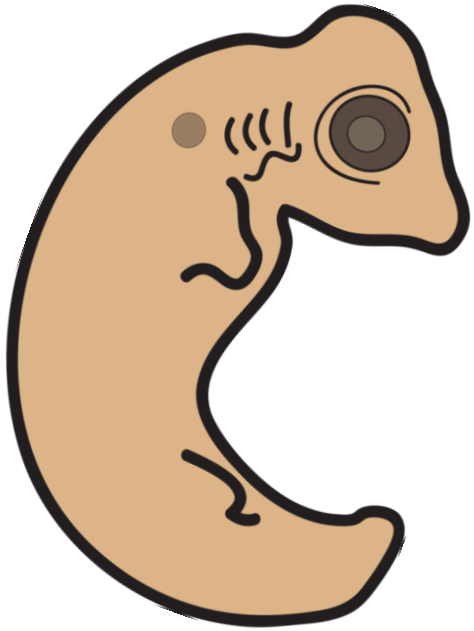

Evidence Of
EVOLUTION

# Introduction

**Chicken or Fish? Introduction to Embryology Activity**

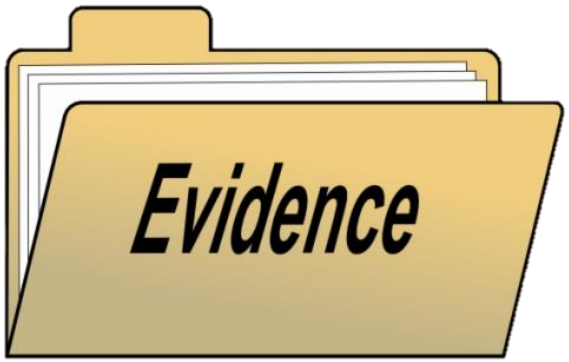
Task: You have been given 18 images of 6 different organisms at 3 different stages of embryonic development.

Follow the instructions provided to you to complete the introductory task.



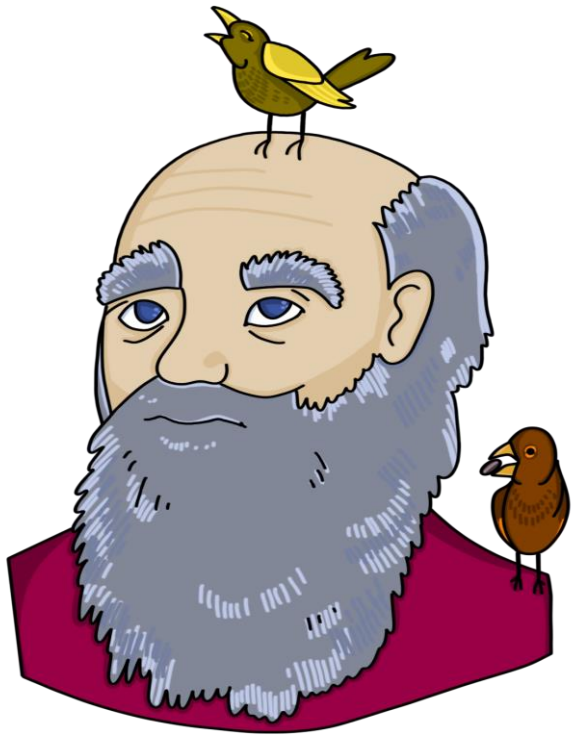
# Introduction

- You might have noticed in the activity that many embryos have similar features.
- Scientists have also noticed these similarities and believe that similar features of embryos in very different organisms provide **evidence of evolution** from a distant common ancestor.
- Today, we will be discussing several different evidences of evolution.



