

Worksheet: Mass extinctions and fossils

FET Phase

Grade 10

Learning area: Life Sciences

Strand: Diversity, change and continuity

Theme: History of life on Earth

Specific Aim 1: Acquiring knowledge of natural sciences

Specific Aim 3: Appreciating and understanding the importance and applications of natural sciences in society



Activity Sheet



Activity 1: Reading and comprehension

During your visit to the West Coast Fossil Park, you will read and find information about the extinction and fossil remains of various animals. What does this all mean for us living in the present? What does this mean for generations to come?

MASS EXTINCTIONS: THE FIVE BIG ONES

Mass extinction occurs when 40 % or more of the living plant and animal species become extinct within a short period. Mass extinctions occur on a world-wide scale, and there have been several mass extinctions in the history of the Earth. In fact, scientists believe, that based on fossil records, about 99 % of species that ever lived are now extinct.

The most recent mass extinction, the Cretaceous extinction event, took place 65 million years ago, when nearly all dinosaur species were destroyed. In the past 540 million years, there have been five major mass extinctions. These were at the end of the following periods: Triassic (about 208 million years ago), Permian (about 245 million years ago), Devonian (about 360 million years ago) and the Ordovician (about 438 million years ago).

Mass extinctions may occur for any of the following reasons:

Climate change - When the climate changes, many habitats are altered or destroyed, causing the death of many plants and animals. Climate change may be caused by volcanic eruptions, changes in the Earth's orbit, imbalances in the atmospheric gases and variations in solar output.

Volcanic eruptions - These may be caused by movement of the continents and land masses. Some of the larger volcanic eruptions lasted many years, pouring out lava that piled up kilometres deep, killing everything it covered. Volcanoes also release large amounts of gases into the atmosphere, changing the atmospheric gas balance, and emitting greenhouse gases, which in turn leads to global warming and climate change. Climate change then leads to environmental change.



Changes in the Earth's orbit - The way in which the Earth moves on its axis.

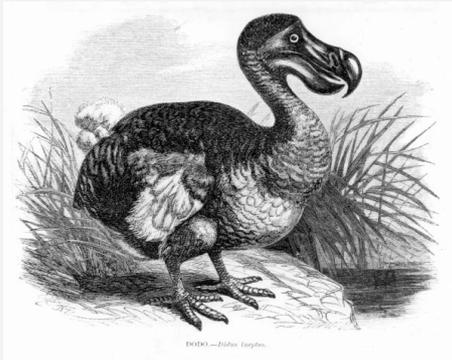
Imbalances in atmospheric gases - Oxygen and carbon dioxide - changes in the oxygen levels in the ocean.

Variations in solar output - How much radiation and heat the sun is sending out.

Changes in sea levels - During an ice age, sea levels drop globally as seawater is taken up in the ice sheets. This is also called a glacial period. As the sea level drops, many sea animals are forced to follow the retreating sea. If species are not able to move to a new, favourable habitat when their old one is destroyed, they are simply wiped out.

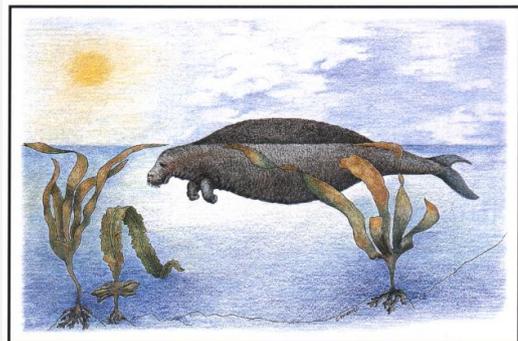
When conditions are warmer, this is known as an interglacial period, the ice sheets melt causing sea levels to rise. A sudden rise in sea levels causes flooding on low-lands, drowning everything in those areas. Sea level changes are caused by climate changes as well as the movement of the Earth's crust.

