Anthro 101:
Human Biological Evolution

Lecture 4 : Evolution by Natural Selection

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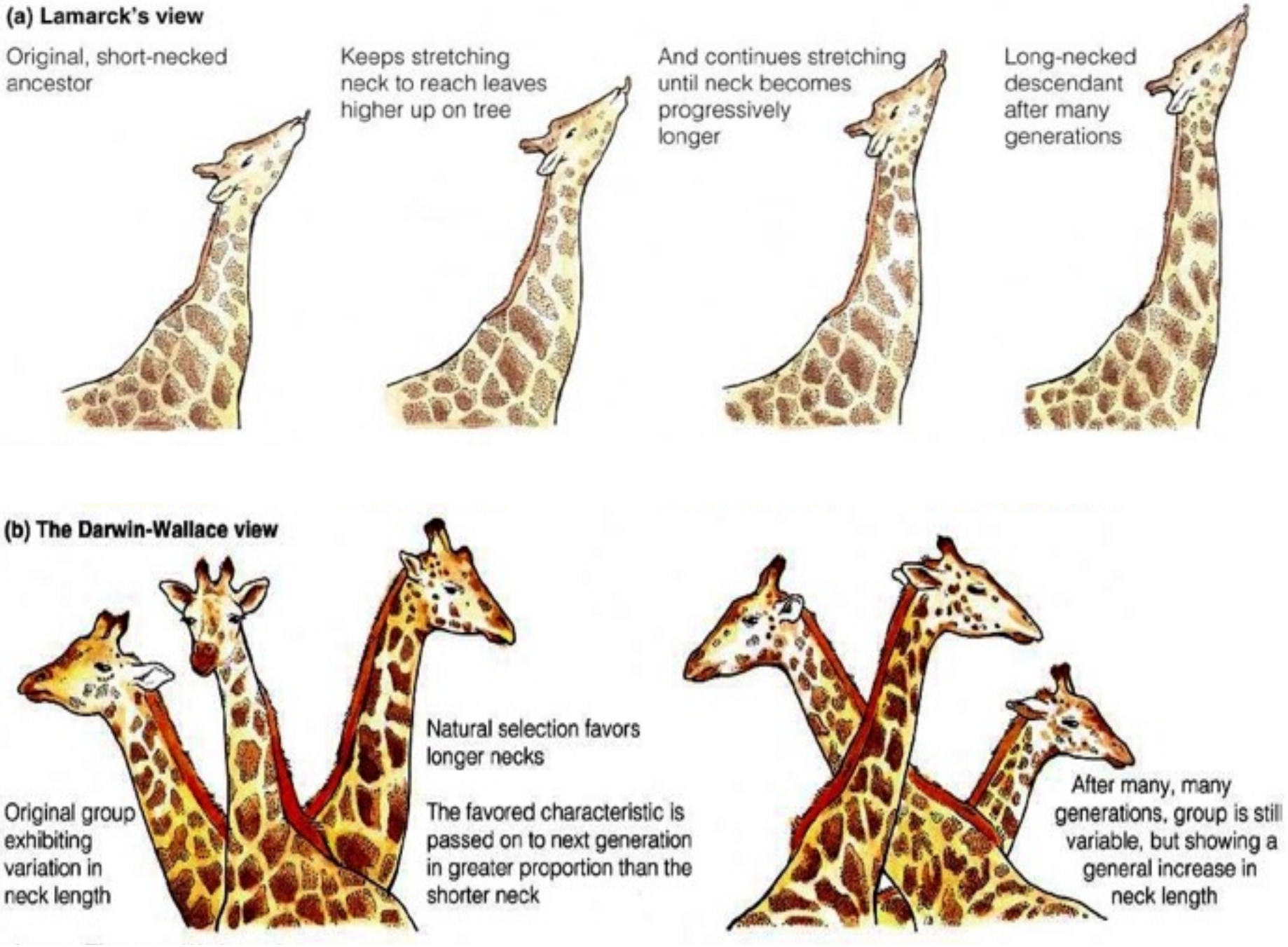
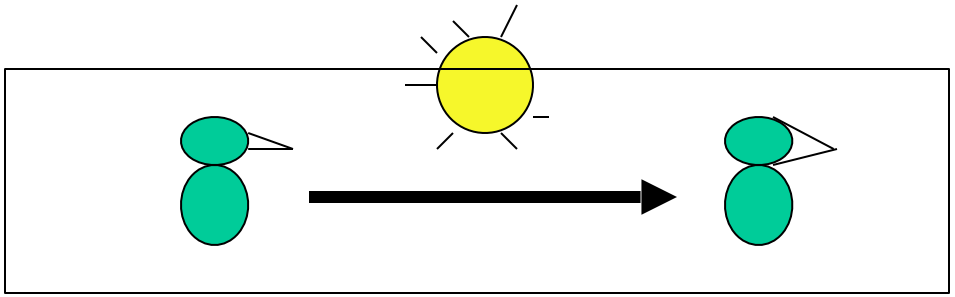
Darwin and the history of evolutionary thinking

