

2. The changes in Australian flora and fauna over millions of years have happened through evolution

All modern “mainstream” Biologists accept the theory of evolution as first explained by Charles Darwin in the 1850’s and developed in the 20th century. The main concepts are:

1. Mutation of DNA occurs which causes;
2. Variation in a population;
3. Many more offspring are normally produced than can survive;
4. If a change of environment occurs then;
5. Natural selection will occur which selects those with the “best” variations; and
6. The survivors pass on their genetics to future generations.

In twenty 28 years of teaching Biology I have never even seen a question that asks what you BELIEVE. In the HSC it would just cause too many complaints. They do however often ask, “How would Darwin explain ...” or “How would modern Biologists explain ...”. Whatever you believe, if you are good at Biology you can answer the question.

(Once again creationists are trying to push their religion into Biology as “Intelligent Design”. Their argument is that some features of organisms are just so perfect that they must have been designed, by someone. Many creationists have only just got over their previous idea that the world was only 6000 years old; they cannot imagine that life on earth began 4 thousand million years ago and that the rules of evolution have been going on since then. Many of the quoted “scientific” sources used by creationists are not from Biologists who have knowledge of a large range of groups of organisms but from “Dr ...” or “Professor ...” who is a Physicist or Doctor or Theologian from an obscure religious college in the US.

Evolution has been shown to occur in thousands of species; rabbits in Australia have evolved because a few had a slight genetic immunity to the Mixomycosis virus. When its introduction, after WWII, changed the environment, most rabbits died but a few that carried accidental beneficial mutations survived and multiplied, passing on their mutations. The rabbits are different genetically from those that were brought here in the 1800s. They have evolved.

Creationist will say that this does not prove that a monkey evolved into a human. Evolution does not say this. Evolution says that about 10 million years ago monkeys and humans had a common ancestor with a range of genetic variation. Natural selection has “chosen” some to survive as environments have changed or our ancestors moved to different environments. Longer and stronger arms were an advantage in forests. Longer legs for walking and more dexterous fingers for collecting seeds are an advantage in grasslands.

The eye is often given as an example of one of these perfect, “intelligent designs”, but a large proportion of the world’s population have genetic or early degenerative problems with their eyes. Natural selection has wiped out most of the variations along the way that did not produce a huge advantage for such a delicate investment. Only a few thousand years ago those people with genetic or early degenerative eye problems would have died out because they could not have hunted or gathered food efficiently, or would not have seen predators. The ones with better eyesight would have been more likely to survive, reproduce and pass on their genes. In some environments such as caves there is no advantage having eyes; they are just a liability. Natural selection has “chosen” some totally blind species to survive.

Suggestions that Intelligent Design be taught as “Science” are limited to a few non-government schools in NSW. The President of the NSW Board of Studies, Gordon Stanley, in an article in the SMH of Nov 15, 2005, said, “If non-government schools choose to teach aspects of intelligent design in a science class it must be in addition to, not instead of, the board’s full program of science courses It will not be tested in any public examination.”

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Students learn to:

- **discuss examples of variation between members of a species**

The stripes on zebras look similar, all koalas look similar, all waratah flowers look similar but in fact all zebras, koalas and waratahs are not the same. There are minor genetic differences that might give slight differences in pattern or size or nectar.

It is these slight differences that Darwin called variations and it is these differences that can lead to evolution;

Zebras with a certain spacing and width of stripe will confuse their predators and so have more chance of escaping and parenting the next generation

Slightly larger koalas will have a smaller SA/V ratio and so will survive better in Victoria where temperatures are lower than would normal sized koalas. In Queensland the smaller koalas are more likely to survive and reproduce.

(SA/V: Surface area to volume ratio is one of the most important concepts in Biology. It crops up in nearly every topic somewhere. The problem is that there is not one answer to the problem. You must understand the whole concept, be able to decide if it is a significant issue in that topic and whether a large or small SA/V ratio is an advantage or a disadvantage. Is it a variation that will effect the survival and evolution of the species?)

