

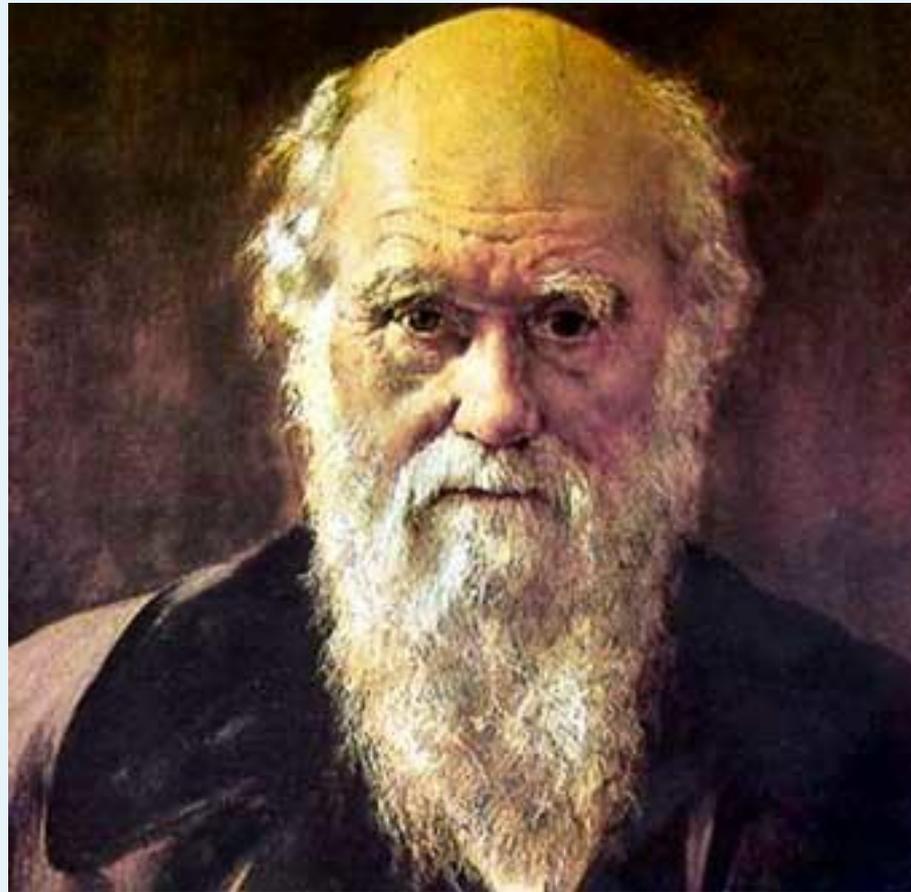
**IT IS NOT THE
STRONGEST
OF THE SPECIES THAT
SURVIVE
NOR THE MOST
INTELLIGENT
BUT THE ONE MOST
RESPONSIVE
TO CHANGE**

Charles Darwin

Guided Questions

- Who first suggested evolution?
- Who first suggested creationism?
- What did humans evolve from?

