

Student Guide: *Darwin to DNA*

Go upstairs to the Darwin to DNA exhibition and spend the first few minutes of your time getting a good overview of what is in the exhibition. Refer to the map to find each segment of the exhibition.

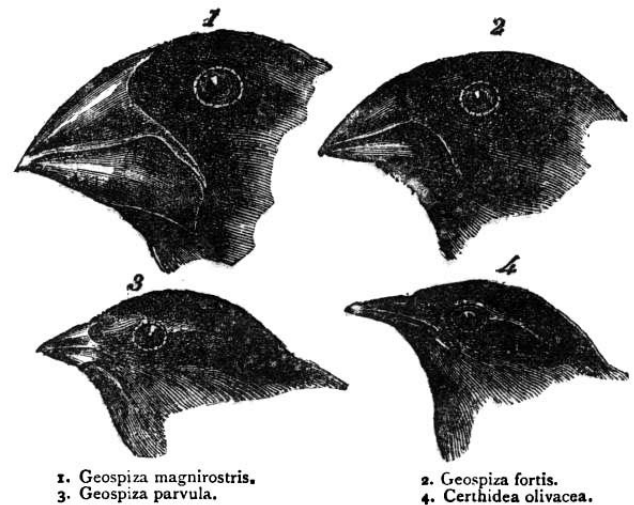
Following in Darwin's Footsteps!

Explore the information presented on the Evolution – Change Over Time wall.

- Describe 3 factors that are necessary for evolution to occur.
- Darwin's theory is based upon the idea that variation exists in populations. How does variation come about in a species?
- Why is variation essential for natural selection to occur?

Look at the drawings of the Galapagos finches located in the Gould display case.

- How did Darwin account for the variation of size and shape of beaks of different finches in the same area?



1. *Geospiza magnirostris*.
3. *Geospiza parvula*.

2. *Geospiza fortis*.
4. *Certhidea olivacea*.

Darwin's Finches.

Artist: John Gould / Source: Museum Victoria

Look at the map showing the distribution of the Sword-grass Brown Butterfly (*Tisphone*) in South-east Australia

- How is the species *Tisphone abeona albifascia* from Melbourne different from *Tisphone helena* from Cairns?
- How does geography influence the development of new species?

Evolution in Action

Examine the specimens on display in the Evolution in Action showcases.

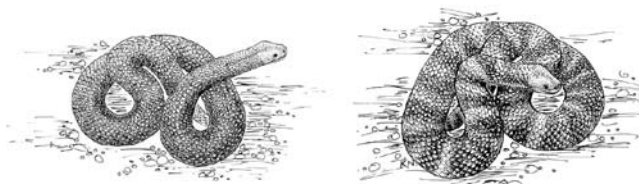
- Describe how evolution has changed each species in different ways through sexual selection, divergent evolution, co-evolution, convergent evolution or drift.
- How do the physical features of each animal contribute to its survival?



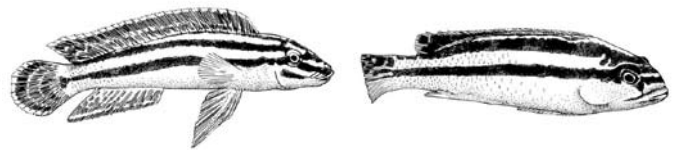
Banksias and Eastern Spinebill.
Artist: Kate Nolan / Source: Museum Victoria



