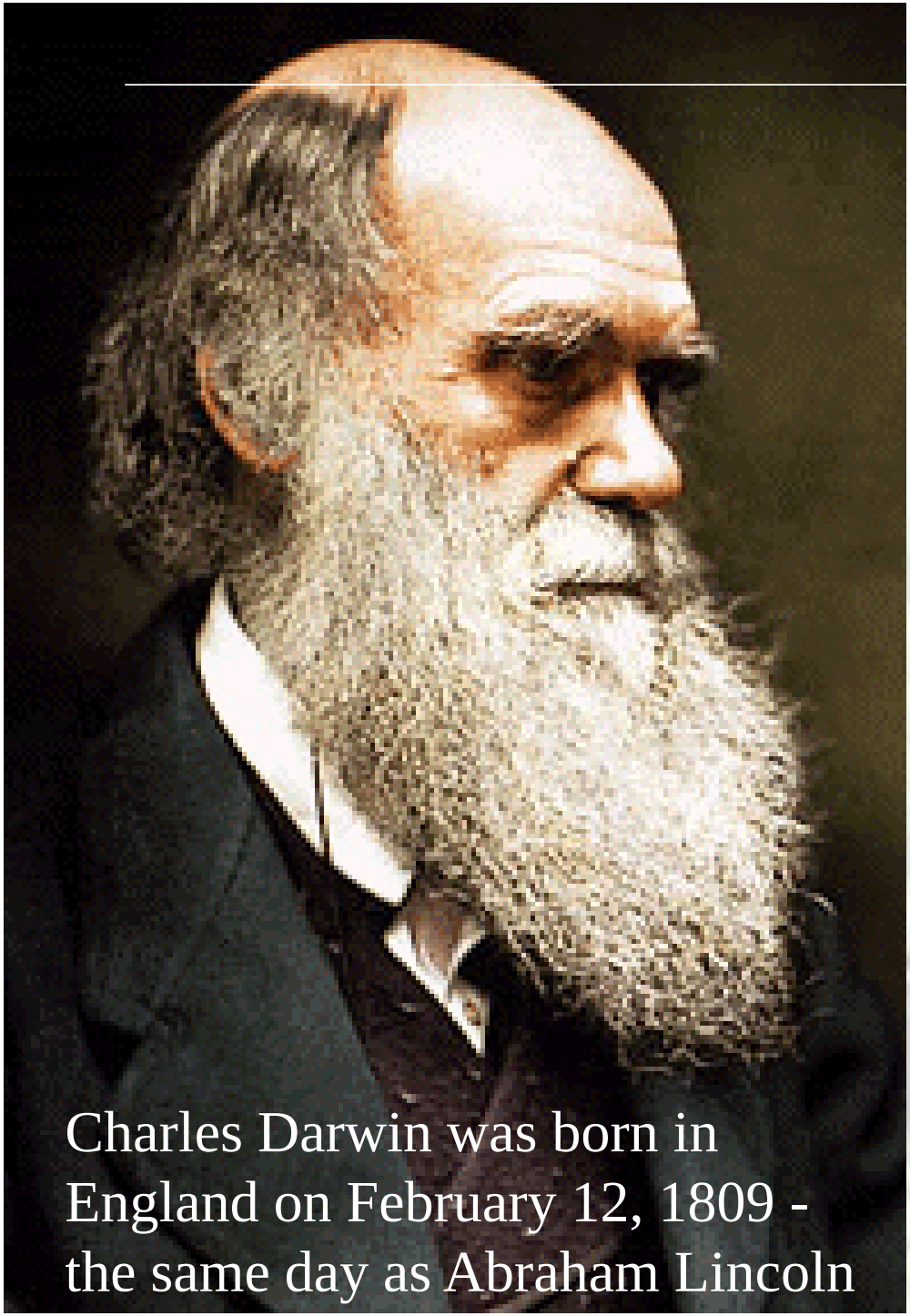
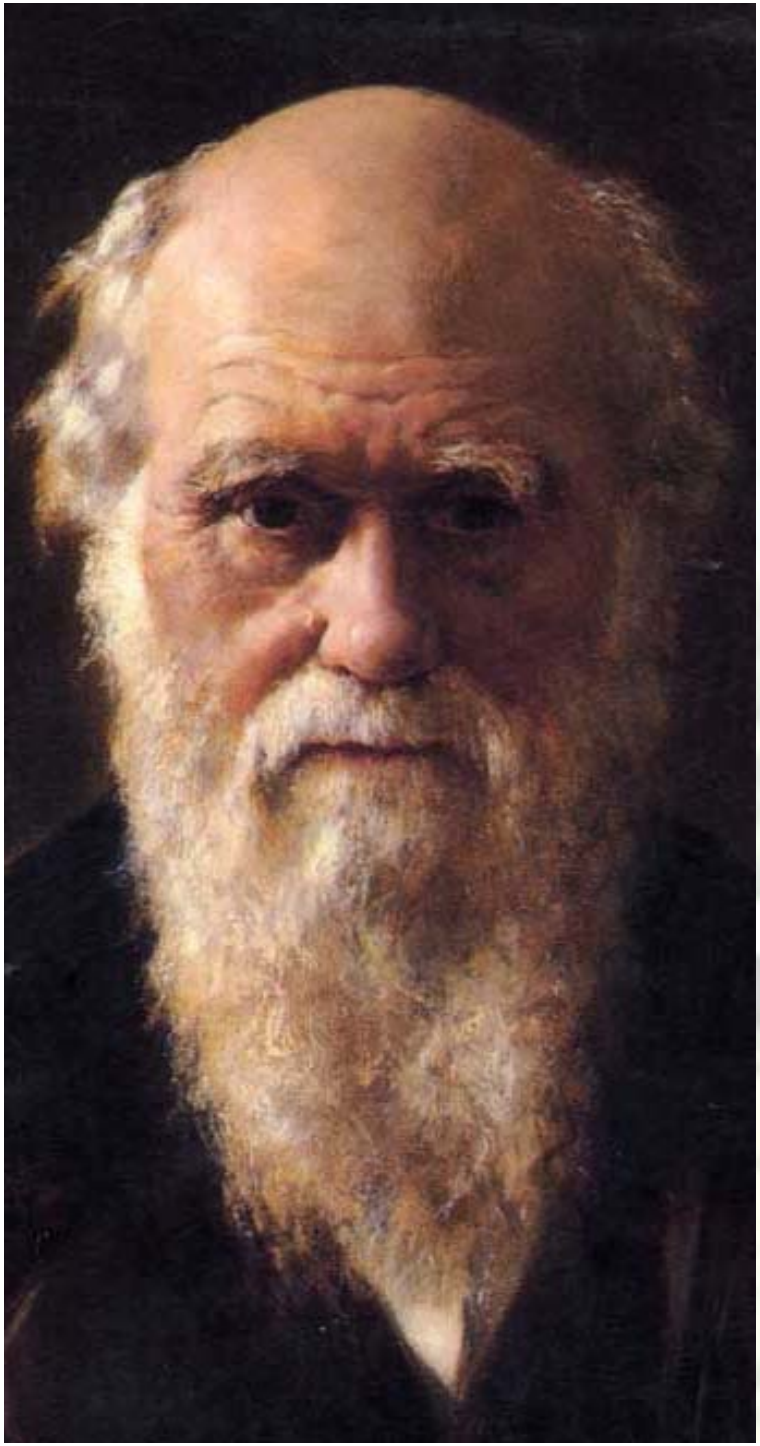