Evolution



The Darwinian View of Life

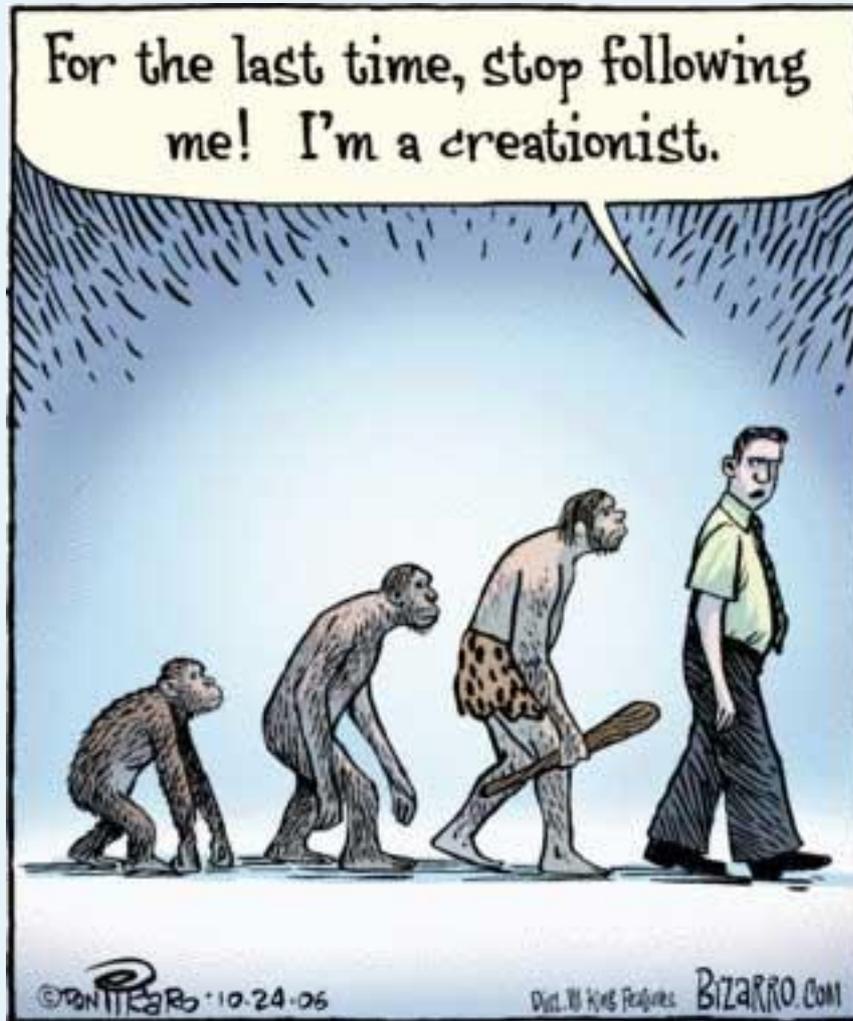
The Importance of Evolution

- This is the most important concept we will cover
- Links all of biology
- Everything we have talked about is a product of evolution
- Can explain nearly everything *but* how life began

A Disclaimer

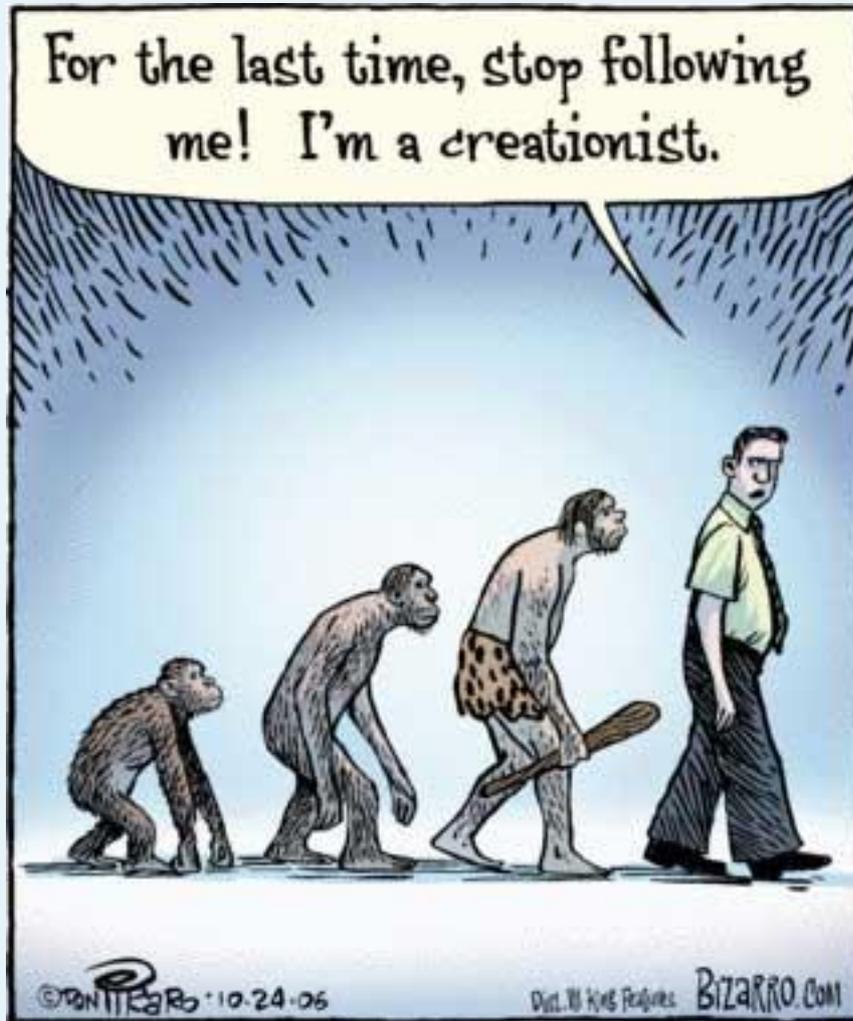
- I am not here to argue against anyone's religious beliefs
- We will focus on the ideas of evolution and the evidence for evolution- it is up to you to decide your own beliefs
- Natural selection and evolution are a model for explaining observations that has yet to be disproven

