

Mr Darwin's Birds - teachers resources

The finches and natural selection.

Mr Darwin's Birds is a story about the arrival of a pair of finches from Central America onto the Galapagos archipelago, and aims to explore the principles of natural selection. The birds settle into their new home and start raising chicks. Some of the chicks, like their parents, are primarily seed eaters and they find grass species to eat on the Galapagos similar to those they favoured in South America.

However, slight differences in the genetics of their parents leads to variation in the baby birds; some of their beaks look noticeably different to their siblings and they are able to eat new things, such as insects or different sized seeds. This opens up other resources for the finches and reduces the competition for food amongst future generations. Over many subsequent generations this leads to further variation and specialisation of the finches beaks and eventually the birds become several different, though still closely related, species.

In the book, the beginning of this process is shown in a single generation, but in reality it would have been an incremental process over a far longer time period. It's been estimated that the initial number of finches that colonised the island from South America wasn't two birds, but at least thirty. It is unknown how the first finches arrived on the Galapagos archipelago, especially given their small size and the large distance from the islands to the American mainland; nearly 1000km of open ocean, In *Mr Darwin's Birds* we suggest a tropical storm was the mechanism responsible for blowing the finches out towards the islands.

The Galapagos finches provide an excellent illustrative example of natural selection. The isolation of the archipelago and low number of other landbird species meant there were plenty of opportunities, or ecological niches, for the finches to take advantage of.

Natural selection in a nutshell.

1. **Genetic differences** - Offspring are always slightly different to their parents, both genetically and physically. This occurs through random mutations in their genetic code, and through genetic exchange (recombination) during breeding.
2. **Environmental variability** - Environmental conditions are always changing, thus slight differences between offspring could give an individual an advantage; e.g. a bird with a larger beak that is able to crush larger seeds may gain access to more food.

3. **Differential success** - Due to this greater access to resources, the bird is able to have more young and thus the characteristic of a larger beak is *selected for*, and passed onto the next generation at a higher frequency. This process will then repeat.

Who are the finches and who are their neighbours?

The initial family of finches in the book take their appearance from the dull-colored grassquit (*Tiaris obscurus*) from South America, which is the closest living relative to the Galapagos finches. It is not known if the finches are the direct descendents of the grassquits, or if they are both related to another, unknown ancestor.

The generations following on from the baby finches would eventually form new species of finch on the Galapagos. Because this process is a very gradual one, the baby birds don't yet look much like their eventual descendents, but the process has begun.

Fernandina - medium ground finch (*Geospiza fortis*). Seeds are the primary food source for the medium ground finch, but it can also eat other parts of plants. This species is widespread throughout the Galapagos archipelago.

Floreana - green warbler-finch (*Certhidea olivacea*). The green warbler-finch is found on several of the Galapagos islands. Its beak is far thinner than other finch species, and thus it is better adapted to feed on insects.

Santiago - large ground finch (*Geospiza magnirostris*). The bigger beak of the large ground finch enables it to eat harder seeds than the other finches, and it is the biggest of the 26 species of Galapagos finches.

Isabela - woodpecker finch (*Camarhynchus pallidus*). Tool use in the woodpecker finch sets it apart from the other species, as it has the ability to manipulate cactus spines and other materials to forage for beetle larvae living within the wood of trees. Several other bird species, especially crows and ravens, use tools to help them find food.

Juan - vampire finch (*Geospiza septentrionalis*). The vampire finch has a varied diet, but is named for its ability to use its small, sharp beak to feed on the blood of larger birds. It may be that this developed from the vampire finch feeding on parasitic insects that can live on the feathers of other birds.

Fernandina, Floreana, Santiago and Isabela all take their names from islands in the Galapagos archipelago. Juan is the Spanish version of John and is named for the English ornithologist John Gould, who was instrumental in classifying the different species that Darwin brought back from the Galapagos. Pico is the Spanish word for beak, and Susanah is named after Darwin's mother.

