

## Lesson 4.5

# Extinctions and Human Impacts



## Overview

NOTE: The suggested time for this lesson is 55 minutes.

Building on what they have learned in this unit, students have the opportunity to consider natural selection—and its limits—on a more global scale. Students begin by thinking about what can cause populations to completely die off. They read an article about mass extinctions on Earth and learn that many scientists believe we are currently in the midst of another mass extinction due to climate change. Then students use the *Earth's Changing Climate* Simulation to investigate what might be causing the planet to warm. By running tests in the Sim and analyzing the data, they discover how human activities can change Earth's temperature. Students have a chance to reflect on the chain of causes and effects that connect human activities with mass extinction. To wrap up the lesson, students have the opportunity to discuss and learn about current technologies for preventing further climate change. The purpose of this lesson is for students to see how increases in human population and consumption of natural resources can negatively impact Earth's systems.

Anchor Phenomenon: The dinosaurs (and other organisms) went extinct.

Students learn:

- Mass extinction is when the majority of species on Earth die out.
- Mass extinction can occur when the environment changes so quickly and drastically that populations cannot adapt.
- Earth's climate is changing so quickly that it may cause a mass extinction.
- Earth's temperature increases as a result of human activities, such as population increase, deforestation, and combustion.
- New technologies can help to prevent Earth's temperature from increasing more.



### Lesson at a Glance

ACTIVITY

1

#### Warm-Up (5 min)

Students think about what can cause a population to die out in order to begin investigating mass extinction.



WARM-UP

2

#### Active Reading “The Limits of Natural Selection” (20 min)

Students read an article about the limits of natural selection and how climate change can lead to mass extinction.



READING

3

#### Investigating Climate Change in the Sim (20 min)

Students manipulate human activities in the Sim to discover which activities are connected to an increase or decrease in Earth's temperature.



SIM

4

#### Reflection (10 min)

Students consider what they have learned about the causes and effects of climate change.



CLASS



## Materials & Preparation

### Materials

#### For the Class

- Annotation Tracker\*
- Annotation Tracker Instructions

#### For Each Student

- optional: printed copy of “The Limits of Natural Selection” article\*
- optional: *Natural Selection* Investigation Notebook, pages 142–147\*

### Digital Tools

- [Earth’s Changing Climate Simulation](#)
- “The Limits of Natural Selection” article in the Amplify Library

\*teacher provided

## Preparation

### Before the Day of the Lesson

1. Preview the [Earth’s Changing Climate Simulation](#) in Activity 3 of this lesson. Familiarizing yourself with the Sim will help you support students during class.
2. Preview the article, “[The Limits of Natural Selection](#)” in the Amplify Library. This article is also located in Digital Resources. Familiarizing yourself with the article will help you support students as they add questions and comments during class.
3. Prepare to model Active Reading. You can use the think-aloud script that is provided in Activity 2, or you can modify the script, modeling in a way that makes the most sense for your students.
4. Prepare a space on the board or elsewhere to create the Causes and Effects Graphic Organizer. On the board, write “Causes and Effects” at the top. You will draw 4 circles and add words and arrows to this



### VOCABULARY

- adaptive trait
- cause
- climate change
- effect
- environment
- extinct
- human activities
- mass extinction
- natural selection
- organisms
- population
- prediction
- species

### UNPLUGGED?

#### Digital Devices Required

It is highly recommended that students have access to digital devices for this lesson. If students do not have individual devices, print copies of the Investigation Notebook pages for this lesson and have students complete the Simulation activities in pairs or groups. (PDF files of the article and Investigation Notebook pages can be found in Digital Resources.)



organizer during Activities 2, 3, and 4 of this lesson. Refer to the Causes and Effects Graphic Organizer PDF (in Digital Resources) to see what the completed organizer will look like and which items should be added in each activity. If desired you can print out the Causes and Effects Graphic Organizer PDF so you can have it on hand during the lesson.

