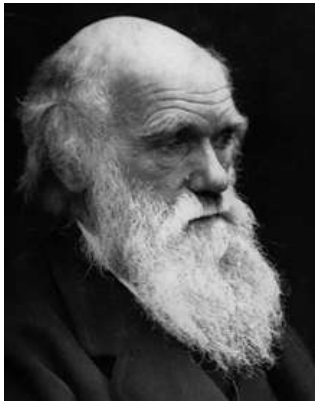
# Evolution

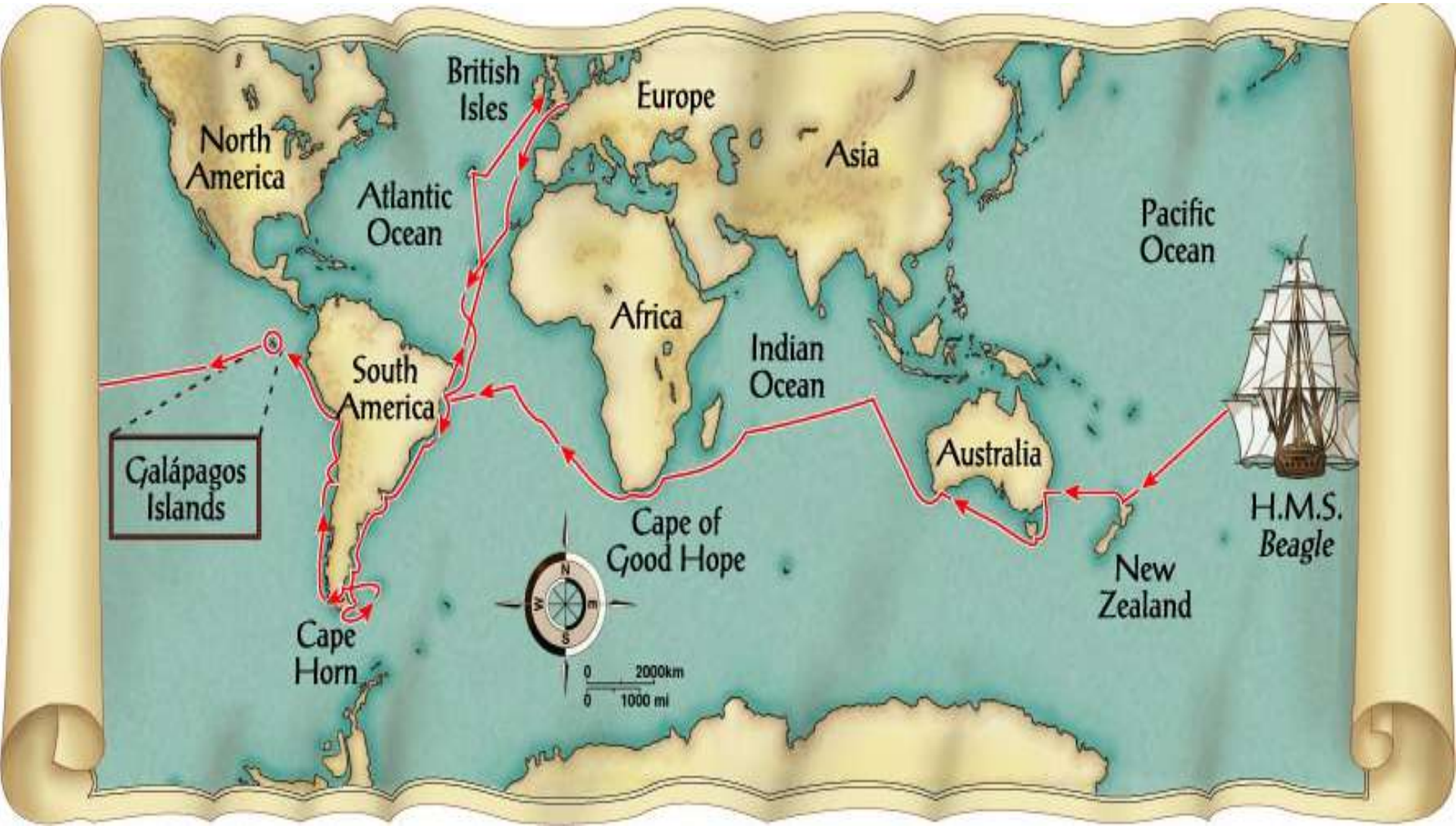
## Darwin's Voyage

# Charles Darwin

- Explorer on an observation trip to the Galapagos Islands.
- He set sail on the HMS Beagle in 1858 from England on a 5 year trip.
- He was a naturalist (a person who studied nature).