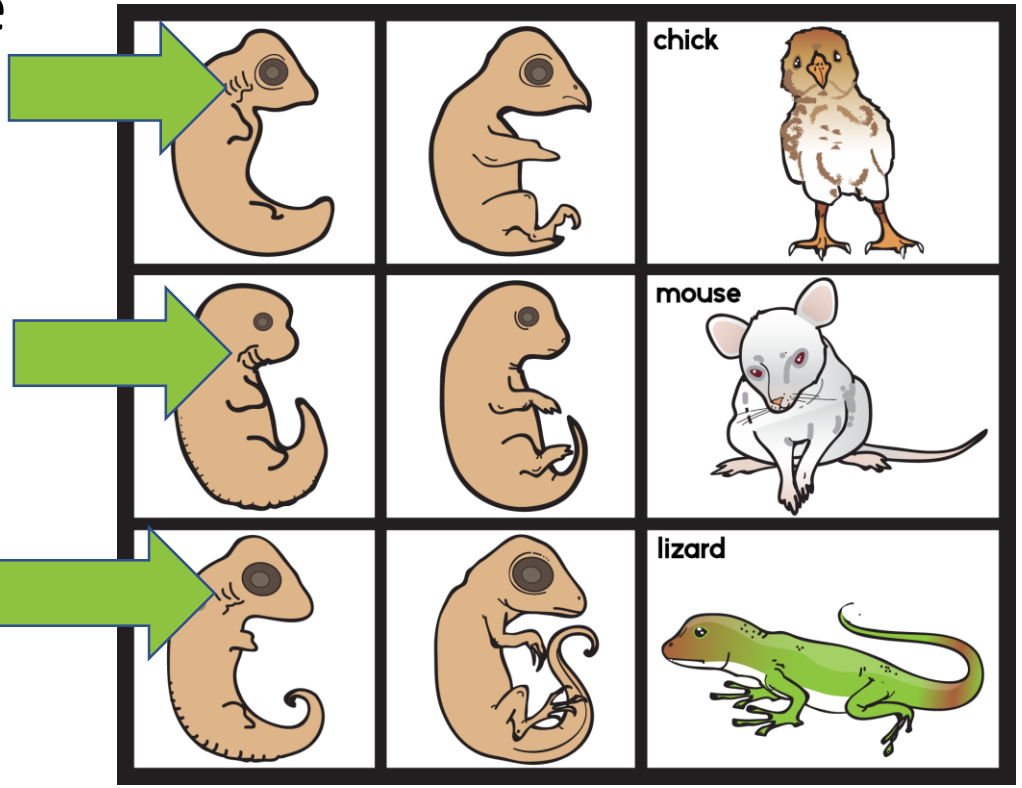
# Introduction

- Genetic **inheritance** was not known in Darwin's time.
- However, Darwin believed that all organisms share a common **ancestor**.
- In his travels/studies, he collected strong **evidence** to support his theories.
- Today, the concept of evolution ties together all fields of **biology**.
  - embryology
  - paleontology
  - morphology
  - biogeography
  - biochemistry



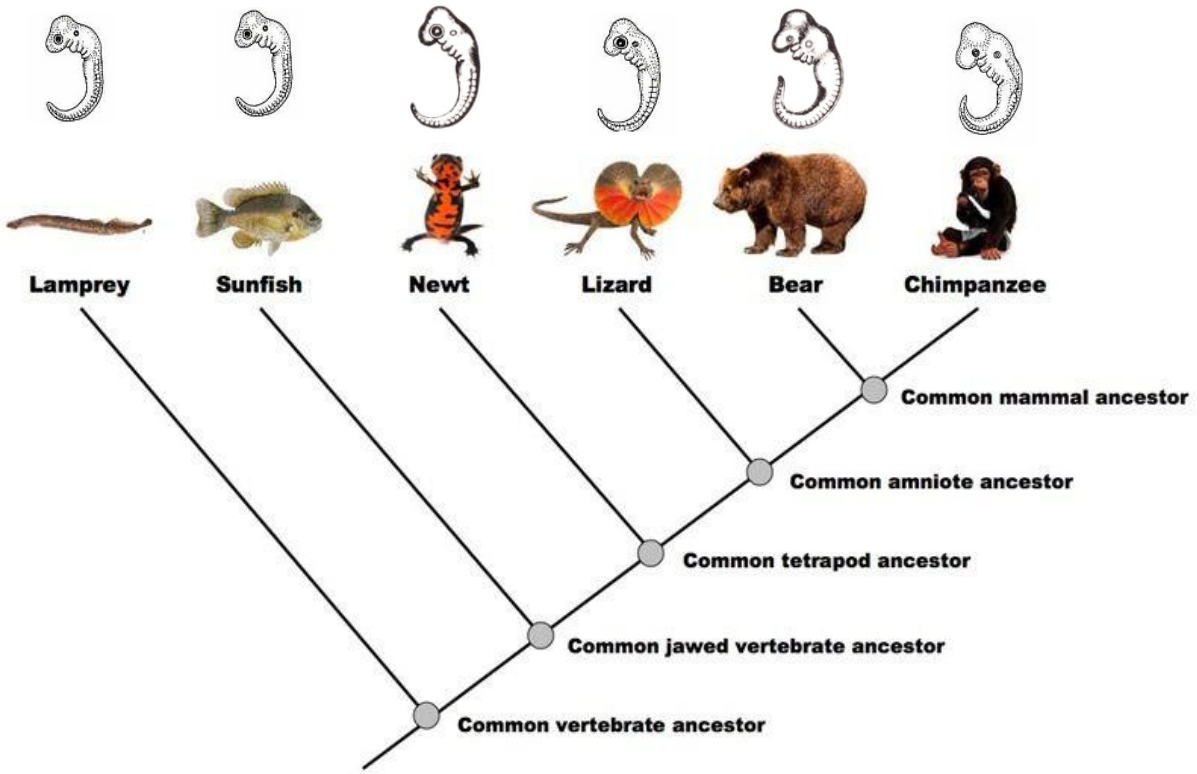
# Embryology

- **Embryology** is the study of embryos and their development.
- Darwin noticed that the embryos of different species may look very similar, although the adult species look very **different**.
  - Ex. Fish, birds, reptiles and mammals all have gill slits as embryos.



