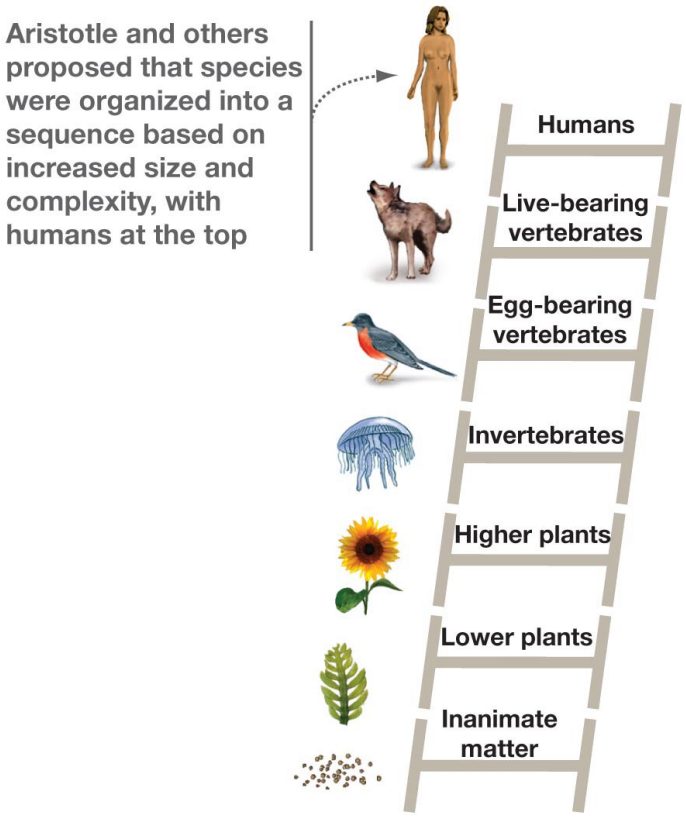
EVOLUTION BY NATURAL SELECTION

Ancient ideas of evolution

- Plato
  - Every organism was perfect type from creator
  - Variations were unimportant
  - Typological thought
    - Species are unchanging
- Aristotle
  - Great chain of being
  - Species are unchanging
  - Some species are higher



Jean-Baptiste de Lamarck

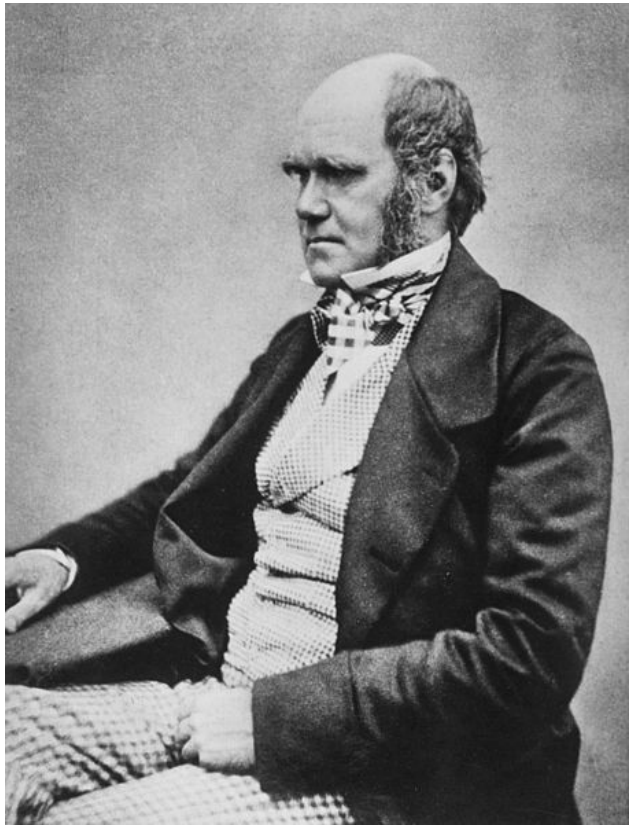
- 1809: First to propose formal theory of evolution
- Organisms originate
  - At base of great chain of being
  - Evolve by moving up over time
- Process
  - Inheritance of acquired characteristics
    - Individuals change in response to environment
    - Pass those changes to offspring