The Western View



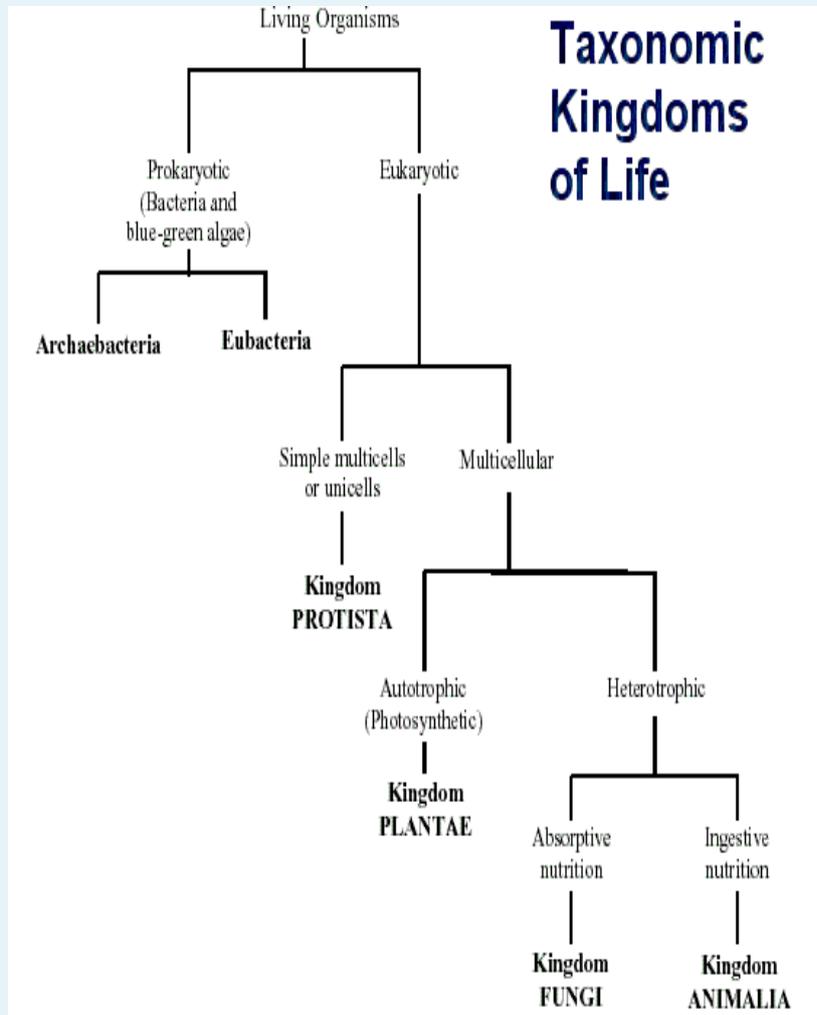
- Plato and Aristotle viewed species as discrete, perfect and designed
- Fit with the Old Testament – that a Creator designed all animals and placed them on Earth