Waratahs producing more or sweeter nectar will attract more birds or insects and so have more chance of cross-pollinating other flowers

- **identify the relationship between variation within a species and the chances of survival of species when environmental change occurs**

If the environment of a species stays constant then there will be no new selective pressures to drive evolution. Crocodiles are nearly the same as they were 200 mya because they have lived in extremely stable ecosystems that have not changed in that time. There have been no advantages for those slightly different crocodiles that were produced by mutations.

If an environment does change over time then there will be more chance for plants or animals with variations caused by mutations to survive and multiply; the species will evolve. Darwin thought that environmental changes occurred very, very slowly and normally they do; Australia has been drying for 20 million years.

Recent evidence suggests that more rapid changes to an environment can occur producing stronger selective pressures and so speeding up the rate of evolution. This sometimes called punctuated evolution. The mass extinction 65 million years ago, and sudden evolution of many types of mammals into ecological niches previously dominated by dinosaurs, was almost certainly caused by a meteorite collision. An earlier mass extinction event at the end of the Permian about 250 mya wiped out 95% of marine species.

On a local scale sudden environmental changes drive evolution. We regard fires occurring every few years as a selective pressure in most of the woodland areas of Australia. If fires occurred more frequently, say three years in a row, then species that drop seeds after a fire might die out because the young trees would all die before they produce seeds. Trees with fire resistant seeds might flourish. Animals depending on certain plant species would have even greater fluctuations of

numbers. It is possible that species would become extinct in many areas in a short space of time.

Charles Darwin when he visited the Galapagos in 1835 guessed that the different types of finches on each island were all descended from a common ancestral type and were a result of different selective pressures: food type, water supply, nest sites etc on each island.

An El Niño climate event over one year produced such a change of selective pressure, that the evolution of one group of “vampire” finches was observed on one of the islands. Locate the video of this story at <http://www.abc.net.au/nature/vampire/darwin.htm>

- **identify and describe evidence of changing environments in Australia over millions of years**

Australia has been moving north since separating from Antarctica (but was never very cold and covered by ice like present day Antarctica) about 45 million years ago. Until about 10 mya most of Australia was covered by cool temperate rainforest, similar to those now in western parts of Tasmania. Deserts, open grasslands and Eucalyptus forests have probably only appeared in the last few million years. Aborigines with their “fire stick” agriculture have continued this change to open grassland and open forest in the last 50,000 years. A few pockets of “remnant” (= remaining in inaccessible places such as deep valleys) rainforest have survived these climate changes (and white man’s axe).

- **identify areas within Australia that experience significant variations in temperature and water availability**

Australia’s south eastern corner (Tasmania and coastal NSW and Victoria) has between 1000mm and 2000 mm of rainfall spread evenly through the year (despite the current drought). Average temperatures in Sydney are between about 10 degrees minimum in winter to 28 degrees maximum in summer.

Inland regions have a much wider temperature ranges. Alice Springs has a July minimum average of about 3 degrees with many nights well below zero and a January maximum average of nearly 40 degrees.

Northern Australia is very strongly affected by tropical monsoonal weather; Darwin has two seasons, the “wet” and the “dry”. The “wet” is from November to April with high temperatures, storms, cyclones (= similar to the typhoons in Asia), very high humidity and floods spread out over huge areas of floodplain across Northern Australia. The “dry” is from April to October: temperatures are still high (average daytime temperature in Darwin in July is 30 degrees), rainfall is very rare, humidity is very low and all but the largest rivers are dry. This variable environment has selected the organisms that are able to cope with the changes that occur each year.

- **identify changes in the distribution and abundance of Australian species, as rainforests contracted and sclerophyll communities and grasslands spread, as indicated by fossil evidence**

Eucalypt fossils show narrow distribution before 5 mya, but as Australia has dried out the adaptations that Eucalypts have for surviving fires; growth buds under the bark that sprout after fires, has allowed them to spread across nearly all of Australia. There are Eucalypts in nearly all ecosystems in Australia, from the Snow Gums near Mt Kosciusko to the River Red Gums along every creek in inland Australia.