Lamarckism

- Lamark thought
  - Traits acquired in life passed on
- Mechanism of evolution
- Randomness exists in all populations
- Those most ‘fit’ to survive are more likely to reproduce

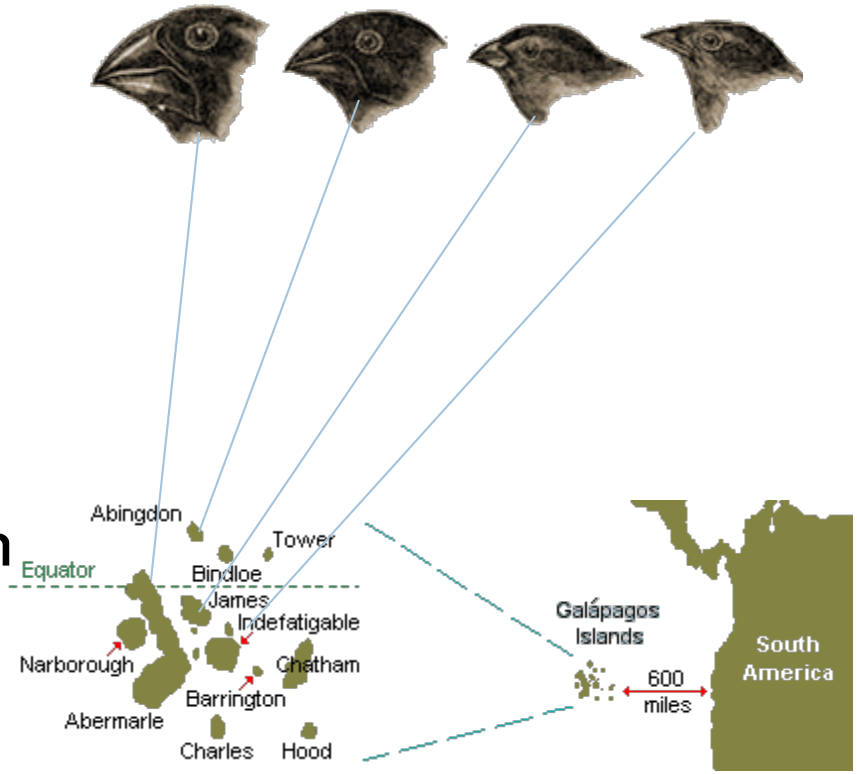
Charles Darwin

- Some fossils extinct?
- Why same fossils on different continents?



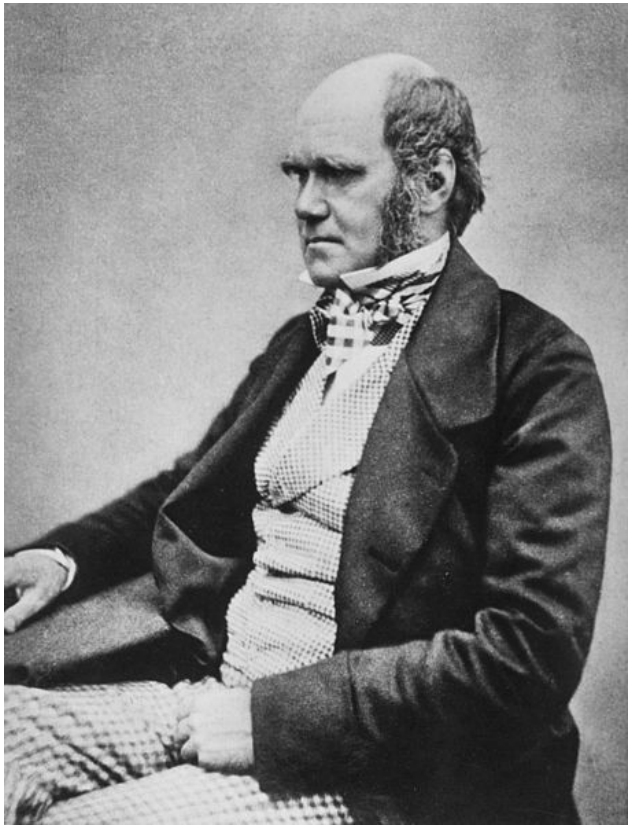
Darwin's Finches

- *HMS Beagle*
- Galapagos Islands
- Different but similar
  - Common ancestor
- Beak size related to food source
- Inferred natural selection caused speciation



Charles Darwin

- Population thinking
  - Not individual (typological)
- New species via natural selection
  - Variation in populations
  - Organisms differ in 'fitness'
    - Fitness = ability to survive (food, defense) and reproduce
  - Giraffe evolution via nat. sel.



