



# 7.4 Evidence of Evolution



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# Goal

By the end of this lesson, I will be able to...

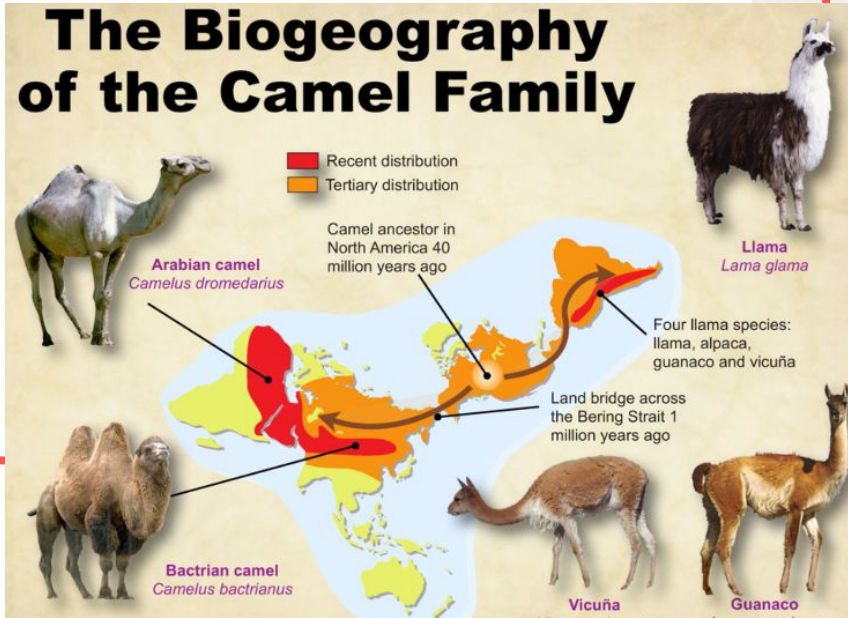
- ❑ Identify evidence for evolution that allowed Darwin to develop his theory
  - ❑ Biogeography
  - ❑ Homologous structures
  - ❑ Embryological development
  - ❑ Analogous structures
  - ❑ Vestigial structures
  
- ❑ Define the terms homologous, analogous and vestigial structures



# Biogeography

## Compelling evidence for evolution.

- **Biogeography:** the scientific study of the geographic distribution of organisms based on both living species and fossils.



## Examples:

- Fossilized species were found in the same locations as similar present day species
- Species found only on islands were **resembled** those on the **nearest land mass**
- **Remote islands** had some of the most interesting species

# Remote Islands: Interesting Species

- Many of the species in the Galapagos are not fearful of humans
  - Since they had no natural predators on the islands, they have lost their instinct of fear



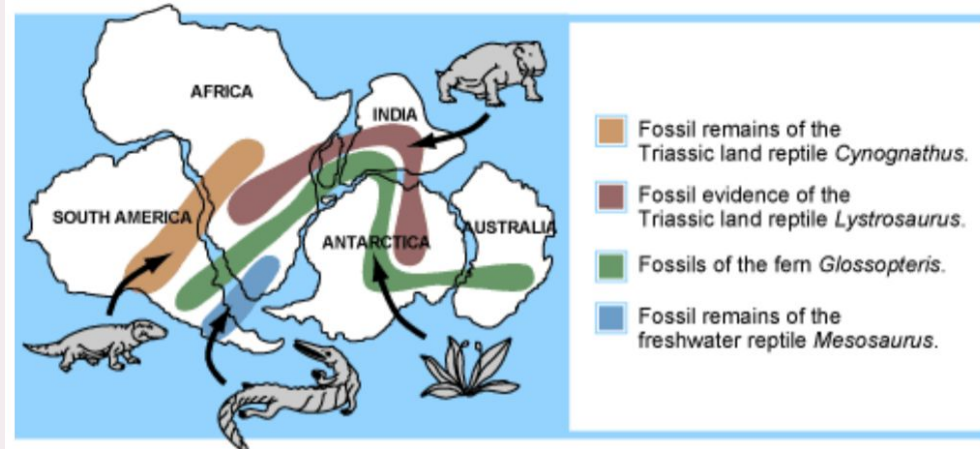
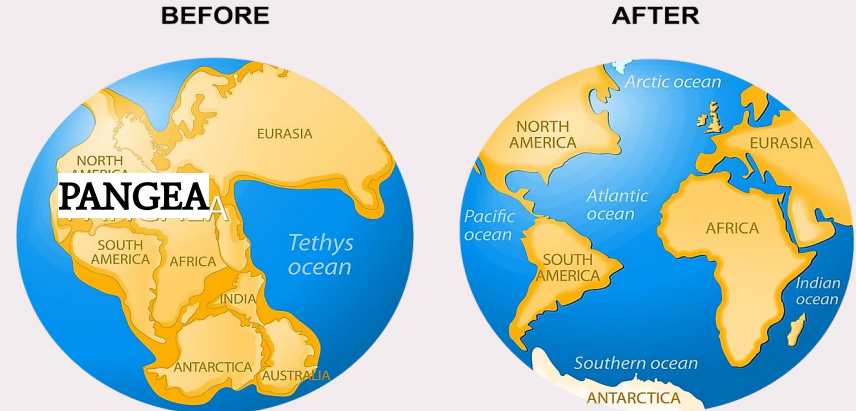
# More on Biogeography



