

TOPIC: EXTINCTIONS

- ◆ Extinctions: events that _____ tree of life.
 - **Background Extinction:** average _____ level of extinction.
 - Due to competition, environmental change etc.
 - **Mass Extinctions:** catastrophic _____ events.
 - Simultaneously affect species _____ tree of life.
 - Takes ____ - ____ million years for similar levels of diversity to return.
 - “The Big _____”: major extinctions in the Phanerozoic (time since the start of the Cambrian).

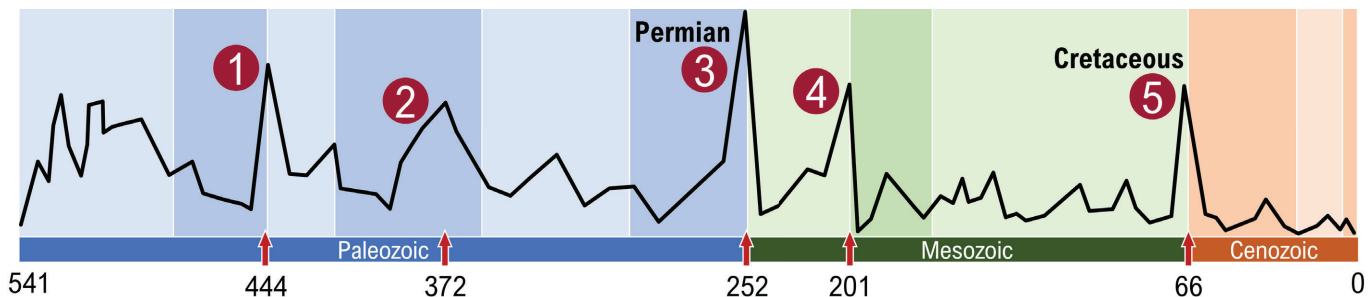
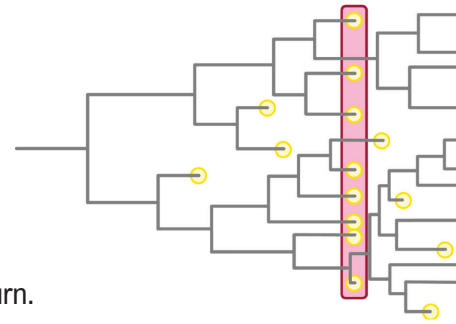


Image adapted from: J. John Sepkoski, Mass Extinctions, Concept of, Editor(s): Simon A Levin, Encyclopedia of Biodiversity (Second Edition), Academic Press, 2001, Pages 156-166.

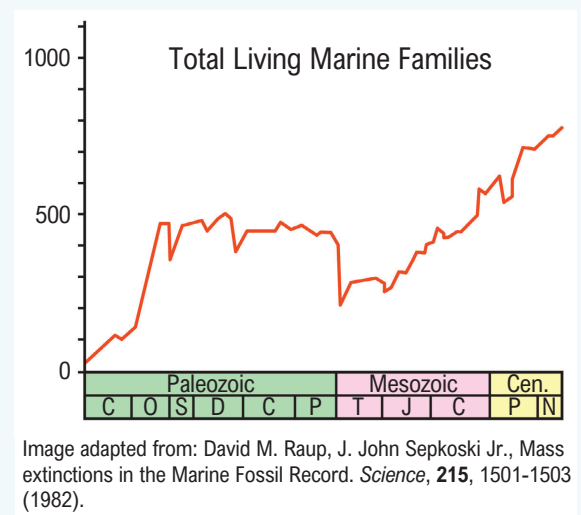
EXAMPLE

Below is a graph showing the number of marine families alive over time during the Phanerozoic. Use the graph to answer the questions below.

- a) Draw arrows to where the five major extinction events occurred.
- b) Are there other extinction events that you see in the data? If so, mark 2 with an asterisk.
- c) Circle which extinction event appears to have been the most consequential.
- d) Why do you think the data is based on marine families?

- e) Despite extinctions, what has happened to the total number of families over time?

- f) The end-Cretaceous extinction event is thought to have killed 75% or more of all species on Earth. The graph does not show a 75% reduction at that time, however. How could you explain the discrepancy?



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PRACTICE

How do mass extinctions differ from background extinctions?

- a) Mass extinctions affect larger numbers of diverse species simultaneously.
- b) Mass extinctions tend to affect larger organisms instead of smaller organisms.
- c) Mass extinctions can be caused by a change in the environment, while background extinctions cannot.
- d) Mass extinctions are typically caused by an increase in competition, while background extinctions are not.

PRACTICE

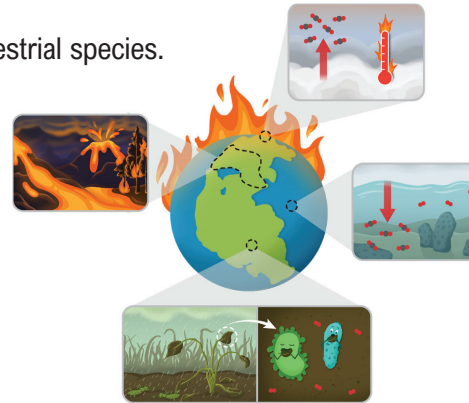
What could be one reason why paleontologists mostly study extinctions in the Phanerozoic (since the Cambrian explosion)?