- Historical Context
- Darwin's theory of evolution
- Darwin's postulates in nature
- The finer points of natural selection
- Common myths about natural selection


(a) Lamarck's view
Original, short-necked ancestor
Keeps stretching neck to reach leaves higher up on tree
And continues stretching until neck becomes progressively longer
Long-necked descendant after many generations
(b) The Darwin-Wallace view
Original group exhibiting variation in neck length
Natural selection favors longer necks
The favored characteristic is passed on to next generation in greater proportion than the shorter neck
After many, many generations, group is still variable, but showing a general increase in neck length

Evolution changes the characteristics of a population, NOT an individual



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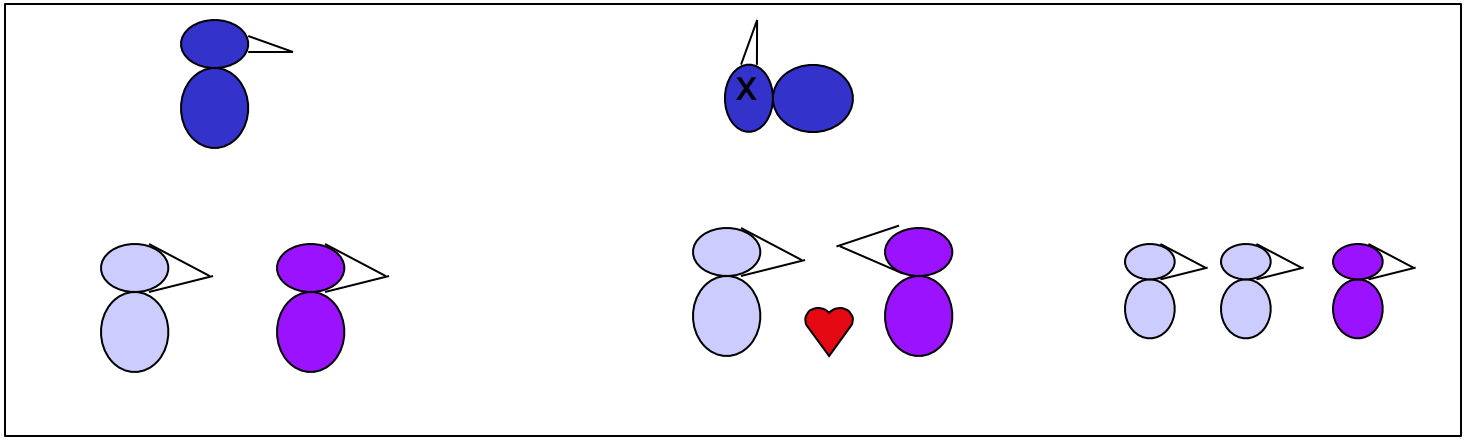