The map below shows the route of the HMS beagle:
England, South America, Galapagos Island, Australia, South Africa, back to England.



# Galapagos Island

- Located in Pacific Ocean, North West of South America.
- 600 miles from Ecuador
- 13 major islands and 6 smaller ones
- They were formed by undersea volcanic activity, almost 5 million years ago.

# What did Darwin find on his voyage?

- He found a variety of species similar to those found in South and Central America.
- He also encountered new and unusual organisms while on his voyage, especially on the Galapagos Islands.

# What did Darwin observe on his visit to Galapagos Islands?

- Darwin observed similarities and differences between the individual islands and the mainland organisms.
- Darwin wondered why these organisms had different characteristics from those on the mainland.
- He concluded that these organisms faced conditions that were different to that of the mainland.
- As a result they had to develop adaptations or traits that helped the organisms survive.

# What did Darwin hypothesize?

Darwin hypothesized that a small number of different plant and animal species had come to the islands from the mainland.

His hypothesis is an example:

Dispersal and physical or geographical barriers.

Explain your answer:

Organisms are carried to the islands by ocean currents, drifting on logs; Physical barriers would be how the ocean limits their movement

# Dispersal

- Defined as the movement of organisms from one location to another
  - Some might have blown out to sea during a storm
  - Some may have set adrift on a fallen log
- Once the plants and animals reached the islands, they reproduced.
- Eventually their offspring became different from the mainland species.

# Three conclusions that Darwin made during his voyage were:

1. The diversity of living things.
2. The remains of organisms that lived in the past (fossils).
3. The adaptations that led to the variety of organisms on the Galapagos Islands.

# What is an adaptation?

It is a trait that helps an organism to survive in its environment.

**Figure 1** **Adaptations in Species of Frogs**

The red-eyed tree frog hides among a tree's leaves during the day and comes out at night.

The smokey jungle frog blends into the forest floor.

The bright coloring of the strawberry poison frog warns predators that the frog is poisonous.

# How did Darwin's voyages and observations lead to the theory of natural selection?

- He hypothesized that the species gradually changed over many generations and became better adapted to the new conditions.

- The gradual change in an organism's genetic makeup lead to the development of new species.

- From his voyages, Darwin wrote a book called "The origin of Species."

# What is natural selection?

Natural Selection: means that organisms with traits best suited to their environment are more likely to survive and reproduce.


*Natural selection does not grant organisms what they "need".*

# Results of natural selection

- The offspring will inherit these helpful traits and will be more likely to survive and reproduce.
- Over time helpful variations may gradually accumulate while unfavorable ones may disappear.

# What factors affect natural selection?

## 1. Over production –

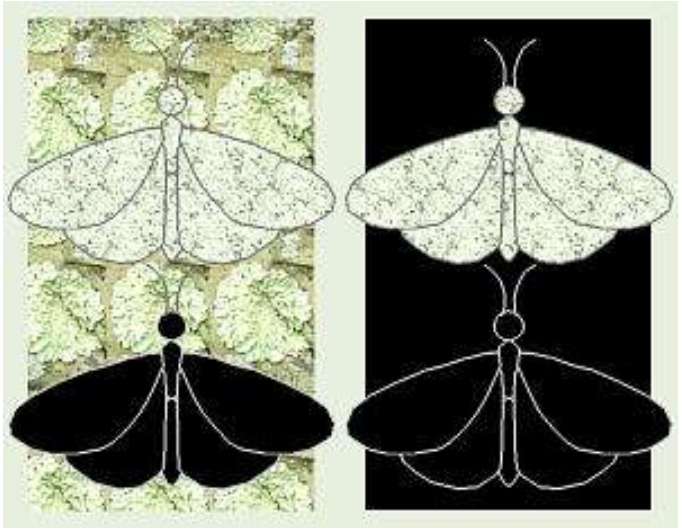
Organisms produce more offspring than can survive.

# 2. Variations

- Variations are found among individuals of a species (some may move faster, hard shell, or keen eye sight).
- Some variations allow members of a population to survive and reproduce better than others.

# What is variation?

- It is an inherited trait (change in the DNA) that makes an individual different from other members of the same species.
- Can be color, shape, behavior or chemical makeup.



# 3. Competition

Organisms compete for the same food and other resources in a restricted or specific space.