Dancing seabirds - Blue footed boobies (*Sula nebouxii*). The courtship ritual of the blue-footed boobies was the inspiration for the dancing seabirds that greet the finches upon their arrival on the islands. The Galapagos archipelago is an important breeding habitat for the blue-footed booby.

Surfing lizards - Marine iguana (*Amblyrhynchus cristatus*). The lizards that the finches meet on the foreshore of the Galapagos are the marine iguanas, which are endemic to the islands and eat algae from the sea.

Other animals featured in the book include:-

- Flightless Cormorant (*Phalacrocorax harrisi*)
- Galapagos Dove (*Zenaida galapagoensis*)
- Galapagos Giant Tortoise (*Chelonoidis spp*)
- Galapagos Penguin (*Spheniscus mendiculus*)
- Galapagos Short-eared Owl (*Asio flammeus galapagoensis*)
- Green Warbler Finch (*Certhidea olivacea*)
- Large Ground Finch (*Geospiza magnirostris*)
- Lava Lizard (*Microlophus spp*)
- Magnificent Frigatebird (*Fregata magnificens*)
- Sally Lightfoot Crab (*Grapsus grapsus*)

The development of the theory of evolution.

Darwin's theory of evolution changed how we view all life on Earth. Instead of fixed species existing as the result of perfect design, there is constant change and variation to find something new and better suited to the environment. Darwin came up with the theory to explain observations he made on his round the world trip in the ship HMS *Beagle* (1831-1836), during which he visited the Galapagos islands. He noted the apparent similarities of species in different areas of the globe, and also between living creatures and their fossilised ancestors.

The finches on the Galapagos were important to Darwin's idea of natural selection, as their interrelatedness raised the possibility that they were all descended from one

common ancestor. Due to their very different appearance, Darwin initially thought the birds were several different types; blackbirds, finches and wrens etc., but the ornithologist John Gould discovered that they were all one new, interrelated group of finches. This diversification from a single colonising species into multiple different ones showed the adaptability of life when exposed to the opportunities of a new environment. Whilst on the Galapagos, Darwin also noted that the birds on the islands appeared similar to those he'd seen in South America. From this information, Darwin put forth the notion that from an initial colonisation by one type of finch from South America, the development and diversification of many new species of finch occurred.

In *On The Origin of Species*, Darwin writes of a similar occurrence in birds on the Cape de Verde islands off the coast of Africa. The initial colonising species adapted to the new environment over time, but still showed similarities to their African relatives, which was seen as further evidence of his theory. From there, the theory expanded and could be used as a framework to explain the forces that act to shape all life on earth. The environment exerts a selective pressure and all living things that are suitably adapted to it will continue to persist. The different habitats and conditions that exist across the globe have thus produced a myriad of forms of life.

Australian Curriculum content description.

Foundation

- ❖ When they arrived on the Galapagos, how did the finches go about meeting their needs for food and shelter? (ACSSU002).
- ❖ There were many different types of food available for the finches on the Galapagos; discuss the student's favourite food and see how many things you can list? What different kinds of foods do the students' families have at home? (ACSSU002).
- ❖ Darwin spent time observing the differences between the finches on the Galapagos - what similarities and differences do the students notice in the birds they see everyday? (ACSHE013).

Year 1

- ❖ Over time the beaks of the finches became better adapted to eat their favourite foods. Look at pictures of other birds and animals, and think what they might be well suited to feed on? (ACSSU017).

- ❖ The adaptation of the finches beaks enable them to thrive in their new habitat of the Galapagos. Discuss with the class what traits might be well suited for a range of different environments (desert, jungle, marine, etc)? (ACSSU211)
- ❖ Humans have adapted to all habitable environments on the planet - what are the tools and technologies that have enabled them to do so? (ACSHE022)

Year 2.

- ❖ The baby finches shared many similar characteristics to their parents, Looking at eye and hair colour; examine what similarities the students have with their parents? (ACSSU030).
- ❖ The Galapagos archipelago is over 1000km from the American continent. Look at this distance on the globe, and consider how small birds, insects, and terrestrial lizards initially arrived on the islands? (ACSHE034).