Charles Darwin was born in England on February 12, 1809 - the same day as Abraham Lincoln

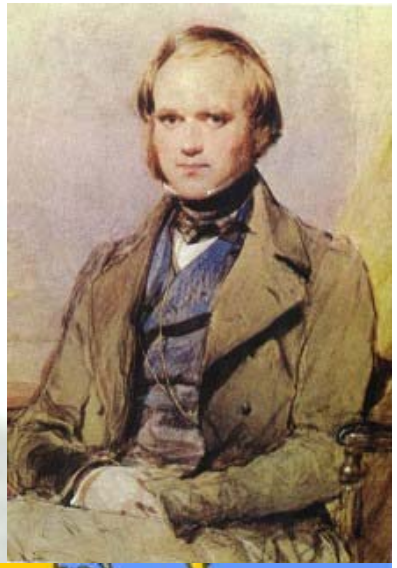
Chapter 15

Darwin's Theory of Evolution



- Charles Darwin was an English naturalist
- A naturalist is a scientist who studies natural history
- Natural history is the scientific study of plants and animals in their natural environments. It is concerned with levels of organization from the individual organism to the ecosystem, and stresses identification, life history, distribution, abundance, and inter-relationships.

Voyage of the H.M.S. *Beagle*

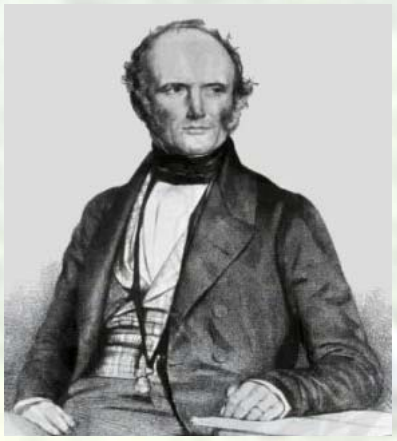


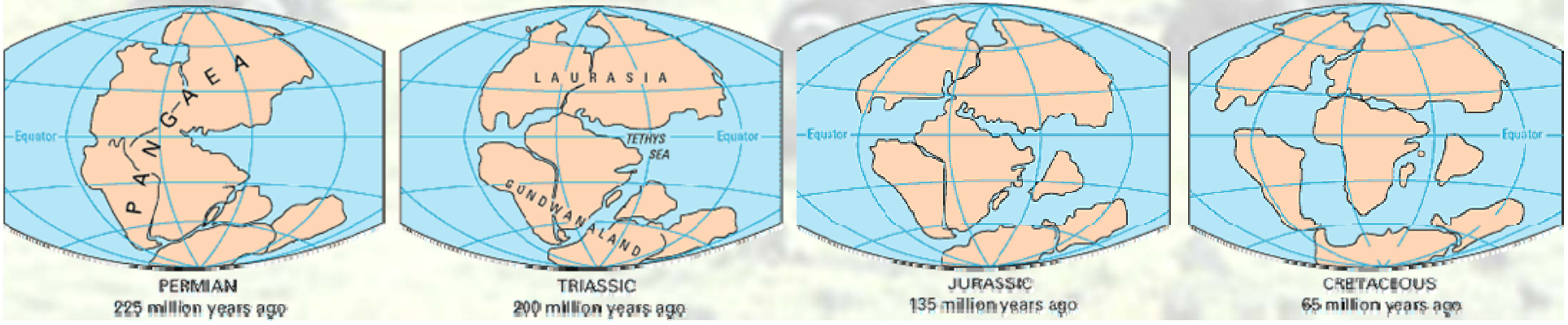
- After college, Darwin joined the crew of the H.M.S. *Beagle*
- In 1831, he set sail from England for a 5 year voyage around the world.


Darwin
Wolf
Pinta
(Abingdon)
Marchena
(Bindloe)
Genovesa
(Tower)
EQUATOR
N
W
E
S
Roca Redonda
Cabo Berkeley
Volcán Ecuador
Volcán Wolf
Cabo Marshall
Punta Espinosa
Volcán Darwin
Punta García
Caleta Tagus
Fernandina
(Narborough)
Cabo Hammond
Volcán Alcedo
Bahía Barrington
Santiago
(San Salvador o James)
Isla Bartolomé
Isla Daphne
Seymour Norte
Baltra Is.
Rábida
(Jervis)
Punta Alfaro
Pinzón
(Duncan)
Santa Cruz
(Indefatigable)
Puerto Ayora
Bahía Elizabeth
Punta Moreno
Isabela
(Albemarle)
Volcán Sierra Negra
Volcán Chico
Punta Cristóbal
Cerro Azul
Punta Villamil
Isla Cuatro Hermanos
Tortuga
Santa Fé
(Barrington)
Punta Pitt
León Dormido
(Kicker Rock)
Caleta Sappho
Isla Lobos
Puerto Baquerizo
Moreno
San Cristobal
(Chatham)
Corona del Diablo
Punta Carrocoral
Bahía de los Correos
Isla Champion
Santa María
(Floreana o Charles)
Isla Enderby
Española
(Hood)
Punta Suárez
Islote Gardner
Bahía Gardner
Punta Cevallos

