# What are Mass Extinctions and what causes them? KEY

Adapted from https://www.nationalgeographic.com/science/prehistoric-world/mass-extinction/

Read the text and use the highlighter tool to highlight the information using this color key:
**Highlighting Key:** How Long Ago  Causes of the Extinction  % and Types of Species that Went Extinct

## Ordovician-Silurian extinction - 444 million years ago

The Ordovician period, from 485 to 444 million years ago, was a time of dramatic changes for life on Earth. Over a 30-million-year stretch, species diversity blossomed, but as the period ended, the first known mass extinction struck. At that time, massive glacier formation locked up huge amounts of water in an ice cap that covered parts of a large south polar landmass. This ice formation may have been triggered by the rise of North America's Appalachian Mountains. The large-scale weathering of these freshly uplifted rocks sucked carbon dioxide out of the atmosphere and drastically cooled the planet.

As a result, sea levels dropped by hundreds of feet. Creatures living in shallow waters would have seen their habitats cool and shrink dramatically, dealing a major blow. Once sea levels started to rise again, marine oxygen levels fell, which caused ocean waters to store toxic metals.

The second worst mass extinction known to science, this event killed an estimated 85 percent of all species. The event took its hardest toll on marine organisms such as corals, shelled brachiopods, eel-like creatures called conodonts, and the trilobites.

## Late Devonian extinction - 383-359 million years ago

Starting 383 million years ago, this extinction event eliminated about 75 percent of all species on Earth over a span of roughly 20 million years.

Several times during the Devonian, ocean oxygen levels dropped steeply, which dealt serious blows to conodonts and ancient shelled relatives of squid and octopuses called goniatites. The worst of these came about 372 million years ago. Rocks from the period in what is now Germany show that as oxygen levels dropped, many reef-building creatures died out, including a major group of sea sponges called the stromatoporoids.

Volcanism is a possible trigger for all of this. Within a couple million years, a large igneous province called the Viluy Traps erupted 240,000 cubic miles of lava in what is now Siberia. The eruption would have spewed greenhouse gases and sulfur dioxide, which can cause acid rain. Asteroids may also have contributed. Sweden's 32-mile-wide Siljan crater, one of Earth's biggest surviving impact craters, formed about 377 million years ago.

During this time, land plants developed a substance called lignin that allowed them to get bigger—and allowed for their roots to get deeper than ever before, which would have increased the rate of rock weathering.
The faster rocks weathered, the more excess nutrients flowed from land into the oceans. This would have triggered algae growth, and when these algae died, their decay removed oxygen from the oceans to form what are known as dead zones. In addition, the spread of trees would have sucked carbon dioxide out of the atmosphere, potentially ushering in global cooling.

## Permian-Triassic extinction - 252 million years ago

Some 252 million years ago, life on Earth faced the "Great Dying": the Permian-Triassic extinction. This terrible event was the single worst event life on Earth has ever experienced. Over about 60,000 years, 96 percent of all marine species and about three of every four species on land died out. The world's forests were wiped out and didn't come back in force until about 10 million years later. Of the five mass extinctions, the Permian-Triassic is the only one that wiped out large numbers of insect species. Marine ecosystems took four to eight million years to recover.
The extinction's single biggest cause is the Siberian Traps, an immense volcanic complex that erupted more than 720,000 cubic miles of lava across what is now Siberia. The eruption triggered the release of at least 14.5 trillion tons of carbon, more than 2.5 times what'd be unleashed if every last ounce of fossil fuel on Earth were dug up and burned.
The resulting global warming was downright hellish. In the million years after the event, seawater and soil temperatures rose between 25 to 34 degrees Fahrenheit. By 250.5 million years ago, sea surface temperatures at the Equator got as high as 104 degrees Fahrenheit, a hot tub's maximum temperature. At the time, almost no fish lived near the Equator.
As temperatures rose, rocks on land weathered more rapidly, hastened by acid rain that formed from volcanic sulfur. Just as in the late Devonian, increased weathering would have suffocated the oceans of oxygen. Climate models suggest that at the time, the oceans lost an estimated 76 percent of their oxygen inventory. These models also suggest that the warming and oxygen loss account for most of the extinction's species losses.

## Triassic-Jurassic extinction - 201 million years ago

Life took a long time to recover from the Great Dying, but once it did, it diversified rapidly. Different reef-building creatures began to take hold, and lush vegetation covered the land, setting the stage for a group of reptiles called the archosaurs: the forerunners of birds, crocodilians, pterosaurs, and the non-avian dinosaurs. But about 201 million years ago, life endured another major blow: the sudden loss of up to 80 percent of all land and marine species.
At the end of the Triassic, Earth warmed an average of between 5 and 11 degrees Fahrenheit, driven by a quadrupling of atmospheric carbon dioxide levels. This was probably triggered by huge amounts of greenhouse gases from a large igneous province in

central Pangaea, the supercontinent at the time. Remnants of those ancient lava flows are now split across eastern South America, eastern North America, and West Africa. The lava volume from this igneous province could cover the continental U.S. in a quarter-mile of rock. The uptick in carbon dioxide acidified the Triassic oceans, making it more difficult for marine creatures to build their shells from calcium carbonate. On land, many of the crocodilians died out. These species were bigger and far more diverse than they are today. The ones who survived diversified into the earliest dinosaurs.

## Cretaceous-Paleogene extinction - 66 million years ago

The Cretaceous-Paleogene extinction event is the most recent mass extinction and the only one definitely connected to a major asteroid impact. Some 76 percent of all species on the planet, including all non-avian (non-flying) dinosaurs, went extinct.

One day about 66 million years ago, an asteroid roughly 7.5 miles across slammed into the waters off of what is now Mexico's Yucatán Peninsula at 45,000 miles an hour. The massive impact—which left a crater more than 120 miles wide—flung huge volumes of dust, debris, and sulfur into the atmosphere, bringing on severe global cooling. Wildfires ignited any land within 900 miles of the impact, and a huge tsunami rippled outward from the impact. Overnight, the ecosystems that supported nonavian dinosaurs began to collapse.