

# Darwin and the theory of Evolution

# What is Evolution?

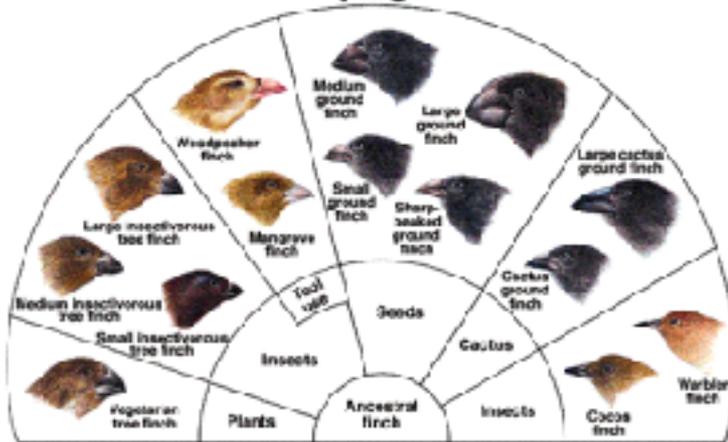
- As the environment changes, species either adapt or go extinct.
- Evolution: Change over time, the process by which modern organisms descended from common ancestors.



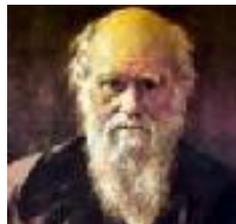
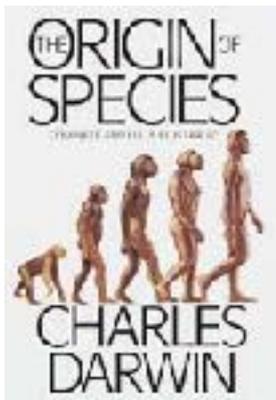
# Charles Darwin

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## Darwin's Theory of Finches on the Galápagos Islands

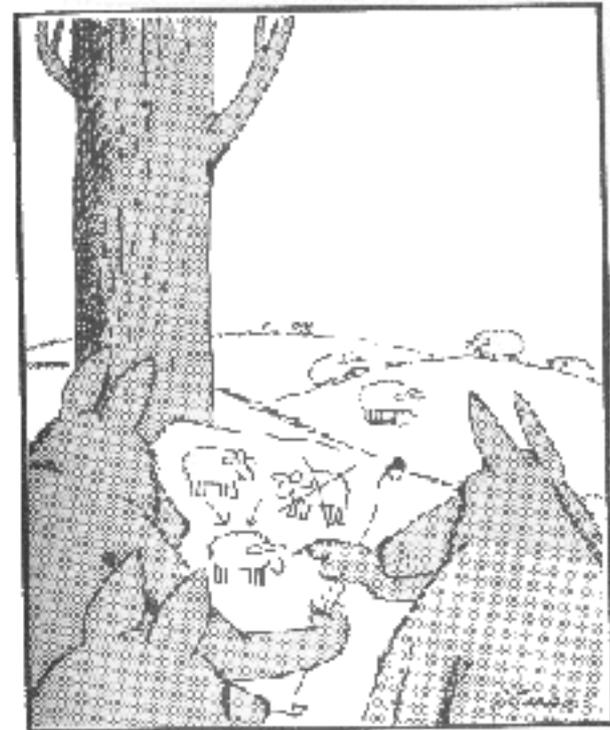


- Born 2/12/09, went around the world in the HMS Beagle.
- Collected observations and compiled the **theory of evolution**.
- Wrote *Origin of the Species*. (1859)
- Most important work was with the finches of the Galapagos Island.



# Darwin's Observations

- Organisms are well-suited to their environment.
  - Galapagos tortoises had adaptations to help them survive.
  - Finches had adapted beaks to eat available prey in their environments.
- Some species do not survive (extinction).
- Those who are well suited to their environment survive, those not well suited die or leave fewer offspring.
- Called “**Survival of the Fittest.**”
- Called “**Natural Selection.**”
- Fitness: physical traits and behaviors that enable organisms to survive and reproduce in its environment.



Natural selection of work

"The Far Side" cartoon by Gary Larson is reprinted by permission of Chronicle Media Co., San Francisco, CA.