# Genes and Natural Selection

- Darwin could not explain what caused variations or how they were passed on.
- Today we know that they can result from both mutations and the shuffling of alleles during meiosis.
- Genes are passed from parent to offspring on chromosomes, because of this, only traits that are controlled by genes can be acted upon by natural selection.

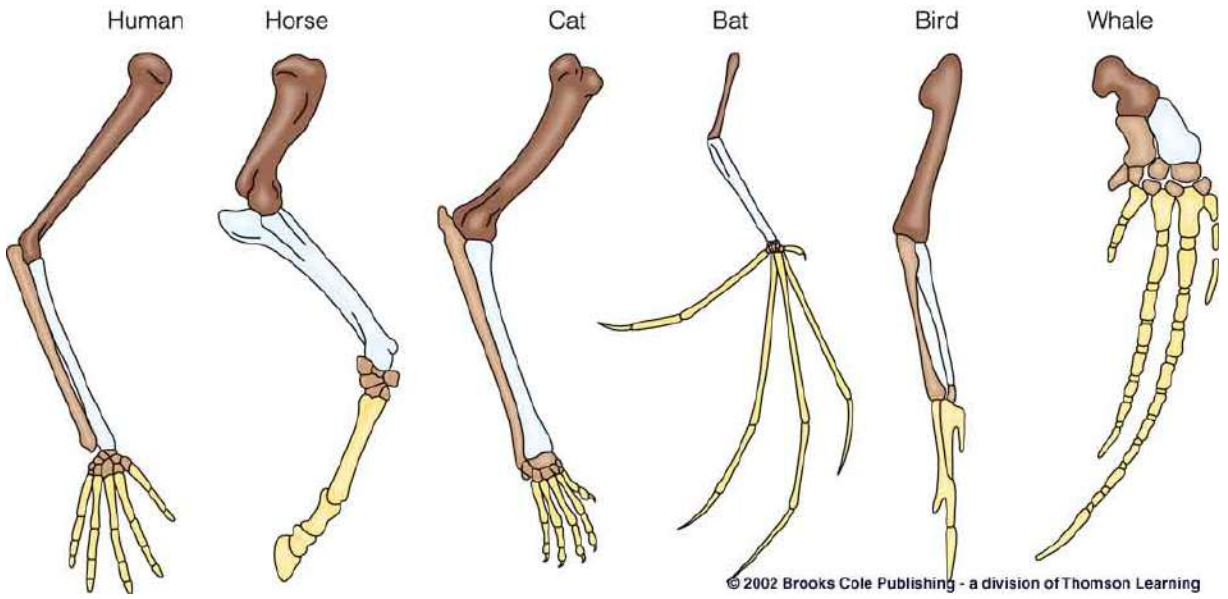
# Evidence of Evolution

1. Geographical distribution: A new species will form when a group of individuals remains isolated from the rest of its species long enough to evolve different traits.
- Isolation can occur from a river, a volcano, or a mountain range.

# Example : populations of squirrel separated by Grand Canyon.

# Evidence of Evolution

2. Homologous structures: Similar structures in a variety of different organisms. Shared trait provides evidence that the organisms had a shared common ancestor with that trait.