YES

Time

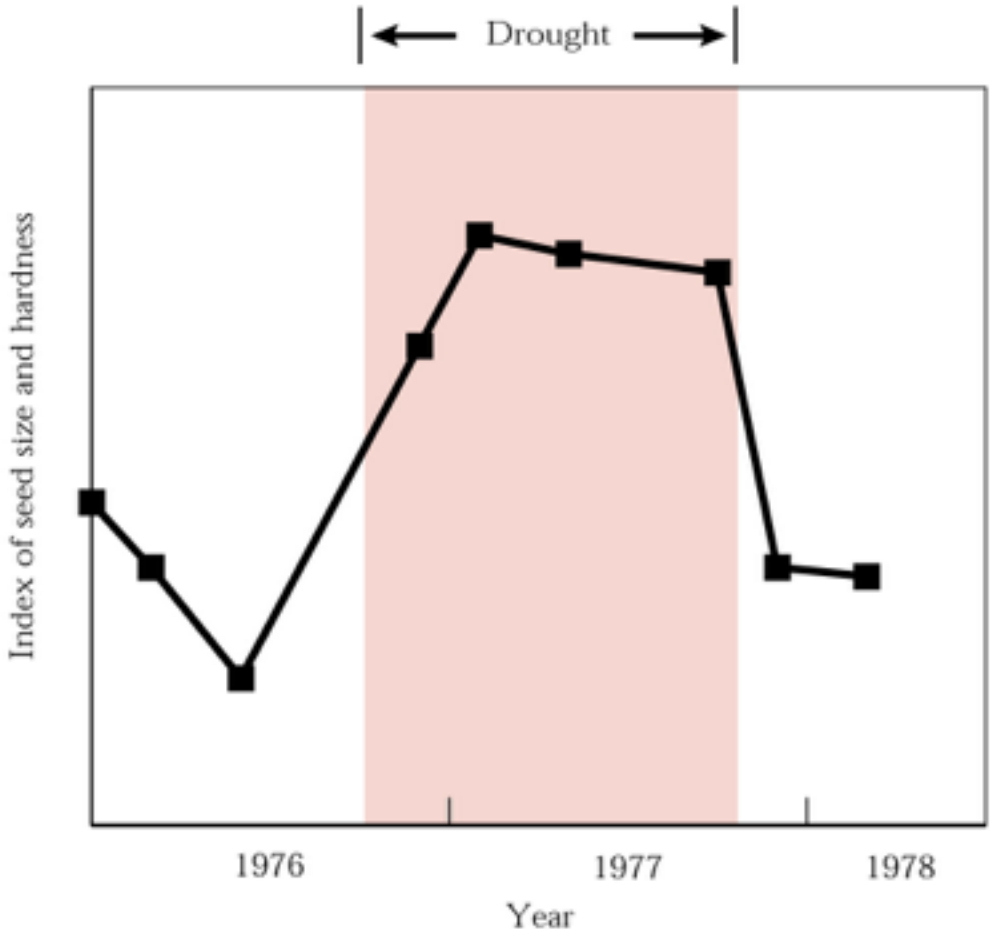
The Vocabulary of Evolution

- **Evolution**: Change over time
- **Natural Selection**: Process by which species evolve
- **Reproductive Success:** The number of offspring an individual produces and rears to reproductive age
- **Fitness:** A measure of *relative* reproductive success
- **Adaptation:** An anatomical, physiological, or behavioral trait which improves an organism's fitness *in a given environment*
- **Selective Pressures:** Forces in the environment that influence reproductive success in individuals