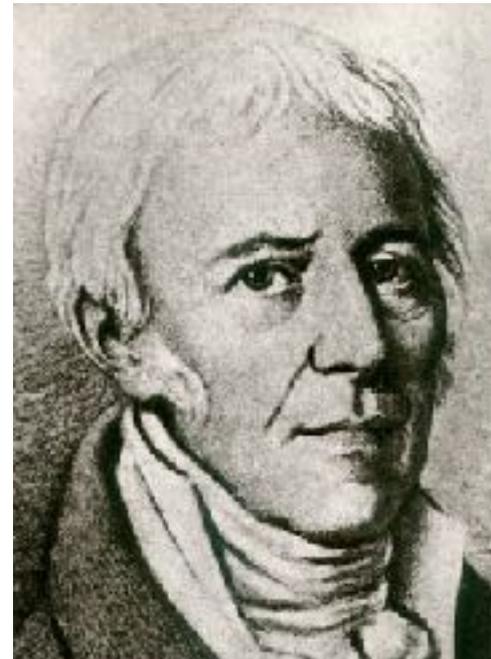
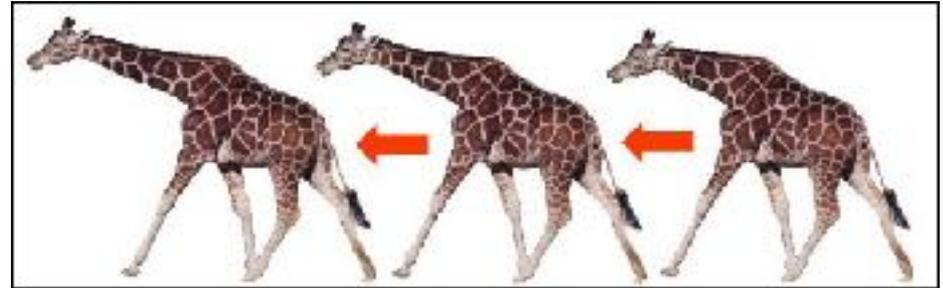
# Adaptation and Evolution



- **Adaptation**: any inherited characteristic that increases an organism's fitness.
  - Over time, natural selection causes a change in characteristics of a population
  - **Common descent**: idea that organisms with similar characteristics share a common ancestor.

# Other ideas: Lamarck

- Lamarck suggested that organisms change over time and adapt as they saw fit.
- Believed organisms could change shape depending on their needs and pass those traits onto their offspring.
- **“Acquired Characteristics”**
  - Modern example, **intelligent design** (life is too complex to have occurred randomly; intelligent causes are responsible for the origin of the universe and of life and its diversity).



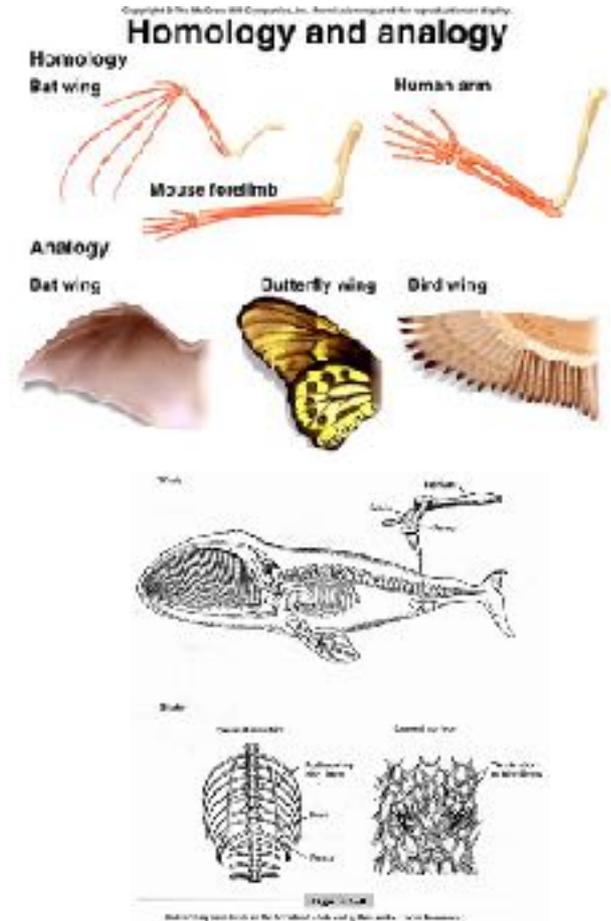
# Evidence for Evolution: Fossils



- 1. Fossils: provide indirect evidence that evolution has occurred and a sequence of organisms and geographic distribution.
  - Note: They are an incomplete record.