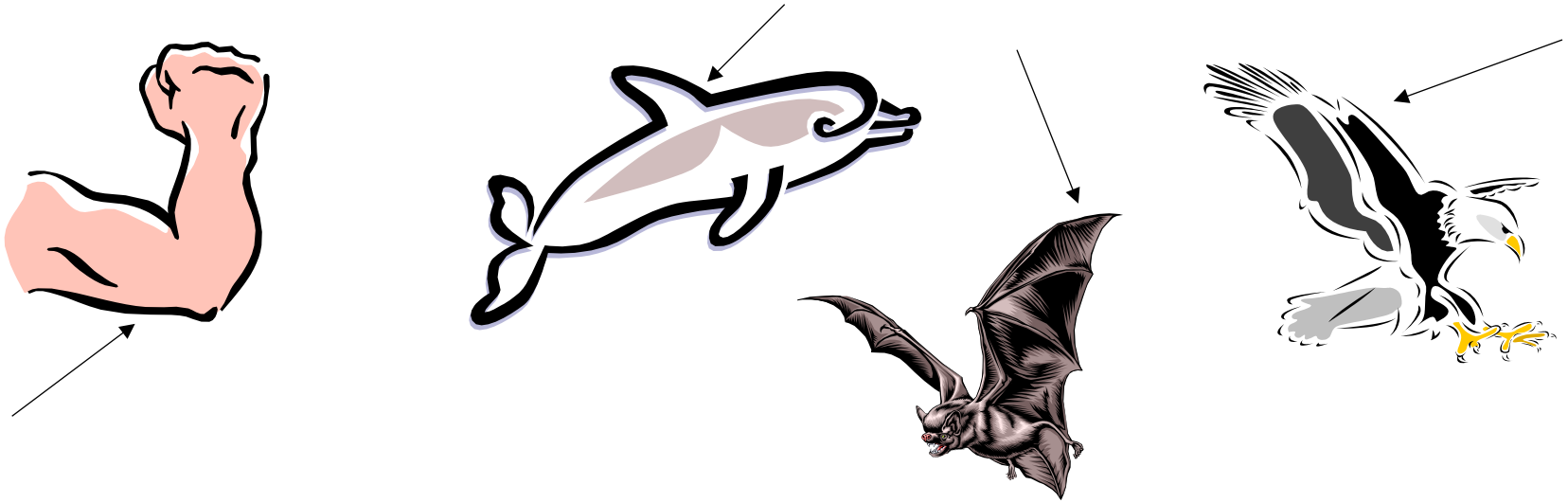



Homologous bone structure in forelimbs of all mammals

# What are homologous structures?

These are body parts that are similar in both origin and structure.

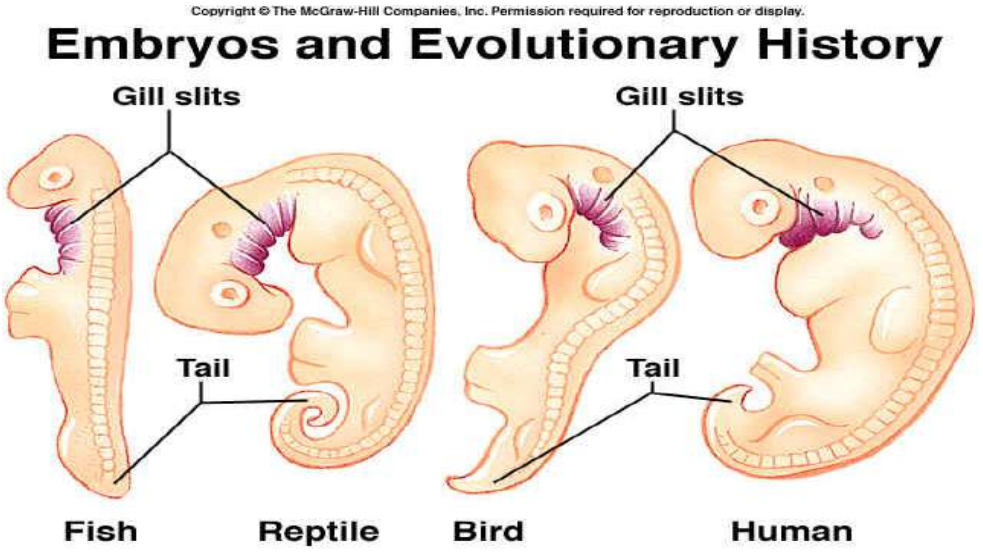
Example: arms, dolphin fin, bat wing, bird wing.



# Evidence for Evolution

3. Vestigial organs - organs that serve no useful function in an organism.

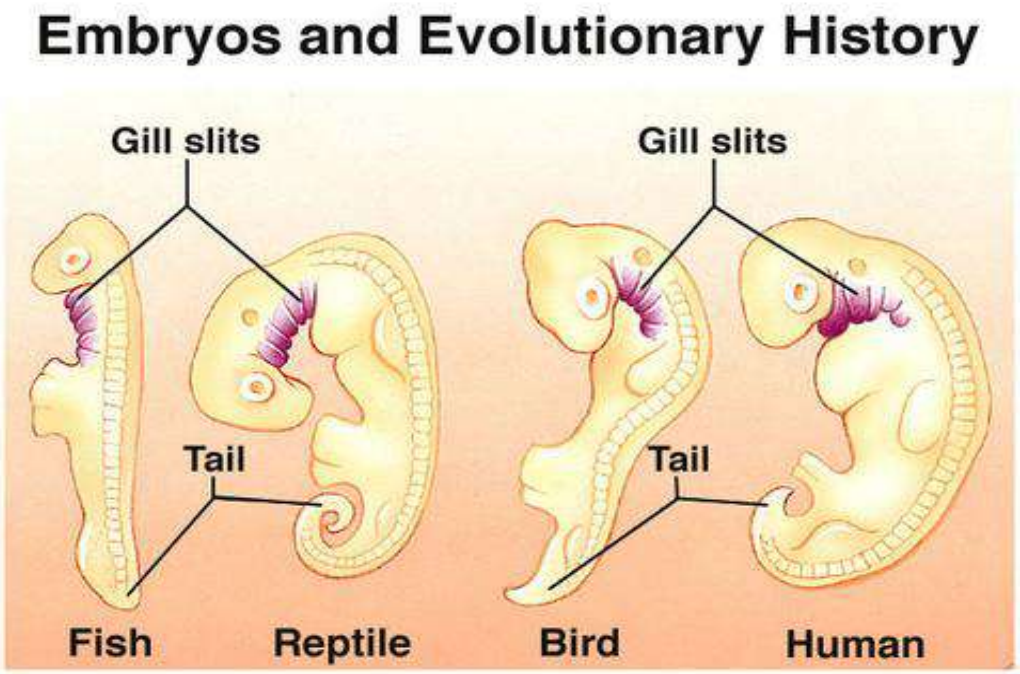
**Examples**: **gills** and tailbones in humans