Alfred Wallace

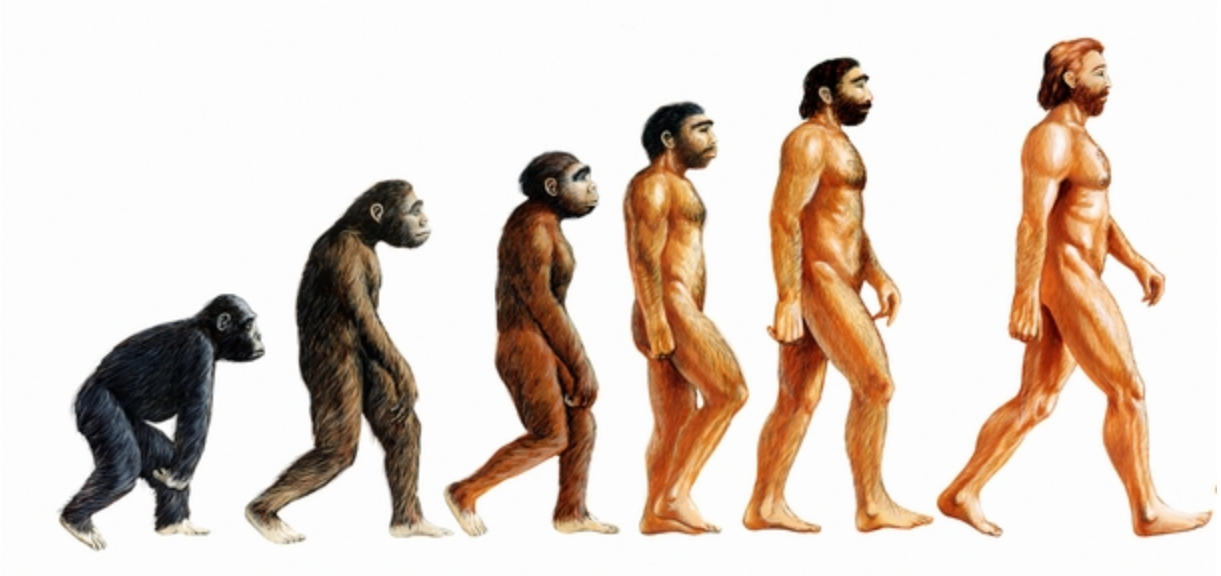
- Independently came up with the theory of species emergence
- Speciation by environmental pressures
- Greatly encouraged Darwin publish his findings

Darwin-Wallace theory

- Why was it revolutionary?
  - Species are not static
  - Species' change through time is not linear
  - Utilizes population rather than typological thinking
  - It was scientific, not philosophical
    - Made predictions
    - Tested through experimentation

Darwin's descent with modification

- Change produced modified species from ancestral species
- Claims about species
  - Species change through time
  - Species related through common ancestry

