time period: one with data about global average temperature and the other with data about energy from the sun, and then answer the question.

Global Average Temperature, 1880–2009



Energy from the Sun



Examine the trend for sunlight. Does the sunlight trend mirror the temperature trend? In other words, does sunlight increase at the same time as temperature increases?

a yes

b no

Do you think an increase in energy from the sun could be the cause of the most recent climate change? What is your evidence?

No, an increase in energy from the sun could not be the cause of recent climate change. The graph, Energy from the Sun, shows that energy from the sun has not been increasing over the same time period that average temperature has been increasing.



# ECC: 2.2.1 WARM-UP

Relating sunlight claim to energy entering and exiting.

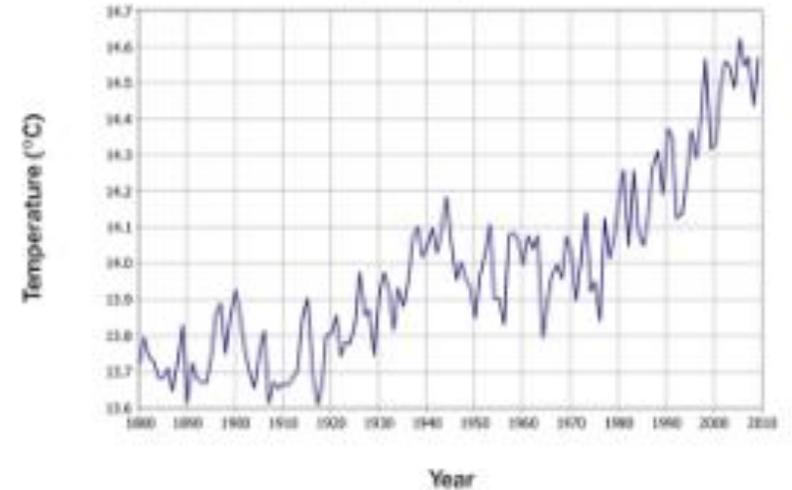
In a previous lesson you found that increasing sunlight caused temperature to increase because more energy entered the system than exited.

So, an increase in energy from the sun *can* cause an increase in temperature.

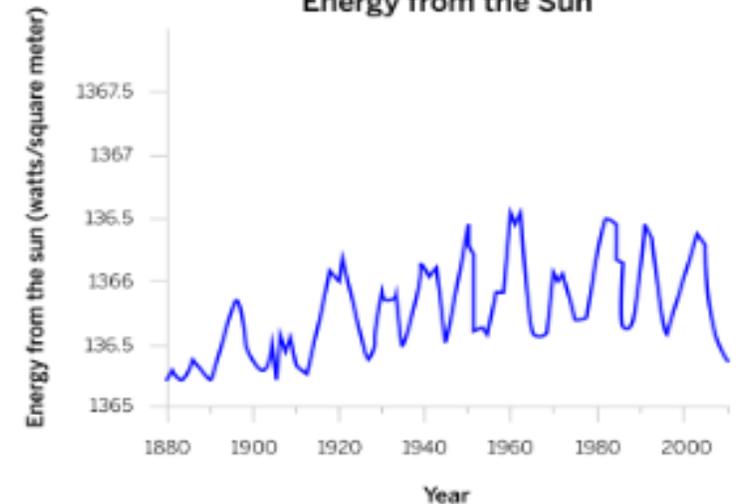
However, can this explain the current warming climate?

If so, we would also expect to see an increasing trend for sunlight.