Recent extinction: Dodo



The recently extinct Dodo was a flightless bird that lived on the island of Mauritius. It was discovered in 1598 by sailors who landed on the shores of Mauritius. However, due to being hunted by humans, as well as dogs and pigs who were introduced to the island, these large birds were extinct by 1681. With humans wiping out the Dodo, the Mauritian calvaria tree stopped sprouting seeds, facing extinction itself. The calvaria tree would only sprout after having been eaten and digested by the Dodo bird.

Recent extinction: Steller's Sea Cow



Steller's Sea Cow (*Hydrodamalis gigas*)

The recently extinct Steller's Sea Cow, which lived around the Aleutian Islands in the Bering Sea, was discovered by George Steller in 1741. These animals weighed up to three-and-a-half tons and were easily killed by sailors who hunted them for their meat, and used their hides for leather. They were hunted to extinction in 1768, only 30 years after their discovery.

Both these extinction stories highlight the dangers of animals becoming extinct and how the delicate balance of ecosystems can be upset. Man's lack of knowledge and respect for other living species emphasises the potential effects mankind can have on the environment, and shows how easily man can disrupt the delicate balance of ecosystems by wiping out whole species.



What are fossils?

Fossils are the remains or evidence of prehistoric plants and animals that have been preserved.

The definition from the *MacDonald's Encyclopaedia of Fossils* defines fossils as:

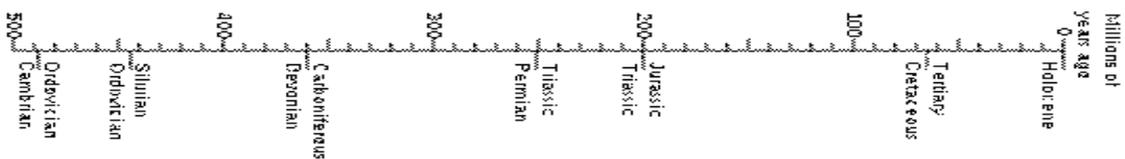
The term "fossil" is used to describe the remains of all animals or plant residue from the past, including any traces of their activities, which have survived up until the present day thanks to the physiochemical process known as fossilization.

The West Coast Fossil Park is one of the areas in South Africa that has conditions which were favourable to fossilization.



Activity 1: Make a geological timeline

Your teacher will divide the class into groups. Each group will be provided with an A3 sheet of paper to draw your geological timeline. Copy the timeline in the middle of your paper.



1. Read the information in the text "Mass Extinctions: The Five Big Ones". Research the probable cause for each of these mass extinctions and find out which animal species were the main victims of each event using the library, books and the Internet.
2. On your timeline, mark the mass extinctions mentioned in the text. Include the information you have researched next to the mass extinctions on your timeline.



Activity 2: Causes of mass extinctions

Give a brief description how the following factors could cause mass extinctions:

1. Asteroid impacts
2. Climate change
3. Volcanic eruptions
4. Sea-level changes
5. Oxygen in the atmosphere





Activity 3: Create a poster

Two examples of recently extinct animals have been given. Your class has been invited to an international conference, "Save mother Earth and her biodiversity." This conference is to emphasize the potential effects mankind can have on the environment, by showing how easily man can disrupt the delicate balance of ecosystems by wiping out whole species.

Research a recently extinct animal, plant or bird and then prepare a poster that will be displayed in the "Gone forever" exhibition.

The following must be included in your poster: a picture, a brief history, the habitat, the cause of extinction, and what other environmental impact this extinction event had on the environment.

Your poster must be neat and to the point, and make sure that the layout resembles a poster. Check for any spelling and punctuation errors and include a bibliography.



Teacher notes

Activity 1: Make a geological timeline

The class should be divided into groups. Each group will be provided with an A3 sheet of paper to draw your geological timeline.

Major extinction events occurred on Earth 65 million years ago, 200 million years ago, 251 million years ago, 360 million years ago and 440 million years ago . These mass extinction events are outlined below.

Cretaceous - About 65 million years ago.