# What we know now...

- Closely related species are sometimes found on different continents.
  - Continents were once connected in a supercontinent known as Pangea.
  - Continental drift separated the continents.

## CONTINENTAL DRIFT

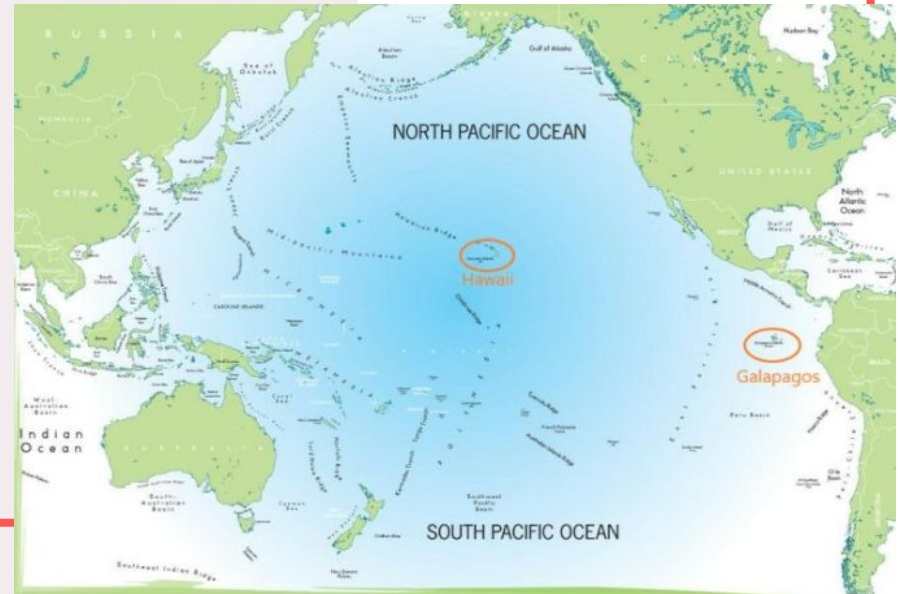
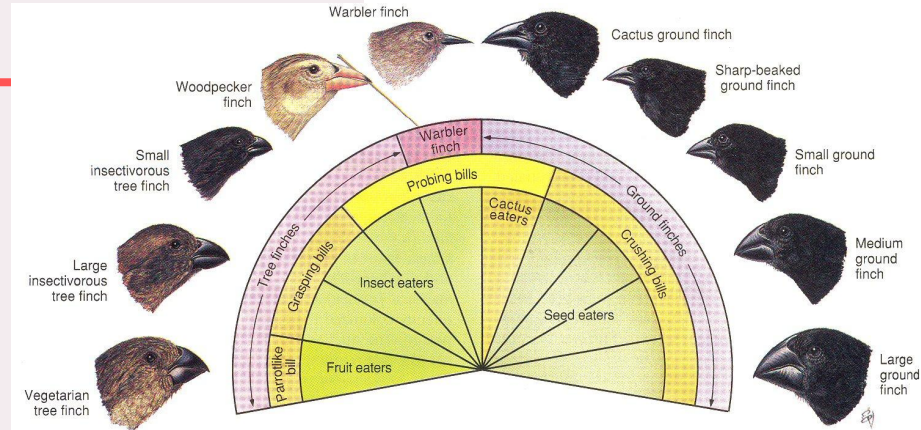