### Immediately Before the Lesson

1. Write the Investigation Question on the board: *What can cause mass extinctions?*
2. Have on hand the following materials:
  - Annotation Trackers
  - digital devices
  - optional: printed copy of “The Limits of Natural Selection” article
  - optional: *Natural Selection* Investigation Notebook, pages 142–147

### Between-Class Prep

1. Locate a new Annotation Tracker for your next class.
2. Erase digital annotations. Erase the digital annotations you made in the article in the Amplify Library before modeling for the next class.
3. Erase the Causes and Effects Graphic Organizer from the board or prepare a space to create it for your next class.

### At the End of the Day

1. Print a copy of the Annotation Summary Sheet for each class. A PDF file of the Annotation Summary Sheet is in Digital Resources. Use the Annotation Trackers to review students’ submitted articles. If you have time to review students’ submitted articles and annotations, continue to fill out each Annotation Tracker to identify questions, alternate conceptions, and exemplary annotations. Use the Annotation Summary Sheets to analyze students’ annotations. The Annotation Summary Sheet is intended to help you identify trends in student thinking, recurring questions students have about the text, and other issues that you might want to address. Use your Annotation Trackers to fill out the Annotation Summary Sheets. Collect exemplary annotations and recurring alternate conceptions to share with the class. Exemplary annotations and recurring alternate conceptions can be shared with students in whatever feedback method is convenient for you. Identify examples of student annotations that are thought provoking, exemplify the Active Reading approach, and/or target key science ideas.



### DIGITAL RESOURCES

Annotation Tracker

Annotation Tracker Instructions

Annotation Summary Sheet

Causes and Effects Graphic Organizer

The Limits of Natural Selection

Printable Article: “The Limits of Natural Selection”

Natural Selection Investigation Notebook pages 142–147

Natural Selection Glossary

Natural Selection Multi-Language Glossary



## Differentiation

### Embedded Supports for Diverse Learners

Multiple modalities with the same topic. Students consider climate change and extinction through a short reading, an exploration of the *Earth's Changing Climate* Simulation, and student-to-student discussion. Engaging with the same ideas in many ways provides students multiple opportunities to make sense of a complex concepts and provides access points for different types of learners.

Student-to-student discussion. This lesson provides many opportunities for students to work in pairs and learn from each other as they discuss their thinking around the article, “The Limits of Natural Selection” and the Sim activity. The class and peer discussions are built into the lesson as a way of supporting both engagement and deeper student learning.

### Potential Challenges in this Lesson

Interpretation of visuals. Much of this lesson depends on students' abilities to make interpretations of line graphs. If you have students who may have trouble making such interpretations, consider ways to adjust the lesson to support their participation. For instance, you may want to extend the lesson and provide more whole-class time to talk about how each factor changes the graph and what that means.

Teacher modeling and independent practice. Analyzing climate data and reading graphs can be difficult for students. To support this challenging work, the lesson follows a supportive structure that includes teacher modeling, followed by independent student practice and then whole-class discussion. The ‘I Do, We Do, You Do’ progression has been shown in research to be a supportive way to organize difficult cognitive classroom activities.

### Specific Differentiation Strategies for English Learners

Strategically choose partners for English learners. For English learners, strategic pairings with supportive peers are especially important. Partners can help explain instructions to English learners, and English learners can then use English or their primary languages to explain their thinking to their partners. Consider pairing ELs with students who have a higher English proficiency, who will be positive, and who will be helpful. Considering how to pair students who are less proficient in English with partners that are supportive is an important adjustment you may want to make to this lesson.

Students summarize. Detailed instructions (such as the instructions for using the Simulation) and extended class discussions may be challenging for some English learners to follow. Having a few students summarize the main points of instructions or a discussion in their own words can help. If many English learners in the class have the same primary language, you could invite a student to summarize in that language.



### Specific Differentiation Strategies for Students Who Need More Support

Extended discussion of the visual representation from the Sim. Students may be confused by the central visual representation in the Sim, and providing some extra discussion of this visual representation can help students to understand what is being represented, what the icons mean, etc.