About 17 % of all families, 50 % of all genera and 75 % of species went extinct. It ended the reign of dinosaurs and opened the way for mammals and birds to become the dominant land vertebrates. In the seas it reduced the percentage of sessile (animals that stay in the same place e.g. coral) animals to about 33 %.

A giant asteroid, ten kilometres across, entered the atmosphere, creating a brilliant flash. It rushed towards earth as a colossal fireball that smashed into the shallow sea. Gigantic fragments of red-hot rock and steam exploded high into the sky causing giant forest fires and destroying everything. The impact also caused giant waves, called tsunamis, to roar across the coastal land, washing away or drowning anything in their way. Huge clouds of dust and steam spread quickly from the impact site, covering earth and blocking out the warm rays of the sun. Earth became dark, cold and desolate. These conditions may have lasted for about 6 months to a year. Plants and algae died due to lack of sunlight needed for photosynthesis. Chemicals from the fires, asteroid, and dust formed poisonous acid rain that contaminated the rivers, lakes and oceans, causing many animals and plants to die. The dinosaurs died as a result of fire, storm, poison, and starvation.

Triassic-Jurassic extinction - About 200 million years ago.

About 23 % of all families and 48 % of all genera (20 % of marine families and 55 % of marine genera) went extinct. Most non-dinosaurian archosaurs, mostly therapsids, and most of the large amphibians, were eliminated, leaving dinosaurs with little terrestrial competition.

Several explanations for this event have been suggested, these include:

- Gradual climate change or sea-level fluctuations during the late Triassic. However, this does not explain the suddenness of the extinctions in the marine realm.
- Asteroid impact, but no impact crater has been dated to coincide with the Triassic–Jurassic boundary.
- Massive volcanic eruptions releasing carbon dioxide or sulfur dioxide and aerosols, which would cause either intense global warming or cooling.



Permian - About 245 million years ago.

Earth's largest extinction killed 57 % of all families and 83 % of all genera (53 % of marine families, 84 % of marine genera, about 96 % of all marine species and an estimated 70 % of land species) including insects.

Although the cause of the Permian mass extinction remains a debate, numerous theories have been formulated to explain the events of the extinction. One of the most current theories for the mass extinction of the Permian is an agent that has also been held responsible for the Ordovician and Devonian crises, glaciation on Gondwana. A glaciation event would likely produce mass extinction by a global widespread cooling and worldwide lowering of sea level.

Climate change, and massive basaltic lava eruptions in Siberia have also been suggested as causes. These volcanic eruptions were large and sent a quantity of sulphates into the atmosphere. Evidence in China suggests that these volcanic eruptions may have been silica-rich, and thus explosive, and may have produced large ash clouds world-wide. The combination of sulphates in the atmosphere together with the ash clouds may have lowered global climatic conditions. The age of the lava flows has also been dated to the interval in which the Permian mass extinction occurred.

Devonian - About 360 million years ago.

Eliminated about 19 % of all families, 50 % of all genera and 70 % of all species. This extinction event lasted perhaps as long as 20 million years.

A number of causes are listed, such as climatic change, global cooling and a drop in sea level. Other scientists have suggested that asteroid impacts, global dissolved oxygen shortages and plate tectonics played a part. One of the more interesting theories of these is the "Devonian Plant Hypothesis". This theory, first proposed by Thomas Algeo, Robert Berner, J. Barry Manard and Stephen Scheckler in 1995, credits the expansion of terrestrial plants as the ultimate cause for mass extinctions in the tropical oceans. The marine burial of massive quantities of organic carbon and inorganic carbonates substantially reduced atmospheric CO₂ levels. The loss of this greenhouse gas is believed to have contributed to global cooling.

Ordovician - About 440-450 million years ago.

Two events occurred that killed off 27 % of all families and 57 % of all genera. Together they are ranked by many scientists as the second largest of the five major extinctions in Earth's history, in terms of percentage of genera that went extinct.