Global Average Temperature, 1880–2009



Energy from the Sun

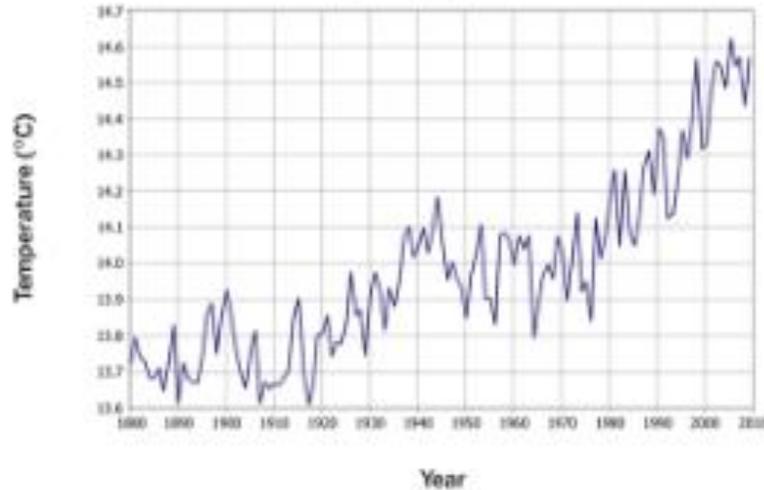




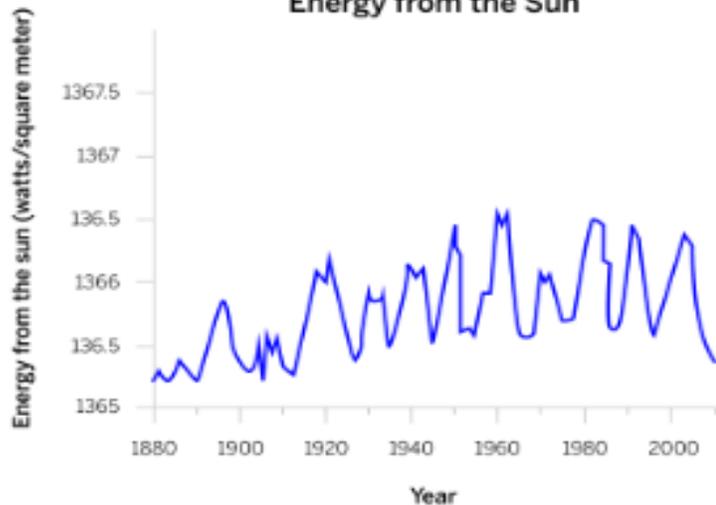
# ECC: 2.2.1 WARM-UP

## Trends and fluctuations in sunlight data.

Global Average Temperature, 1880–2009



Energy from the Sun



The data shows some fluctuations, but overall the trend looks more or less stable.

It is important to focus on trends rather than short-term fluctuations when looking at climate change.

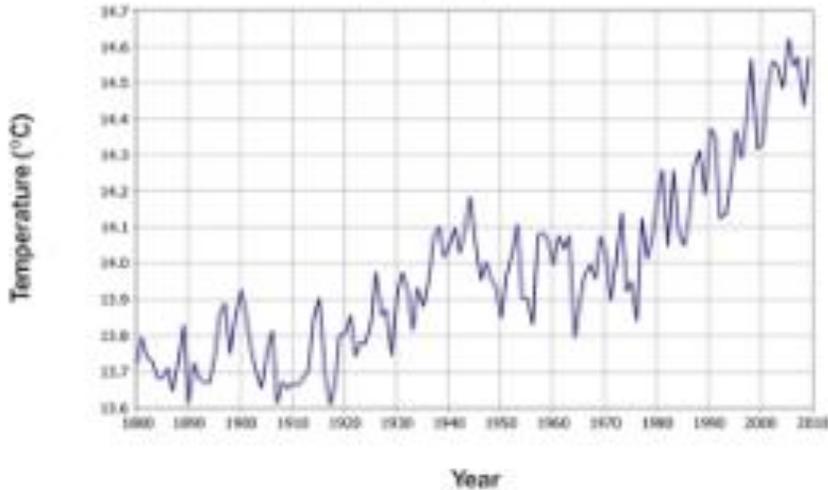
If you only looked at data from a short period of time, you might see a sharp increase in energy from the sun, and you could be fooled into thinking that that was the cause of the current climate change.