Read with a small group. You could choose to read the article, “The Limits of Natural Selection” with a small group of students. Have one student read aloud each paragraph as others in the group read along to themselves. After each paragraph, stop to annotate. You can have students discuss as they annotate to help them generate ideas and questions about the article. You can also stop to discuss as a group any particularly challenging sections of article.

### Specific Differentiation Strategies for Students Who Need More Challenge

Provide independent research opportunities. For students who need more challenge, ask them to do independent online research to find out more about mass extinctions and/or climate change. You may wish to have them share their findings with the class.

Asking deeper questions and making broader connections. Students who need more challenge should be encouraged to push themselves to explain the connections between what they discover in the Sim, the article, and what they have learned throughout the year or even throughout grades 6-8. It might help students to keep track of their questions and connections in a 3-column graphic organizer. Column 1 could be titled “Discoveries,” column 2 “Connections,” and column 3 “Questions.” These self-generated questions encourage students to think beyond the activity itself and can help them gain a deeper understanding and appreciation for what they are learning.

## Standards

### Key

Practices Disciplinary Core Ideas Crosscutting Concepts

### 3-D Statement

Students gather evidence from an article and a digital model to understand how Earth is being negatively impacted by increasing human population and consumption of natural resources (cause and effect).

## Next Generation Science Standards (NGSS)

### NGSS Practices

- Practice 1: Asking Questions and Defining Problems
- Practice 2: Developing and Using Models
- Practice 3: Planning and Carrying Out Investigations
- Practice 4: Analyzing and Interpreting Data



- Practice 8: Obtaining, Evaluating, and Communicating Information

#### NGSS Disciplinary Core Ideas

- **LS4.C: Adaptation:**
  - Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)
- **LS2.C: Ecosystem Dynamics, Functioning, and Resilience:**
  - Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5)
- **ESS3.C: Human Impacts on Earth Systems:**
  - Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3),(MS-ESS3-4)

#### NGSS Crosscutting Concepts

- Patterns
- Cause and Effect

#### Common Core State Standards for English Language Arts (CCSS-ELA)

- CCSS.ELA-LITERACY.RST.6-8.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks
- CCSS.ELA-LITERACY.RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- CCSS.ELA-LITERACY.RST.6-8.9: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic
- CCSS.ELA-LITERACY.WHST.6-8.2.D: Use precise language and domain-specific vocabulary to inform about or explain the topic.

#### Common Core State Standards for Mathematics (CCSS-Math)

##### CCSS-Math Practices





- CCSS.MATH.PRACTICE.MP1: Make sense of problems and persevere in solving them.
- CCSS.MATH.PRACTICE.MP2: Reason abstractly and quantitatively.
- CCSS.MATH.PRACTICE.MP4: Model with mathematics.
- CCSS.MATH.PRACTICE.MP5: Use appropriate tools strategically.

### CCSS-Math Content

- CCSS.MATH.CONTENT.8.F.5: Describe qualitatively the functional relationship between two quantities by analyzing a graph. Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

### California Environmental Principles and Concepts

- **Principle II: People Influence Natural Systems:** Concept a: Direct and indirect changes to natural systems due to the growth of human populations and their consumption rates influence the geographic extent, composition, biological diversity, and viability of natural systems.
- **Principle II: People Influence Natural Systems:** Concept c: The expansion and operation of human communities influences the geographic extent, composition, biological diversity, and viability of natural systems.



1

WARM-UP  
Warm-Up



## Warm-Up



Students work independently to consider extinction.

### Instructional Guide

1. Project Warm-Up, students work independently. Press the pin to collapse the instructional guide and project the student screen. Allow a few minutes for students to individually respond to the Warm-Up.

### Possible Responses

What do you think could cause a population to die out in the Sim?

Answers will vary but some students may say: If the environment changes too quickly for the population to adapt then they will all die. For example, when the environment got too cold and there were no ostrilopes with a lot of fur, they could not adapt and they died.