# Evidence for Evolution: Anatomy

- **2. Anatomy**: the study of the shape and structure of organisms
- **Homologous structures**: structures which meet different needs but develop from the same part because there is similar bone arrangement.
- **Analogous structures**: parts which meet similar needs but develop from different body parts.
- **Vestigial Structures**: Organs that are so reduced in size that they are only traces of ancient organs.
  - Example: coccyx, ear muscles, appendix



# Evidence for Evolution: Embryology

- 3. Embryology: The study of organisms in an early stage of development, related organisms have similar embryos suggesting common ancestry.

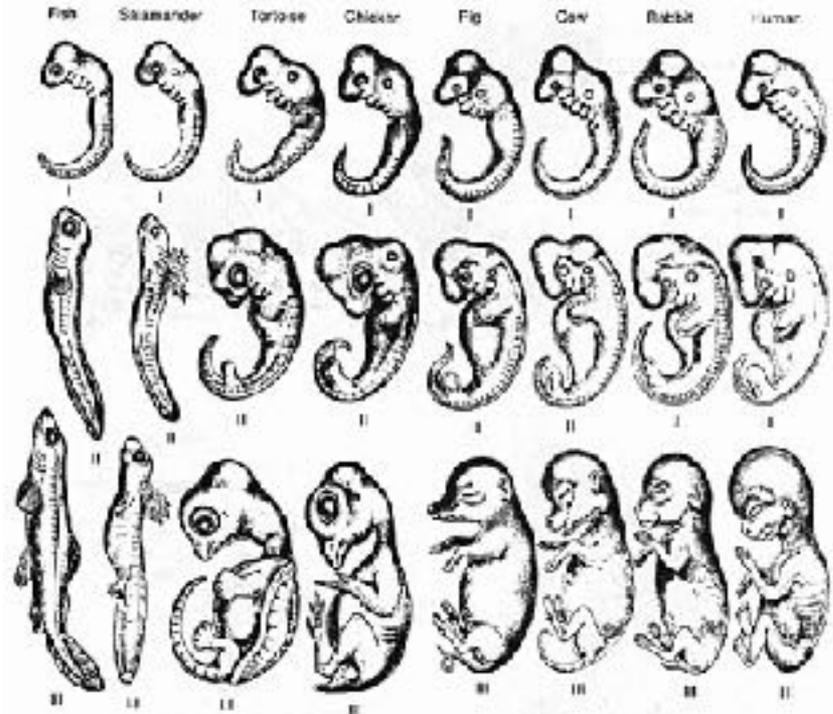


Figure 3-10

*A series of embryos of different vertebrates at comparable stages of development. The earlier the stage of development, the more strikingly similar are the different groups. Note that each of the embryos begins with a similar number of gill arches (pouches below the head) and a similar ventral column. In later stages of development, these and other structures are modified to yield the various different forms. (The embryos in the different groups have been scaled to the same approximate size so that comparisons can be made between them.) (From Huxley, adapted from Haeckel.)*

# Evidence for Evolution: Biochemistry

## Comparative Biochemistry

- All living things use the same **basic biological molecules** for similar functions.
  - DNA and RNA store and express genetic information.
  - Proteins serve as enzymes.
  - ATP, carbohydrates, fats used for energy storage.
  - Lipids used to build membranes.
- **Metabolic systems are similar among species.**
  - Photosynthesis, respiration, fermentation, etc.
  - Genetic code, gene expression, protein synthesis.
- **Basic cell structure is almost universal.**

Evolution

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9

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human	378	S	G	S	D	K	I	S	K	E	V	V	P	S	L	A	392
dog	369	N	G	T	D	K	I	S	K	E	I	V	L	S	S	A	383
mouse	369	S	Q	N	E	E	I	C	N	E	A	V	Q	C	S	D	383
rat	367	S	Q	N	G	D	I	C	S	E	A	G	Q	C	S	D	381
chicken	394	S	V	N	E	K	L	V	K	D	V	L	S	S	/	S	407

- 4. Biochemistry: The study of biochemical molecules.
- All organisms use **DNA and RNA** to transmit genetic information
- **ATP** is an energy carrier in all organisms.
- You can compare the similar amino acid sequences (i.e. **proteins!**)