Ideas That Shaped Darwin's Thinking

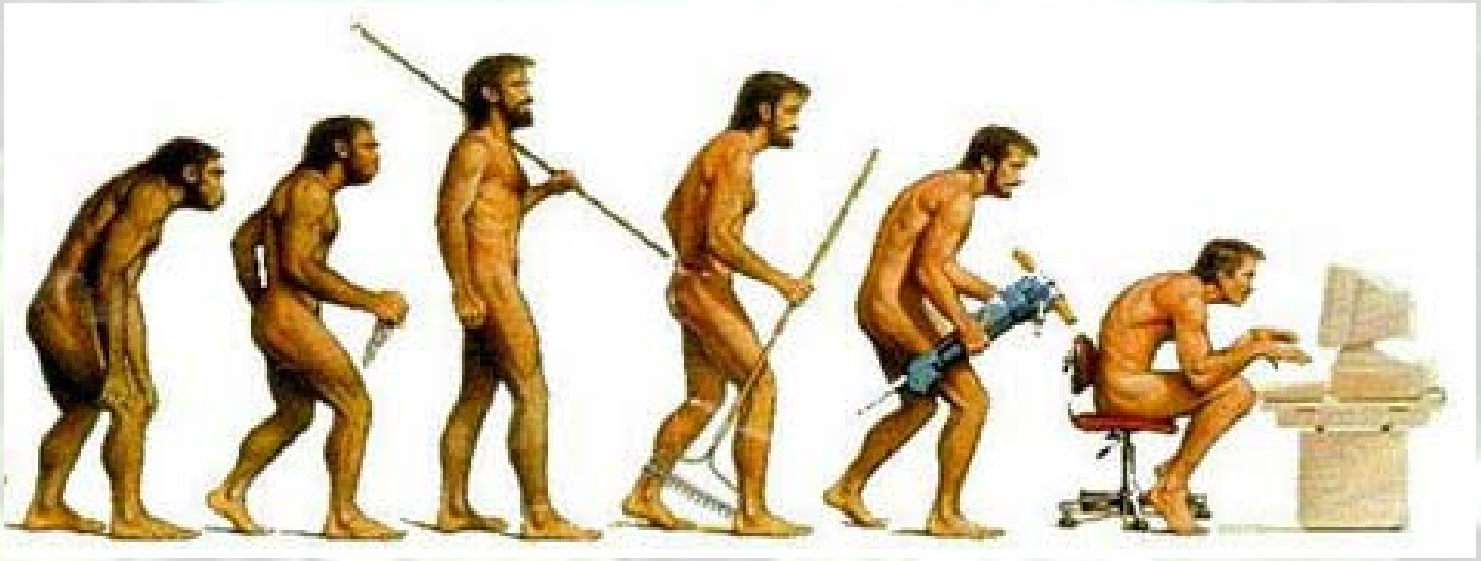
- **Hutton and Lyell** helped scientists recognize that Earth is many millions of years old, and the processes that changed Earth in the past are the same processes that operate in the present





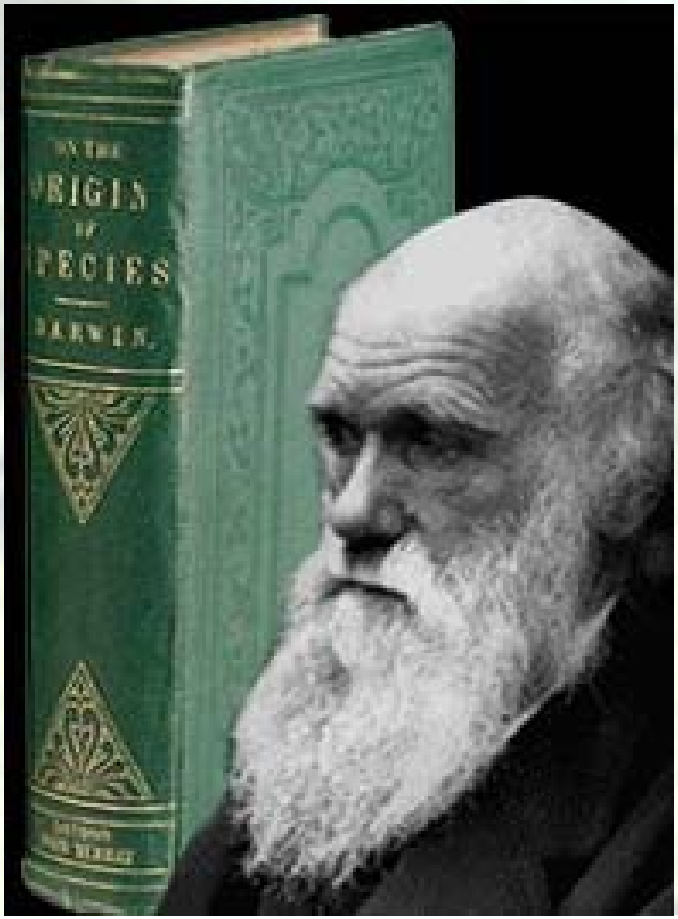
- During his travels, Darwin made numerous observations and collected evidence that led him to propose a revolutionary hypothesis about the way life changes over time

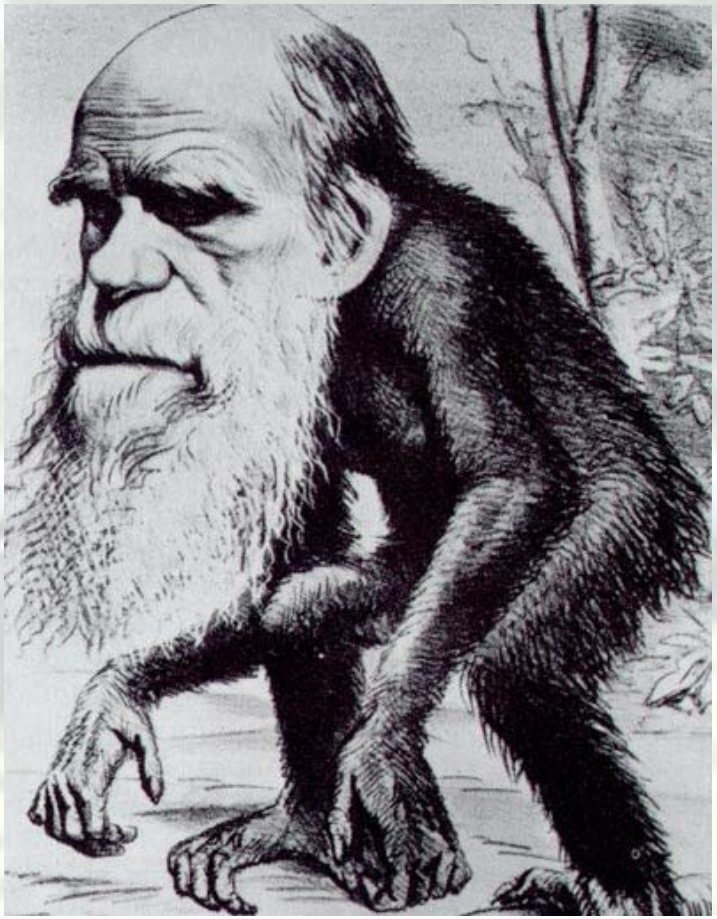
  <u>Examples from Galapagos</u>: Tortoise necks/shells, Beaks of Finches



- **<u>Theory of Evolution</u> - change over time, is the process by which modern organisms have descended from ancient organisms**

- In 1859, Darwin published on the ***Origin of Species***
- Some considered Darwin's ideas to be genius
- Others opposed and criticized Darwin's ideas because they strongly conflicted with religious beliefs.