2

READING


Active Reading “The Limits  
of Natural Selection”


# Active Reading “The Limits of Natural Selection”



Students read and annotate a short article about mass extinction and climate change.

## Instructional Guide

1. Make a connection to the Warm-Up. Invite students to share their responses and explain what circumstances would cause all of the organisms to die in the *Natural Selection Sim*.
  2. Introduce the Investigation Question. Point out the Investigation Question on the board and read (or ask a student to read) it aloud: *What can cause mass extinctions?* Ask students to describe what the term *extinction* means and ask them if they have an idea about what a *mass extinction* might be. Then ask them if they know of any mass extinctions that occurred in the past [students may mention the dinosaur extinction].
  3. If you haven't already drawn 4 circles on the board, do so now. This will become the Causes and Effects Graphic Organizer. Tell students you will be using a graphic organizer to help organize their thinking about causes and effects during this lesson. Refer to the PDF file (in Digital Resources) to see what the completed organizer will look like and which items should be added in each activity.
  4. Write the term *mass extinction* inside the circle that is furthest to the right.
-  In the article you will read more about mass extinction.
5. Review Active Reading Guidelines. Point to the guidelines posted in the classroom. Briefly discuss each guideline.
  6. Project and introduce the article, “[The Limits of Natural Selection](#)”. You can also access this article from Digital Resources or use a document camera to project a printed copy.

 This article will help us to understand how a large change in Earth's environment can cause extinctions.



7. Model Active Reading. After you read the first paragraph with students, they will read the rest of the article with their partner. You can use the following script, or you can model your own thinking. You may wish to include any other strategies you have emphasized with your students, for example, identifying challenging words or summarizing.

- Begin by reading the title of the article aloud.
- Highlight “The Limits of Natural Selection.” Press ADD NOTE and write “Limit means the point beyond which something can’t go. I wonder what could make natural selection not go or happen?”
- Begin reading the projected article aloud, starting with the first paragraph. Stop after the first sentence.
- Highlight “For billions of years, populations of organisms on Earth have adapted to changing environments through natural selection.” Press ADD NOTE and write “When the environment changes, different traits become adaptive.”
- Continue reading through the end of the first paragraph. Highlight any additional words or sentences students might find confusing.

8. Look ahead to partner discussion. Inform students that they will read and annotate independently. Partners will share their annotations with each other once they have finished reading.

9. Prompt students to read and annotate the article. Allow about five minutes for reading and annotating. Circulate as students read, using the Annotation Tracker to record annotations that you would like to invite students to share.

*If using devices, ask students to press NEXT to continue this activity.*

10. Collapse the instructional guide and project the student screen: Discussing Annotations. Regain students’ attention and remind them how to review and tag annotations.

11. Ask students to discuss their annotations with their partner.

12. Facilitate a brief class discussion about annotations. Invite students to share their tagged questions and connections. Ask students to compare the circumstances that could cause a population to die out in the Sim with the circumstances that cause mass extinctions that they read about in the article.

*If using devices, ask students to press NEXT to continue this activity.*

13. Instruct students to skim the article again and answer the questions on their student card. Tell students they have some questions to answer and a prediction to make. They can find evidence about these questions in the article they just read.

14. Give students time to work in pairs. Circulate and assist pairs as needed.

15. If time allows ask students to share answers to the questions and their predictions. Highlight ideas about how Earth’s climate is changing and what might be causing that.



16. Return to the Causes and Effects Graphic Organizer and write the term “climate change” inside the circle second from the left.



In the article you read about mass extinction, which is when the majority of species on Earth die off. You found out that a mass extinction can be caused by climate change.