# Embryology

- The similar features of embryos in very different organisms suggests **<u>evolution</u>** from a distant common ancestor.



# Embryology

- What can embryos tell us about evolution?
  Video Link: https://youtu.be/uAZmLYWEPGk

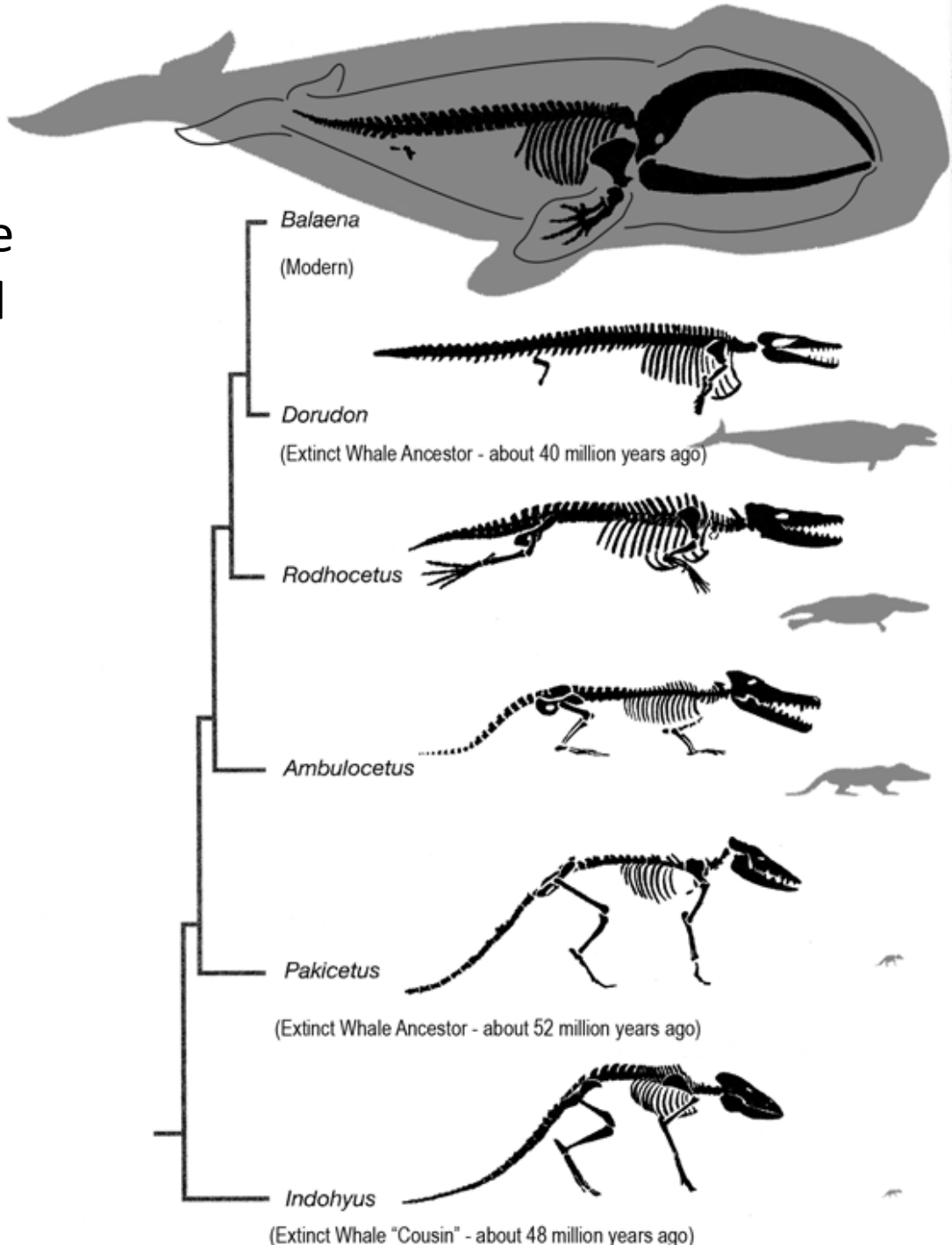
# Paleontology

- Paleontology is the study of **fossils** or **extinct** organisms.
- Scientists were studying fossils long before Darwin and knew that organisms **changed** over time.
- Darwin collected many fossils during his travels and these fossils provided evidence for what he (and other scientists) knew- **species change over time, give rise to new species, and share a common ancestor** (descent with **modification**).