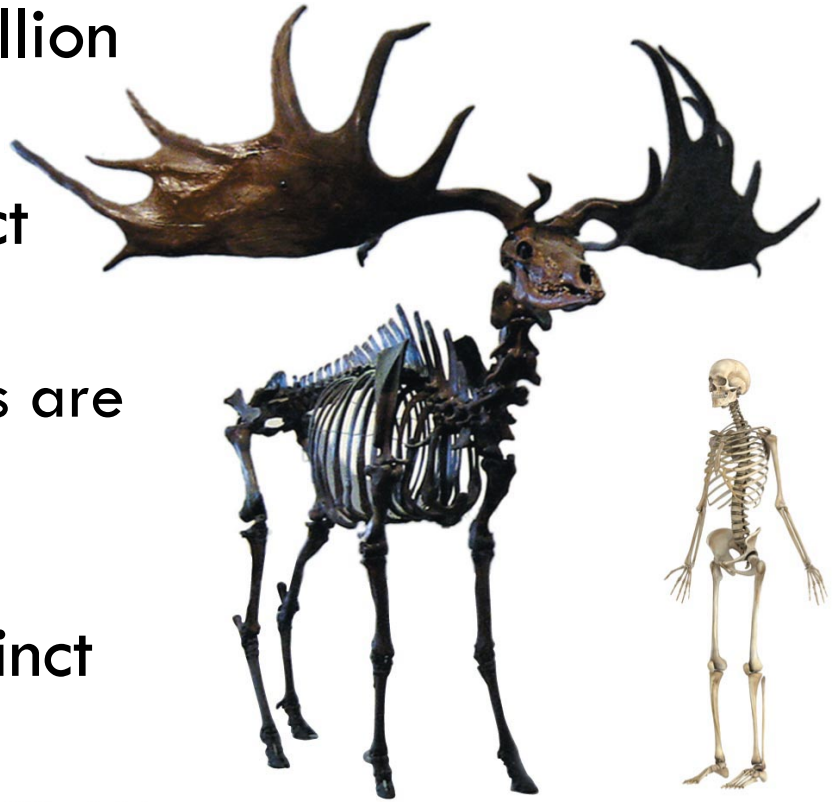


Darwin's four postulates of nat. sel.

1. Individuals' traits in populations vary
2. Traits are heritable
3. More offspring produced than can survive
4. Those "most fit" more likely to reproduce

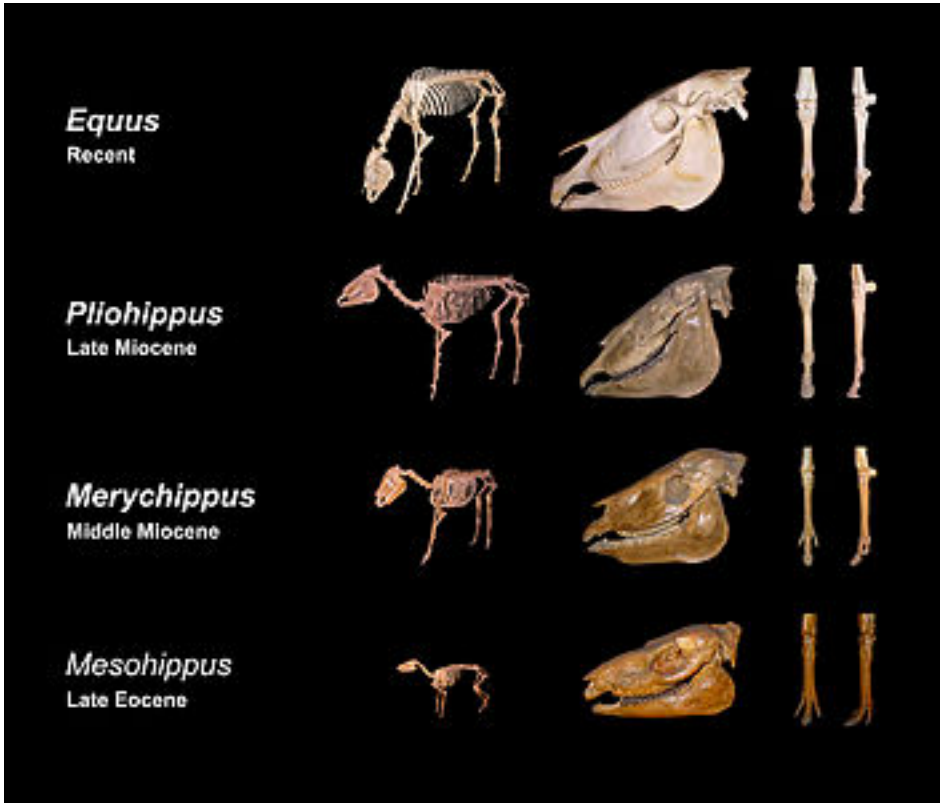
Evidence of change through time

- Geologic data show Earth is 4.6 billion years
- Earliest signs of life is 3.5 billion years
- Many fossils represent extinct species
  - Darwin: evidence that species are dynamic
- Recent evidence: 99.99% species ever existed are extinct