17. Remind students to hand in their annotations.

## Teacher Support

### Rationale

Science Note: Increases in Earth’s Temperature

Over the past century, Earth’s average temperature has increased by 0.8°C (1.4°F). Although projections about future temperatures vary, we will likely experience another 1.1–6.6°C (2–12°F) temperature increase in the next century. We chose not to include these temperatures in the article because it is unnecessary information for this lesson and may distract students from the other important ideas. In addition, students may think that these increases seem insignificant. However, small changes in Earth’s temperature can have a dramatic effect on global weather patterns such as increased droughts, floods, and stronger hurricanes. Earth’s ocean is also warming, resulting in rising sea levels, ice cap melt, and changes in both land and ocean ecosystems. These changes generate challenges of environmental, social, economic, and political significance. If students ask, you might want to tell them how much the temperature has increased. Give them an analogy to help them understand how these small changes can make such a large difference. Encourage them to think about how sick they feel when their body temperature rises just a few degrees.

## Possible Responses

Why might a species go extinct rather than just adapt?

If a species doesn’t have enough time for individuals with adaptive traits to reproduce and pass on those adaptive traits, then the species will go extinct.

What do scientists say caused most of the species of the dinosaurs to become extinct?

Scientists say that climate change caused by an asteroid colliding with Earth and massive volcanic eruptions caused the dinosaurs to become extinct.



3

SIM

Investigating Climate  
Change in the Sim

# Investigating Climate Change in the Sim



Students change different factors in the Sim in order to figure out what human activities cause climate change.

## Instructional Guide

1. Introduce the Activity. Collapse the instructional guide and project the student screen. Explain that students will use the *Earth's Changing Climate* Sim to investigate why Earth's climate is changing.



We know from the article that humans are causing climate change. But what specifically are humans doing to cause climate change?

2. Review the goal and the steps to complete the Sim activity. Read the Goal, the Do steps, and the Tips aloud (or call on students to read them). You may wish to demonstrate the tips when you project the Sim in the next step.

3. Project [Earth's Changing Climate Simulation](#) and select Human Activities mode. Introduce the factors that students can change:



Human activities refers to things people do that affect the Earth system, including their consumption of natural resources. Every day humans consume—or use—Earth's natural resources such as water, land, fossil fuels, plants, and animals in order to survive or to make our lives easier.

In the Sim, students will be able to change various factors related to human activities.

- Population. This slider changes the number of people on Earth. The default setting represents population right now; about 7 billion people live on Earth.
- Combustion per Person. Combustion is the process of burning fuels like coal, oil, natural gas, and wooden logs that produce heat and—for many fuels—carbon dioxide, which is released into the atmosphere. Emphasize that this slider represents the average amount of combustion from each person on Earth. Combustion includes engines (cars) and the way most electrical energy is produced. The medium setting in the Sim models the current level of combustion per person.



- **Livestock per Person.** Explain that livestock are farm animals that humans raise and use, such as cows and sheep, and this represents the average number of these animals for each person on Earth. The animals are raised for meat, milk, wool, and more. The medium setting in the Sim models the current amount of livestock per person.
- **Forest Cover.** This represents how much of the Earth's land is covered by forest. Humans can cut down forests or plant trees, decreasing or increasing the amount of forest cover. The low setting in the Sim models the current amount of forest.
- **Gas Capture.** Explain that gas capture in the Sim represents technologies that are being developed to trap gases as they are released from factories or other sources. These technologies are just beginning to be used. The low setting models the current amount of gas capture.

4. Have students decide with their partner who will try to change Earth's climate by increasing Earth's temperature, and who will try to decrease Earth's temperature.



As you change various factors, look for patterns in the graph to determine what is causing the temperature to increase or decrease.

5. Prompt students to launch the Sim, load the Human Activities mode and begin working.

6. Circulate to support students. Remind students to view graphs by pressing the graph icon in the lower left corner. Students should only view temperature on the graph.

7. Remind students to answer the questions.

Press NEXT to continue this activity.

*Ask students to press NEXT (or turn the page in their Investigation Notebooks) to complete the Sim Activity.*

8. Have students share their results with their partner and write about what they think can cause Earth's temperature to increase or decrease. Remind students to record their responses on their screens.