- a) Mass extinctions were rare before the Phanerozoic but have become more common since.
- b) Plants and animals did not live on land until the Phanerozoic.
- c) More hard-bodied organisms evolved in the Phanerozoic.
- d) The Phanerozoic was a time of more active volcanic activity, leading to more easily dateable fossils.

TOPIC: EXTINCTIONS

Permian Extinction

- ◆ Permian Extinction (The Great _____): ~252 mya.
- ◆ At this point, we had: ▸ Reptiles & mammal ancestors ▸ _____ ▸ Land _____ ▸ Insects
 - One super-continent - _____.
- ◆ **Permian extinction:** wiped out _____ of marine species & 70% of terrestrial species.
 - “World-Went-to-Hell Hypothesis” – Massive _____ activity.
 - _____ hundreds of meters thick covered Siberia.
 - Increased _____ levels caused a ~6 °C rise in atmospheric temp.
 - Acid Rain killed plants (and organisms that fed on the plants).
 - Acidification & _____ levels in the ocean dropped.



PRACTICE

What is thought to have been the major cause of the end-Permian extinction event?

- a) An asteroid impact that caused global winter.
- b) The diversification of the dinosaurs forced other species into extinction.
- c) Major volcanic activity disrupted the global atmosphere and ocean chemistry.
- d) Continental drift shifted environments suddenly and drastically.

TOPIC: EXTINCTIONS

Cretaceous Extinction

◆ Cretaceous Extinction: ~66 million years ago. Also known as the ___-___ extinction.

▸ At this point, we had: ▸ _____ ▸ Flowering plants ▸ _____ ▸ Bees & Ants

◆ **Cretaceous Extinction:** wiped out _____ of all species → all non-_____ dinosaurs.

“Impact Hypothesis” (a very bad day on planet Earth).

▸ _____ struck near the Yucatan peninsula.

◆ Mega-_____.

◆ World-wide _____.

→ Short-term

◆ Global _____;

◆ Acid rain and ocean _____;

◆ 100,000 years of global warming.

→ Long-term

▸ Other factors (_____ activity) may have contributed.



PRACTICE

The extinction at the end of the Cretaceous period is most closely associated with what?

- a) The extinction of many organisms that evolved in the Cambrian, such as trilobites.
- b) The extinction of the dinosaurs.
- c) Massive worldwide volcanic activity.
- d) Opening of terrestrial environments for colonization by vertebrates.

PRACTICE

Which piece of evidence is consistent with the leading hypothesis for the cause of end-Cretaceous extinction?

- a) Massive lava flows have been found in Siberia, large enough to disrupt global atmospheric chemistry.
- b) Plant colonization of land led to a major increase in the nutrients available in the oceans and a worldwide decrease in oxygen levels.
- c) The super-continent Pangea broke up, forming many of the current continents during the Cretaceous.
- d) Worldwide, a layer of sediment dated to 66 mya contains iridium, an element common in asteroids.

TOPIC: EXTINCTIONS

Sixth Extinction

◆ Scientists believe a ____ extinction may be underway due to _____ impacts.

- ◆ Current extinction rate is _____ times the background extinction rate.
 - This rate may _____ represent the actual number of extinctions.
 - Likely due to _____ impact, such as pollution, climate change, habitat loss, etc.

- *Recall:* Fossil record indicates it takes _____ million years for diversity to return.

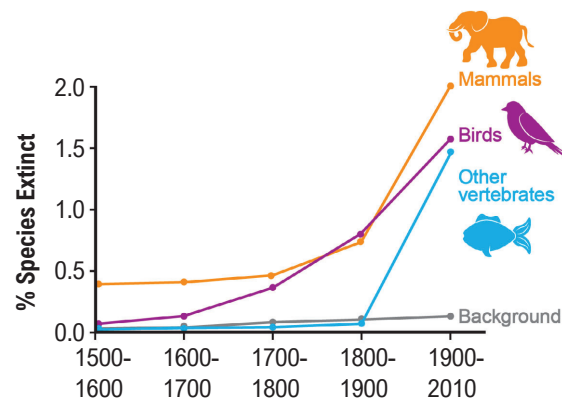


Image adapted from: G. Ceballos, et al, Accelerated modern human-induced species losses: Entering the sixth mass extinction. Science Advances, 1, e1400253 (2015)

PRACTICE

During the late Pleistocene, between 50,000 and 10,000 years ago, about 65% of megafauna species (animals with mass over 44 kg, or 100 lb) went extinct around the world. Australia and the Americas had the highest megafauna extinction rates with 100% of mammals over 1000 kg (~2,200 lbs) going extinct. Many scientists consider these extinctions as the leading edge of the world's 6th major extinction event. If the causes of the late Pleistocene extinctions and the causes of the 6th major extinction event are linked, which of the following statements about the Pleistocene extinctions is most likely true?

- a) Volcanic activity in South America led to widespread ocean acidification.
- b) Modern humans moved into new areas at the end of the Pleistocene, notably into Australia and the Americas.
- c) A large asteroid impact in what is today Northern Canada occurred during the late Pleistocene.
- d) An adaptive radiation of new species forced these resident species into extinction.