NATIONAL GEOGRAPHIC

RESOURCE LIBRARY | LESSON

The Sixth Mass Extinction?

Students collaboratively investigate our planet's five mass extinctions and the possibility of a sixth mass extinction. Then, students explore the Anthropocene Epoch's cultural and environmental complexities and impacts before selecting a biome and endangered species that exist within it to be the focus of their research throughout the rest of the unit. They predict how human activity has impacted these biomes and species. This lesson is part of the *Engaging in the Fight Against Extinction* unit.

GRADES

6, 7, 8

SUBJECTS

Anthropology, Biology, Ecology, Conservation, Earth Science, Geology, Oceanography, Geography, Human Geography, Physical Geography, Social Studies, Civics, Economics, U.S. History

CONTENTS

3 Activities

ACTIVITY 1: MASS EXTINCTIONS OVER TIME | 50 MINS

DIRECTIONS

***Engaging in the Fight Against Extinction* Unit Driving Question**: *How can we, as planetary stewards, take an active role in saving species from extinction?*

***The Sixth Mass Extinction?* Lesson Driving Question**: *How have humans impacted Earth for better and for worse?*

1. Introduce students to mass extinctions through an inquiry discussion focused on the Permian Extinction.

- Begin by showing students the first 1:30 minutes of the video, *Ancient Earth: The Permian* (13:27).
- Using the think-pair-share method, have students partner up to determine what could have happened to cause the extinction of nine out of 10 plant and animal species alive during the Permian period. Record and display partner theories to the following questions:

    - *Why would multiple plant and animal species get wiped out together within the same ancient ecosystem?*
    - *What possible catastrophic natural disasters might have caused mass extinction (share examples, if necessary)?*
    - *How might the extinction of one species affect other species?*

2. Have students investigate multimedia resources to build their knowledge of the five mass extinctions.

- Distribute the *Five Mass Extinctions Four-Square* and divide the class into teams of three to research each of the five mass extinctions.
- Number groups from one to five to determine each group's focus, then have each student in the group use one of the following resources:

    - *Extinction* encyclopedic entry
    - *Mass Extinctions* infographic
    - American Museum of Natural History's *Shelf Life* multimedia webpage

- Have students fill in their *Five Mass Extinctions Four-Square* handout with information from their assigned source.
- After reading their resource, have students collaborate, sharing their combined knowledge to complete a large Four-Square on chart paper.

    - If multiple teams researched the same mass extinction, combine the teams for this portion of the step.

- Have each mass extinction team present their four-square and share their learning with the rest of the class.

3. Facilitate a whole-class discussion to guide students' analysis of past extinctions and predictions about future mass extinctions.

- Conduct a class discussion around the following questions:

    - *Looking across all of these extinctions, do they have anything in common?*
    - *Do you think any of the conditions that led to a mass extinction are present today?*
    - *Have you heard about any species that are in danger of extinction? What is causing that danger?*

4. Introduce the unit's driving question, the lesson's driving question, and the planetary stewardship project that will anchor all unit learning objectives together.

- As a class, return to the *Mass Extinctions* infographic and read about the sixth mass extinction.
- Lead a class discussion on the causes and preventative measures for mass extinction. Ask:

    - *What kinds of things do humans do that would contribute to mass extinction?*
    - *What kinds of things do humans do that might save the planet from a mass extinction?*

- Share with students the driving questions for the unit and lesson.

    - Unit Driving Question: *How can we, as planetary stewards, take an active role in saving species from extinction?*
    - Lesson Driving Question: *How have humans impacted Earth for better and for worse?*

- Define for students what it means to be a planetary steward.

    - Planetary stewardship is taking action to shape the trajectory of change on the planet to enhance the sustainability of both human well-being and the planet's ecosystems and nonliving resources.
    - Give students an opportunity to provide examples of how they are planetary stewards or how people might demonstrate planetary stewardship.

- Have students choose either the unit or lesson driving question and, with a partner, come up with an initial response to the question. Have students share their initial responses as a class and record student thinking to revisit later in the lesson.

Tip

Assessment: Note any potential needs for grouping changes or coaching in collaborative work that the group may need in order to be successful with the longer-term project. Use the time to emphasize the importance of the roles in effective group work. Ask follow-up questions to gain a sense of students' understanding of their group's mass extinction.

Tip

Begin a word wall with the vocabulary, beginning with the words from this activity.

Tip

Step 1: More information on the Think-Pair-Share Strategy is available here to support implementation.

Modification

Step 2: For more in-depth research on the five mass extinctions, to provide different resources for additional team members, or for added differentiation, access the Five *Mass Extinctions Curated Resources*.