***Archaeopteryx*: a transitional fossil that shows the link between dinosaurs and the modern-day bird**

# Paleontology

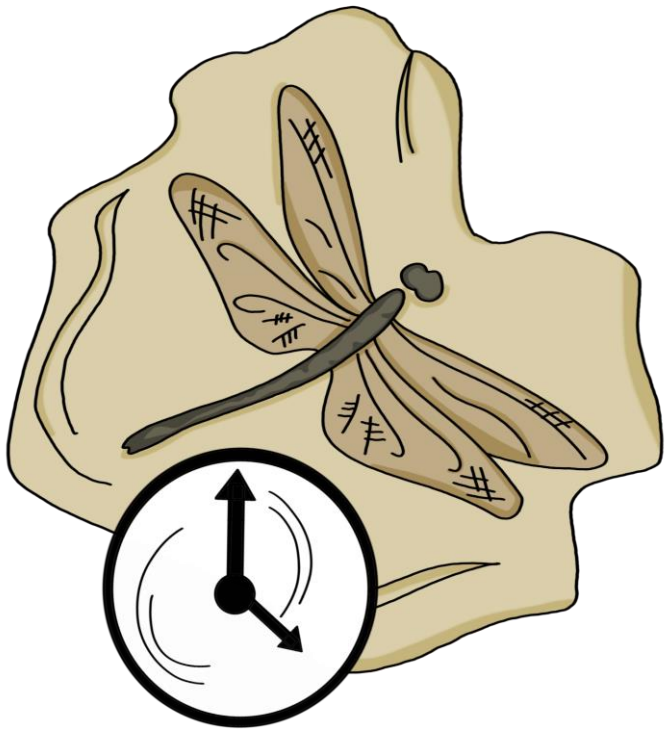
- Fossil evidence supports the idea that whales descended from hoofed animals.
- *Pakicetus* had a whale-shaped skull and teeth adapted for hunting fish.
- *Ambulocetus* lived on both land and water.
- *Dorudon* had tiny hind legs that were useless on land, similar to modern day whales.



# Paleontology

- The ages of fossils and extinct organisms are determined through

- **relative dating**
  - estimates a fossil's age
- **absolute dating**
  -(C-14 dating)- calculates a fossil's precise age



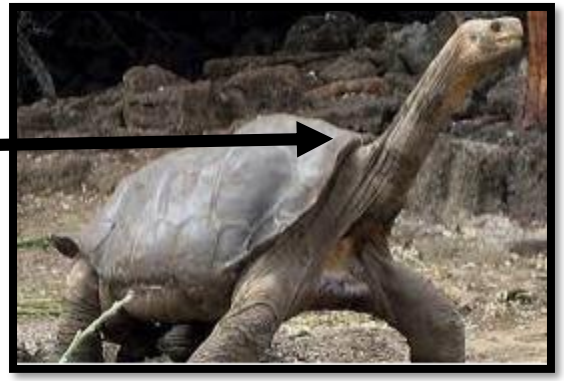
# Paleontology

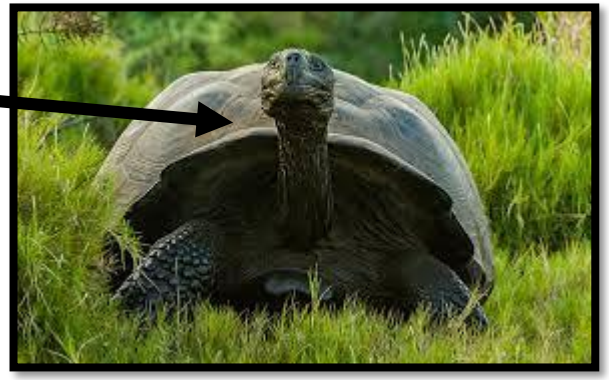
- The evolution of whales:

  Video Link- https://youtu.be/8degAk6WHkA

# Biogeography

- During Darwin's travels, he noticed that plants and animals on islands looked similar to species on the mainland, but not exactly the same.