The Western View



- Plato-saw variation as imperfections
- Aristotle- organisms are diverse and could be arranged in order of increasing complexity became the “*scala naturae*” (sequential ladder)

Linnaeus and Taxonomy



- Linnaeus (1707-1778) believed in fixity of species, but gave us **binomial nomenclature**
- Taxonomy originated before evolution
- Similar species were grouped together

The first scientist to suggest evolution...



- Jean Baptiste Lamarck (1744-1829)
- Noticed similarities between fossil species and current species and linked diversity with adaptation to the environment.

Lamarck's Theory

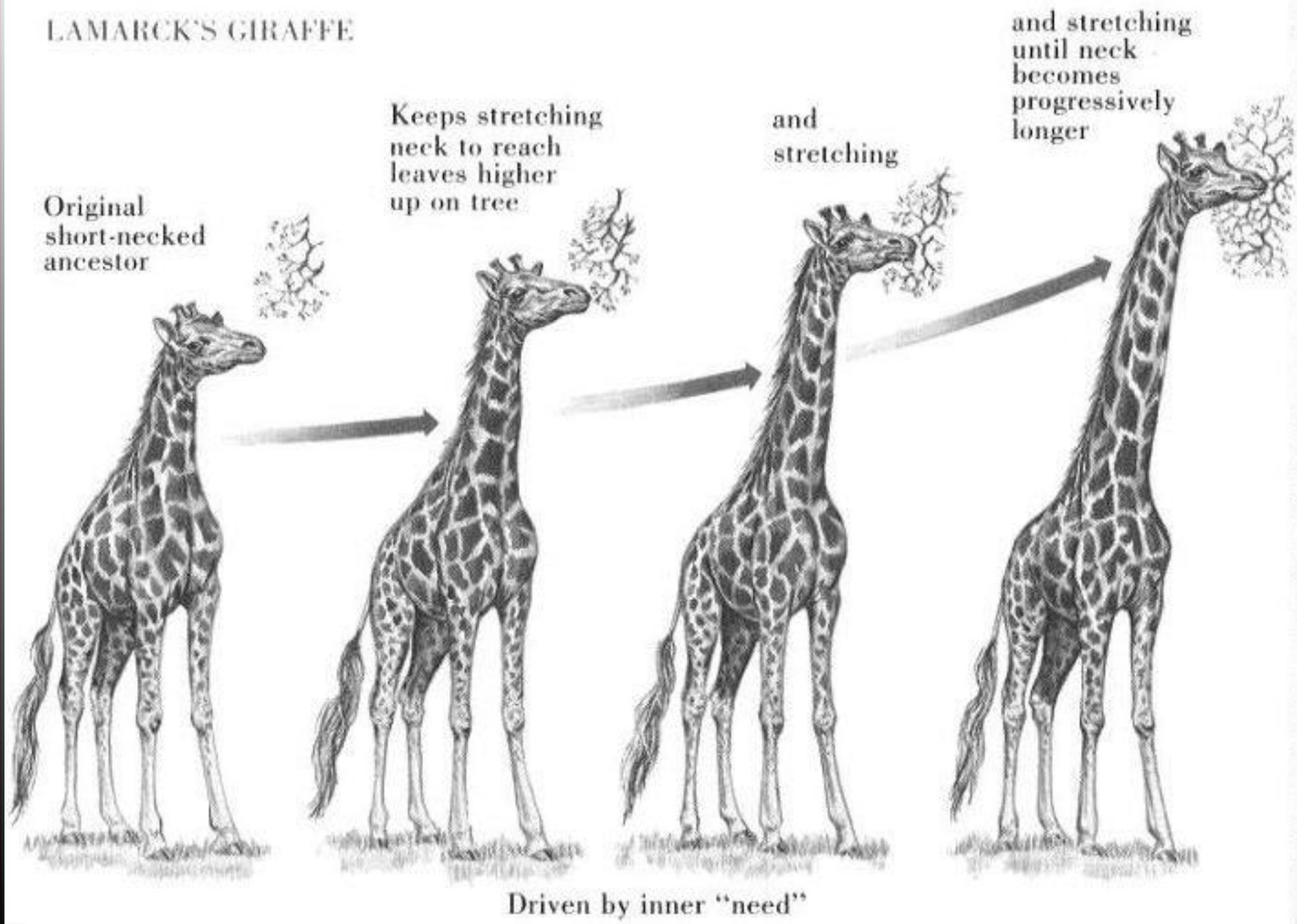
- Evolution was a natural progression towards perfection
- Organisms proceeded up a ladder from simple bacteria to complex organisms
- The parts of an organism that are used grow bigger and bigger, those that are not used disappear or diminish
- These **inherited acquired characteristics** are passed on to offspring