Natural Selection

- Nature Selects most favorable traits that allow individuals within a species to survive and reproduce.
- Nature selects who lives and who dies with various **selecting agents (limiting factors or environmental conditions)**
- Examples include temperature, sunlight, water, pH, availability of food, amount of competition, disease, natural disaster, etc.

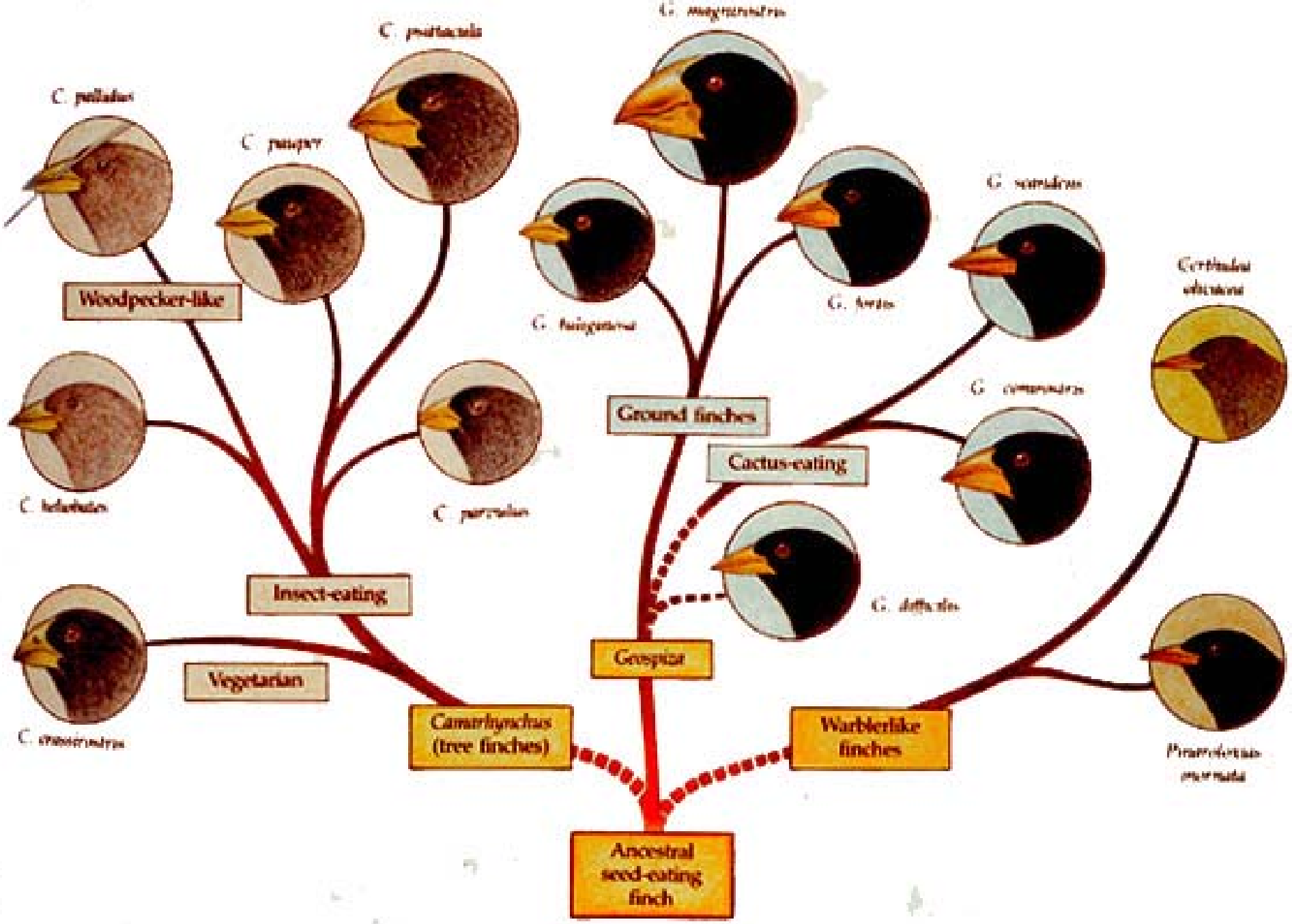
- The **struggle for existence** means that members of each species compete regularly to obtain food, living space, and other necessities of life.

  *Struggle between individuals of the same species to pass on their genes. (not predator vs. prey)

- **Survival of the fittest** – strongest and most beneficial traits enable organisms to survive – traits are then passed on to next generation

- An **adaptation** is any inherited characteristic that increases an organism's chance of survival. If a trait has high adaptive value it is passed on. If it has low adaptive value it will stay the same or fade out of the gene pool.

  Adaptation AKA "Adaptive advantage"


Woodpecker-like
Insect-eating
Vegetarian
Camarhynchus (tree finches)
Ground finches
Cactus-eating
Geospiza
Warblerlike finches
Ancestral seed-eating finch

Evolution by Artificial Selection

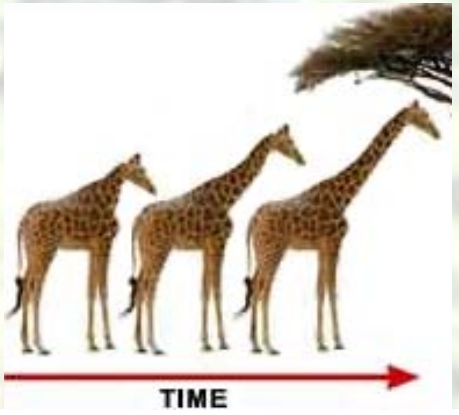
- In artificial selection, nature provides the variation, and humans select the variations that they find most useful

