Evolution by Natural Selection

Who Was Charles Darwin?

* Darwin was born in 1809 in England. He attended college to become a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** and clergyman
* When he was 22 years old he sailed on the H.M.S. **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** as the ship’s naturalist (1831)
* He collected many animal and plant specimens from South America, documenting their diversity
* Darwin was struck by the unique animals of the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** islands in particular

Timeline of Evolutionary Thought:

* 1785 – **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** proposes that the Earth is shaped by geological forces that happen over long periods of time; estimates the Earth to be **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (not thousands) of years old
* 1798 – Thomas **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** writes an essay which predicts that the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** will grow faster than the space and food to sustain it
* 1809 – Jean-Baptiste **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** publishes his hypotheses about the inheritance of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** traits. His ideas were flawed, but his is the first to propose a mechanisms for evolution
* 1831 – **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** sets sail on the Beagle, a voyage that will provide evidence for his theory
* 1833 – Charles **\_\_\_\_\_\_\_\_\_\_\_\_** explains that **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** have changed Earth over long periods of time
* 1858 – Alfred **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** writes to Darwin with his own speculations on **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** by natural selection, based on his observations in Malaysia
* 1859 – Darwin publishes his book ***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

Developing Darwin’s Theory:

* Suspected that living forms of similar organisms may have descended from an ancient **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
* Different landmasses acted like isolated nurseries in which sets of species could **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** independently
* Predicted that the 13 different species of finches on the Galapagos all evolved from a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ species from South America
* Became convinced that **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** could account for the location of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** and formation of mountains
* Figured nature must have a natural force similar to **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** selection
* Used information from Thomas Malthus’, *Essay on the Principle of Populations*, to finish his theory
* Malthus showed that all species produce far more offspring than can be expected to survive
* Darwin realized this led to an intense **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, he called this the theory of evolution by **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
* Alfred Russell Wallace independently arrived at the same conclusion as Darwin, while working in Malaysia

Their theory is based on 3 observations and 3 inferences:

* + Observation 1: individuals within any species exhibit **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + Observation 2: More offspring are produced than can **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + Observation 3: Populations tend to remain **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + Inference 1: Individuals of a species are in a constant **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** for survival
  + Inference 2: Favourable **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** make individuals more likely to survive and pass on these traits. This is **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + Inference 3: These favourable variations will become **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** in future generations. This is **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Evidence of Evolution

Evidence from Fossils:

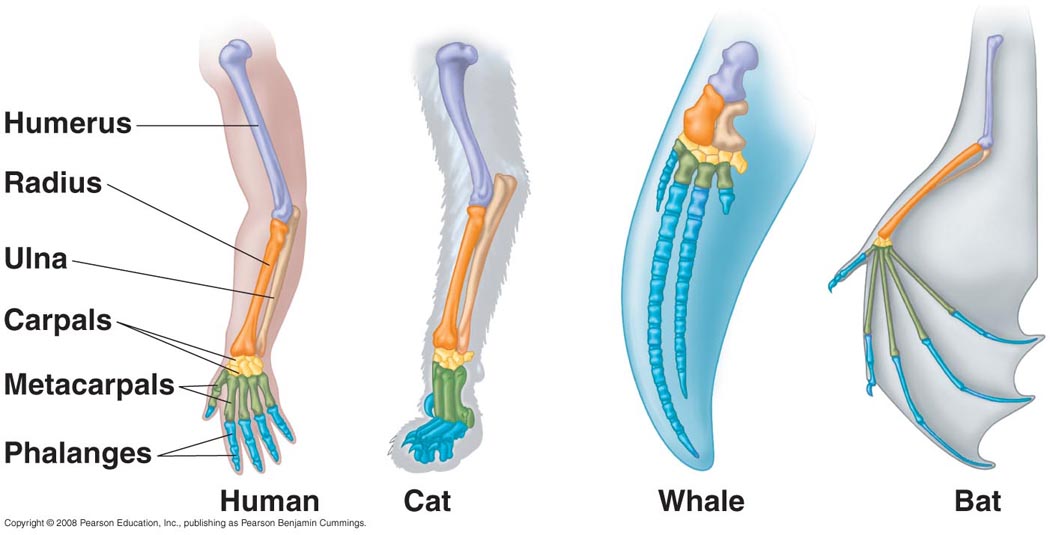
* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (study of fossils) has produced strong evidence for a changing earth by providing direct physical evidence of past life

Patterns found:

* 1. \_\_\_\_\_\_\_\_\_\_\_\_\_ species are now **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
* 2. There is a systematic progression from only very simple organisms to more **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** ones
* 3. Living species and their most closely **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are typically located in the **\_\_\_\_\_\_\_\_\_\_\_\_\_** geographic region

Evidence from Biogeography

* Biogeography explores the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** and **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** of life on Earth’s surface today and in the past
* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** has caused major changes to Earth’s landmasses
* Fossils of species from more than 150mya were once found in the **\_\_\_\_\_\_\_\_\_\_\_\_\_** geographic location
* Fossils of species **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** than 150mya are now restricted to **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** suggesting that they evolved after the breakup of the continents from the supercontinent of Pangea
* Remote islands are often home to **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** species suggesting that they evolved in isolation after an ancestor colonized



Evidence from Anatomy

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** features have similar structures but may perform very different functions.

Examples: forelimb of human, whale, cat, bat, bird…

* Embryonic development of many species also seems to indicate an evolutionary relationship
* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** features are rudimentary structures that serve no useful function and are usually taken as very compelling evidence for evolution. The explanation is that they must once have served a function that was beneficial

Examples:

Evidence from Artificial Selection

* Through **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** humans can produce dramatic changes in a species appearance over a relatively short period of time

Examples:

* Nature could have a similar mechanism to produce change over many \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The Process of Natural Selection

**Practice Note-Taking Skills:**  
Watch the video “How does Evolution Really Work?” and take your own notes:

**The Four Processes of Natural Selection:**

* Genetic \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  1. There is variation within a species, and most of this variation is inherited \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of Offspring
  1. Only a few offspring will survive long enough to **­­­­**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Struggle for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  1. There is intense competition for **­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** such as **\_\_\_\_\_\_\_,** space, and **\_\_\_\_\_\_\_\_\_\_**
* **Differential** Survival and Reproduction
  1. Individuals with **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**traits will be more likely to survive and reproduce
  2. Over time those traits will become **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** in the population

Isn’t Evolution Just a Theory?

* Yes it is a Theory. However, a theory in science is NOT a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** as it would be in everyday language. We have to remember the definition of a Theory in Science:
  + **Theory:** An **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** based on observation, experimentation, and reasoning, especially one that has been **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** as a general principle helping to explain and predict natural phenomena.

Why Does Evolution Matter Now?

* An understanding of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** helps us to understand and predict how **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** will change due to **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
* This can allow us to **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** effectively to new threats and concerns.
* **Example:** Creating “Super Bugs” such as Multi-Drug Resistant **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are a powerful tool against disease, but they also act as a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** for the bacteria
  + Those bacteria that can **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** the antibiotics become more common, and over time the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + The **\_\_\_\_\_\_\_\_\_\_** and **\_\_\_\_\_\_\_\_\_\_\_\_** of antibiotics is causing the evolutionof **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ­­­­ \_\_\_\_\_\_\_\_\_\_\_\_\_\_** of diseases like TB

**What can you do?**

* Don’t use **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** and products!
  + 1. This just provides more **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** for dangerous bacteria to evolve
* If prescribed antibiotics, **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** carefully!
  + If you don’t **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** the treatment, then some bacteria will survive and pass on their genes for better survival, making the species stronger