This extinction is believed to have occurred because of worldwide glaciation. Evidence for this glaciation event is provided by glacial deposits discovered by geologists in the Saharan Desert. When Gondwana passed over the north pole in the Ordovician, global climatic cooling occurred to such a degree that there was global widespread glaciation. This glaciation event also caused a lowering of sea level worldwide as large amounts of water became tied up in ice sheets. A combination of this lowering of sea-levels, reducing ecospace on continental shelves, in conjunction with the cooling caused by the glaciation itself, are likely to be the causes for the Ordovician mass extinction



Activity 2: Causes of mass extinctions

Since life was present on Earth, several major mass extinctions have occurred. A mass extinction occurs when an unusually large number of plant and animal species go extinct within a short period ('short' being tens of thousands of years). Mass extinctions affect all living life forms present at the time, worldwide. Scientists believe that, based on the fossil records, about 99 % of species that ever lived are now extinct. Scientists have come up with several theories as to the cause or causes of these mass extinctions.

Asteroid and comet impacts

Large mountain-sized asteroids from space may collide with Earth, causing disastrous changes in the Earth's environment. The dust created from large impacts blocks out the sun for many years, creating a very dark and cold environment. This in turn causes many ecosystems to collapse. Asteroids could also cause fires, tsunamis and earthquakes on Earth!

Climate change

When the climate changes, many habitats are altered or destroyed, causing the death of many plants and animals. Climate change may be caused by:

- volcanic eruptions
- changes in the Earth's orbit (the way in which the Earth moves on its axis)
- imbalances in atmospheric gases
- variations in solar output (how much radiation and heat the sun is sending out)
- plate tectonics (i.e. movement of the continents and land masses)

Volcanic eruptions

Some of the larger volcanic eruptions lasted many years, pouring out lava that piled up kilometres deep, killing everything it covered. Volcanoes also release large amounts of gases into the atmosphere, changing the atmospheric gas balance, and emitting greenhouse gases, which in turn leads to climate change. Climate change then leads to environmental change.

Sea level changes

Sea levels drop worldwide during an ice age, also called a glacial period, as sea water is taken up in the ice sheets. When the sea level drops, many sea animals are forced to follow the retreating sea. If species are not able to move to a new, favourable habitat when their old one is destroyed, they are simply wiped out. During an interglacial period, when conditions are warmer, the ice sheets melt and sea levels rise. Climate change, as well as the movement of the Earth's crust, cause sea level changes. The sea level is currently rising by approximately 2 mm per year as we are in an interglacial period.

Changes in atmospheric gases

The amount of oxygen in the atmosphere, and the proportion of atmospheric gases may change over time, leading to climatic change.

Activity 3: Poster presentation

Assess with rubric.



POSTER COMMUNICATION SKILL ASSESSMENT

Assessment Criteria	Performance Indicator Levels				Comments	
	0	1	2			
Title	No title	Title present but incomplete	Complete title			
Aim of poster	Not clear	Partially clear	Very clear			
Main points	Not relevant	Some points relevant	All points relevant			
Facts / concepts	Mainly incorrect	Some correct with limited detail	Correct with interesting detail			
Language / spelling	Many language and spelling errors	Some language and spelling errors	No language and spelling errors			
Organisation / layout	Organisation / layout muddling	Organisation partially clear and logical	Organisation clear and logical			
Use of colour	No colour / all one colour	Some use of colour	Effective use of colour			
Letter size	Letters very small	Some letters larger	Most letters large			
Diagram / picture appeal / attractiveness	Not appealing / not attractive	Has some appeal / attractiveness	Appealing / attractive			
Diagram / picture relevance	Not relevant	Partially relevant	Totally relevant			
Diagram / picture accuracy (scientifically correct)	Not accurate	Partially accurate	Totally accurate			
Impact of poster	Does not make an impact	Makes an impact				
Impact of poster	No new ideas	Some signs of creativity / new ideas	Very creative and original			
Total = 25 marks						
7 Outstanding 80-100 %	6 Meritorious 70-79 %	5 Substantial 60-69 %	4 Adequate 50-59 %	3 Moderate 40-49 %	2 Elementary 30-39 %	1 Not achieved 0-29 %

Review and recommendations