* Also known as selective breeding

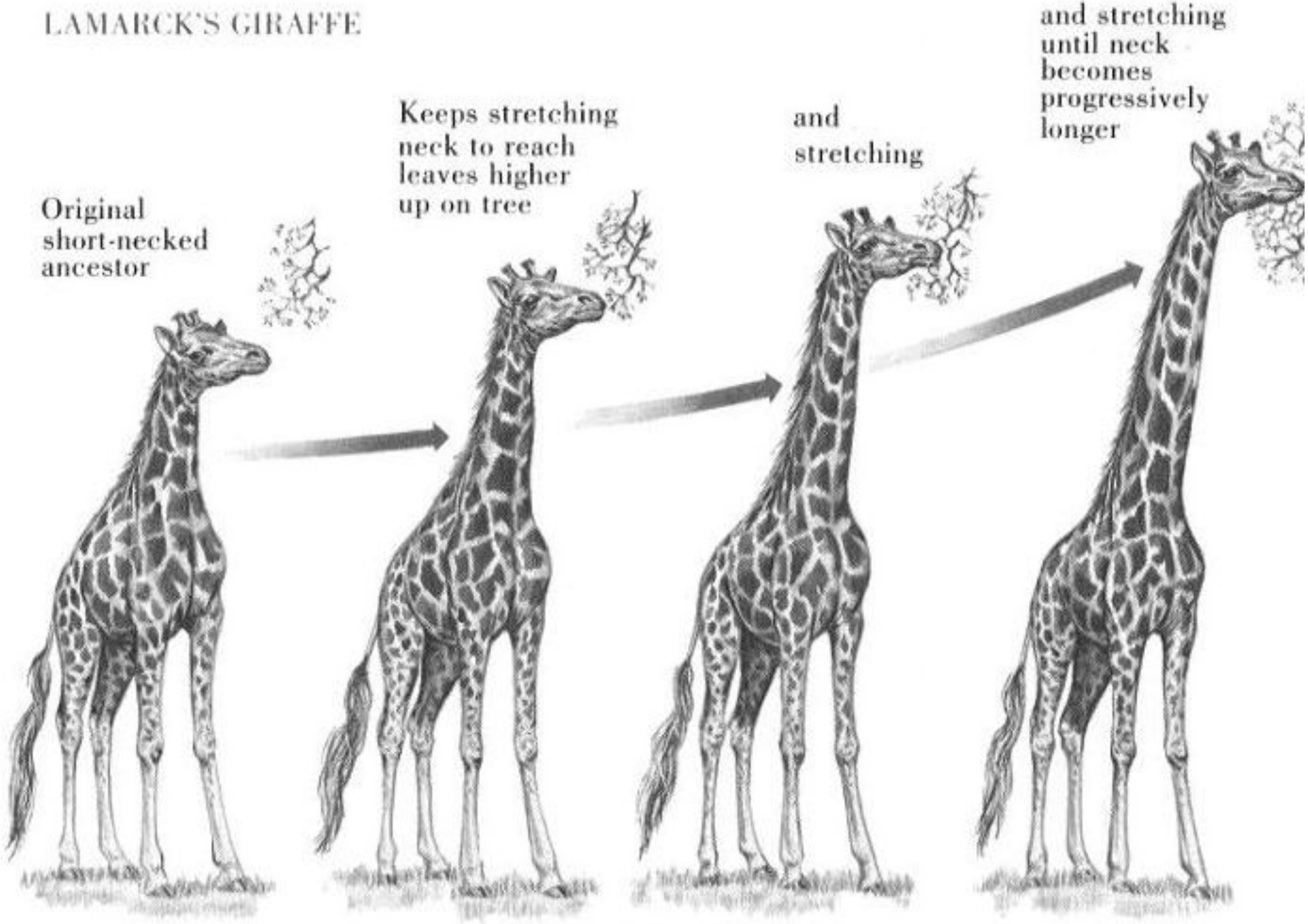
Jean Baptiste Lamarck (1744 -1829)

- First person to try explaining evolution
- Lamarck proposed that by <u>selective use or disuse</u> of organs, organisms acquired or lost certain traits during their lifetime.
- These traits could then be passed on to their offspring.
- There was no solid evidence to back up this theory and was later disproved