9. Lead a whole class discussion about what can cause Earth's temperature to increase or decrease. Bring the class back together to discuss what patterns they observed and to share their written responses.

10. Debrief by projecting the [Earth's Changing Climate Simulation](#) to show how to increase or decrease Earth's temperature. Load the Human Activities mode, show the graph and change factors to show students what they should have observed in the Sim activity.

11. Return to the Causes and Effects Graphic Organizer.

- Under the climate change circle, write "increase in Earth's temperature."



Right now on Earth, the climate change we are experiencing is due to an increase in Earth's temperature.



- Fill in the circle furthest left. In the circle furthest left write “human activities.”



What human activities did we find out are causing an increase in Earth’s temperature?  
[Increase in population, increase in combustion, increase in livestock, cutting down forests.]

- Record notes on student responses in or under the human activities circle.

*Remind students to press HAND IN.*

## Teacher Support

### Background

Science Notes: About Human Activities and Climate Change

There is a strong consensus among climate scientists that the current climate change is caused by human activities. While there was disagreement during initial investigations, consensus developed by the early 1990s. Disagreement since then has come almost exclusively from people who are not climate scientists, especially from politicians, industry, and advocacy groups concerned about attempting to change human activities to ameliorate climate change. Most of the carbon dioxide that humans add to the atmosphere comes from combustion of fuels—for transportation, to generate electricity, for heating buildings, and in industry. Conversion of forest to agricultural land also contributes—as does production of concrete, which accounts for about 5% of carbon dioxide emissions. Methane emissions come from livestock, landfills, and from the production and distribution of fuels. All these human activities are related to choices people make in their everyday lives about transportation, food, and more. As the NGSS highlights, the total level of these activities and the total release of carbon dioxide and methane are related both to per-person levels and to world population. At this time, world population, per capita combustion, and livestock are increasing dangerously.

### Instructional Suggestion

Technology Note: About Rate Changes in Graph View

The relationship between humans and the gases, carbon dioxide and methane, in the atmosphere is complex. At our current population, we are increasing the amounts of both carbon dioxide and methane in the atmosphere. This is reflected in the Sim’s Human Activities mode. Keeping the population at the default level—7 billion people, medium combustion, medium livestock—will result in an increase in carbon dioxide and methane and, therefore, an increase in temperature. This is different from Earth System mode where temperature remains constant at the default settings. Although changing the different factors will result in different rates of the temperature increasing, all students need to know for this lesson is that the temperature does increase due to increase in population, livestock, and combustion. They will get more experience with the different rates of increase in the *Earth’s Changing Climate* unit.

### Background

Science Notes: About Combustion

When fossil fuels burn (or other materials such as wood that contain carbon), a chemical reaction takes place in which oxygen gas from the air combines with carbon from the fuel to form carbon dioxide. This carbon dioxide is what contributes to the greenhouse effect, causing more heat to remain in Earth’s atmosphere, and increasing Earth’s





average temperature. (Combustion also directly produces thermal energy, heating the nearby air. However, the amount of thermal energy released by combustion is extremely small compared with the heating of Earth by sunlight and has a negligible effect on global average temperature.)

### Background

Science Notes: About Livestock and Methane

Livestock that eat grass (such as cows and sheep) rely on microorganisms in their guts to digest the cellulose in the grass. As the microorganisms digest the cellulose, a chemical reaction occurs, one product of which is methane gas. This methane, which escapes from the livestock in flatulence and burps, contributes to the greenhouse effect, causing more heat to remain in Earth's atmosphere, and increasing Earth's average temperature.