# Darwin's Hypothesis

## Darwin's Hypothesis:

Remote oceanic islands became populated by species that arrived by water or air.

- After the species became established, many evolved into new species over time.



# Darwin - Remote Island Species

## Observations and Hypotheses:

<b>Observations from the Galapagos Islands</b>	<b>Darwin's hypotheses regarding remote islands</b>
many species of plants, birds, insects, and, in some cases, reptiles	Only these kinds of organisms are able to reach remote islands by crossing large expanses of open ocean.
no native amphibians and very few land mammals	Amphibians and most mammals are unable to cross open ocean and will not be found on remote islands.
many unique species found nowhere else on Earth	Over time, ancestral species have evolved into new geographically isolated species.
unique species most closely resemble species on the nearest continental land mass	Unique species are descendants of ancestral species from the nearest continental land masses and will exhibit some similarities.





# Testing his Theory

Darwin needed to test if his hypothesis would be supported by future research.

**Would Darwin see large land mammals and amphibians on the Hawaiian islands?**

Similar findings to Galapagos Islands with minor exceptions. No land reptiles on Hawaiian Islands (likely due to long distance from the mainland).

Darwin proposed an alternate hypothesis to support the original.

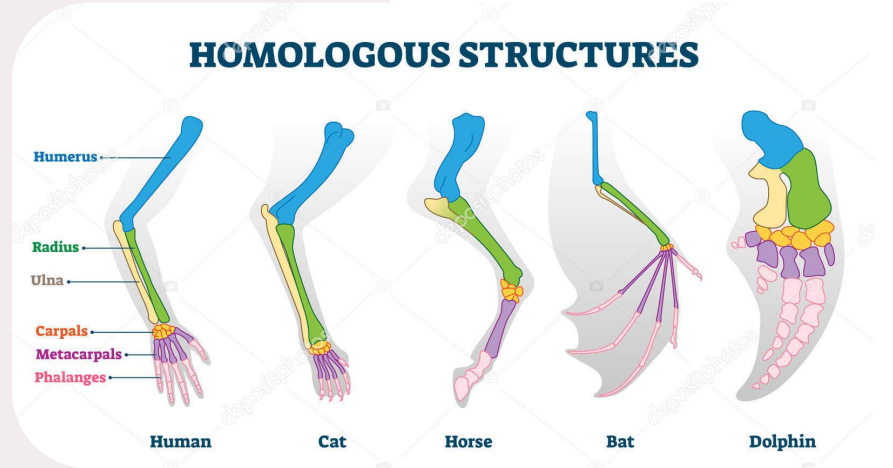
**What if land mammals are not present because they are just unable to live on islands?**

Darwin introduced rats, dogs and pigs, to test this hypothesis. They thrived and negatively affected native species.

# Evidence for Evolution: Homologous Features

**Homologous feature:** a structure with a common evolutionary origin that may serve different functions in modern species.

- Darwin was shocked to see finger bones in a whale flipper.
- He wondered why almost all mammals would have 28 skull bones and 7 neck bones despite the size of the skull or length of the neck





