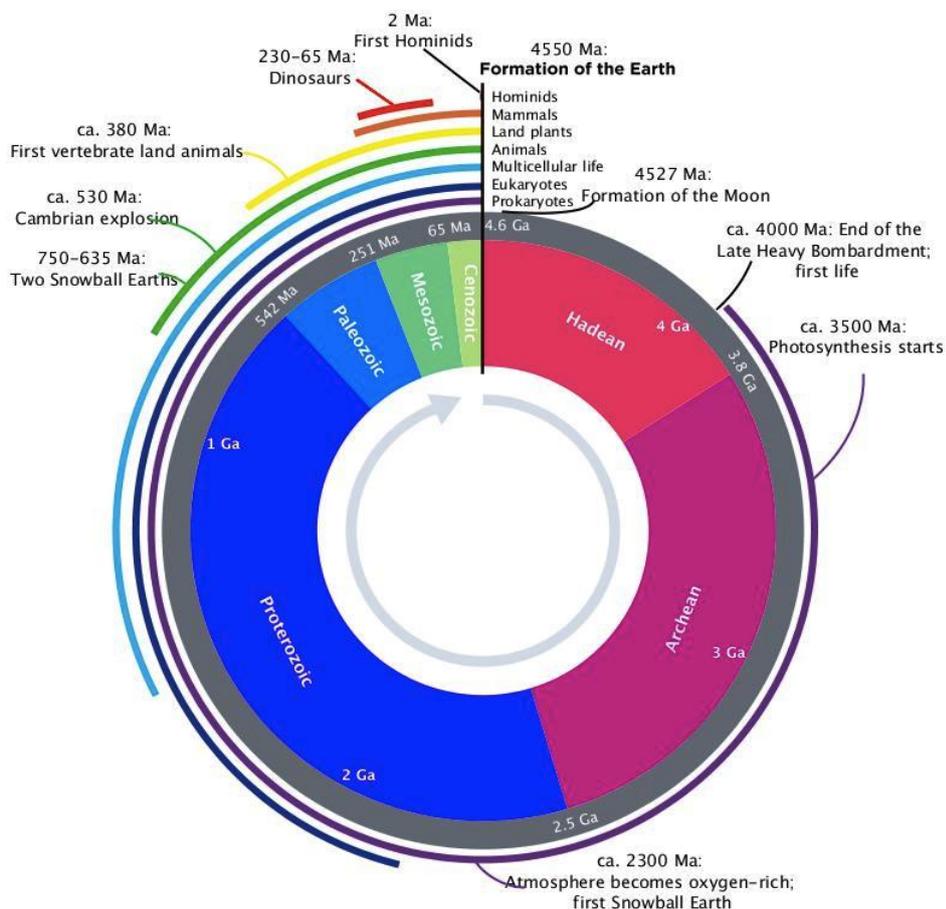


Extinctions & Climate Change – Student Activity

Diagram interpretation and using research data

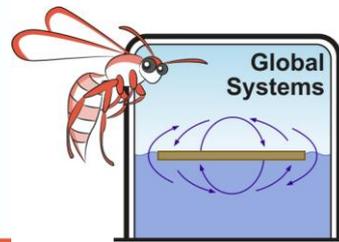
Biodiversity relates to the variety of life found in an area. The number and variety of species is a simple measure of its “health” i.e. its ability to respond to change at a natural rate.

During the geologic past of our planet Earth has suffered many greater and lesser periods of extinction of life. Only the genes of those who survived were available to provide the variety of new species to fill the ecological niches left.



Major extinctions are designated as those in which more than 50% of species alive at that time became extinct. There are five major extinctions. Find information to fill the table below using the Internet or reference books. Mark when each of the five took place on the diagram above.

Name	Time	Major groups lost	Animals benefitting
Cretaceous-Palaeogene (K-T)			
Triassic-Jurassic			
Permian-Triassic			



Extinctions & Climate Change – Student Activity

Name	Time	Major groups lost	Animals benefitting
Late Devonian			
Ordovician-Silurian			

Using coral to discover forcing factors contributing to mass extinctions

We know a lot about normal growth of present coral reefs. Coral reefs endure a long time and their fossil history is relatively well known, as they are excellent reservoirs for oil and gas.

Mass extinctions are marked by a loss of coral reef growth over millions of years.

If extinctions were caused by **meteorite or asteroid impact**, all coral species would be equally affected by heat and dust and would be extinct in a very short time, perhaps even within a few years. Fossil records show that in all the extinction events the dying took place over geologically long periods. So although meteorite impacts may be a contributing factor, they are not the only cause of major extinctions.



Similarly **increased ocean and atmospheric temperature** resulting from volcanic outgassing of CO₂ could have caused coral bleaching due to its effect on enzyme efficiency.

Scientists suggest that the critical factor was indeed an **increase in CO₂ levels in the atmosphere and ocean** from volcanic outgassing **causing a change in ocean chemistry**. NOAA scientists (National Oceanic and Atmospheric Administration – USA government research body) used information gained from studying natural outgassing of the Mauna Loa volcano on the surrounding ocean.

What chemical effect would atmospheric CO₂ have on the ocean? _____

Describe what effect an increase of atmospheric CO₂ would have on corals?

1. Corals have internal carbonate skeletons to support the animals' bodies.

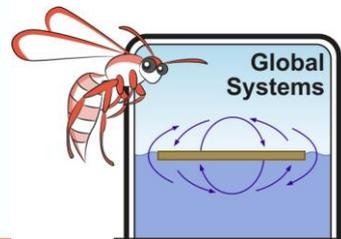
2. Would increased ocean acidity also affect shelled organisms such as mussels, oysters and clams?