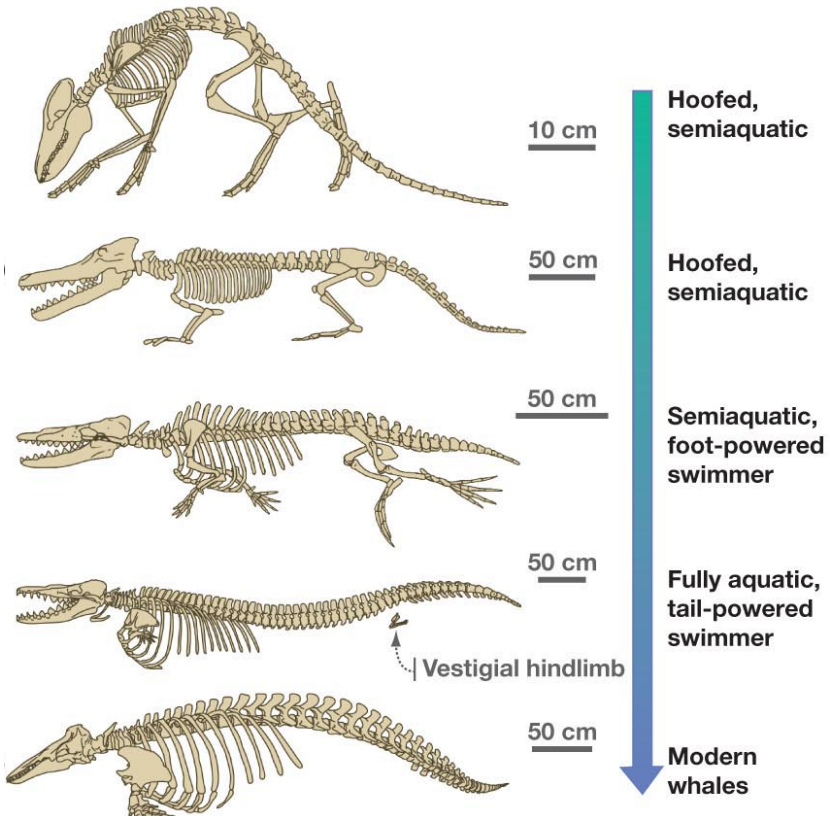


Evidence of change through time

- Transitional forms
  - Intermediate b/n early and late forms of phenotype
  - If traits of recent sp. came from earlier sp. Intermediate forms expected



Whale evolution



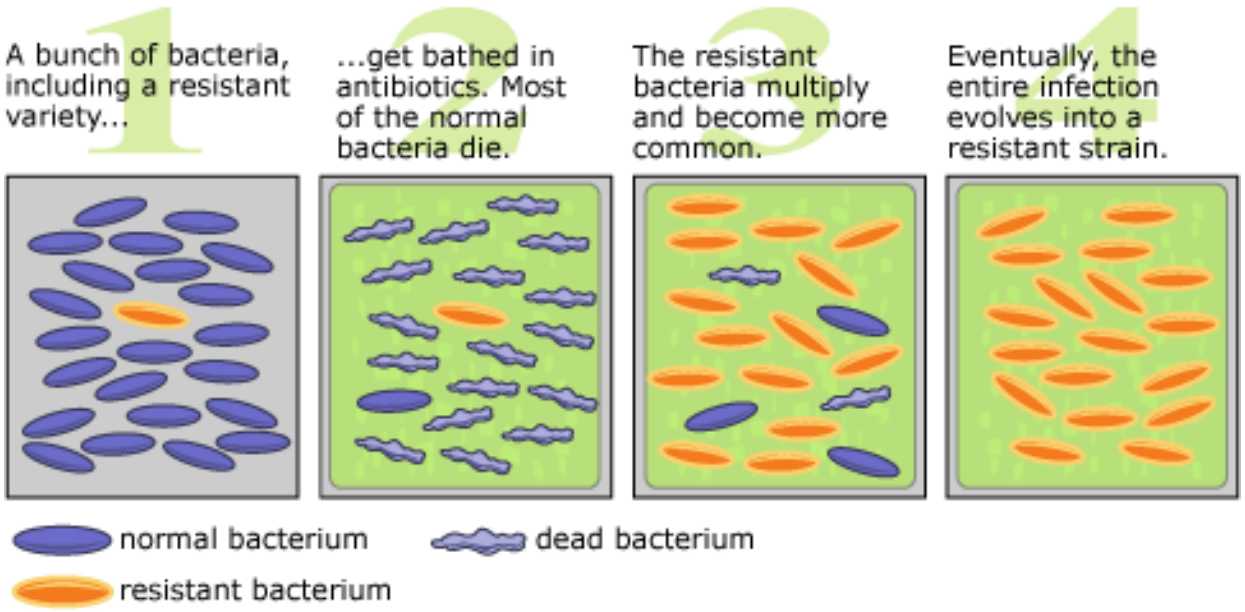
- Whales came from terrestrial ancestors
  - Fossil morphologies found
    - Aquatic
    - Terrestrial
    - Intermediate
  - Geologic dating suggests gradual transition

