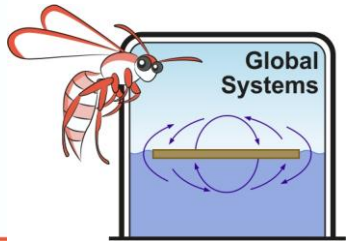


Climate Change - Teacher Background

Biodiversity relates to the variety of life found in an area. This includes the different plants, animals and microorganisms, their genes and the ecosystems of which they are a part. The number and variety of species is a simple measure of its "health", its ability to respond to change at a natural rate. Mass extinctions require over 50% of species to become extinct. There have been five mass extinctions and many minor extinction events.

Major changes in planetary biodiversity

Not all major changes to the range of species present on Earth are only directly attributable to climatic changes. It is thought that the amazing 550 million year old soft-bodied Ediacaran fossils found in South Australia were only preserved in sea floor sands because predators had not yet evolved. When traces of worms and other burrowing scavengers appear in the rocks above, all these species became extinct. The new species that appeared in the overlying layers of rock may contain the ultimate ancestor of animal life, as we know it.

Major climate changes, usually tied to tectonic events have massively impacted on biodiversity.

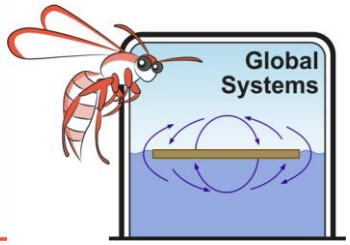
Desertification and extinction events

Massive belts of red desert sandstone crossing many tectonic plates infer large continents and extremely hot climate extending over geologically long periods. This dune sandstone is from Permian times (220mya) when the climate slowly became very hot and dry resulting in the largest mass extinction on Earth. During the "Great Dying" 6% of all marine species, 70% of all terrestrial species, 57% of all families and 80% of all genera were lost. Desertification and species loss progressed over a 30 million year period. It took more than 10 million years for life on the planet to recover and a further ten million years before coral reefs were established in the sea and forests regained the land.

Past Ice Ages and extinction events

During the Permian (250 to 220my), Ordovician (450my) and Pre Cambrian (600 – 900my) glacial deposits on all continents, including those at low latitudes, suggest that ice covered most of the planet almost reaching the equator. During these "Snowball Earth" episodes life became almost extinct.

Although the "Snowball Earth" period ended with the extinction of many life forms, the rapid increase of oxygen in the atmosphere afterwards resulted in "Eden Earth" when there was a massive growth of new, more complex and specialised species. The pale stripes (striae) on the gneiss from near Minginew in our Central Wheat belt are scratches from rocks trapped in ice at the bottom of glaciers during the Permian glaciation.



Climate Change - Teacher Background

Some factors controlling surface temperature variation: Milankovic Cycles

Recently we have uncovered evidence that Earth's surface temperature cycles between 12°C to 22°C over fairly regular 100,000-year cycles. These are named Milankovic Cycles after the Serbian scientist who first researched and described them when held as a prisoner of war during WW1.

They result from:

- Variable solar output due to Sun activity
- Variable distance between Earth and Sun due to gravity variations from planets on an elliptical orbit (orbital eccentricity, axial obliquity and precession)
- Interplanetary dust

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Comparison of ancient and recent climate change rates.

Although radical changes occurred in the past and were responsible for extinctions, they occurred slowly over tens of millions of years. This is much slower than the rate of warming over the last century. We can also read the "fingerprints" of recent climate change to interpret possible cause. Increase in the Sun's radiation would be expected to warm both upper and lower atmosphere and result in days warming more than nights. In contrast greenhouse warming would result in cooling of the stratosphere, as heat would be retained in lower levels of the atmosphere and cause nights to be warmer than days.

That global climate patterns slowly change is a given. With the exception of rare severe changes, which cause global extinctions most organisms have time to respond to the changes by moving their geographic range, changing their behaviours or natural selection favours those who most suit the new conditions and their characteristics become dominant with the group.

Historic influence of man

"Whatever befalls the Earth befalls the sons of the Earth. Man does not weave the web of life; he is merely a strand in it. Whatever he does to the web, he does to himself." (Chief Seattle, 1854)

The Pleistocene (Ice Age) represents the last cold stage from which we are recovering to enter into a warmer period. During the Pleistocene the population of modern humans in the world 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. Other hominid species such as the Neanderthals and Denisovans died out at the end of the Ice Age in the Northern Hemisphere. When the ice retreated modern humans spread out to cover the great plains of the world inhabiting all of the continents except (until recently) Antarctica.

In Western Australia over the last 50,000 years there have been major changes in species diversity. The arrival of man and his fire-stick culture, along with climatic change, have resulted in a more arid period. Soft leaved trees were replaced by sclerophylls such as eucalyptus. Some scientists believe that humankind's arrival in Australia was the critical tipping factor involved in the extinction of our mega fauna about 30,000 years ago. Europeans, who arrived about 300 years ago, introduced plants, animals and European farming practices that rapidly accelerated this loss of local plant and animal species.

Biodiversity can be examined at two levels:

1. Macro-variation amongst different species
2. Micro-variation within one species.