Birds of the Galapagos show us how natural selection works

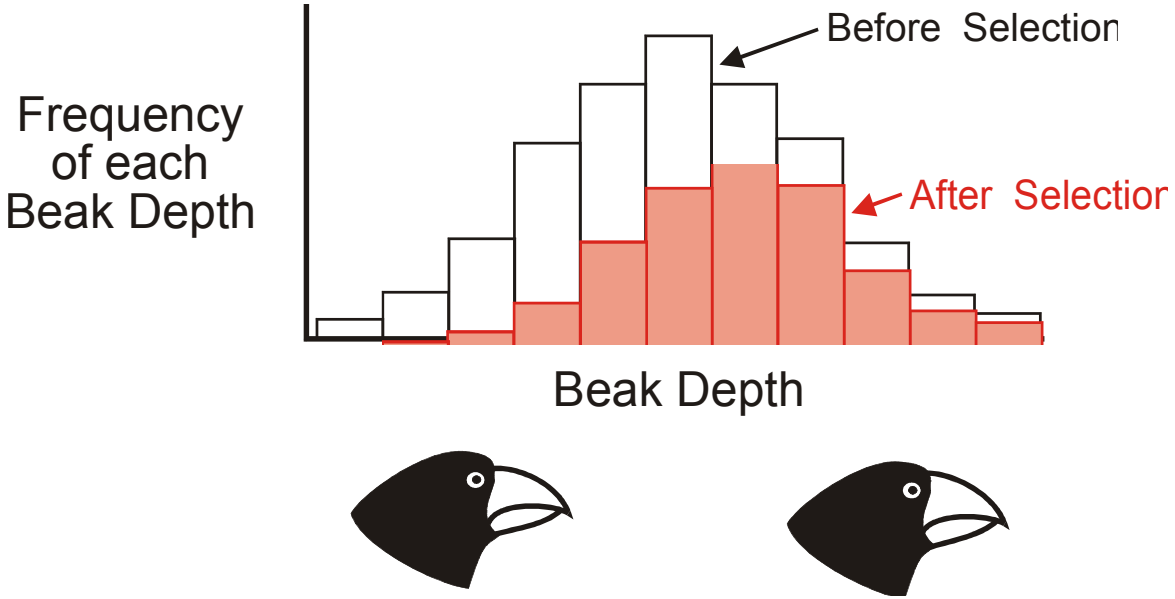
Postulate 1: Environment constrains population growth

- Severe drought occurred 1976-78
- Drought affected seed availability and quality
- Many birds died of starvation



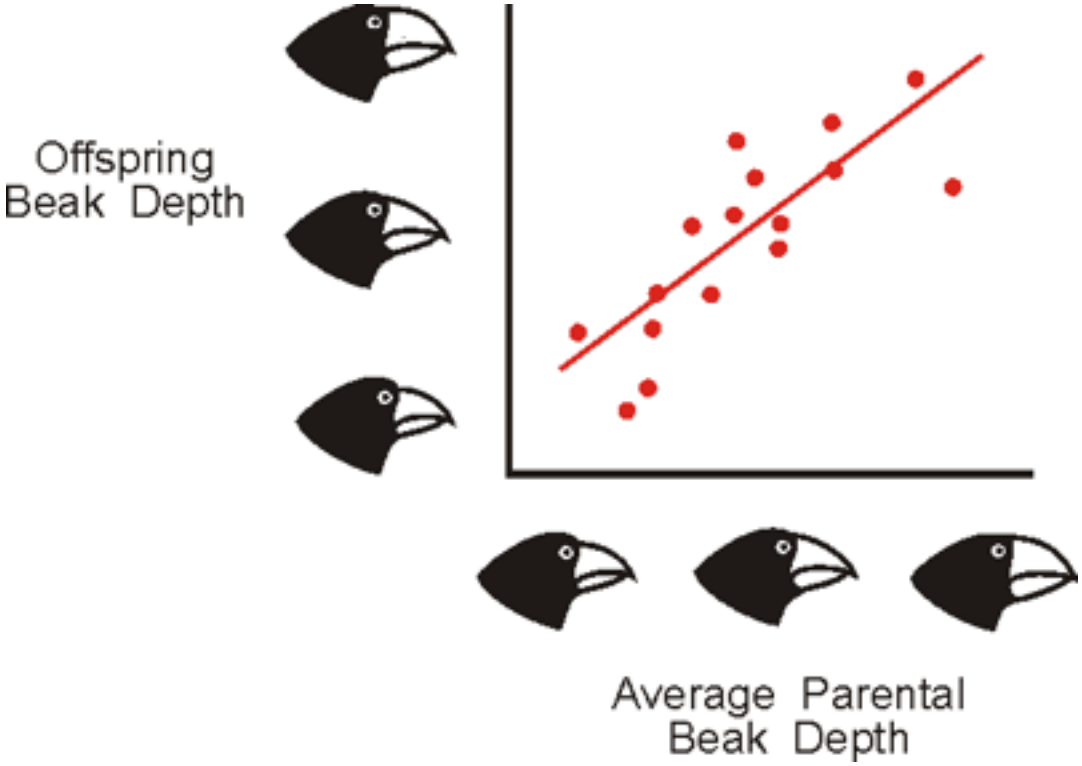
Postulate 2: Individuals vary in ability to survive and reproduce