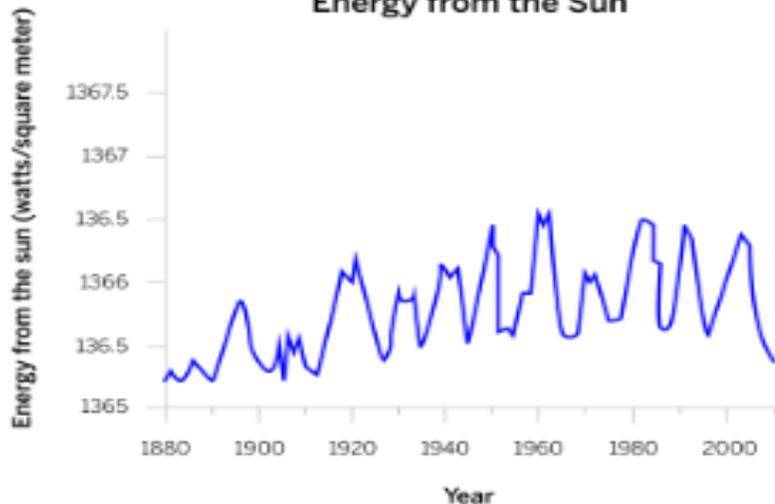
# ECC: 2.2.1 WARM-UP

Update Claims chart.

Global Average Temperature, 1880–2009



Energy from the Sun



## CLAIM

~~An increase in energy from the sun caused the most significant climate change.~~

We can cross out “Increase in energy from sunlight” claims because the evidence from the graphs make this possible.

We also found in the Sim, and it makes sense, that an increase to sunlight does cause temperatures to increase and ice to melt.

But this graph is strong evidence that this is *not* what has happened since about 1880.



# ECC 2.2.2 READING

Students are introduced to and read the article, "Past Climate Changes on Earth." (22 min)

## Investigation Question

"How can the amount of energy absorbed by Earth's surface change?"

You will continue to gather evidence about how the amount of energy absorbed by Earth's surface can change.

The data in the Warm-Up allowed you to eliminate "an increase in incoming solar energy" from the Claims chart, but the remaining claims need further investigation.

To do this, you will read an article that looks back at how climate has changed over Earth's history.

- The article describes two different periods of climate change on Earth.
- The article also describe scientists' best understandings of why these periods of change occurred, based on evidence they collected and are still collecting.

Thinking about these other climate change events can help scientists better understand what is happening today.

Past Climate Changes on Earth



Triceratops and other dinosaurs may have gone extinct because of a change in climate. © Mark Garlick/Scienc

Evidence shows that Earth is getting warmer—the global climate is changing right now. Did you know some periods in Earth's 4.6 billion-year history, Earth has been much warmer than it is now. During climate changes on Earth have to do with the amount of energy that enters Earth's system comes



# ECC 2.2.2 READING

## Review concepts about energy entering and exiting.

As you read the article, you will need to pay particular attention to how changes to energy entering and exiting affected Earth's climate in the past.

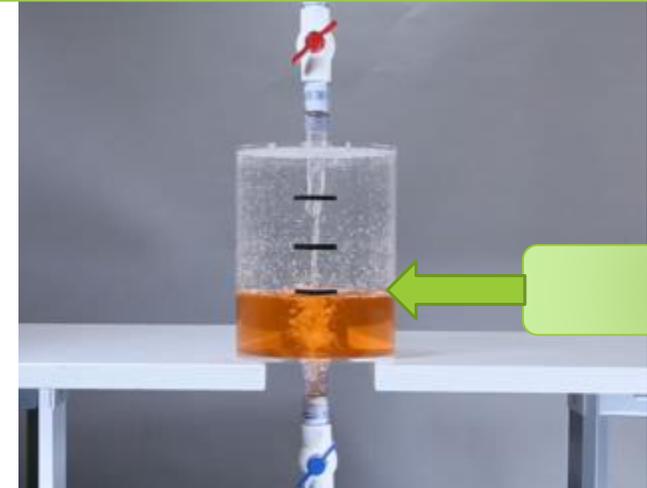
### Key Concept

A system can be stable, even as something flows into and out of the system. If this balanced flow is disrupted, there may be changes to the system.

A change to either the amount of energy entering or exiting the Earth system affects how much energy is absorbed by the surface.

## What have we learned so far?

- When the amount that enters is equal to the amount that exits, the system—and the temperature—are stable.



AMOUNT IN = AMOUNT OUT



# ECC 2.2.2 READING

## Review concepts about energy entering and exiting.

As you read the article, you will need to pay particular attention to how changes to energy entering and exiting affected Earth's climate in the past.

### Key Concept

Temperature increases if more energy enters than exits.

Temperature decreases if less energy enters than exits.

## What have we learned so far?

- When they are not equal, the system—and the temperature—change.





