Modern Extinction — The Sixth Mass Extinction

Lesson Overview:

In this lesson, students explore modern extinctions in the context of mass extinctions from Earth's past. Students watch *Racing Extinction* video clips to enhance their perspective and insight. Activities in this lesson include listing extinct species, creating a timeline of mass extinctions, and investigating scientists' claims that current extinction rates are 1,000 times the natural background rate. Students select a case study of species extinction in modern times to investigate connections between modern extinctions and human activities.

***Racing Extinction* Video Clips:**

- **Video Clip 1: The World Is Singing**

  This clip features the endangered blue whale, which has the loudest song in the animal kingdom. Also in the segment, a scientist at the Cornell Bioacoustic Research Program reveals a vast library of recorded animal sounds. Many of the animals in the library have gone extinct.

- **Video Clip 2: Mass Extinction Events**

  This clip identifies the five mass extinction events that have occurred on Earth since life began. Experts believe that humans will be to blame for the sixth extinction event.

- **Video Clip 3: Vanishing Species**

  This clip compares natural extinction rates with the elevated extinction rates of today. Over the next 100 years, we could lose up to 50% of all species on Earth.

Lesson Duration: Up to two 45-minute sessions

Essential Questions:

- What is extinction?
- Which species have become extinct in modern times?
- What are the characteristics of past mass extinctions?
- How do modern extinction rates compare with natural (background) rates?
- How do human activities result in species extinctions, and what species have become extinct due to human activities?

Objectives:

Students will:

- Define extinction
- Cite examples of (1) past mass extinctions (2) and recent species extinctions
- Compare current extinction rates with background extinction rates
- Analyze the connection between recent extinctions and human activities
- Cite examples of how human activities have caused species extinctions.

Standards:

- *Next Generation Science Standards*
    - HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
    - HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
    - HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- *Common Core State Standards*
    - RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

- WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.
- SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
- MP.2 Reason abstractly and quantitatively.
- MP.4 Model with mathematics.
- HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

Materials Needed:

- Computer or mobile device with Internet access
- Graphics software (optional)

Teacher Preparation:

- Watch *Racing Extinction* video clips, or the entire documentary if possible
- Review online resources provided in lesson
- Consider strategies for ELL, struggling, and accelerated students

Background Information (for the Teacher):

The documentary *Racing Extinction* highlights the scientific consensus that humans are causing an unprecedented spike in the extinction of plant and animal life. Scientists agree that the current spike in species extinctions is a global crisis on a par with that of climate change. In this lesson, students explore the evidence for past mass extinctions and their causes. Students use their exploration to put the current mass extinction into context, giving insight into its causes and consequences, and possible actions to prevent species extinctions.

Key learning points for this lesson:

- The extinction event currently underway ranks with the five previous mass extinctions, most recently the extinction of the dinosaurs 65 million years ago. That is, humans are causing a one in a hundred million years event, significant on geological time scale.
- Extinctions are highly complex events influenced by species biology and ecology, and environmental changes. Tracking past extinctions is challenging, given the incomplete fossil record. However, scientists have put together pieces of the puzzle to determine that current extinction rates are a thousand times the background or natural rate of extinction.
- Local extinctions occur when a sub-population of a species disappears. A species may recover from local extinction if additional populations survive. A total species extinction occurs when all of a species' sub-populations die out. A totally extinct species can never recover or come back.
- Some of this information may seem removed or abstracted from students' daily lives. To encourage interest, emphasize the fact that we are but one of the millions of species, and if we allow others to go extinct, there's a good chance that humans may one day follow them. Moreover, we already directly benefit in many ways from other species including economic, cultural, and aesthetic benefits. For example, you can make the mass extinction concept more tangible by asking students to imagine what would happen if all of the local bees went extinct. What foods would be scarce or even unavailable in that case? You can also refer students to Rachel Carson's seminal 1962 work, *Silent Spring*, which

considers the possibility of the widespread extinction of local songbird populations

- Evidence scientists use to estimate background extinction rates includes the fossil record, speciation rates, and diversification across families.
- Evidence scientists use to estimate current extinction rates includes the theory of island biogeography and the species-area relationship, as well as population studies and species surveys.
- The basic unit of extinction rate is the fraction of species going extinct per unit time — usually a year. The rate is small, so scientists often express it as the number of extinctions per million species, per year.
- For case studies, students can draw from numerous examples of species extinction in modern times (dodo, passenger pigeon, Tasmanian wolf, etc.).