Evidence of change through time

- Vestigial traits
  - Reduced structure in organism that has no function
  - Structurally related to functioning structure of related species

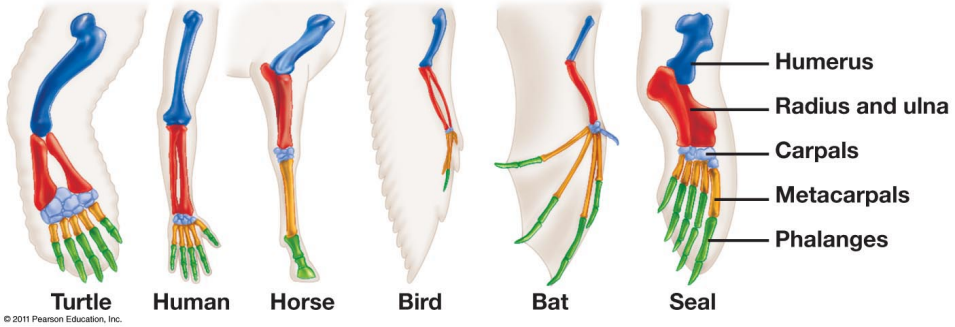
Evidence of change through time

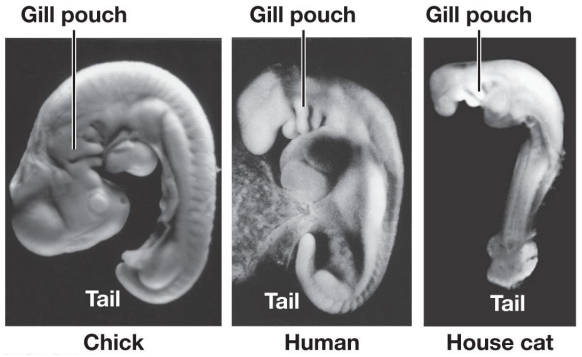
- Species are dynamic
  - Bacteria evolved to resist drugs
  - Insects evolved to resist pesticides
  - Weeds evolved to resist herbicides

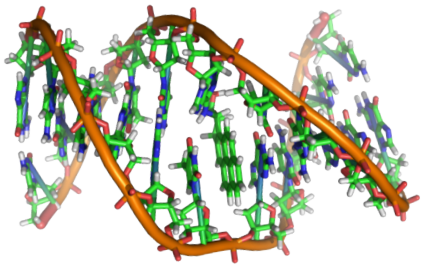


Evidence of change through time

- Homologies
  - Similarity in spp. from common ancestor
  - Structural homology
    - Vertebrates have common structural plan in limbs
  - Developmental homology
    - Tails and gills found on all vertebrate embryos
  - Genetic homology
    - DNA similarity