Bird of Paradise.
Artist: Kate Nolan / Source: Museum Victoria



Tiger Snakes.
Artist: Kate Nolan / Source: Museum Victoria



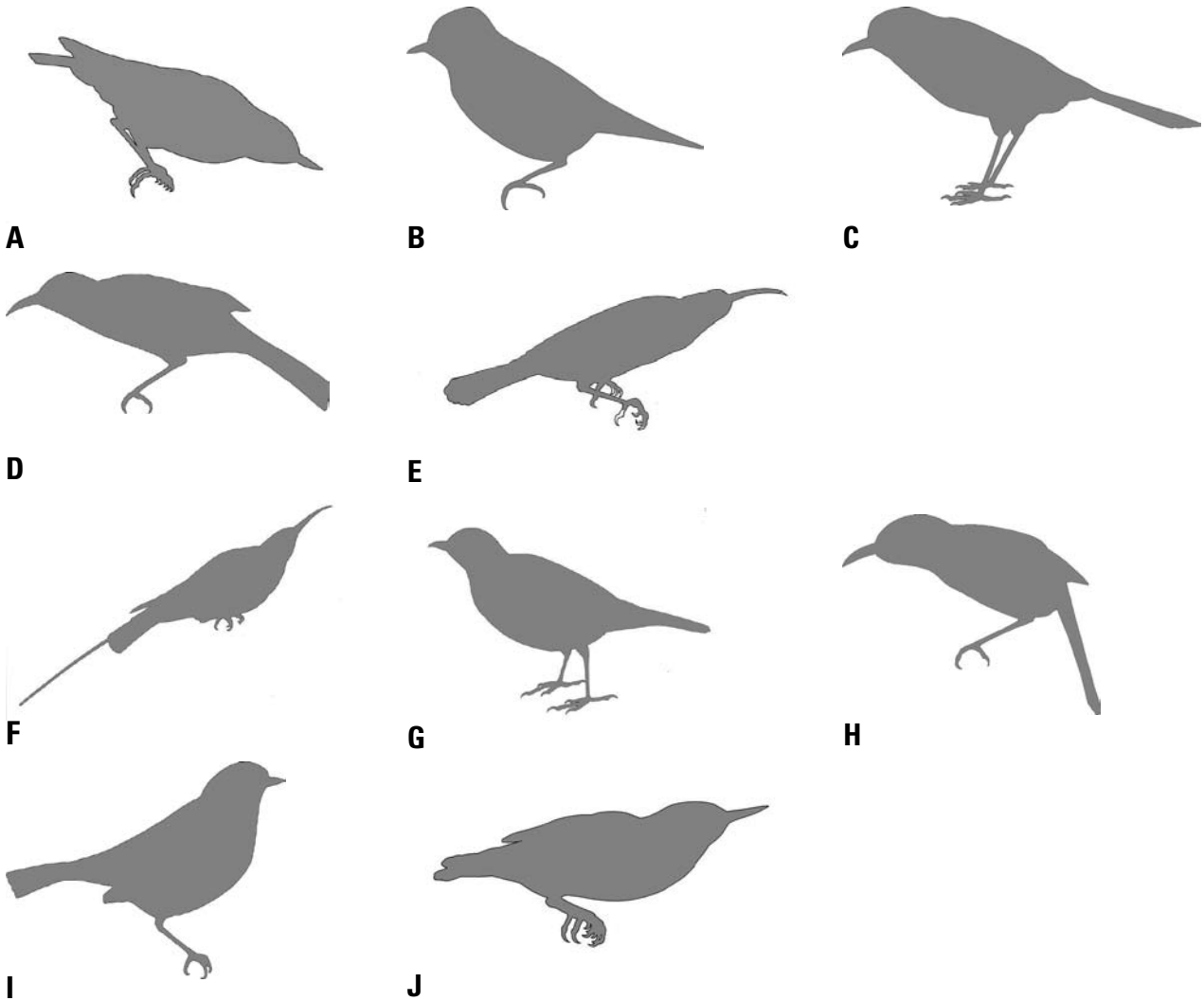
Cichlids.
Artist: Kate Nolan / Source: Museum Victoria

Most Australian songbirds bear a strong resemblance to Northern Hemisphere birds. Based upon this resemblance the early scientists gave the Australian birds typical Northern Hemisphere names: wrens, robins, flycatchers, warblers etc.

Evolution of Songbirds

Look closely at the following bird outlines (A-J) and identify which birds you think are most closely related.

- Draw lines between the birds you think are pairs.



Artist: Kate Nolan / Source: Museum Victoria

- What physical characteristics did you use to match the birds into pairs?
- What other characteristics might scientists use to identify and classify bird species?