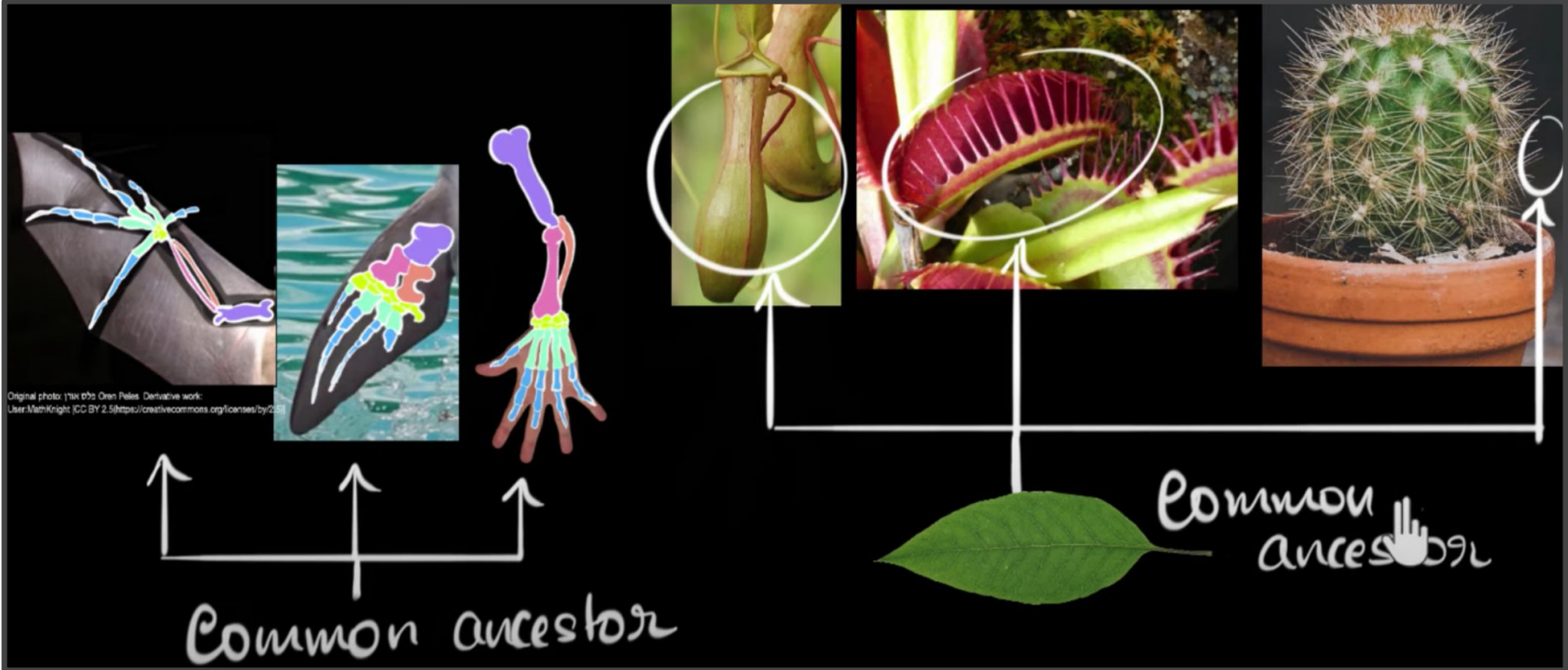
## Darwin's Conclusion

Darwin concluded that closely related species had homologous features because they shared a common ancestor

Over time, original structures were modified as each species evolved.

# Homologous Structures

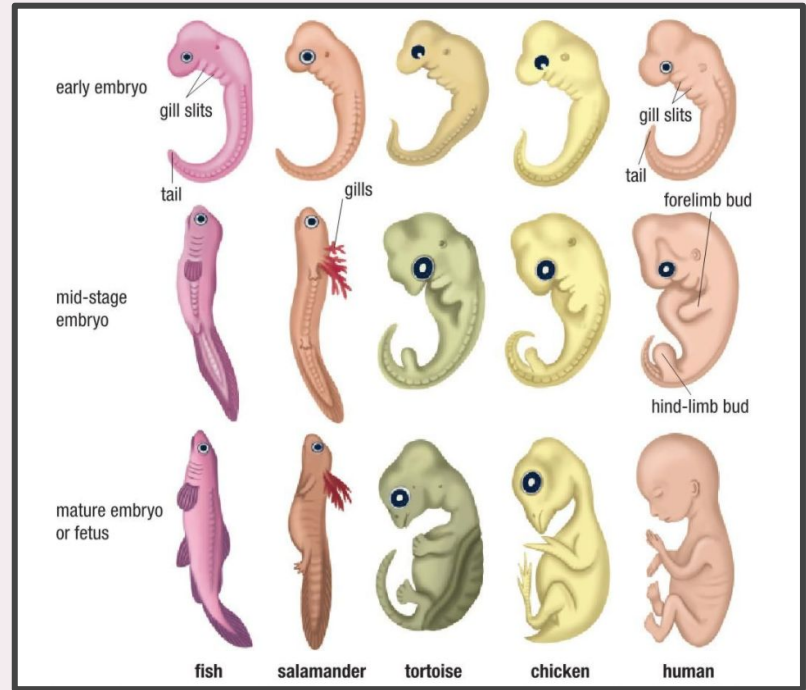
(Khan Academy)