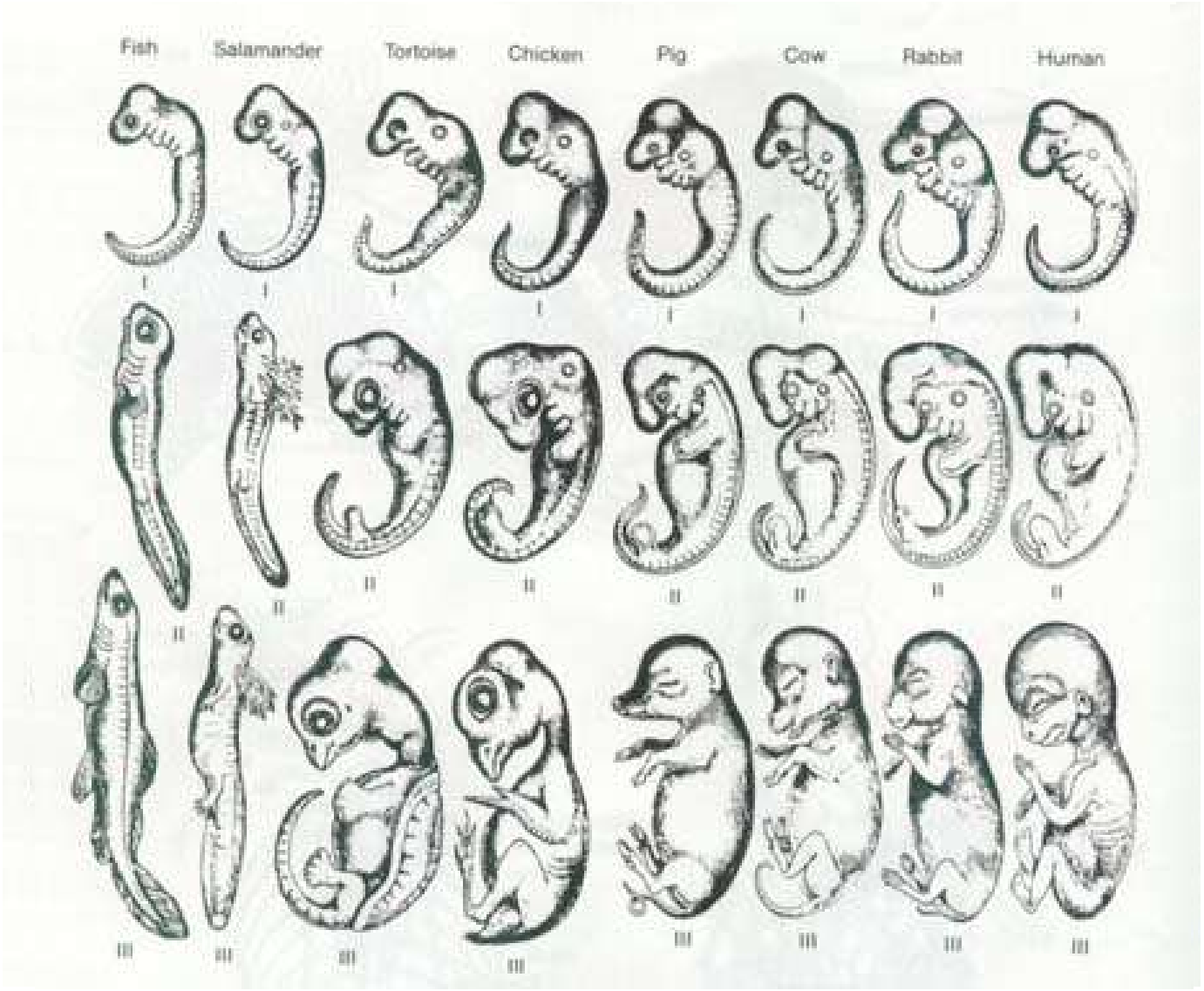
# Evidence of Evolution

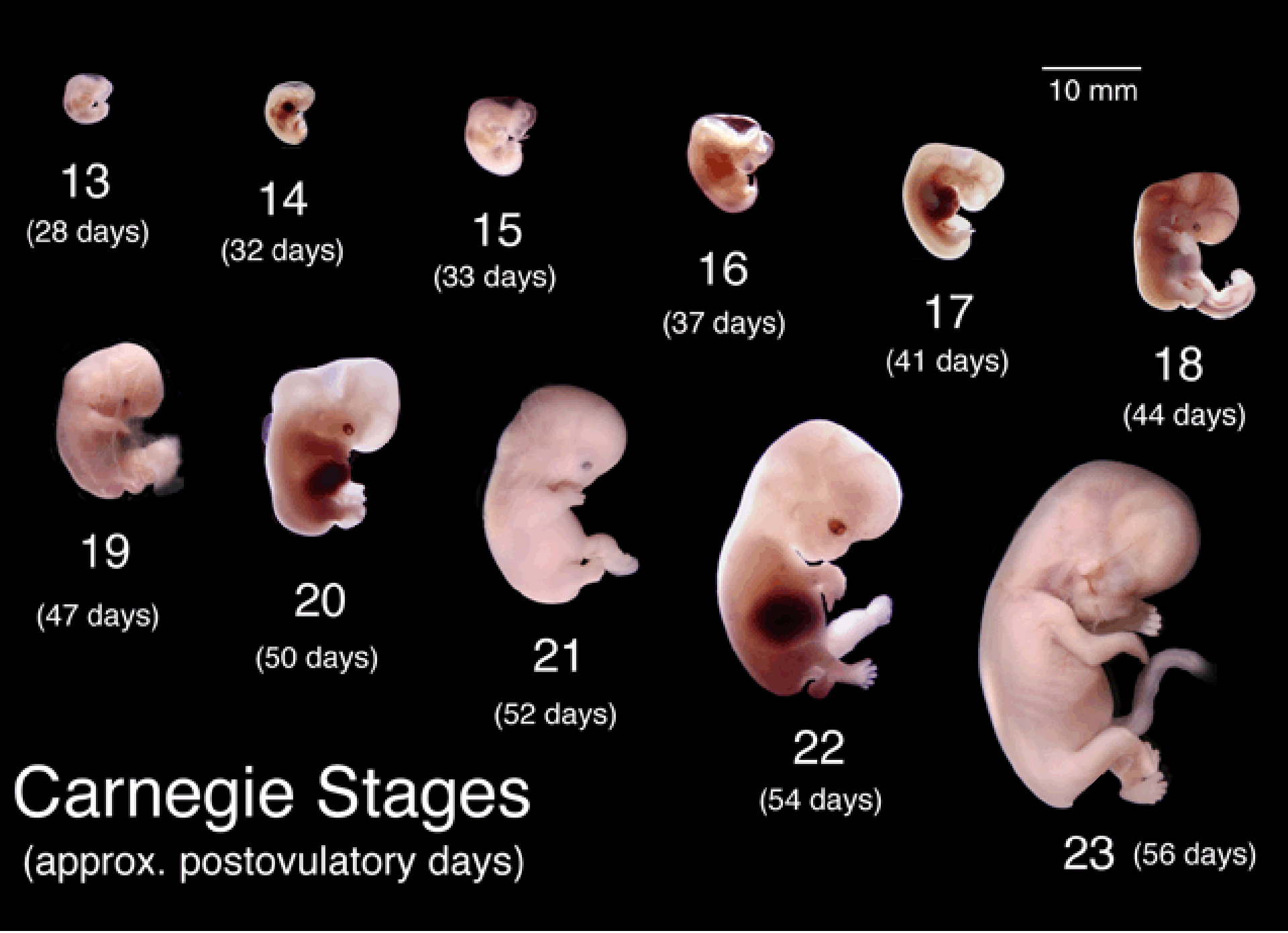
4. Similarities in Embryology - In their early stages of development, chickens, turtles and rats look similar, providing evidence that they shared a common ancestry.





What similarities do you see between these embryos?