- Beak size varies
- Small beaked birds have trouble with large seeds
- During drought, larger beaked birds were at advantage



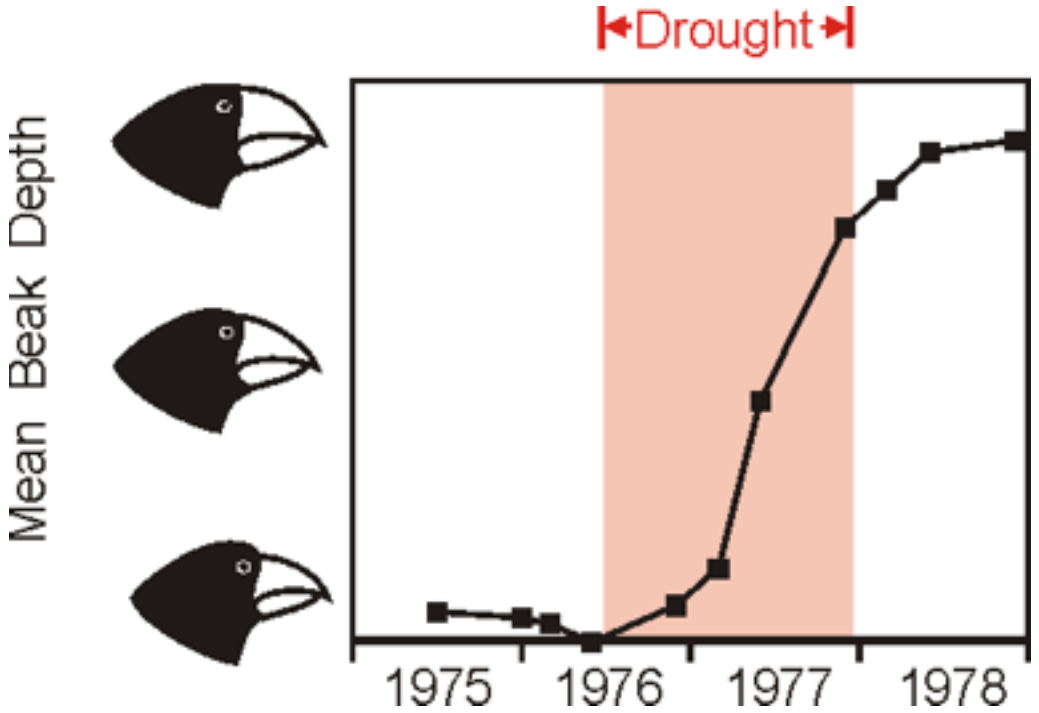
Postulate 3: Variation is transmitted from parents to offspring

- Beak size is inherited



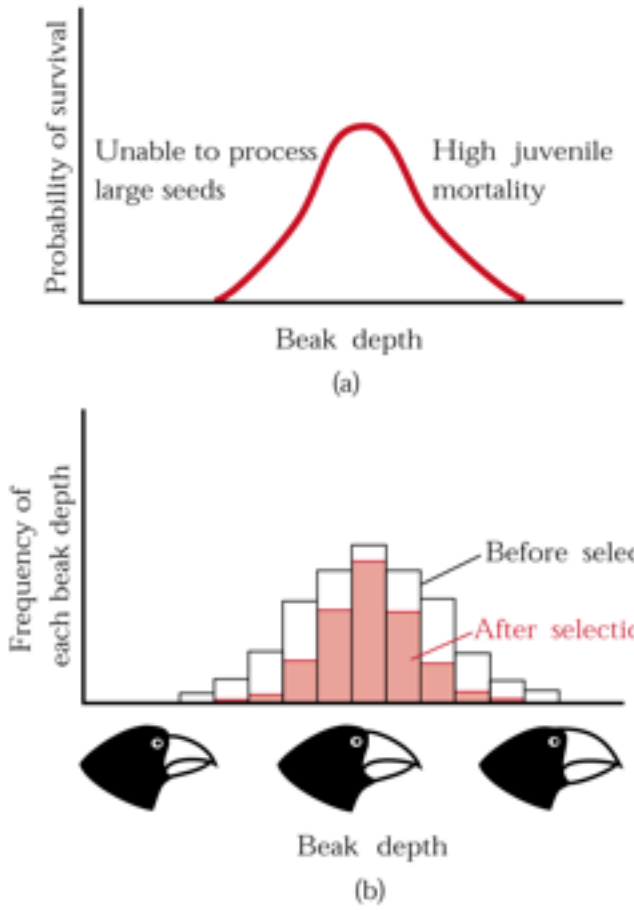
Characteristics of population changed over time