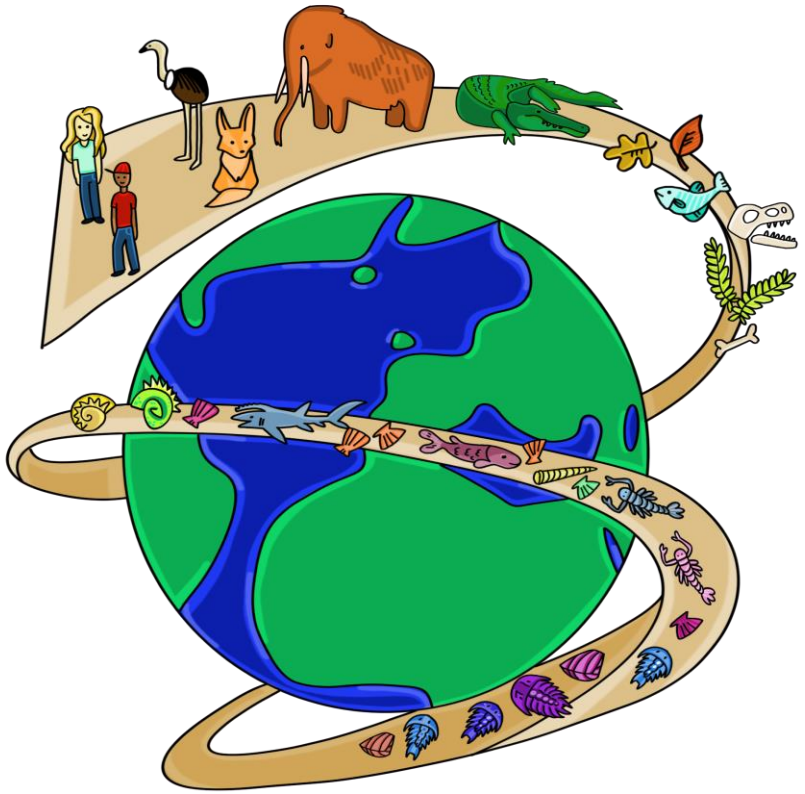
# Biogeography

- Biogeography is the study of the **distribution** of organisms around the world.

- Darwin hypothesized that organisms from the mainland had migrated to the islands.

- Different islands had different food sources, climates, and predators.

- The different environmental conditions favored different traits.

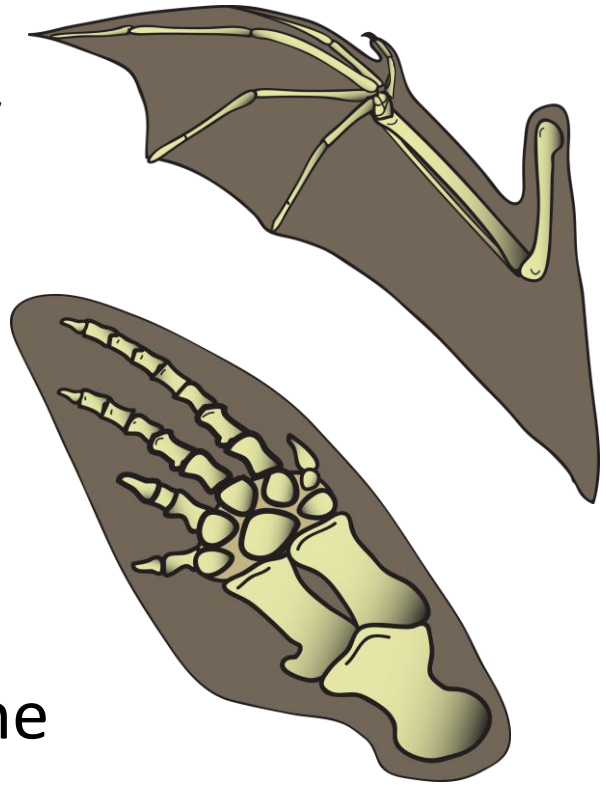


# Biogeography

- Biogeography: Where Life Lives
  Video Link: https://youtu.be/2UQC5ts6hUs

# Morphology

- Morphology is the branch of biology that deals with the form of living organisms and with relationships between their **structures**.
- Sometimes it is referred to as ***comparative anatomy***.
- Some of Darwin's best evidence came from comparing the body parts of different species.
- He found that some organisms have body parts that are similar in structure but might be used differently.



