Background to Darwin

Malthus

*Essay on the Principle of Population* (1798). He concluded there would always be a struggle for existence with war, famine, and disease as population regulators.

Lyell (and Whewell and Hutton)

Uniformitarianism as an argument against creationism and catastrophic theories. Lyell’s *Principles of Geology* was published in 1830.

Lamarck

In 1809 he helped establish the concept of adaptation but research showed that they were not acquired environmentally and then passed to offspring.
Precursors to Darwin

Charles Lyell  Jean-Baptiste Lamarck  Thomas Malthus

1797-1875  1744-1829  1766-1834
Darwin acknowledges his debt to Malthus

"In October 1838, that is, fifteen months after I had begun my systematic inquiry, I happened to read for amusement Malthus on *Population*, and being well prepared to appreciate the struggle for existence which everywhere goes on from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances favourable variations would tend to be preserved, and unfavourable ones to be destroyed. The results of this would be the formation of a new species. Here, then I had at last got a theory by which to work".

Charles Darwin, from his autobiography. (1876)
Lamarck and Darwin

A. Lamarck's View

B. The Darwin-Wallace View
Adaptation and Selection in Changing Environments
Evolution

- **Evolution is simply: descent with modification:**
  - Parents produce offspring who share genes in common.
  - Occasionally mutations in parents arise that cause their offspring to differ from them.
  - If these mutations enhance an offspring’s chances of survival and reproduction, the offspring become better adapted to the environment.
  - Through time, those individuals carrying that adaptation become more common.
Evolution: two key concepts

**Natural selection:** the process by which certain members of a population differentially contribute offspring to the next generation. Measured as reproductive success or fitness (no moral connotation), either as number of offspring or number of genetic equivalents (number of offspring divided by 2 in diploid organisms). It is important to note that RS is a relative measure, relative to other individuals in the population and relative to specific environmental conditions.

**Adaptation:** some individuals are able to make a higher relative contribution to the next generation in a population because they are better adapted to the environment (both social and natural). Adaptation can be defined as "any structure, physiological process, or behavioral pattern which makes an organism more fit to survive and reproduce in comparison to other members of the same species population."
Ways being fit

- Efficient food acquisition
- Resistance to disease
- Detection and evasion of predators
- Insulation from the elements and sources of environmental trauma
- Acquisition of high quality mates
- Quality investment in offspring
Some Principles of Evolution

- Organisms are designed to be reproductively selfish.
- Altruism cannot exist if defined as assisting another to enhance his or her fitness while simultaneously reducing your own.
- Fitness is relative to other members of the population.
- Adaptations are never for the good of the group.
- Adaptations develop in past environments.
- Natural selection is not the only mechanism of evolutionary change. Other mechanisms include drift, bottlenecks, and founder’s effect.
- Adaptations are seldom perfect: they are merely superior to previous solutions.
- The environment determines which traits are useful.
- Mutations are independent of the environment.
Forms of Selection

Directional Selection
- Frequency of trait value
- Trait value

Stabilizing Selection
- Frequency of trait value
- Trait value

Disruptive Selection
- Frequency of trait value
- Trait value