The Theory of Evolution

Chapter 15

Feb 9-11:06 AM

Darwin and Evolution

1. What is unusual about the insect in the picture?
2. How would this be beneficial to the organism?

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Before We Get Started…

- What scientific explanation can account for the diversity of life? (biological diversity)
  - **Evolution** (change over time)-is the process by which modern organisms have descended from ancient organisms
  - **Theory**-a well supported, testable explanation of phenomena that have occurred in the natural world.

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Charles Darwin

- This British naturalist contributed the most to our understanding of evolution
- Sailed on the *H.M.S. Beagle* in 1831
  - One of the most significant voyages in the history of science
- During his travels, he made numerous observations and collected evidence that led him to construct a hypothesis about the way life changes over time

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The Route of the *Beagle*

- It was a 5-year voyage
- While at sea (between being sick) Darwin studied specimens found, read books, and kept notebooks of his thoughts and observations

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Darwin's Observations

- Realized that an enormous number of species inhabit the Earth
- Patterns of Diversity
  - Organisms were well adapted to their environments
  - Puzzled by where species lived– and did not live…
    - Similar grassland ecosystems are not always home to the same organisms (ex: kangaroos and rabbits)

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Darwin's Observations?

- Patterns of Diversity
  - Organisms are well adapted to the Environment
    - » How did this happen?



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Darwin's Observations

- Living Organisms & Fossils
  - Collected preserved remains of ancient organisms → Fossils
  - Some fossils were similar to present day organisms, others looked completely unlike any creature every studied.
- These observations raised questions:
  - Why had these species disappeared?
  - How were they related to living species?

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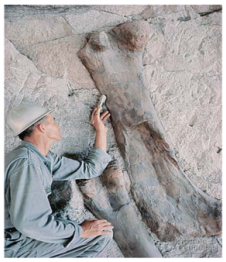
Darwin's Observations?

- Darwin observed living organisms and collected fossils

- What do fossils tell us?

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Darwin's Observations

- The Galapagos Islands
  - 1000 km off the west coast of South America
  - These small islands influenced Darwin more than any other stop on the voyage
- Studied many species of animals and plants
  - Giant Tortoises, Finches, and Iguanas
- Species unique to islands, but similar to species elsewhere

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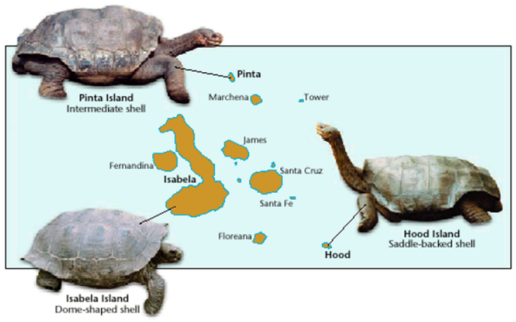
Galapagos Islands



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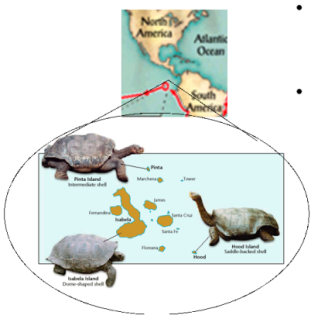
More on the Tortoises



- The tortoises varied in predictable ways from one island to another.
- Found that a tortoise's shell could be used to identify which island a tortoise inhabits.

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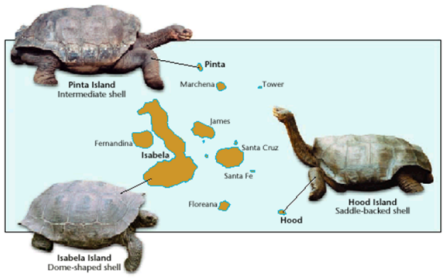
Darwin Asked Why?



Why are there different forms of organisms?