# ECC 2.2.2 READING

## OPEN ARTICLE: "Past Climate Changes on Earth"

### Past Climate Changes on Earth



READ,  
HIGHLIGHT,  
ANNOTATE, &  
SUMMARIZE

## Active Reading Guidelines

1. Think carefully about what you read. Pay attention to your own understanding.
2. As you read, annotate the text to make a record of your thinking. Highlight challenging words and add notes to record questions and make connections to your own experience.
3. Examine all visual representations carefully. Consider how they go together with the text.
4. After you read, discuss what you have read with others to help you better understand the text.



# ECC 2.2.3 DISCUSSION

Students share annotations with their peers and revisit the summarizing strategy. (13 min)

## Discussing and Reviewing Annotations

1. Look over your annotations for "Past Climate Changes on Earth." Choose one or two to share with a partner. Edit the annotations and add #share.

#share

---

Carefully choose an interesting annotation (comment, question, connection, vocabulary word) you'd like to share with your partner and add #share to this annotation.

2. Discuss the tagged annotations with your partner. After your discussion, edit the annotations and change the tag to #discussed.

#discussed

---

Add #discussed to your annotation if you feel that you and your partner have resolved a question OR if your discussion gave you a deeper understanding about something in the article.

3. Now, choose one of your questions or connections, either one you already discussed or a different one you still want to discuss with the class. Edit the annotation and add #present.

#present

---

Add #present to your annotation to mark any unresolved questions or ideas you would like to present to the class.



# ECC 2.2.3 DISCUSSION

## Reflecting on Annotations

Review your annotations, answer the question below the article, and then press HAND IN.

Rate how successful you were at using your Active Reading skills by responding to the following statement:  
**As I read, I paid attention to my own understanding and recorded my thoughts and questions.**

a never

b almost never

c sometimes

d frequently/often

e all the time

Past Climate Changes on Earth



Triceratops and other dinosaurs may have gone extinct because of a change in climate. © Mark Garlick/Scienc

Evidence shows that Earth is getting warmer—the global **climate** is changing right now. Did you know that in some periods in Earth's 4.6 billion-year history, Earth has been much warmer than it is now. During **climate changes** on Earth have to do with the amount of **energy** that enters Earth's system comp

# AFTER READING - SELF PACE

## 2.2: Reading "Past Climate Changes on Earth"

4 **HOMEWORK**  
Homework



## 2.3: Learning More About Past Climate Changes

1 **WARM-UP**  
Warm-Up



2 **READING**  
Second Read of "Past Climate Changes on Earth"



3 **MODELING TOOL**  
Modeling an Increase in Temperature Due to Gases



4 **CLASS**  
Revisiting the Anticipation Guide



Chapter 2: Energy Entering and Leaving Earth's System

7 Lessons

LET'S REVIEW WHAT YOU NEED TO DO BEFORE YOU START



# ECC 2.2.4 HOMEWORK

Students use the Sim to test a decrease in either carbon dioxide or methane, focusing on how that affects temperature and energy entering and exiting the system.

Homework:

1. Predict What Will Happen in the Sim
2. Test your Predictions in the Sim

Predict what you think will happen if either carbon dioxide or methane decreases. Then, press NEXT to test your predictions in the Sim.

1. Will you test a decrease in carbon dioxide or methane?

a carbon dioxide

b methane

SELECT ONE

MAKE PREDICTIONS

2. If you decrease  in the Sim, the temperature will .

3. Predict what will happen to energy entering and exiting.

a More energy will enter than exit.

b Less energy will enter than exit.

c The amount of energy entering and exiting will be equal.



# ECC 2.2.4 HOMEWORK

Students use the Sim to test a decrease in either carbon dioxide or methane, focusing on how that affects temperature and energy entering and exiting the system.

Homework:

1. Predict What Will Happen in the Sim

2. Test your Predictions in the Sim

## RUN YOUR TEST IN SIM

TEST YOUR PREDICTIONS

### Procedure

1. Run the Sim until the time reaches 20.
2. Pause and decrease either carbon dioxide or methane.
3. Run the test until the time reaches 40.
4. Observe the temperature and energy entering and energy exiting.