Australia only has a few pine trees in rainforest and coastal areas. Wollemi Pine fossils show it and other pines such as Bunya Pine were much wider spread 20 mya. Today Wollemi pines are only in two deep valleys about 200 km northwest of Sydney. Bunya pines grow in only two small areas of southern Queensland.

Banksias are in western and eastern Australia and seem to have been isolated for several millions of years as conditions in South Australia has dried out, genetically isolating the two populations and leading to divergent evolution.

Kangaroos so dominant and characteristic of the open grassland areas of Australia do not appear far back in the fossil records (the earliest fossils are of small muskrat kangaroos that lived in rainforests about 25mya) of Australia; large kangaroos are a product of selective pressures in a drying Australia.

- **discuss current theories that provide a model for these changes**

The drying of the Australian mainland over the last 10 million years seems to explain these changes to the distribution and relative abundance of some types of plants and animals.

- **discuss Darwin's observations of Australian flora and fauna and explain how they related to his theory of evolution**

The Wikipedia reference to Charles Darwin is very good at:

<http://www.answers.com/topic/charles-darwin?method=5&linktext=Charles%20Darwin>

It seems that he didn't think much of the people who lived in Sydney. Be very careful of quotations

Darwin visited Australia in the 1830s during his famous voyage aboard the Beagle. In January 1836 he journeyed to Bathurst. He did like the cliffs and valleys of the Blue Mountains but I could find few other references to his trip.

Alfred Wallace cofounder of the theory of evolution with Darwin studied in what is now Indonesia and noted major differences between the Asian "barbets, fruit thrushes and woodpeckers" on Bali and the "cockatoos, honeysuckers and brushturkeys" Australian birds on Lombok island only 25 km away. Wallace did not know it but he was actually describing the boundary between the Australian and Asian plates.

Students:

- **gather, process and analyse information from secondary sources to develop a timeline that identifies key (= very important) events in the formation of Australia as an island continent from its origins as part of Gondwana** see above

- **gather information from secondary sources to describe some Australian fossils, where these fossils were found and use available evidence to explain how they contribute to the development of understanding about the evolution of species in Australia**

Ref. White, M. (1998) *The Greening of Gondwana*. Rosenberg Publishing.

- **perform a first-hand investigation, gather information of named Australian fossil samples and use available evidence to identify similarities and differences between current and extinct Australian life forms**
e.g. Wollemi Pine (Botanic Gardens)

- **present information from secondary sources to discuss the Huxley– Wilberforce debate on Darwin’s theory of evolution**

Darwin like many patient experimental Biologists was not very good at pushing his own ideas in public. Because the study of nature was a significant pastime for many in upper middle class society and the clergy, Darwin’s ideas gained much more attention than he ever expected. Scientists, clergy, the media and even economists began to interpret and read more and more into Darwin’s theory. Darwin’s poor health kept him away from most of the public debates. References to the debates <http://www.answers.com/topic/charles-darwin?method=5&linktext=Charles%20Darwin>

<http://www.blupete.com/Literature/Biographies/Science/Darwin.htm> be careful. I have seen many variations of very similar quotes; even the same quote to different people

Over the years I have had many students ask about Darwin’s deathbed interest in God. This story appears to have been made up about 1900. Darwin supposedly even wrote that people had made the same claims about his grandfather Erasmus Darwin who had suggested the possibility of evolution two generations earlier than Charles. Modern politicians often claim that they were misquoted or their statements were edited even when they are on film. I can see no way that we can accept stories and quotes from 150 years ago. TRUST NO ONE

- **perform a first-hand investigation to gather information of examples of variation in at least two species of living organism**

PTC taste test can show genetic variation in humans.

Ao, Bo, AB, and oo Blood Groups show genetic variation in humans