More recent threats to species diversity: Data measurement

Since the beginning of the Industrial Revolution, powered by burning fossil fuels, we have released increasing amounts of CO₂ to be shared by both ocean and atmosphere. Carbon dioxide enhances the Greenhouse Effect causing atmospheric temperature rise.

NOAA scientists assert that the pH of ocean surface water has fallen 0.1pH units.

Has ocean surface water become more or less acidic? _____



Extinctions & Climate Change – Student Activity

Some scientists suggest that the increased acidification may benefit marine photosynthetic algae. Why is this so? _____

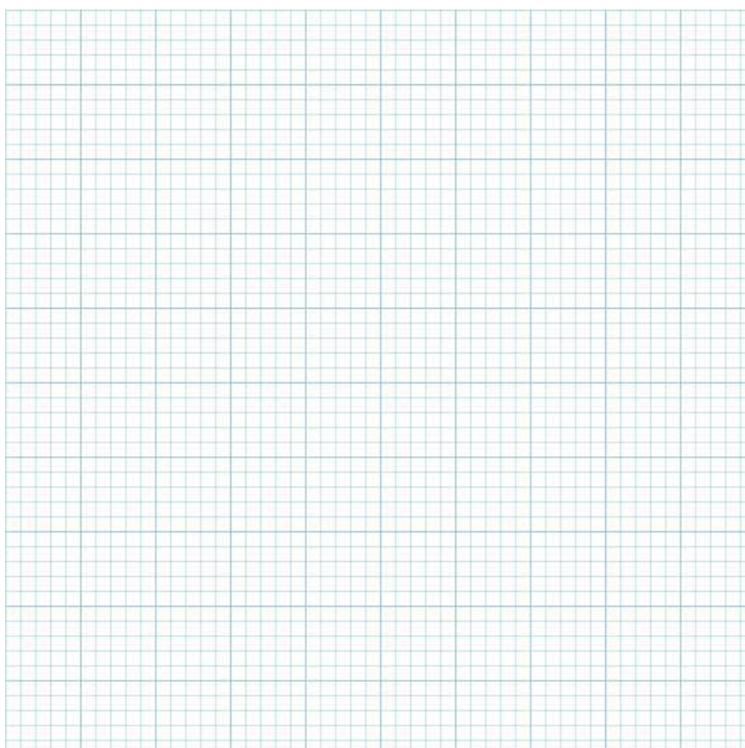
Initial studies suggest that with land plants increasing CO₂ initially produces a growth spurt but the increase is not sustained. More research is required.

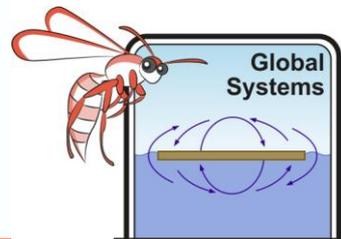
Species loss data

Scientists studying present species loss in their research area have collected the following data.

Species classification	Number	Percentage
Data not present	6,584	
Species of least concern	19,032	
Near threatened	3,931	
Vulnerable	9,075	
Endangered	4,891	
Critically endangered	3,325	
Extinct	373	

Using this data set calculate the percentage species loss for each classification and draw a suitable graph to present it in a simpler form.





Extinctions & Climate Change – Student Activity

Why would the researchers include species for which they have no data? _____

Does this data represent a mass extinction? Explain your answer. _____

Past Ice Ages and extinction events

Several times during Earth's geological history our planet has become colder. Not all of these Ice Ages led to extinctions however. Our most recent (Pleistocene) Ice Age stretched from about 2.6 million years ago to about 20,000 years ago. It varied in time of onset, geographic spread and intensity across the planet and included several warm interglacial periods. We suspect some of these variations result from a combination of:

- Variable sun output activity
- Variable path of the Earth round the sun due to gravitational pull from other planets
- Variations of axial tilt

During the Pleistocene, the population of humans (*Homo sapiens sapiens*) was reduced to about 600 breeding pairs living in tropical Africa, as great glaciers covered most of the landmasses except between the tropics. We know this from genetic evidence collected during National Geographic's human genome project. Life was harsh and food was scarce. Other hominid groups such as the Neanderthals (*Homo sapiens neanderthalensis*) and Denisovan man (*Homo sapiens denisova*) died out around the end of the Ice Age or soon after. Genetic evidence suggests that all these groups interbred, as we share common genes. After the ice retreated modern humans spread out to cover the great plains of the world hunting game and collecting fruits, seeds and berries. Another hominid *Homo sapiens floresiensis*, commonly known as "The Hobbit", perished more recently.

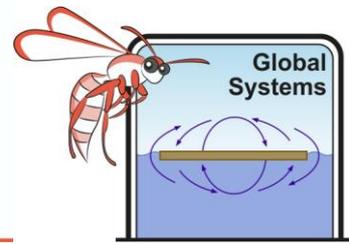
Are modern humans, Neanderthals and Denisovans separate species? Explain your answer.

Did Ice Age events increase or decrease hominid species variation or numbers? _____

Although there is evidence of this last Ice Age glaciation in the Eastern States, in Western Australia only a little is found as glacial moraines south of the Stirling Range. Some remnant Gondwanaland vegetation is found here as well as remnants of Ice Age vegetation on the Range. However we do have evidence of earlier Permian glaciation near Minginew in the Central Wheat Belt. Rocks frozen into glacier ice scraping over them produced the white scratches visible on this rock surface. If you found these scratches when studying these rocks would they be primary data, secondary data or proxy data?



Extinctions & Climate Change – Student Activity



Snowball Earth events



There have been three major occasions when Planet Earth has been almost covered by ice threatening a major extinction event. These are called “Snowball Earth” events.

Using the first diagram on this worksheet, list below when these extinctions took place.