- Large beaked adults survived better
- Large beaked birds had large beaked offspring
- Mean beak size increased in population



But, natural selection can:
produce change (Directional Selection) or maintain status quo (Stabilizing Selection)

- Small beaked birds can't find enough food
- Large beaked birds have higher juvenile mortality
- Selection favors intermediate beak size
- At equilibrium, selection will maintain stasis (no change)



Darwins Finches

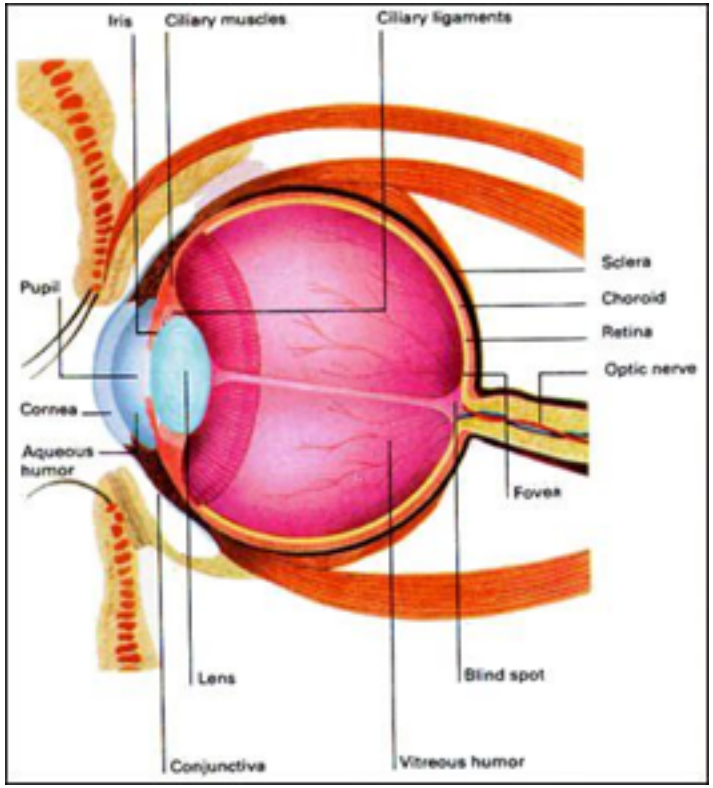
- http://www.youtube.com/watch?v=l25MBq8T77w

Ok, you guys break it down

- How is Darwin’s Theory of Evolution different than Lamark's?
- Can evolution effect individuals?
- What are Darwin’s 3 Postulates?

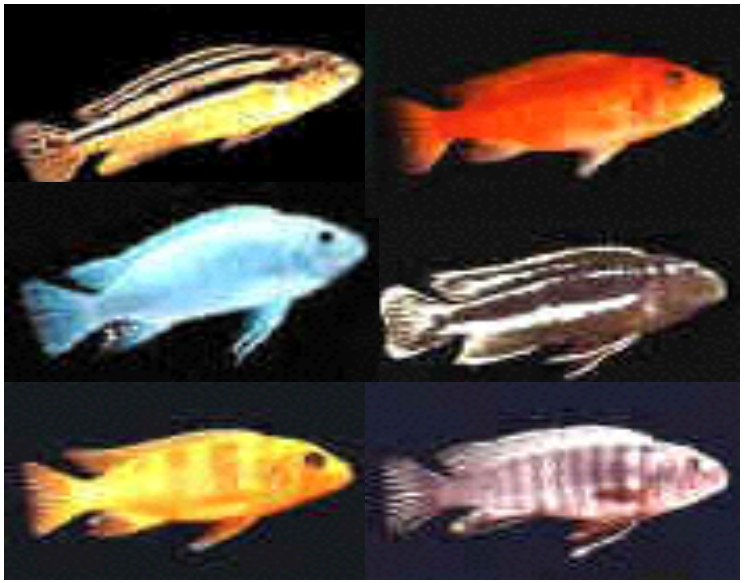
Adaptations evolve in many small steps each favored by natural selection

