

Field research helped Darwin frame his view of life

- Charles Darwin (1809-1882) was born in western England.
 - Very interested in nature as a boy (fished, hunted, collected insects)
 - Father sent him to the U. of Edinburgh to study medicine
 - Darwin left Edinburgh without a degree and enrolled at Christ College at Cambridge University with the intent of becoming a clergyman.
 - At that time, most naturalists and scientists belonged to the clergy and viewed the world in the context of natural theology.
- Darwin received his degree in 1831.
- At age 22, Darwin received an invitation to accompany Captain FitzRoy aboard the HMS Beagle.
- The main mission of the five-year voyage of the *Beagle* was to chart poorly known stretches of the South American coastline.
- Darwin had the freedom to explore extensively on shore while the crew surveyed the coast.
- He collected thousands of specimens of the exotic and diverse flora and fauna of South America.
- He was amazed by the variety of organisms.
- The origin of the fauna of the Galapagos, 900 km west of the South American coast, especially puzzled Darwin.
 - Darwin noted that while most of the animal species on the Galapagos lived nowhere else, they resembled species living on the South American mainland.
 - It seemed that the islands had been colonized by plants and animals from the mainland that had then diversified on the different islands.
- After his return to Great Britain in 1836, Darwin began to perceive that the origin of new species and adaptation of species to the environment as closely related processes.
 - Beaks of the different types of finches are adaptations to the foods available on their home islands.

- By the early 1840's: Darwin had developed the major features of his theory of natural selection as the mechanism for evolution.
- In 1844, he wrote a long essay on the origin of species and natural selection, but he was reluctant to publish his theory and continued to compile evidence to support his theory.
- In June 1858, Alfred Wallace, a young naturalist working in the East Indies, sent Darwin a manuscript containing a theory of natural selection essentially identical to Darwin's.
- Later that year, both Wallace's paper and extracts of Darwin's essay were presented to the Linnaean Society of London.
- Darwin quickly finished *The Origin of Species* and published it the next year (1859).
- While both Darwin and Wallace developed similar ideas independently, the essence of evolution by natural selection is attributed to Darwin because he developed and supported the theory of natural selection so much more extensively and earlier.

***The Origin of Species developed two main points:
the occurrence of evolution and natural selection as its mechanism***

GIVEN:

- Organisms within a population vary
 - Standard curve
- More organisms are born than can survive
- Organisms compete for resources

THEN:

- Some organisms will be better fit for the environment than others and will be more likely to reproduce and pass on their genes → → → beneficial genes are selected

CONCLUSION:

- Natural selection will cause evolution and adaptation over long periods of time
- Central to Darwin's view of the evolution of life is **descent with modification**.
 - In descent with modification, all present day organisms are related through descent from unknown ancestors in the past.
 - Descendants of these ancestors accumulated diverse modifications or adaptations that fit them to specific ways of life and habitats.

- The other major point that Darwin pioneered is a unique mechanism of evolution - the theory of natural selection.
- **Observation #1:** All species have such great potential fertility that their population size would increase exponentially if all individuals that are born reproduced successfully.
- **Observation #2:** Populations tend to remain stable in size, except for seasonal fluctuations.
- **Observation #3:** Environmental resources are limited.
- **Inference #1:** Production of more individuals than the environment can support leads to a struggle for existence among the individuals of a population, with only a fraction of the offspring surviving each generation.
- **Observation #4:** Individuals of a population vary extensively in their characteristics; no two individuals are exactly alike.
- **Observation #5:** Much of this variation is heritable.
- **Inference #2:** Survival in the struggle for existence is not random, but depends in part on the hereditary constitution of the individuals.
 - Those individuals whose inherited characteristics best fit them to their environment are likely to leave more offspring than less fit individuals.
- **Inference #3:** This unequal ability of individuals to survive and reproduce will lead to a gradual ***change in a population***^{**}, with favorable characteristics accumulating over the generations. (***** population – the smallest unit of life that can evolve - individuals cannot***).
- Darwin's main ideas can be summarized in three points.
 - ***Natural selection is differential success in reproduction (unequal ability of individuals to survive and reproduce).***
 - ***Natural selection occurs through an interaction between the environment and the variability inherent among the individual organisms making up a population.***
 - ***The product of natural selection is the adaptation of populations of organisms to their environment.***

- The capacity to overproduce seems to be a characteristic of all species, with only a small fraction of eggs developing to leave offspring of their own.
- In each generation, environmental factors filter heritable variations, favoring some over others.
 - ***Differential reproduction*** - whereby organisms with traits favored by the environment produce more offspring than do organisms without those traits - results in the *favored traits being disproportionately represented in the next generation.*
 - This increasing frequency of the favored traits in a population is **evolution.**
- Darwin's views on the role of environmental factors in the screening of heritable variation was heavily influenced by **artificial selection.**
- Humans have modified a variety of domesticated plants and animals over many generations by selecting individuals with the desired traits as breeding stock.
- The Darwinian view of life has two main features.
 - (1) The diverse forms of life have arisen by descent with modification from ancestral species.
 - (2) The mechanism of modification has been natural selection working over enormous tracts of time.
- If artificial selection can achieve such major changes in a relatively short time, then natural selection should be capable of major modifications of species over hundreds or thousands of generations.
- Darwin envisioned the diversity of life as evolving by a gradual accumulation of minute changes through the actions of natural selection operating over vast spans of time.
- While natural selection involves interactions between individual organisms and their environment, it is not individuals, but populations that evolve.
- Populations are defined as a group of interbreeding individuals of a single species that share a common geographic area.
- Evolution is measured as the change in relative proportions of heritable variation in a population over a succession of generations.
- Also, natural selection is situational.
 - Environmental factors vary in space and time.
 - Therefore, adaptations for one set of environmental conditions may be useless or even detrimental under other circumstances.