Example using Lamarck's Giraffe



- Each giraffe stretched, making his or her neck longer
- Passed that on to their offspring
- All necks became long

LAMARCK'S GIRAFFE



Original short-necked ancestor

Keeps stretching neck to reach leaves higher up on tree

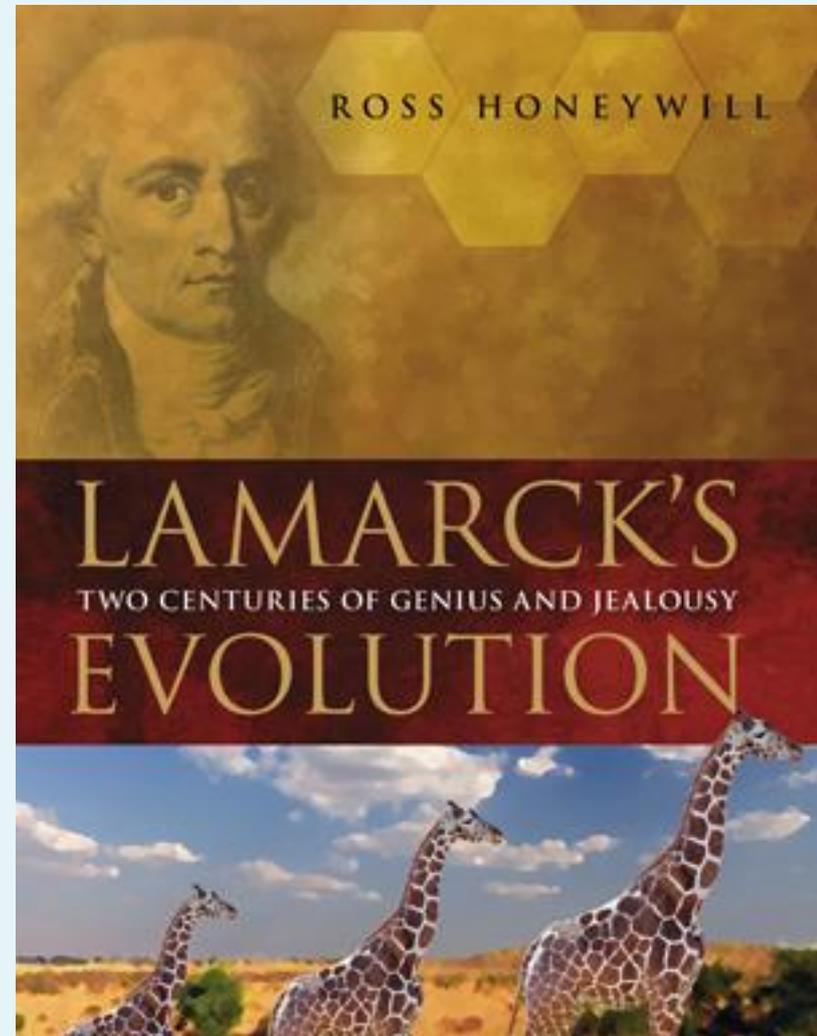
and stretching

and stretching until neck becomes progressively longer

Driven by inner "need"