Modification

Step 4: As the concept of a sixth mass extinction might make some students anxious, ensure that your students are ready to have this discussion. If this would be too anxiety-inducing in students, skip to the part of this step that asks students to create initial responses to the unit driving question or lesson driving question.

Informal Assessment

Five Mass Extinctions Four-Square: As student teams present their collaborative Four-Square charts to the class, evaluate the thoroughness with which each team uses the provided graphic organizer to construct its supporting evidence into an organized, coherent, and presentable argument that expresses the following: the primary reason(s) for their assigned mass extinction; inferences about the extinction's effects, and possible factors, if any, that might have mitigated or prevented tragedy.

OBJECTIVES

Subjects & Disciplines

Social Studies

- Civics
- U.S. History

Teaching Approach

- Project-based learning

Teaching Methods

- Cooperative learning
- Discussions
- Multimedia instruction

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Information, Media, and Technology Skills
    - Information, Communications, and Technology Literacy
  - Learning and Innovation Skills
    - Communication and Collaboration
    - Critical Thinking and Problem Solving
- 21st Century Themes
  - Environmental Literacy
  - Global Awareness
- Critical Thinking Skills
  - Analyzing
  - Applying
  - Evaluating

- Understanding
- Geographic Skills
  - Analyzing Geographic Information

National Standards, Principles, and Practices

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

• **CCSS.ELA-LITERACY.WHST.6-8.9:**
Draw evidence from informational texts to support analysis, reflection, and research.

THE COLLEGE, CAREER & CIVIC LIFE (C3) FRAMEWORK FOR SOCIAL STUDIES STATE STANDARDS

• **D2.His.14.6-8:**
Explain multiple causes and effects of events and developments in the past.

Preparation

BACKGROUND & VOCABULARY

Background Information

More than 90 percent of all organisms that have ever lived on Earth are now extinct. The planet's five mass extinctions resulted in the disappearance of 50-90 percent of all species within a span of 500 million years—a large span of time to humans, but in the blink of an eye in geological terms.

Earth's first five mass extinction events were:

- Ordovician, ~444 million years ago, ~86 percent of species lost
- Devonian, ~375 million years ago, ~75 percent of species lost
- Permian, ~252 million years ago, ~96 percent of marine species lost
- End Triassic, ~200 million years ago, ~80 percent of species lost
- Cretaceous, ~66 million years ago, ~76 percent of all species lost

Prior Knowledge

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Recommended Prior Activities

- None

Vocabulary

Term	Part of Speech	Definition
Anthropocene	*noun*	period of time during which human activities have impacted the environment enough to constitute a distinct geological change.
biodiversity	*noun*	all the different kinds of living organisms within a given area.
endangered species	*noun*	organism threatened with extinction.
extinction	*noun*	process of complete disappearance of a species from Earth.
mass extinction	*noun*	extinction event in which a large number of species go extinct in a relatively short period of time.
Permian	*adjective*	last geologic period of the Paleozoic Era.
species	*noun*	group of similar organisms that can reproduce with each other.
stewardship	*noun*	responsible management to ensure benefits are passed on to future generations.

ACTIVITY 2: THE IMPACTS OF THE ANTHROPOCENE EPOCH | 50 MINS

DIRECTIONS

Engaging in the Fight Against Extinction ***Unit Driving Question****: How can we, as planetary stewards, take an active role in saving species from extinction?*

The Sixth Mass Extinction? ***Lesson Driving Question****: How have humans impacted Earth for better and for worse?*

1. Engage students to consider how humans have made a lasting mark on the planet.

- Use *Google Earth* to show students satellite images of a place that has visible signs of human impact (such as Disney World; New York City; Las Vegas; Tagebau Hambach, Elsdorf, Germany; the Democratic Republic of the Congo).
- Ask students to discuss the following:

    - *What is the human impact on these locations?*
    - *Which of these impacts are permanent?*
    - *Which could be changed over time?*

2. Introduce students to the Anthropocene Epoch (Age of Humans) and explore this unofficial unit of geologic time.

- Build students' background knowledge using multimedia resources. Share with students that they will need to be able to define Anthropocene Epoch using these sources:

    - *Anthropocene* encyclopedia entry
    - *What is the Anthropocene?* (3:14) video
    - Merriam-Webster's Dictionary's definition of *Anthropocene*

- Distribute a copy of the *Exploring the Anthropocene Epoch* handout to each student. Guide students through a close reading of the first three sections (listed below) of *The Age of Humans: Evolutionary Perspectives on the Anthropocene* article and have students respond to the first five questions on the handout.