# Embryological Evidence

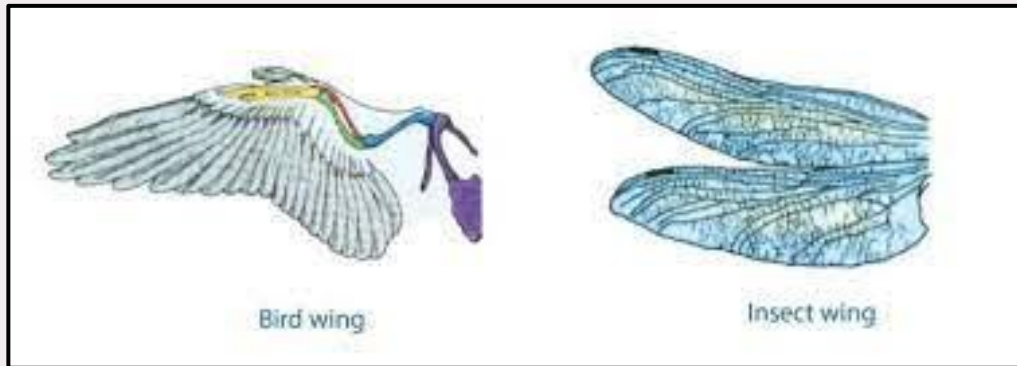
Closely related species have homologous developmental processes.

*Notice that all **early** embryos of vertebrate animals have tails and gill slits.*



# Analogous Structures

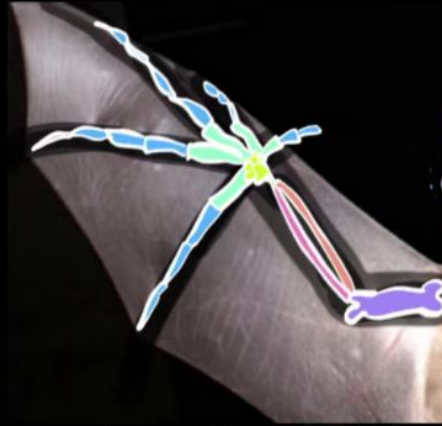
**Analogous features:** a structure that performs the same function as another but is not similar in origin or anatomical structure



E.g. insect wings and bird wings **are very different from one another** structurally.

- They are more distantly related and evolved the ability to fly independently from one another.

# Analogous Structures (Khan Academy)



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Ancestor (1)

Ancestor (2)

# Vestigial Features and Anatomical Anomalies

**Vestigial feature:** a rudimentary and non-functioning, or only marginally functioning, structure that is homologous to a fully functioning structure in closely related species

- E.g. Cave fish, living in the dark, have eye sockets that serve no purpose.





# Vestigial Structures Cont'd



(a) dog

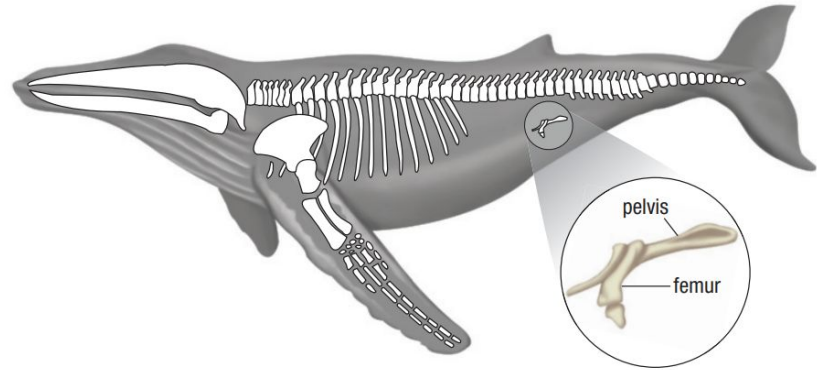


(b) pig



(c) horse

E.g. Dogs, pigs and horses have extra toe(s) that serve no purpose in the modern species.