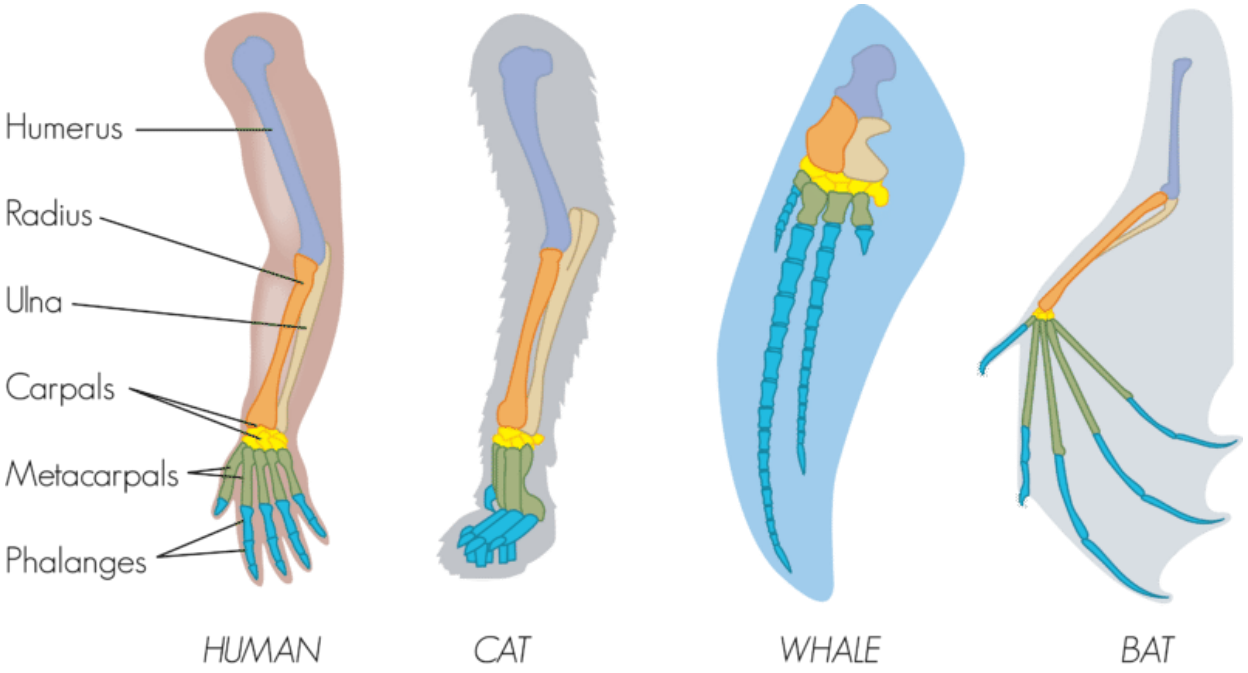
Ex. The forelimbs of a bat and dolphin are similar in structure but are used differently from one another. The bat uses its forelimbs to fly, while the dolphin uses its forelimbs to swim.

# Morphology

- There are 3 different types of structures that provided evidence of evolution:
  - homologous structures
  - analogous structures
  - vestigial structures

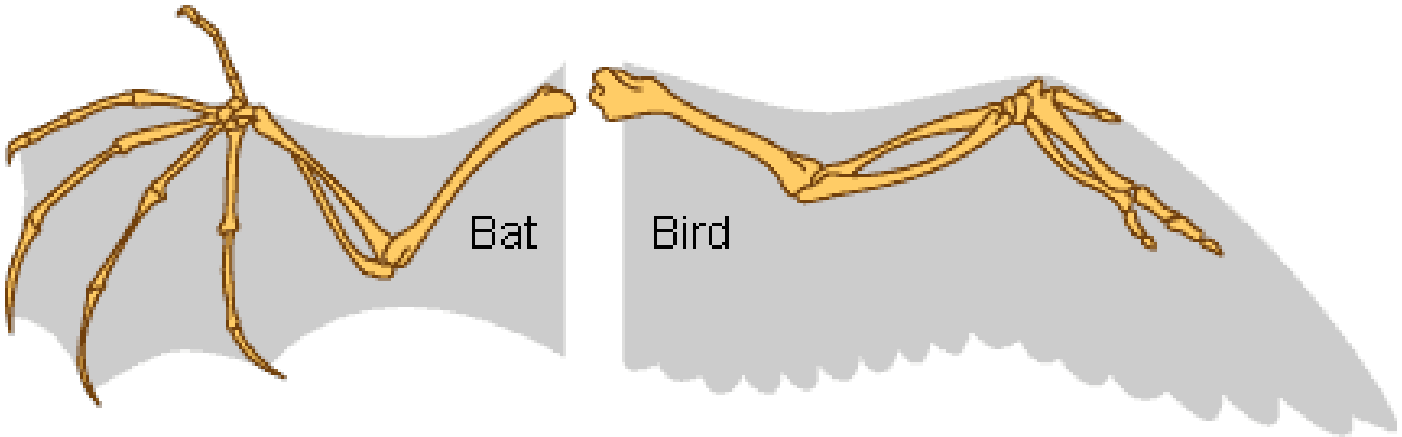
# Morphology

- **homologous structures**
  - structures that are similar in related organisms because they were inherited from a common ancestor
  - These structures may or may not have the same function in the descendants.