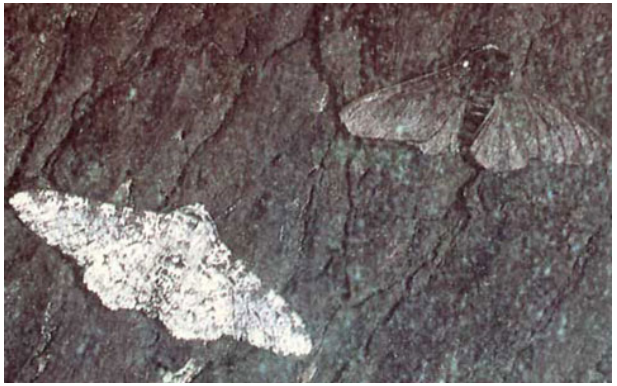




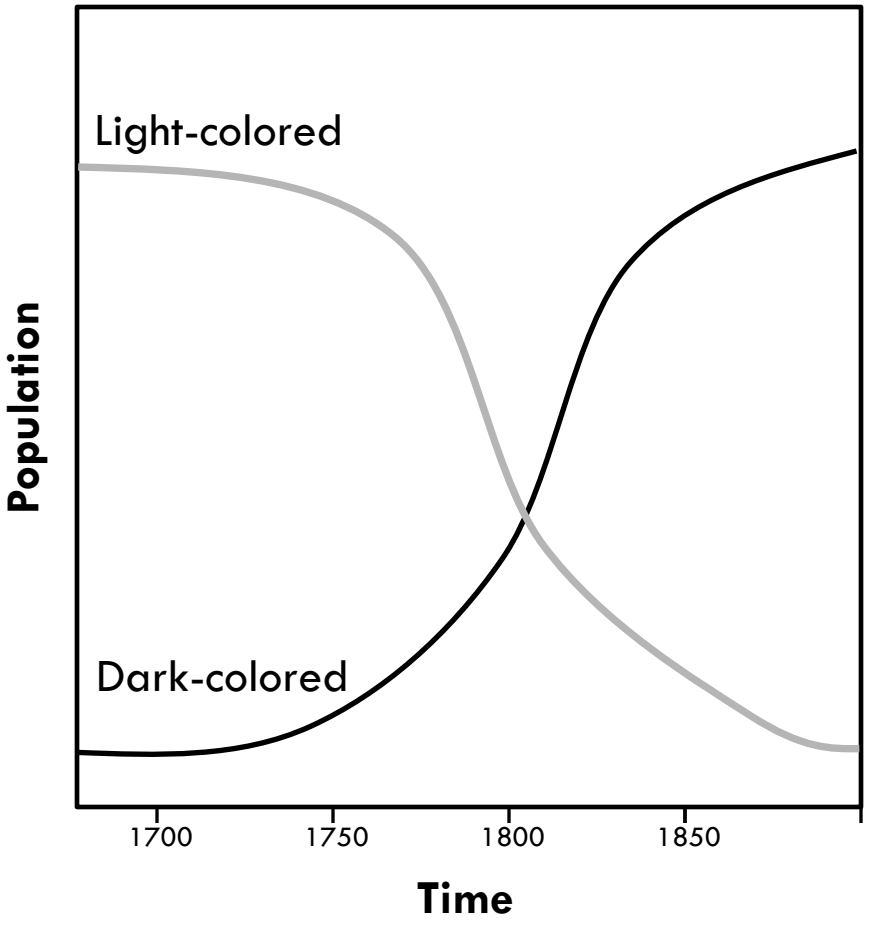


Pepper Moth Evolution

- England
- Before Industrial Revolution
  - Light-colored predominant
- During Industrial Revolution
  - Dark-colored predominant



Pepper Moth Evolution



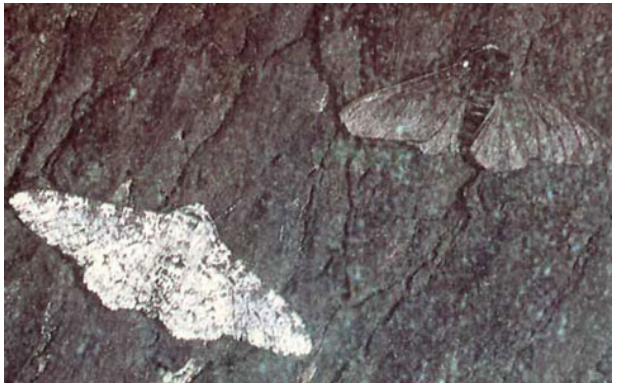


Image Credit: Miler & Levine

Evolution is not…

- Goal-oriented
  - Favors better adapted individuals
- Typological
  - Happens at population level, not individual
- Progressive
  - Doesn't make "better"
  - Can favor simpler or more complex organisms
  - Traits are routinely lost