DISPROVED

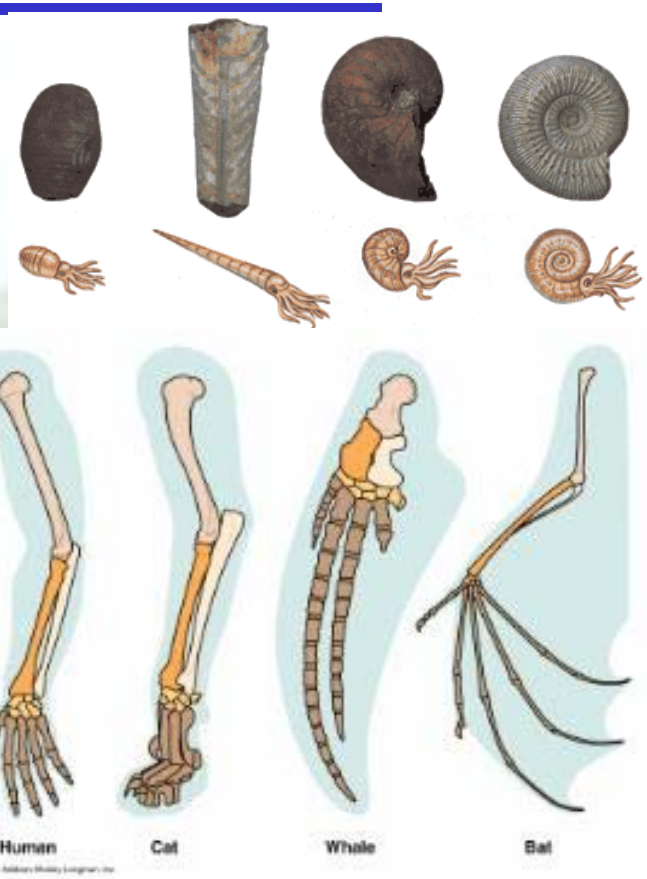


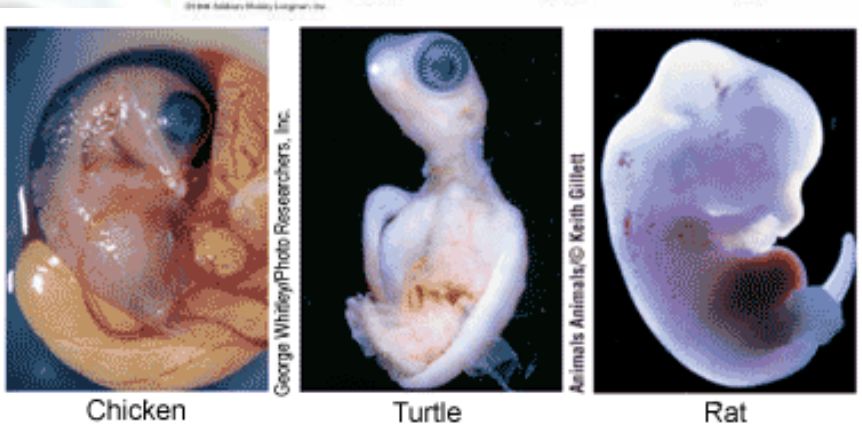
LAMARCK'S GIRAFFE

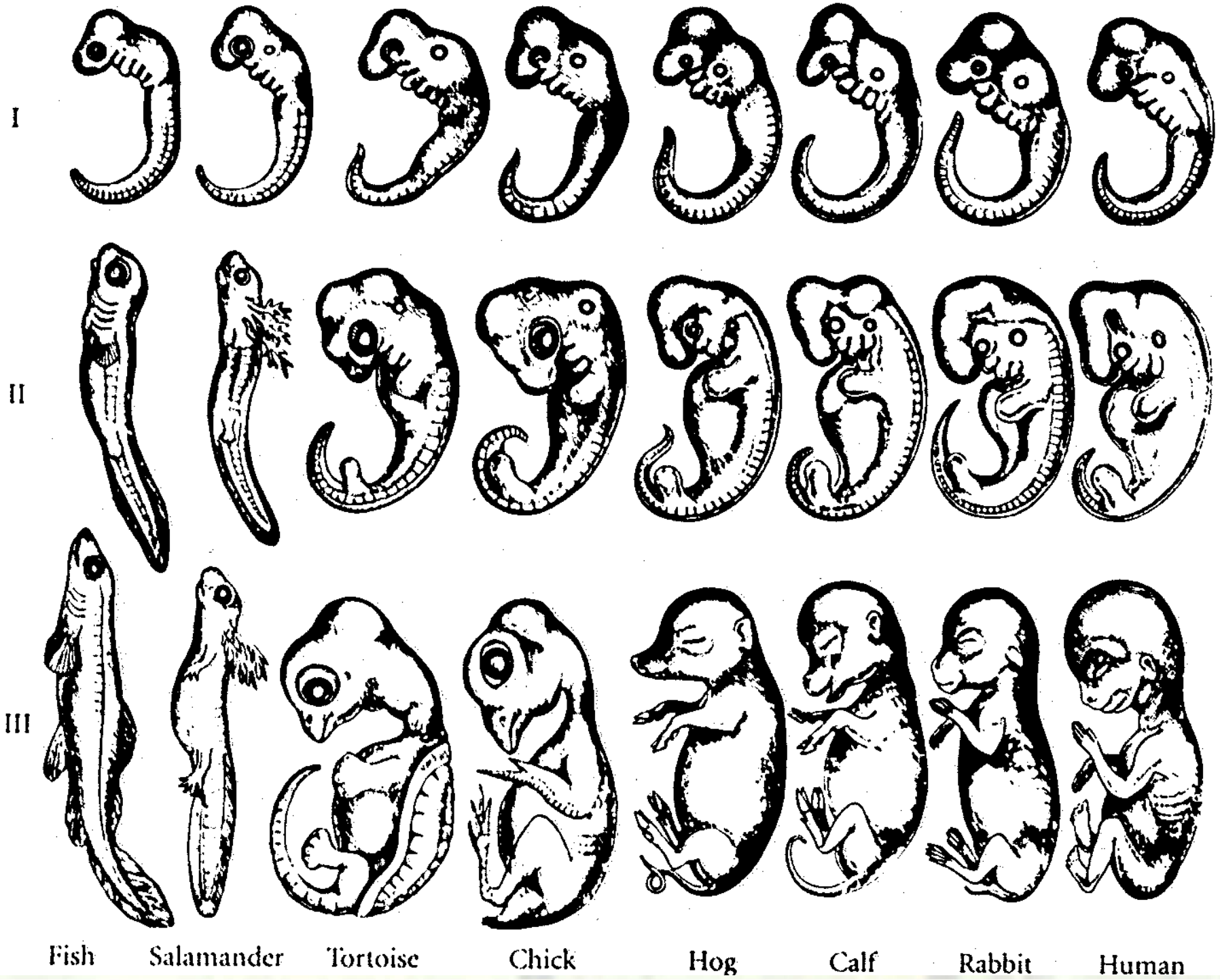


15.3 Evidence for Evolution

A.) Fossil Record/Radiometrics
B.) DNA
C.) Biochemistry
D.) Homologous structures
E.) Analogous structures
F.) Vestigial Organs
G.) Comparative Embryology
H.) Ontogeny
I.) Biogeography
J.) Geographic Distribution
K.) Environmental factors