It Was a Very Good First Guess

- Not really how it works, but important none the less
- He developed the ideas of *adaptation* and *heritability*



Charles Darwin



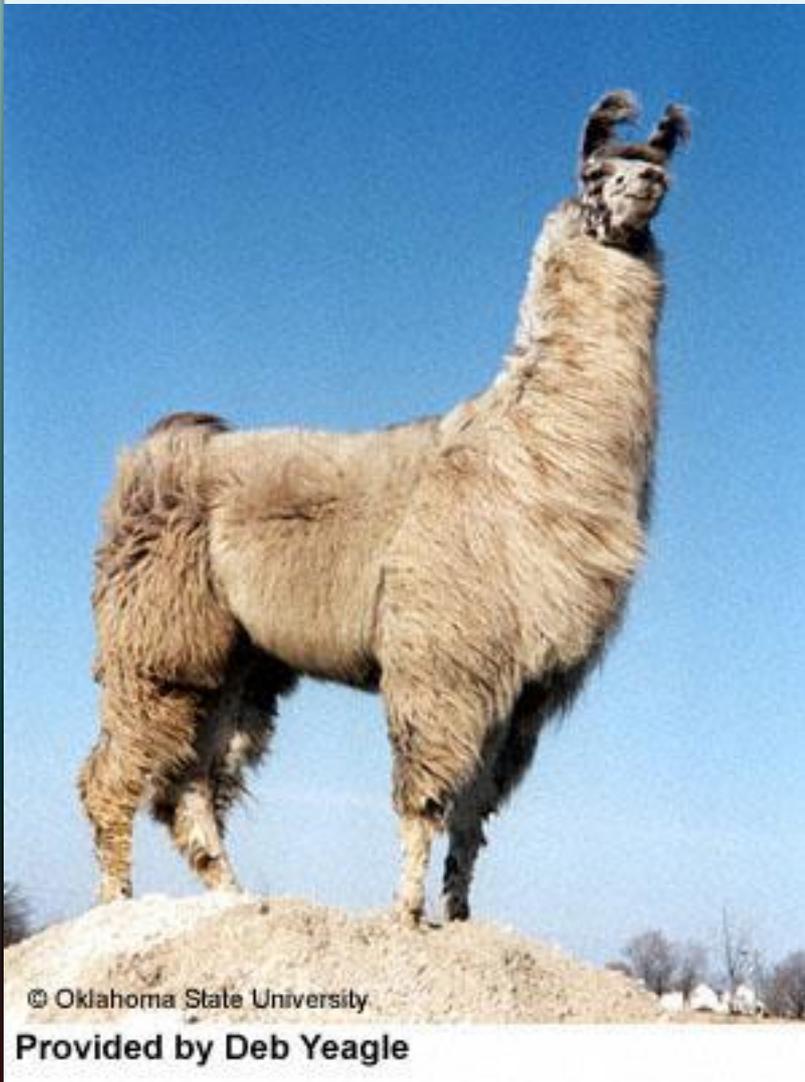
- Darwin went to Med school at 16, but dropped out
- Did what any aspiring scientist at the time would do – tried join the clergy
- A priest got him a job on the HMS Beagle

Darwin's Research on the *Beagle*

- Traveled to South America and the Galapagos Islands off the western coast
- Collected plants and animals from all over the continent, gaining fame as a naturalist



Darwin's Observations in South America aka Biogeography



- Species in S. America were related, but distinctly different from European species from which he was familiar
- The fossils didn't match European fossils
- S. American fossils were related to S. American species, implying some sort of descent

The Galapagos

- Small islands off the coast of S. America
- Unique species that were related to mainland species
- The different islands had different varieties of a species