10 mm
13
(28 days)
14
(32 days)
15
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16
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17
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18
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19
(47 days)
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(50 days)
21
(52 days)
22
(54 days)
23 (56 days)
Carnegie Stages
(approx. postovulatory days)

# Similarities in Body Structures

- Fish, amphibians, reptiles, birds, and mammals are classified in one group because they have similar body structure
- Scientists have recently discovered fossils of ancient whale-like creatures that have legs and walked on land

# Inferring Species Relationships

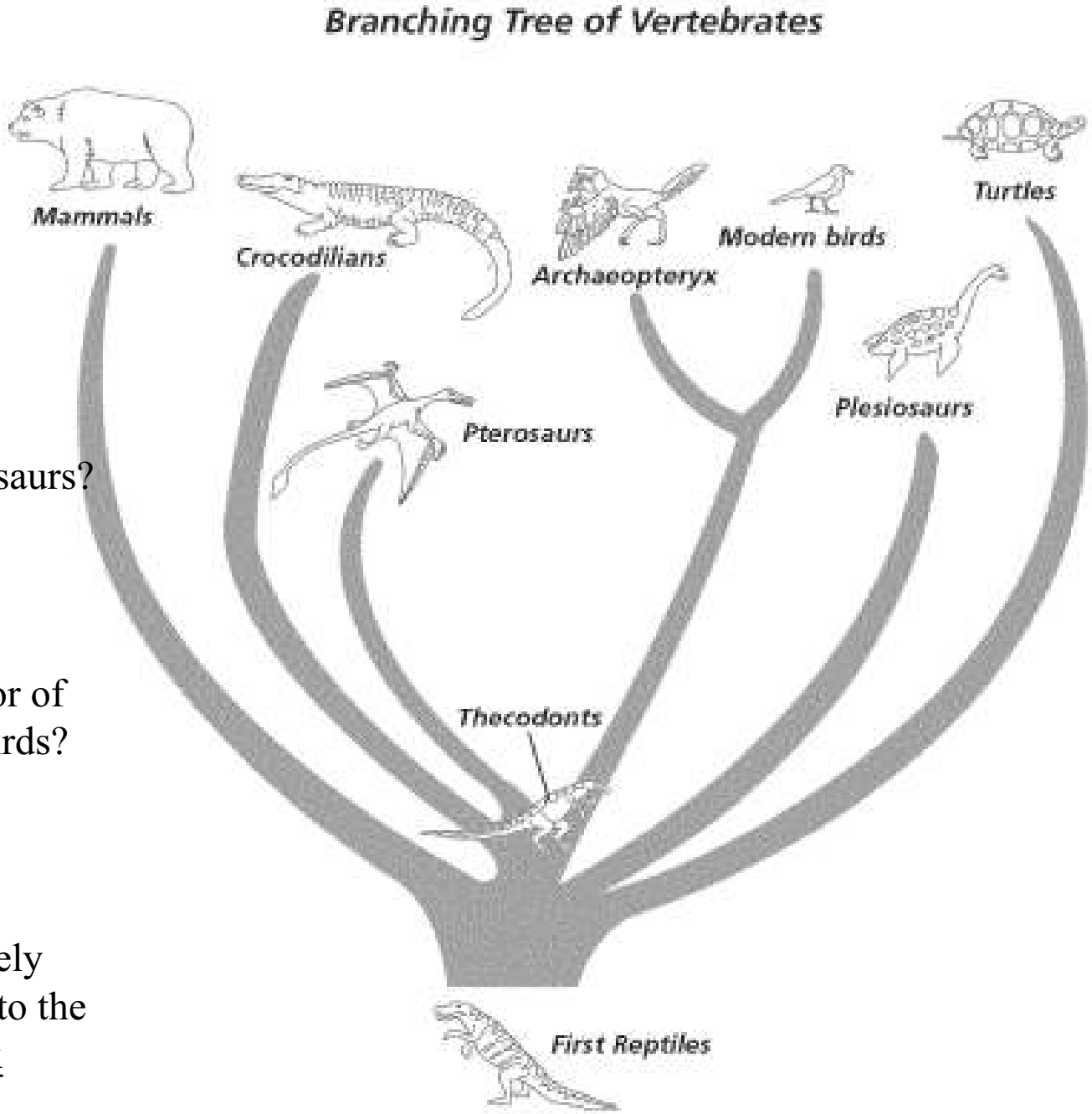
- Scientists have combined the evidence from DNA, protein structure, fossils, early development, and body structure to determine evolutionary relationships among species
  - The more closely related species are, the more similar their DNA sequences
    - Elephant shrew is more closely related to elephants than to rodents

# Combining Evidence

- Dogs are more similar to wolves than they are to coyotes
- Giant pandas are more closely related to bears
- Lesser pandas are more closely related to raccoons
- Branching trees can be used to show how scientists think different groups of organisms are related

# Branching tree

- A diagram or tool that shows how scientists think different groups of organisms are related.
- Scientists use all the evidence available to make a tree (Body structure, embryology, DNA, and fossil record etc.)