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Ideas that shaped Darwin's Thinking

Hutton

- **James Hutton (1785)-** Proposed that the earth is much more than 1000 years old. It is shaped by geological forces that took place over extremely long periods of time.

Malthus

- **Thomas Malthus (1798)-** Predicted that the human population will grow faster than the space and food supplies needed to sustain it.

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Ideas that shaped Darwin's Thinking

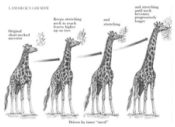
- **Jean-Baptiste Lamarck (1809)-** First to propose that species change over time.

His exact theory of use and disuse was wrong:

  - Proposed that by selective use or disuse of organs, organisms acquired or lost certain traits during their lifetime.
  - These traits could be passed onto their offspring.
  - Over time this process led to change in a species.

- Species do change over time but not this way!

Lamarck



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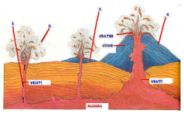
Ideas that shaped Darwin's Thinking

- **Charles Lyell-** Proposed that processes occurring now have shaped earths geological features over a long period of time. Stated you can actually observe these processes today. Earths layers are rising and falling with volcanic activity etc.



- **Alfred Wallace-** Wrote to Darwin in 1858 speculating evolution by natural selection, based on his studies of plants and animals

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Evidence for Evolution

- Fossils- provide record of early life and evolutionary history
  - Ex: Supports that ancestors of whales were probably land-dwelling, doglike animals.
- As the fossil record becomes more complete, the sequences of evolution become more clear.

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Evidence for Evolution

- Anatomy
- Structural features with common evolutionary origin are called homologous structures
  - Can be similar in arrangement, function, or both
  - Evidence that organisms evolved from a common ancestor

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Evidence for Evolution

- Anatomy
- Analagous Structures- body parts of organisms that do not have a common evolutionary origin but are similar in function
  - Provide evidence of evolution, but not evolutionary relationships
  - Ex: Insect and butterfly wings probably evolved when their separate ancestors adapted to similar ways of life

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Evidence for Evolution

- Vestigial Structure- a body structure that has no function in a present-day organism but was probably useful to an ancestor
- Embryology- the embryos of a fish, reptile, bird, and a mammal exhibit similar structures; these similarities suggest evolution from a distant, common ancestor
- Biochemistry-comparisons or DNA/RNA of different species produce evidence for evolution.

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Summary of theory

- **Theory of Natural Selection**
  - In nature there is a tendency to overproduce (exp: mice, ants, fish)
  - All offspring do not survive
  - Variations exist in all populations
  - Variations are inherited
  - Members of the population that have the most suitable variations will live longer and will pass on these traits to offspring
- The resulting population will change as it become better adapted

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Darwin's scientific hypothesis to explain how evolution occurs

- Consists of 3 parts:
  1. struggle for existence **(competition)**
  2. survival of the fittest **(those who have the best adaptations for the moment live and have babies)**
  3. descent with modification

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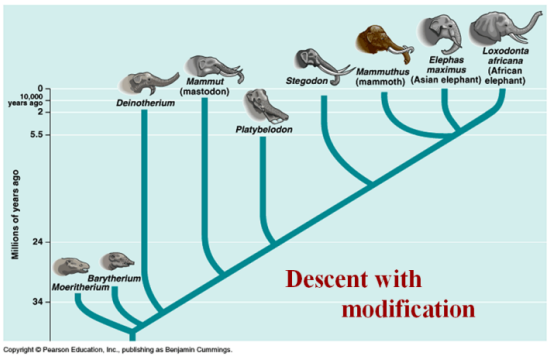
Descent with modification



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Types of Adaptations

- **Structural** – internal or external structural changes that help an organism survive. (Bird beak, long legs of rabbit)
- **Physiological** – chemical based adaptation (enzymes for digestion, snake venom)
- **Behavioral** – response to the environment (plants grow toward the light, bird migration)

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