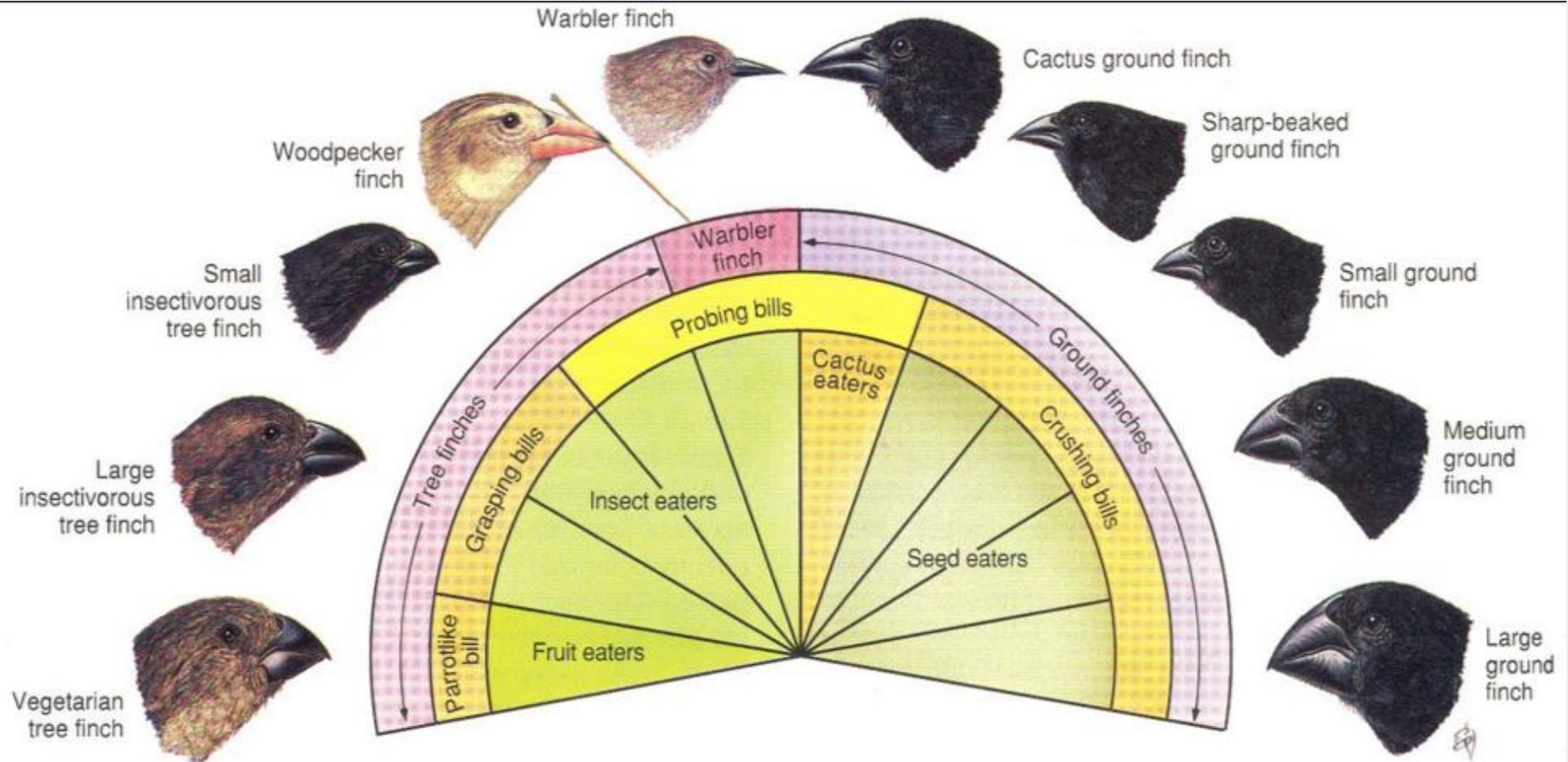


Darwin's Finches

- Darwin noticed each island had unique finches that seemed perfectly suited to its own habitat