# Morphology

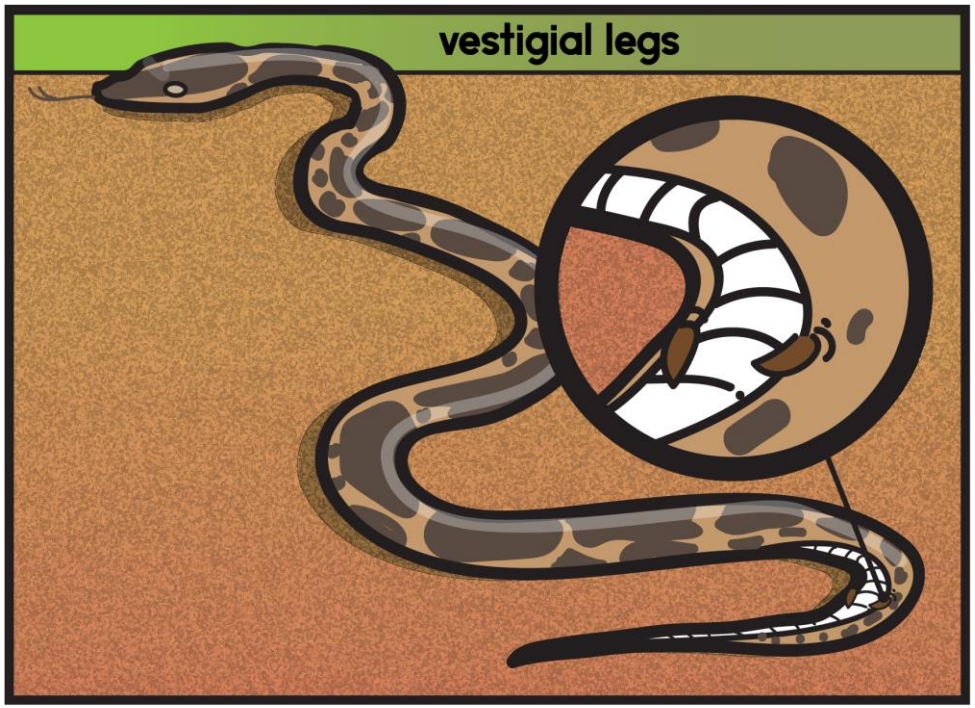
- **analogous structures**
  - Structures that are similar in unrelated organisms.
  - The structures are similar because they evolved to do the same job, not because they were inherited from a common ancestor.

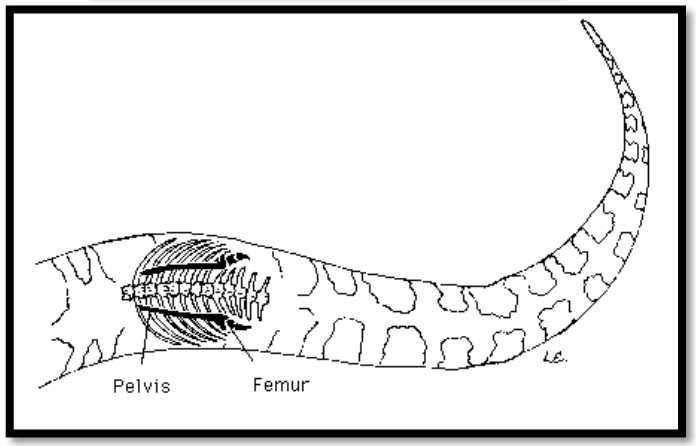



The wings of bats and birds, look similar on the outside. They also have the same function. However, wings evolved independently in the two groups of animals. This is apparent when you compare the pattern of bones inside the wings.

# Morphology

- **vestigial structures**
  - Small leftover organs or structures that had a function in an early ancestor.