    - Section 1: *What is the Anthropocene?*
    - Section 2: *When did it begin?*
    - Section 3: *Why does the Anthropocene matter?*

- After students have completed reading and answering questions one through five on the handout, conduct a full-class discussion to review students' responses.

3. Students brainstorm and classify what they believe to be the positive and negative qualities of humans on the *Exploring the Anthropocene Epoch* handout.

- Have students answer question six on the *Exploring the Anthropocene Epoch* handout. Give students a few minutes to brainstorm both positive and negative human qualities that they believe influence humanity's impact on the environment and list these qualities in the appropriate columns of the T-chart.

- In their research teams, have students share their brainstormed lists and work together to identify the most positive and negative qualities that specifically influence environmental issues.
    - *Positive examples:* creativity, cooperation, problem solving, kindness, adaptability, common sense
    - *Negative examples:* laziness, vanity, selfishness, vengeance, discrimination, hypocrisy
- Call on students to share one of their examples of a positive or negative trait and provide an example of how that positively or negatively impacts Earth.
- Explain that as students begin work on their projects, they will find evidence of these traits both in actions that lead to extinction and in efforts that support species survival. Then, when developing their pamphlets, they can appeal to these traits when proposing specific action steps that others can take to prevent the extinction of a species.

4. Debrief students by having them respond to closing questions.

- Facilitate a class discussion about how the positive and negative qualities of humans can either help or hurt the future of our planet. Ask:
    - *As planetary stewards, which human qualities will be most important to protecting the future of the planet?*
    - *What actions can we take to emphasize our positive qualities and support the sustainability of Earth?*
    - *What actions might you personally change to make yourself an even stronger planetary steward?*
- Have students write their responses to the following questions on two sticky notes:
    - *What do you want Earth to look like in the future? To what parts of our planet do we need to pay more attention?*
    - *What changes do you think humans will need to make in order to have that future?*
- Label two pieces of chart paper with the questions and direct students to place their sticky notes with their answers on the appropriate paper. These questions will be revisited later in the unit.

Tip

Continue adding key terms to the unit word wall throughout the lesson or teach these key terms prior to the unit so that the word wall is visible throughout the two-week span.

Informal Assessment

Exploring the Anthropocene Epoch: Collect student worksheets and check for appropriate responses and enlightening reflections that might be shared in the following lesson.

OBJECTIVES

Subjects & Disciplines

Anthropology

Biology

- Ecology
- Conservation

Earth Science

- Geology
- Oceanography

Geography

- Human Geography
- Physical Geography

Social Studies

- Civics

Teaching Approach

- Project-based learning

Teaching Methods

- Brainstorming
- Cooperative learning
- Research

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Information, Media, and Technology Skills
    - Information Literacy
    - Information, Communications, and Technology Literacy
    - Media Literacy
  - Learning and Innovation Skills
    - Communication and Collaboration
    - Creativity and Innovation
    - Critical Thinking and Problem Solving
- 21st Century Themes
  - Environmental Literacy
  - Global Awareness
- Critical Thinking Skills
  - Analyzing
  - Remembering
  - Understanding
- Geographic Skills
  - Acquiring Geographic Information
  - Analyzing Geographic Information
  - Organizing Geographic Information

National Standards, Principles, and Practices

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

• **CCSS.ELA-LITERACY.RH.6-8.2:**
Determine the central ideas or information of a primary or secondary source; provide an accurate summary of the source distinct from prior knowledge or opinions.
• **CCSS.ELA-LITERACY.RH.6-8.7:**
Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.
• **CCSS.ELA-LITERACY.WHST.6-8.9:**
Draw evidence from informational texts to support analysis, reflection, and research.

THE COLLEGE, CAREER & CIVIC LIFE (C3) FRAMEWORK FOR SOCIAL STUDIES STATE STANDARDS

- **D2.His.1.6-8:**

Analyze connections among events and developments in broader historical contexts.

Preparation

BACKGROUND & VOCABULARY

Background Information

The Anthropocene Epoch, or the Age of Man, is the name given to the time period up to the present in which humankind has had a significant impact on the natural world. Though the date of the start of this new era is debated, the Anthropocene follows the Holocene, which started about 12,000 years ago, when humans began engaging in agriculture, in addition to hunting and gathering. Due to the impacts humans have had on Earth's biomes, evidence suggests that we may be causing the extinction of many of Earth's species, and perhaps, even our own.

Prior Knowledge

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Recommended Prior Activities

- None

Vocabulary

Term	Part of Speech	Definition
Anthropocene	*noun*	period of time during which human activities have impacted the environment enough to constitute a distinct geological change.
biodiversity	*noun*	all the different kinds of living organisms within a given area.
biome	*noun*	area of the planet which can be classified according to the plant and animal life in it.