Recent developments in molecular biology have provided scientists with further information on the evolution of Australian songbirds based upon DNA analysis.

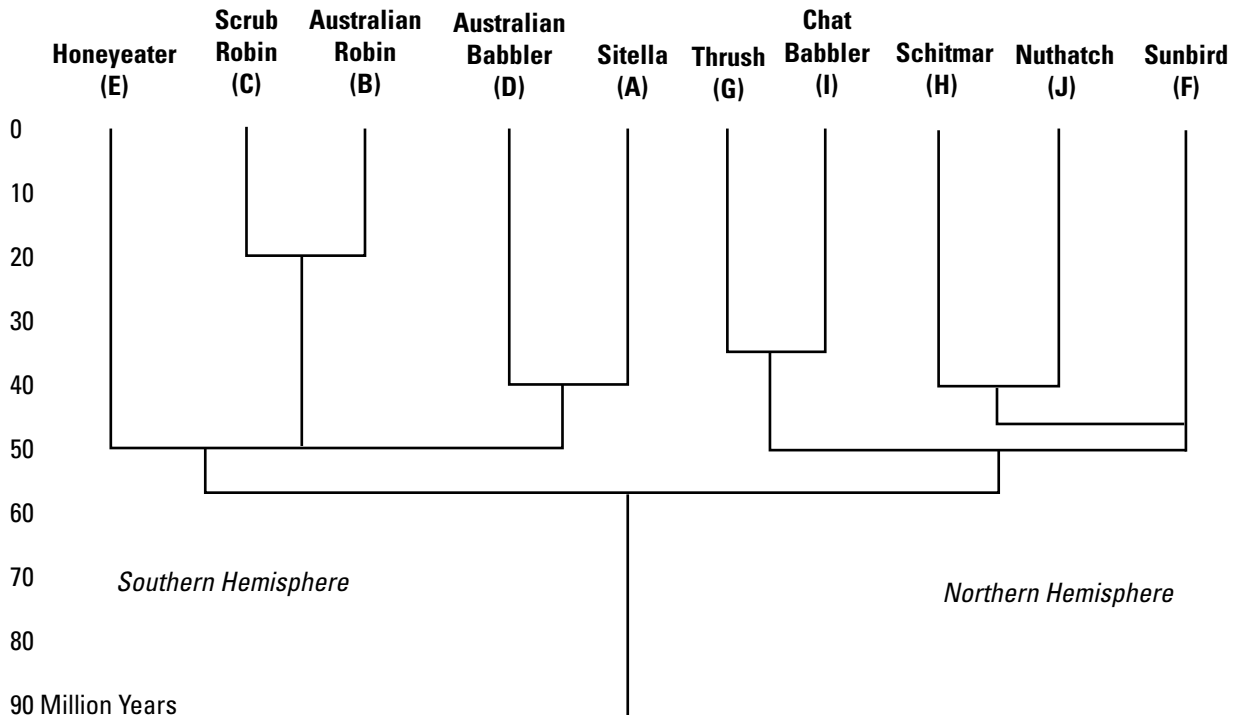
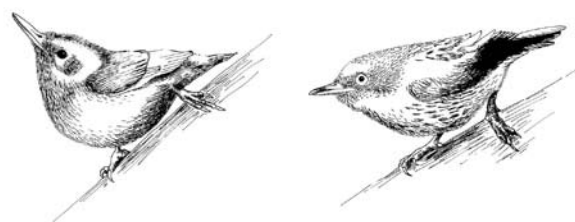


Table: Evolutionary tree of songbirds

- According to DNA investigations, when did the Australian songbirds and Northern Hemisphere songbirds last share a common ancestor?
- Use the information in the evolutionary tree to calculate how many closely related pairs you correctly identified in question one.
- The remarkable similarity in appearance and behaviour between songbirds from Australia and the Northern Hemisphere is an example of what type of evolution?

Originally sittellas and nuthatches were thought to be closely related.