Did birds evolve from Pterosaurs?

No

What is the common ancestor of Crocodilians and Modern Birds?

Thecodonts

Are modern birds more closely related to Archaeopteryx or to the first reptiles? Archaeopteryx

# Summary of Darwin's Theory

- Individuals in nature differ from one another

- Organisms in nature produce more offspring than can survive, and many of those who do not survive do  not reproduce.

# Summary of Darwin's Theory

- Because more organisms are produced species may struggle for resources.
- Each organism is unique, each has advantages and disadvantages in the struggle for existence.

# Summary (cont.)

- Individuals best suited for the environment survive and reproduce most successful.
- Species change over time.

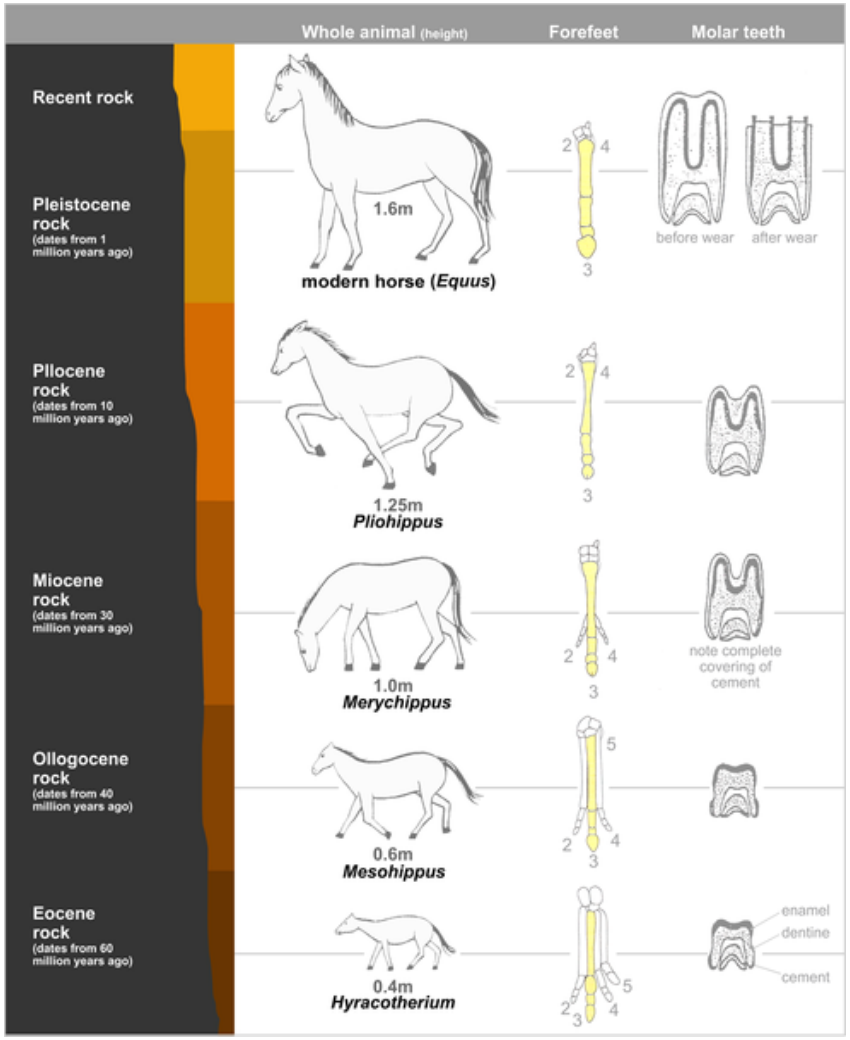
# Evolution can occur in two ways:

1. Gradualism
2. Punctuated Equilibrium

# 1. Gradualism

- A slow steady process where you can see different forms of the new species.
- Minor changes occur.

Example: horse



# 2. Punctuated Equilibrium

- Happens quickly.
- Sometimes intermediate species are not there.
- Species branch off and evolve simultaneously.
- Example: elephants; anti-biotic resistant bacteria, viruses/ colds, flu).