Term	Part of Speech	Definition
endangered species	*noun*	organism threatened with extinction.
epoch	*noun*	particular period of time in history marked by an event that begins a new period.
Holocene	*noun*	having to do with the present geological time period. The Holocene Epoch began at the end of the last glacial period, about 10,000 years ago.
mass extinction	*noun*	extinction event in which a large number of species go extinct in a relatively short period of time.
species	*noun*	group of similar organisms that can reproduce with each other.
stewardship	*noun*	responsible management to ensure benefits are passed on to future generations.

ACTIVITY 3: ENDANGERED SPECIES AND THEIR BIOMES | 1 HR 15 MINS

DIRECTIONS

Engaging in the Fight Against Extinction ***Unit Driving Question****: How can we, as planetary stewards, take an active role in saving species from extinction?*

The Sixth Mass Extinction? ***Lesson Driving Question****: How have humans impacted the Earth for better and for worse?*

1. Have students explore images to develop an understanding of how humans and nature influence species survival.

- Have students navigate to Joel Sartore's *Gallery: Conservation Stories* and have them look through the photos.
- After students have looked through the images and captions, use the following prompts to conduct a whole-class discussion about observations that support their previous learning about human and natural impacts affecting species:
    - *In what images do you see evidence of human or natural influence on the survival of a species?*

    - *Describe the habitats of some of these animals, or choose one of the animals and describe/identify the habitat where this animal lives.*

- Create a class Know and Need to Know chart to gather students' initial knowledge and lines of inquiry.
- Explain to students that their final unit project is to develop a pamphlet that shares information about an endangered species, and the Know and Need to Know chart will be the main tool they will be using to guide their research and collect information.

2. Introduce students to the five major world biomes through encyclopedic entries and an infographic.

- Distribute the *Introductory Research on Biomes* handout to each student and preview the information students will be gathering during the rest of this activity.
- Read aloud the first two paragraphs of the encyclopedic entries on *biome* and *ecosystem* to students to develop background knowledge.

    - Help students differentiate between biomes, ecosystems, and habitats by displaying the infographic *Biomes, Ecosystems, and Habitats: What's the Difference*?

        - Clarify that the habitats and species that live within specific biomes will vary depending on where the biome is located.

- Display and read through the infographic *What Are the Major Types of Biomes?* highlighting the differences between the five types of biomes.

    - Explain that while areas are marked to represent the location of specific biomes, they are not the only location where each biome can be found.

3. Scaffold students' understanding of how animals come to be classified as threatened or endangered.

- Explain to students that they are going to be researching specific threatened and endangered species whose habitats are found within these biomes.
- Read the *Following the Science* section in the National Geographic article *How Do We Decide Which Species are Endangered or Threatened?*

- Share with students that the IUCN stands for the International Union for the Conservation of Nature, an organization that is tasked with gathering data about the environment and supporting governments in making policies using that data.
- Have students discuss with a neighbor: *Based on this article, how confident are you about how species are classified? Do you think the IUCN is a trustworthy organization?*

4. Assign students to research teams focused on one biome and have the team select an endangered species from that biome to focus on throughout the unit.

- Remind students: *For your project, you will be creating a conservation pamphlet that focuses on one animal that needs our attention. To do that work, we first need to build our background knowledge and get to know these biomes and species.*
- In research teams, have students read the encyclopedia article on their assigned biome (listed below) by browsing the appropriate initial resource. Have at least two teams research each biome; each team researches a unique animal later in this step.

    - *Tundra Biome*
    - *Aquatic Biome*
    - *Forest Biome*
    - *Desert Biome*
    - *Grassland Biome*

- Next, have each team select a species from their biome. The options for each biome are:

    - Tundra: *polar bear* or *wood bison*
    - Desert: *desert tortoise* or *Peninsular bighorn sheep*
    - Grasslands: *black-footed ferret*, *black rhino*, or *American burying beetle*
    - Aquatic: *blue whale*, *Galápagos penguin*, or *hawksbill turtle*
    - Forest: *pygmy three-toed sloth*, *harpy eagle*, *bonobo*, *Sumatran tiger*, or *orangutan*

- Have teams report out their selected biome and species before collecting the *Introductory Research on Biomes* handout from each student.

5. Debrief the activity by revisiting the class Know and Need to Know chart.

- Have students suggest information they've learned that should be added to the Know column.
- Revisit the lesson driving question: *How have humans impacted the Earth for better and for worse?*

- Solicit student volunteers to provide some examples from their research that support an answer to the driving question.