1. When you decreased  in the Sim, the temperature .

INDICATE RESULTS

2. What did you observe about the energy entering and exiting?

- |   |   |
|---|---|
| a | More energy entered than exited.                        |
| b | Less energy entered than exited.                        |
| c | The amount of energy that entered and exited was equal. |



# ECC 2.3.1 WARM-UP

Students explain how an energy imbalance would affect energy absorbed by Earth's surface, as well as its effect on Earth's temperature. (5 min)

## Warm-Up

Earth's current climate is changing, but there have been other times in Earth's history when the climate changed. During some of these times in the past, **more energy entered than exited** the Earth system.

Explain how this affected energy absorbed by the surface and temperature by making choices that complete the statement below.

If **more energy enters than exits** the Earth system, energy absorbed by the surface would  , causing global average temperature to .



# ECC 2.3.2 SECOND READ

Students revisit a portion of the article in order to focus on how carbon dioxide affects energy entering or exiting the Earth system.(20 min)

## Effects of Carbon Dioxide and Methane

Today, you will reread part of this article to help you better understand why increased carbon dioxide or methane can cause temperatures to increase. Reread the introduction and the section, "Alligators in the Arctic: The Eocene Period." As you read, highlight any information that helps answer the question, *How do carbon dioxide and methane affect energy entering or exiting the Earth system?* After you read, use your annotations to help you answer the two questions below the article.

1. When more energy enters than exits the Earth system, what happens to temperatures on Earth?

2. Do carbon dioxide and methane affect energy **entering** or **exiting** the Earth system?

Alligators in the Arctic: The Eocene Period



During the Eocene Period, even the Arctic was warm enough to be a comfortable home for



# ECC 2.3.3 MODELING TOOL

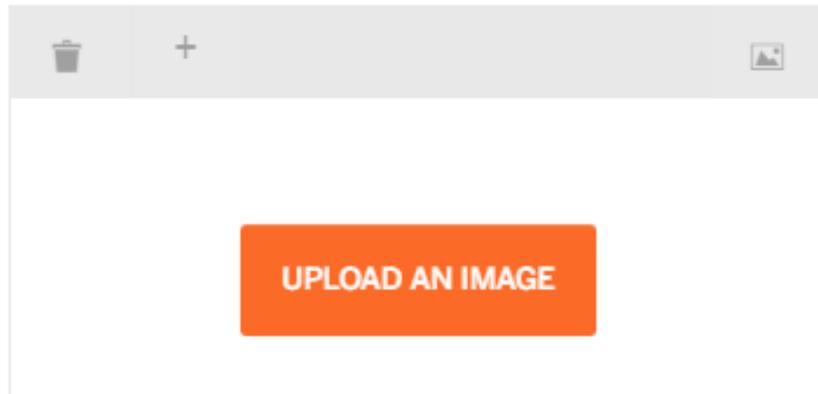
Students create models that show what is happening in the Earth system during the current climate change. (15 min)

## Modeling Tool Activity: Temperature Increase Due to Gases

You've already found that temperature increases when either carbon dioxide or methane increases.

1. Use what you learned about energy entering and exiting to show why temperature increases when the amount of carbon dioxide or methane increases.
2. Launch the Modeling Tool activity: [Carbon Dioxide/Methane](#).
3. Choose either carbon dioxide or methane.
4. When your model is complete, press HAND IN, and then explain what it shows.

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



Explain what your model shows.

A large, empty rectangular box with a thin grey border, intended for students to write their explanation of the model's results.



# ECC 2.3.3 ANTICIPATION GUIDE

Students reflect on their thinking about Earth's climate in the past by revisiting a statement in the Anticipation Guide. (5 min)

## Revisiting the Anticipation Guide

Review your original response to the statement from the Anticipation Guide:  
4. There have been times in the past when Earth's climate was very different.

Do you currently agree or disagree with this claim?

Have your views changed throughout the unit?

Describe the evidence you would use to support your current thinking about this claim.

# AFTER READING - SELF PACE



Chapter 2: Energy Entering and Leaving Earth's System

7 Lessons

## 2.2: Reading "Past Climate Changes on Earth"

4 **HOMEWORK**  
Homework



## 2.3: Learning More About Past Climate Changes

1 **WARM-UP**  
Warm-Up



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Second Read of "Past Climate Changes on Earth"



3 **MODELING TOOL**  
Modeling an Increase in Temperature Due to Gases



4 **CLASS**  
Revisiting the Anticipation Guide



What is not finished is due for HW on Thursday!