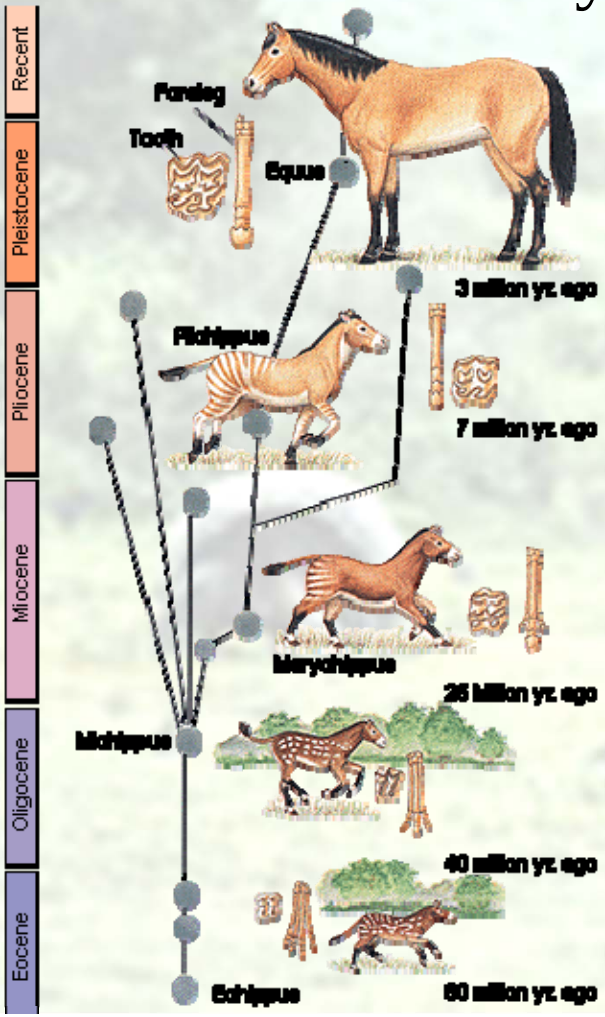




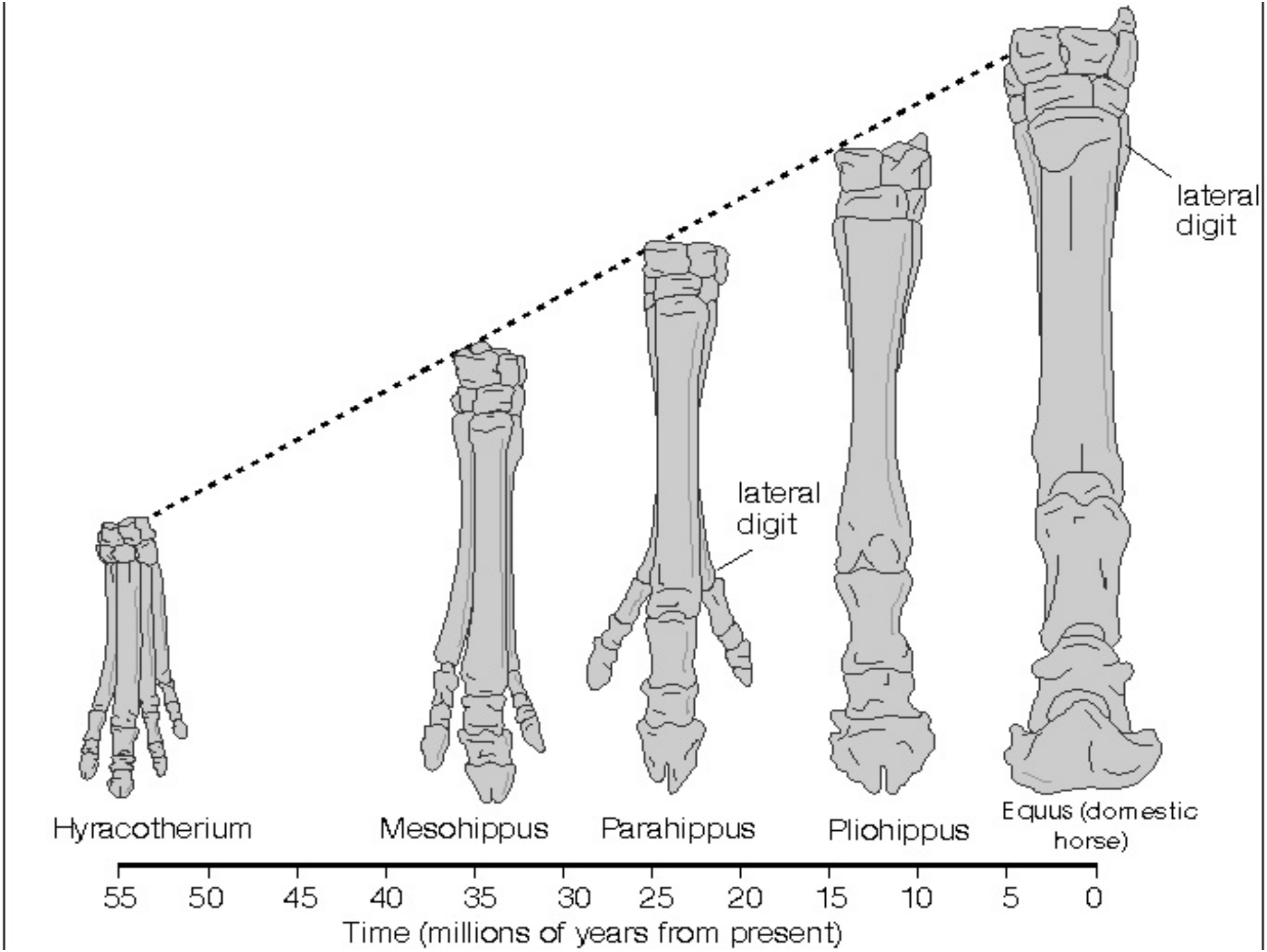

I
II
III
Fish
Salamander
Tortoise
Chick
Hog
Calf
Rabbit
Human

Fossil Record

- Information about past life, including the structure of organisms, what they ate, what ate them, in what environment they lived, and the order in which they lived



- **Paleontologist** - scientist who studies fossils
- **Relative dating** - method of determining the age of a fossil by comparing its placement with that of fossils in other layers of rock
- **Index fossil** - distinctive fossil used to compare the relative ages of fossils


lateral digit
lateral digit
Hyracotherium
Mesohippus
Parahippus
Pliohippus
Equus (domestic horse)
55
50
45
40
35
30
25
20
15
10
5
0
Time (millions of years from present)

Radiometric Dating

- Use of radioactive isotopes allow scientist to decipher the approximate age of specimens marking significant events in the geologic time scale

Earth Formed: 4.5 BYA

First Life: 3.5 BYA

First Vertebrates: 500 MYA

Reptiles/Dinos: 250 MYA

Birds: 248-213 MYA

Primates: 65 MYA

Ape-Human Split: 5-8 MYA

Homo sapiens sapiens: 2 MYA

- Speciation – the formation of new species.

Evolution by Sexual Selection

- Sexual selection is another theory proposed by Charles Darwin that explains how "ornamentations" evolved throughout the animal kingdom.
- Females usually chose the best mate who displayed the most impressive ornamentation (colorful feathers, body size, mating call/song, dance, smell, etc.)
- Ornamentations are indications of healthy genes, which is why sexual selection has complimented natural selection over time.
- Darwin was criticized because females were not supposed to have a choice.

Sources of Genetic Variation

1. Mutations are changes in a sequence of DNA. Mutations can occur because of mistakes in the replication of DNA or as a result of radiation or chemicals in the environment

2. Recombination of alleles during meiosis leads to new combinations/variations of genes. Gene shuffling occurs as a result of crossing-over.

3. Random mating/fertilization. Gametes carrying hereditary information (DNA) ½ from male and ½ from female combine to form new and unique diploid cell. This cell will undergo mitotic cell division (mitosis) to grow and develop.

Resistance

- Natural variations that occur sometimes allow a small percentage of a population to survive certain environmental conditions (ex. disease). These individuals reproduce and lead to the resistance of a population to the limiting factor. They inherit immunity.

Example: Pesticides used in agriculture need to be reformulated every other year. When a farmer sprays a field there are always some insects resistant and their resistant genes are the only ones passed on to the next generation.