Whales have hip bones that serve no purpose in the current species.

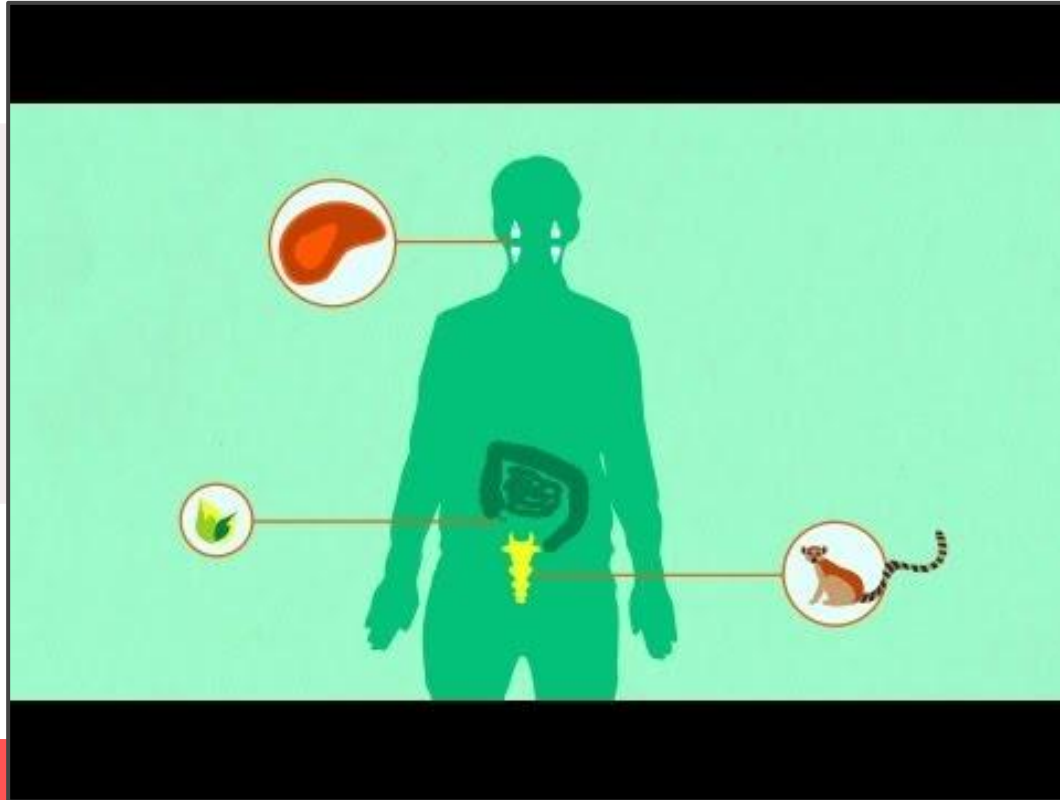
- Hip bones allowed their ancestors to walk on land.

# Vestigial Features in Humans: Goosebumps

- Each hair is attached below the surface of the skin to a **tiny muscle**
- Goosebumps are the result of these tiny muscles **contracting** and lifting up the hair
- In mammals this reaction serves two purposes:
  1. In response to **cold temperature** to **increase insulation value** of the hair
  2. In response to a **threat** to look **larger** (e.g. cat)
- Neither of these functions exist with human hairs  $\therefore$  **vestigial!**



# Vestigial Structures



# Darwin's Thoughts: Competition

## Why are species changing?

All populations are **limited in size** by environmental pressures, especially **food supply**.

Due to the **limited resources** organisms **must compete**.

The **most fit** pass down their traits!

# Recap - Evidence for Evolution Overview