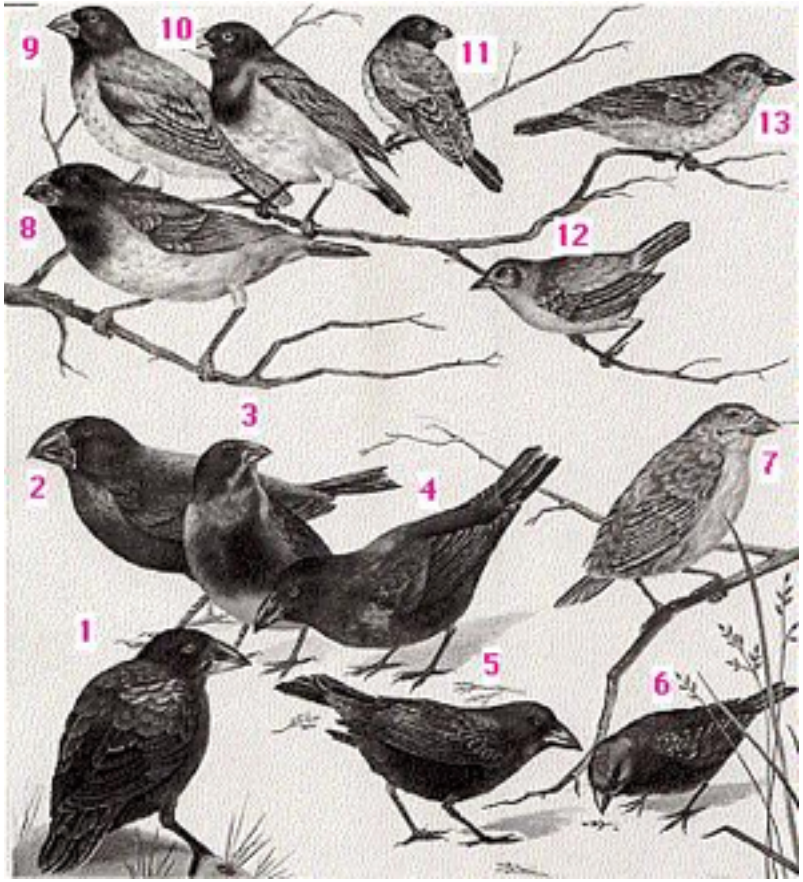
- The key to natural selection is **variation + selective retention**
- Small changes occur
- Selection retains beneficial changes
- Complexity emerges
- Each step must be favored by natural selection