ENGAGE

1. To engage students initially, show them the *Racing Extinction* video clip: *The World Is Singing.*
2. Students write in their notebooks a list of animal sounds that they have heard in real life or media such as films or videos.
3. If time allows, students can explore the Cornell Macauley Library website (featured in the *Racing Extinction* film) to hear additional animal songs and sounds.
4. From prior knowledge, students list extinct species that they know of. If necessary, prompt students with one or two examples they will know, such as dinosaurs or mammoths. Encourage students to include recent extinctions such as the dodo.
5. Students write their own definition of the word “extinction” in their notebooks.
6. Students choose one extinct species from their list and write a short passage titled “The Sound of Extinction” and describe the sounds they think that species would have made.
7. Explain to students that they will learn about the concept of extinction and evidence for actual extinctions in Earth’s history and in modern times.

EXPLORE

1. Working in small groups, students watch the video clip: *Mass Extinction Events.*
2. In their groups, students research online resources to discover data regarding prior mass extinctions on Earth. Example websites:
    a. Penn State College of Earth and Mineral Sciences: Extinction over Earth's History
    b. *National Geographic*: Mass Extinctions
3. Each group uses graphics software to create a timeline of extinctions that includes the past five mass extinctions.
4. Students compare two graphs that show mass extinctions over time.
    a. Marine genera
    b. Families per million years
5. Students interpret the data in these graphs to evaluate the difference between showing extinctions as a percentage of taxa or as an extinction rate (families per million years).
6. Each group chooses a particular mass extinction event. Ensure that the class as a whole includes all of the five mass extinctions. See the BBC website for a summary list of the events.
7. Students watch the *Racing Extinction* video clip: *Vanishing Species*.
8. In small groups, students research online resources to explore evidence used to estimate and compare background extinction rates and current extinction rates. For information on current extinction rates:
    a. PBS/WGBH: The Current Mass Extinction
    b. *Conservation Biology:* Estimating the normal background rate of species extinction
    c. *Science:* The biodiversity of species and their rates of extinction, distribution, and protection
    d. Mongabay: Deforestation and Extinction
9. Ensure groups research data related to the fossil record, speciation rates, and diversification across families, which are used to estimate background extinction rates. Also, check that groups explore the theory of island biogeography as the basis for estimating current extinction rates. Information on applying the theory of island biogeography to estimate extinction rates.

EXPLAIN

1. Each group creates a resource such as a web page, digital slide presentation, or e-brochure explaining their chosen mass extinction event. The resource should include fossil and radiometric evidence for dating the event, the kinds of species that went extinct, and the severity of the event. The explanation should emphasize scientific hypotheses that explain their chosen event.
2. Each group writes a one- to two-page report explaining the types of evidence and methods used to estimate background extinction rates and current extinction rates. The report should include methods and data related to the fossil record, speciation rates, and diversification across families. The report should also include different units for measuring extinction rates, and potential sources of error or inaccuracy in estimating extinction rates.
3. Students write a short passage explaining the role of the theory of island biogeography as the key biological theory for estimating current extinction rates.

ELABORATE

1. Still working in small groups, each group selects for case study a species that has gone extinct in modern times. The group researches online resources to explore the causes of the extinction of their chosen species. Resources include:
    a. IUCN Red List (click “Extinct” in the top menu)
    b. The 10 best known extinct species
2. Each group creates a concept map to illustrate the case study of a species that has gone extinct in modern times. The concept map should include key data including:
    - Species names
    - Illustrations or photos if available
    - Dates of discovery and extinction
    - Biogeographical data (location, initial population size, ecology, and behavior)
    - Causes of extinction
    - Possible actions that may have prevented the extinction

3. Working individually or in small groups, students brainstorm specific activities that publicize and educate about the Sixth Extinction. Students create a list of possible activities and discuss which are feasible to implement in a class setting. (They can later use this list as possible projects for Lesson 4.)

EVALUATE

Working individually students complete the following constructed responses.

- Write a short passage describing characteristics of past mass extinctions.
- Describe how modern extinction rates compare with natural (background) rates.
- Describe five kinds of human activities that result in species extinctions.
- List three species that have become extinct due to human activities and the causes of those extinctions.