### Assessment

Assessment Opportunity: Student Understanding of Impact of Human Population and Resource Use on Earth Systems  
This activity can be used to assess students' understanding that typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth systems, unless the activities and technologies involved are engineered to minimize impact. Look for whether students can explain that human activities, including combustion, keeping of livestock, and deforestation, increase climate change, and that these activities can increase due to increases in population or per-capita consumption. Also, look for whether students can explain that human activities such as gas capture and reforestation can decrease the rate of climate change. If students do not seem to understand how human activities and human population affect climate change, lead students to make and test predictions in the *Earth's Changing Climate* Simulation. This may be done as a class or with a small group of students who need support. Have students make predictions about the effect on carbon dioxide in the atmosphere and on global average temperature for the following changes: 1) increasing per-capita combustion to the maximum; 2) increasing human population to the maximum; and 3) increasing gas-capture to the maximum. For each change, after students discuss predictions, run the test and compare it to the results for the same time period without these changes to the simulation's settings. You could also provide a more local and concrete example. Ask, "Imagine that each person in our city throws away two bags of garbage every week." Then ask, "What would the effect be on our city's garbage if the population of the city doubled?" and "What would the effect be if people started recycling more and each person only threw away one bag of garbage a week?" After discussing these questions, help students connect this to global population, and to other types of resource use.

## Possible Responses

What students should do and notice in the Sim:

Students will observe the effects on Earth's temperature of adjusting human factors. Results will vary depending on how much they change the human activities and if they change more than one activity at a time. The following are some results they may obtain:



- To increase Earth's temperature in Human Activities mode students may do one or more of the following:
  - increase population
  - increase combustion
  - increase livestock
  - decrease forest cover
  - decrease gas capture

NOTE: If students make no changes, they will see temperature increase. This is because Human Activities mode is set to reflect the present day.

- To decrease Earth's Temperature in Human Activities mode students may do one or more of the following:
  - decrease population
  - decrease combustion (a decrease in combustion alone will not decrease Earth's temperature)
  - decrease livestock (a decrease in livestock alone will not decrease Earth's temperature)
  - increase forest cover (an increase in forest cover alone will not decrease Earth's temperature)
  - increase gas capture (an increase in gas capture alone will not decrease Earth's temperature)


What human activities can cause Earth's temperature to increase?

Answers will vary. Students may say an increase in population, an increase in combustion, an increase in livestock, and/or cutting down forests.

What human activities can cause Earth's temperature to decrease?

Answers will vary. Students may say a decrease in population and combustion or a decrease in combustion and livestock and an increase in forest cover and gas capture.



			<b>4</b> CLASS Reflection 
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# Reflection




Students return to the article to identify effects of rising temperatures on Earth.


## Instructional Guide

1. Continuing to work in pairs, instruct students to reread part of the article. Allow students a few minutes to read and answer the question.
2. Invite students to share responses with the class. Highlight responses that include changes to global weather patterns and habitats.
3. Return to the Causes and Effects Graphic Organizer. Write “weather and habitat changes” inside of the second circle from the right (the last remaining circle, to the left of the one that says “mass extinction”).
4. Starting at the far left, draw in arrows from circle to circle as you summarize the Causes and Effects Graphic Organizer for the class or ask for a volunteer to do it. Explain the chain of causes and effects between human activities, climate change and temperature increase, weather and habitat changes, and mass extinction.

 In the Sim we saw how an increase in human population and use of natural resources like burning fuels (combustion) and cutting down forests leads to an increase Earth’s temperature. From the article, we know that an increase in Earth’s temperature affects global weather patterns and can cause habitat destruction. If these changes happen too quickly and drastically, then the effect can be mass extinction.

5. Invite students to brainstorm ways to disrupt this chain of cause and effect with a partner. Then, have students share out to the class.

 What might humans do to stop our activities from leading to mass extinction?  
[Accept all ideas.]

 There are lots of ways people are already trying to combat climate change. For example, people are inventing and using energy sources like solar and wind; and driving less by choosing to ride a bike, carpooling, or using public transportation. Some people also take part in reforestation—the replanting of trees that have been cut down. Even simply using less electricity can help by turning off or unplugging lights, televisions, and appliances when not in use.



## Possible Responses

What are some of the effects of Earth's rising temperature?

Rising temperatures are causing changes in global weather patterns, as well as causing habitat destruction such as the melting of arctic ice sheets and the killing of coral reefs.