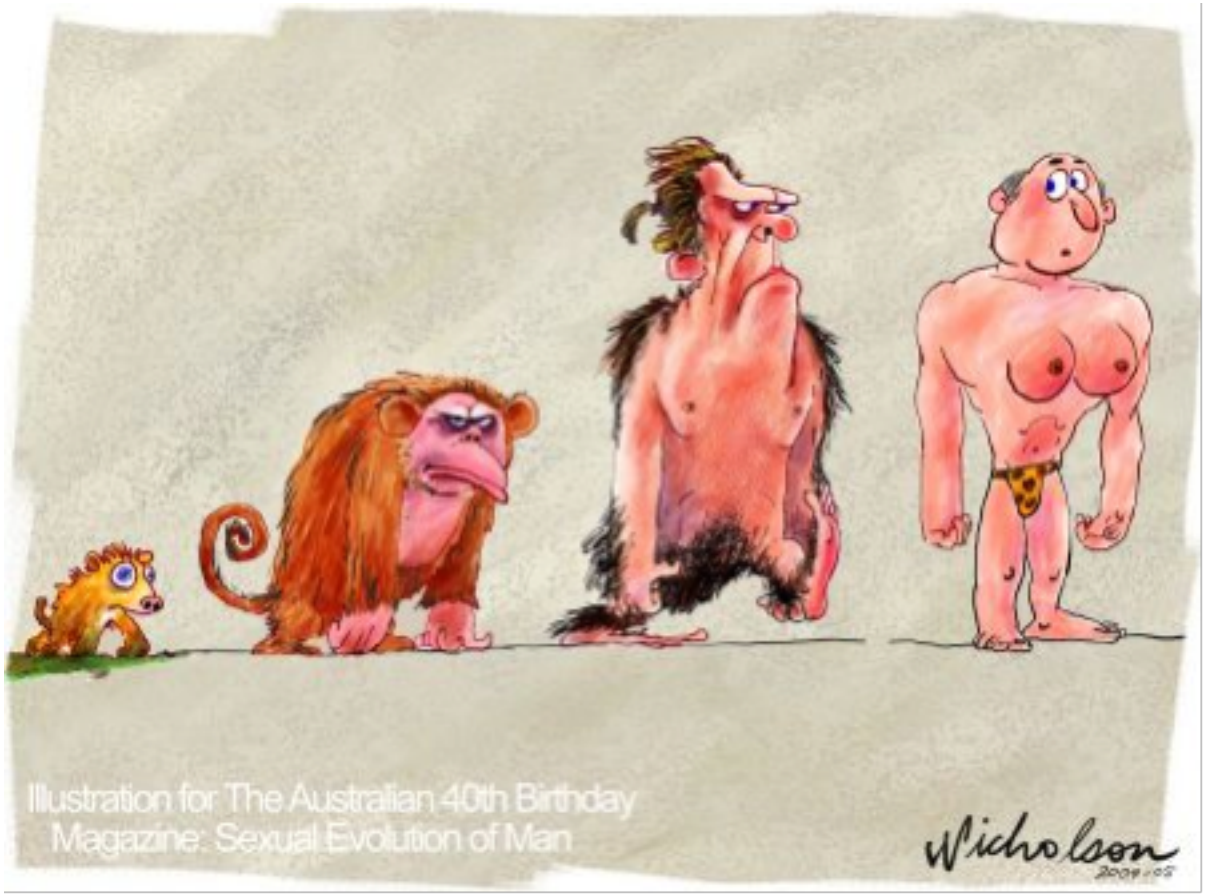
Evolution can produce rapid change

- Examples in nature
  - Radiation of Darwin's finches (≈ 500,000 yrs)
  - Radiation of African cichlids (≈ 12,000 yrs)





Evolution doesn't mean change towards greater complexity, progress, or improvement



Loss and Imperfection

- Natural Selection can remove complexity
  - Cave fish lose eyesight
  - Penguins have small wings
- Imperfect features
  - Human fondness for sugar, fat, salt
  - Peacock's tail
  - Human appendix

MYTH: ‘Survival of the fittest’ justifies everyone for themselves

- Survival of the fittest is NOT natural selection
- Fittest does NOT always mean most aggressive, strongest, most selfish

- Don’t use the **NATURALIST FALLACY**
  - “because its natural its the right way to behave, or its moral or good”

- Natural selection describes what happens in the world, NOT how we should chose to live our lives

MYTH: Evolution cannot be disproved

What would disprove evolution?

- Major jumps or different ordering in the fossil record
- Novel combinations that counter the predicted trajectory of evolutionary history
- Animals & plants that don't change
- Young earth = not enough time for all that we see to have evolved
- Variety in the building blocks used by life and perfect forms

Key points

- Without variation, there can be no evolution
- Characteristics acquired during life are not heritable
- Whether a trait is favorable or not is determined by the environment
- Natural selection acts on **individuals**
  - Even at a cost to the population or species
  - No “good of the species”
- **Populations** evolve
- Small steps add up to more complex traits

Lets check out a real example

- http://www.youtube.com/watch?v=wrTXvrKBlbc

Homework

- Video and Questions on WEBSITE!!!

- Watch video at home again and answer questions on the website.
- Due Monday