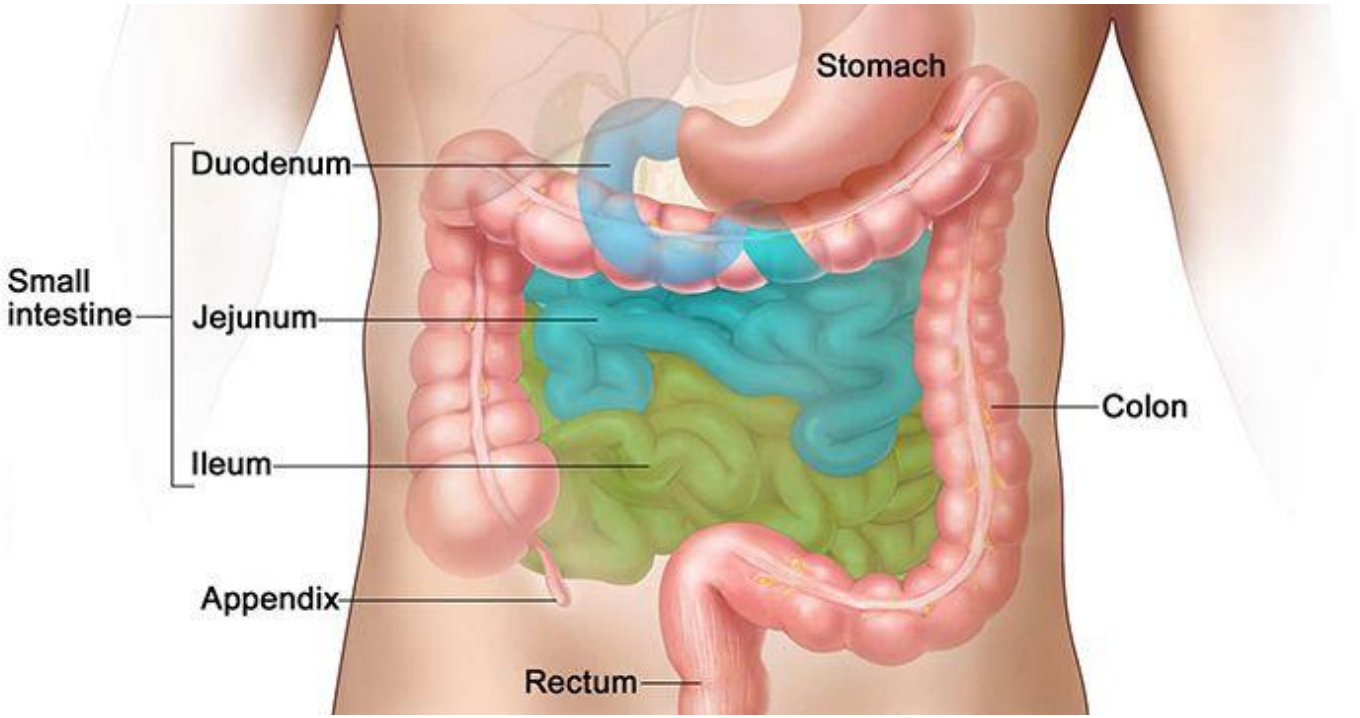



Ex. Snakes have tiny hind leg bones buried in muscles toward their tail ends.

# Morphology

- **vestigial structures**



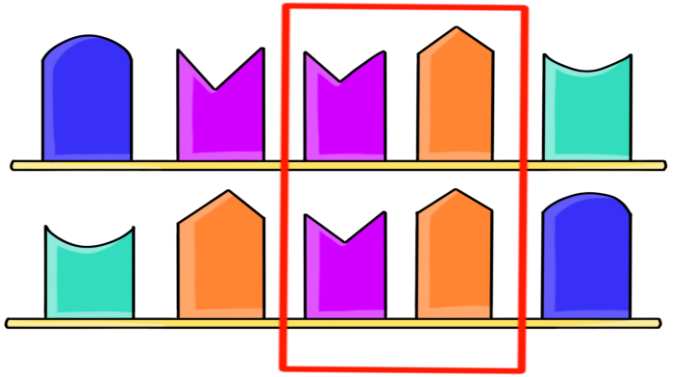

The appendix is an example of a vestigial structure in humans. The appendix is a remnent of an organ that helped to digest certain plant material eaten by human ancestors. The human appendix has lost the ability to digest this material, and actually has no known function.

# Morphology

- **Proof of evolution that you can find on your body**
  **Video link: https://youtu.be/rFxu7NEoKC8**

# Biochemistry

- Scientists also observe similarities among organisms at the molecular level.
- The fields of genetics and molecular biology have added strong support to Darwin's theory of natural selection.
- Comparisons of **DNA** and protein sequences can be used to show evolutionary relationships between different organisms.



# Biochemistry

- The more related two organisms are, the more **similar** the sequences will be.

- Because there are thousands of genes in even simple organisms, DNA contains a huge amount of information on evolutionary history.

| | Short DNA Sequence | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Monkey | C | A | T | C | G | A | T | T |
| Hawk | C | T | T | C | C | A | T | A |
| Squirrel | C | A | T | C | C | A | T | A |
| Frog | C | T | T | C | C | A | T | G |

*Which species is most closely related to the monkey?*

# Biochemistry

- Some particular genes are found in many organisms and give evidence of a very distant common ancestor.
  - ex. humans and chimpanzees

Comparing the Human Genome Between Humans and Chimpanzees:
Video Link- https://youtu.be/WMPlr4tD64A

# Biochemistry

To be clear….

Evolution does **not** tell us that humans descended from monkeys (or any other primate living today.)

It does tell us that we most likely shared a **common ancestor** with chimpanzees.

Humans and chimpanzees evolved differently from that same ancestor. All apes and monkeys share a more distant relative, which lived about 25 million years ago.