Tip

Continue the unit word wall by adding key terms to it throughout the lesson.

Tip

Assessment: Address misunderstandings in small groups at the beginning of group work during the next activity.

Tip

Step 1: A *Know & Need to Know* chart is an information organization tool that can be used to gauge prior knowledge and track learning throughout a research-based project. Students start by listing information they already know about a topic in the Know column of the chart, and then they begin generating questions that will move them toward understanding potential answers to the driving question(s). As they discover answers to their questions, they can strike out their question in the Need to Know column and add the learned information to the Know column.

Modification

Step 2: Students read about biomes and ecosystems in the provided links and develop their own explanations for how they are different.

Modification

Step 4: Encourage students who would like more information to skim this infographic on threats: *The Threats Facing Biomes Today*.

Modification

Step 4: Have students research endangered species of the biome as homework and be prepared to present their findings to their team to determine the group's focal species.

Informal Assessment

Collect the *Introductory Research on Biomes* handout at the end of this activity to review students' documents for general understanding.

Extending the Learning

Check the National Geographic's *Explorer Classroom* site to potentially connect with *Rae Wynn-Grant (NG Explorer)*, an ecologist specializing in conservation biology or other relevant explorers.

Create a closed classroom website, blog, discussion board, or shared document for student teams to share questions, ideas, comments, and concerns as they conduct their research across this two-week unit.

Geo-Inquiry: Have students investigate the geographic distribution of biomes and the human impact on the prairie and its animals by participating in *Altered Biomes*, an Esri GeoInquiries activity.

OBJECTIVES

Subjects & Disciplines

Biology

- Ecology
- Conservation

Earth Science

- Geology
- Oceanography

Geography

- Human Geography
- Physical Geography

Social Studies

- Civics
- Economics

Learning Objectives

Students will:

- Research one of the world's five major biomes and select a focal species that lives in that biome.

Teaching Approach

- Project-based learning

Teaching Methods

- Discussions
- Reading
- Research

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Information, Media, and Technology Skills
    - Information Literacy
    - Media Literacy
  - Learning and Innovation Skills
    - Communication and Collaboration
- 21st Century Themes
  - Environmental Literacy
  - Global Awareness
- Critical Thinking Skills
  - Analyzing
  - Applying
  - Understanding
- Geographic Skills
  - Acquiring Geographic Information
  - Analyzing Geographic Information
  - Organizing Geographic Information

National Standards, Principles, and Practices

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

- **CCSS.ELA-LITERACY.WHST.6-8.9:**

Draw evidence from informational texts to support analysis, reflection, and research.

THE COLLEGE, CAREER & CIVIC LIFE (C3) FRAMEWORK FOR SOCIAL STUDIES STATE STANDARDS

- **D3.1.6-8:**

Gather relevant information from multiple sources while using the origin, authority, structure, context, and corroborative value of the sources to guide the selection.

Preparation

BACKGROUND & VOCABULARY

Background Information

Biomes are defined as major communities on Earth, classified by climate, predominant vegetation and characterized by species' adaptations to that particular environment. Latitude and annual rainfall are also used to classify biomes.

While there are many ideas about how many biomes exist, there are five major categories of biomes on Earth: aquatic, desert, forests, grasslands, and tundra. The animal species living within the biome depends heavily upon the continent, country, or even smaller region in which the biome is located.

Prior Knowledge

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Recommended Prior Activities

- None

Vocabulary

Term	Part of Speech	Definition
aquatic	*adjective*	having to do with water.
biome	*noun*	area of the planet which can be classified according to the plant and animal life in it.
climate	*noun*	all weather conditions for a given location over a period of time.
conservation ecology	*noun*	study of Earth's biodiversity, with the goal of protecting species, habitats, and ecosystems. Also called conservation biology.
desert	*noun*	area of land that receives no more than 25 centimeters (10 inches) of precipitation a year.
driver	*noun*	any natural or human-induced factor that directly or indirectly sets a change to an ecosystem in motion.
ecosystem	*noun*	community and interactions of living and nonliving things in an area.
endangered species	*noun*	organism threatened with extinction.
extinction	*noun*	process of complete disappearance of a species from Earth.
forest	*noun*	ecosystem filled with trees and underbrush.
grassland	*noun*	ecosystem with large, flat areas of grasses.
habitat	*noun*	environment where an organism lives throughout the year or for shorter periods of time.
tundra	*noun*	cold, treeless region in Arctic and Antarctic climates.

Informal Assessment

Throughout the lesson, students respond to the driving question for the lesson and track how their thinking changes and deepens over time.

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