Nuthatch Sittella
Artist: Kate Nolan / Source: Museum Victoria

- Using Sittellas and Nuthatches as an example, explain how this type of evolution can occur.
- Use the information in the evolutionary tree to determine which birds Sittellas are actually most closely related to.

Examining DNA

Scientists are using DNA to study how different species evolved.

Watch and listen to the explanation on the four video screens outlining the processes involved in extracting and analysing DNA to see how different possum species are related.

- What 4 bases make up the DNA code?
- What is the gel rig used for?
- Why do scientists study DNA?
- Why is the gel developed onto X-ray film?
- How many copies of each small section are needed to study DNA?
- How can one part of the code tell us how one possum is related to other possums?
- What is the PCR machine used for?

Look at the information presented on the 'DNA and History' wall.

The classification of possums was originally based upon morphology or body structure including dental structure, presence of a gliding membrane and skull size and shape. The information on the 'DNA and History' wall discusses how the results from the DNA testing were used to show the evolutionary relationships between different possum species.

- How many differences are there between the DNA sequences of the Greater Glider and Common Ringtail Possum?
- How many differences are there between the DNA sequences for the Greater Glider and Sugar Glider?
- Which species is the Greater Glider more closely related to?



Greater Glider Possum.
Mammals of Australia,
Gould, J. 1863 Vol 1: 29

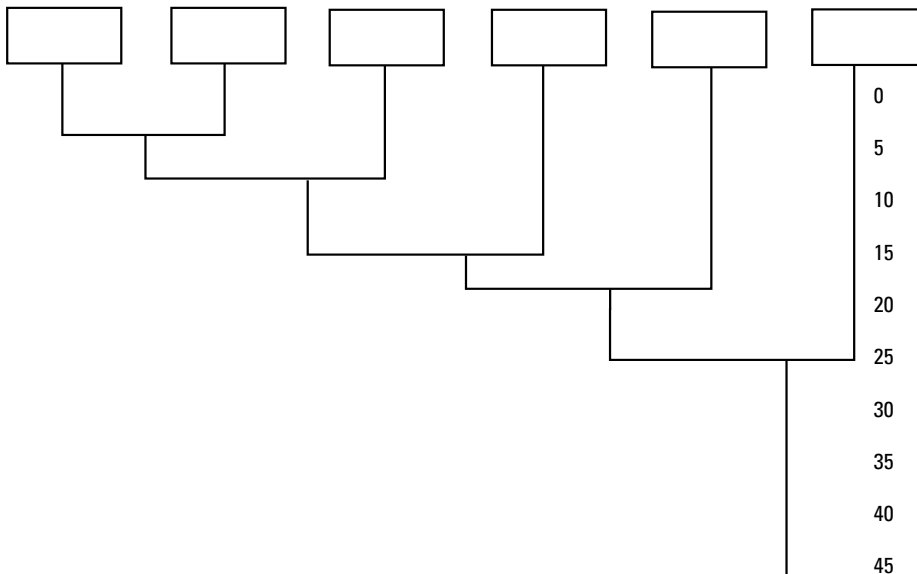


Sugar Glider.
Mammals of Australia,
Gould, J. 1863 Vol 1: 32

Hominid Evolution

Look at the information on primate evolution in the 'Our Relatives' display case.

- Complete the following DNA-based evolutionary tree by including the appropriate primate species in the boxes provided.



- What evidence would have been used to develop this timeline?
- Prior to DNA-based studies, when did scientists believe that humans separated from apes?
- Based upon DNA studies, how closely related to chimpanzees are humans and when did the evolutionary divergence take place?

Look at the information 'Human DNA' and 'Our Family'

- Based upon DNA analysis how many human races are there?
- How many human species have existed over the past 5 million years?
 - at least 5 at least 10 at least 15 at least 20

Horses, zebras and donkeys are all species within the genus Equus. They last shared a common ancestor 4-6 million years ago. This is the same amount of time for the separation of humans and chimpanzees.

- Does this mean we should include chimpanzees in our genus Homo? Justify your decision.