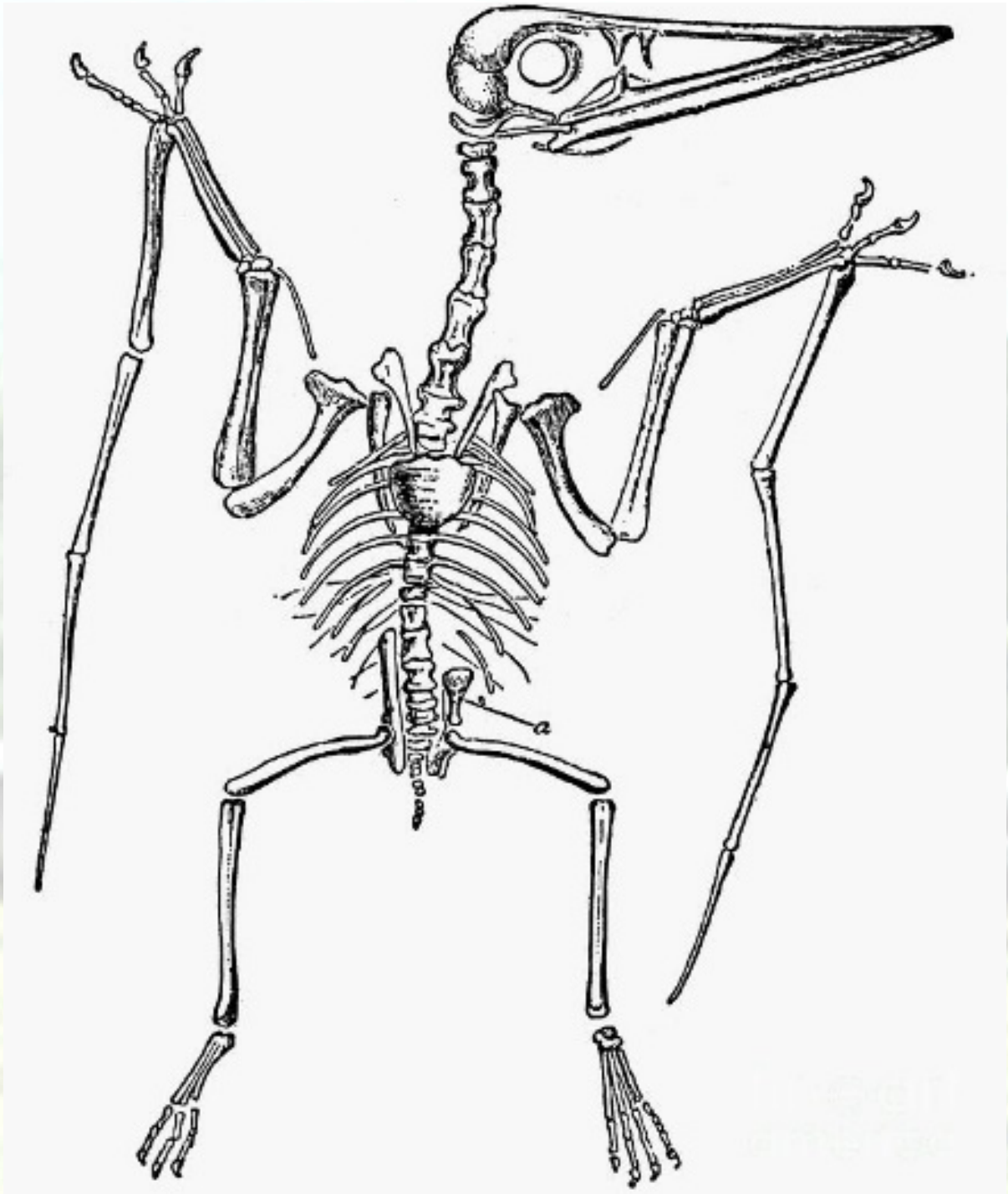
Instinct

- Genetically pre-programmed behavior that some organisms are born with.
- Genes that translate into beneficial brain chemistry, result in behaviors that come natural
- Very little or no training is needed to learn behaviors
- These natural instincts have been passed on and enhanced through the evolution of species and exist because they gave the species an adaptive advantage.

Extinction – the end of a species

Throughout evolutionary time mass extinctions occur roughly every 26 million years

THE END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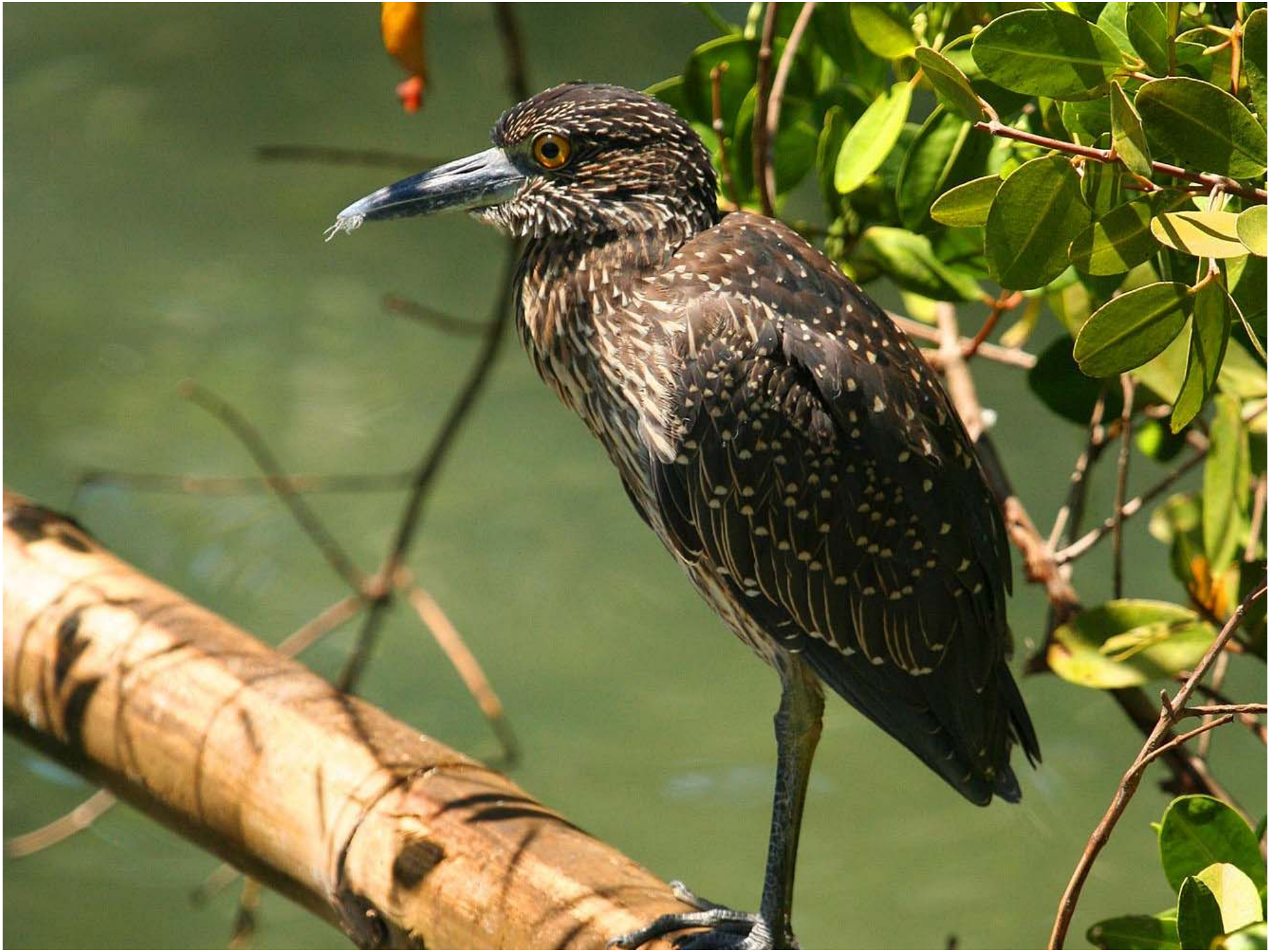


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