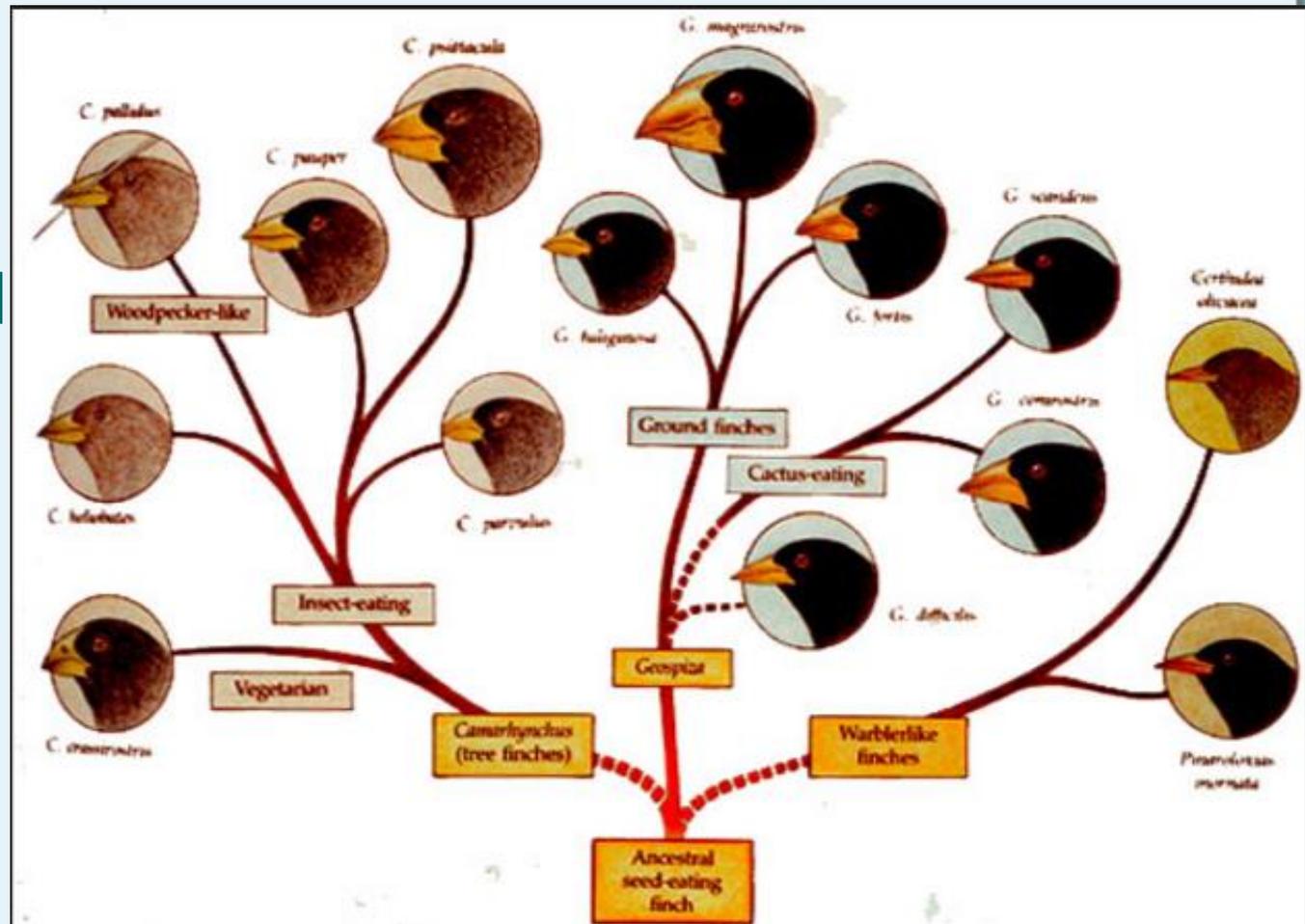


Darwin's Finches

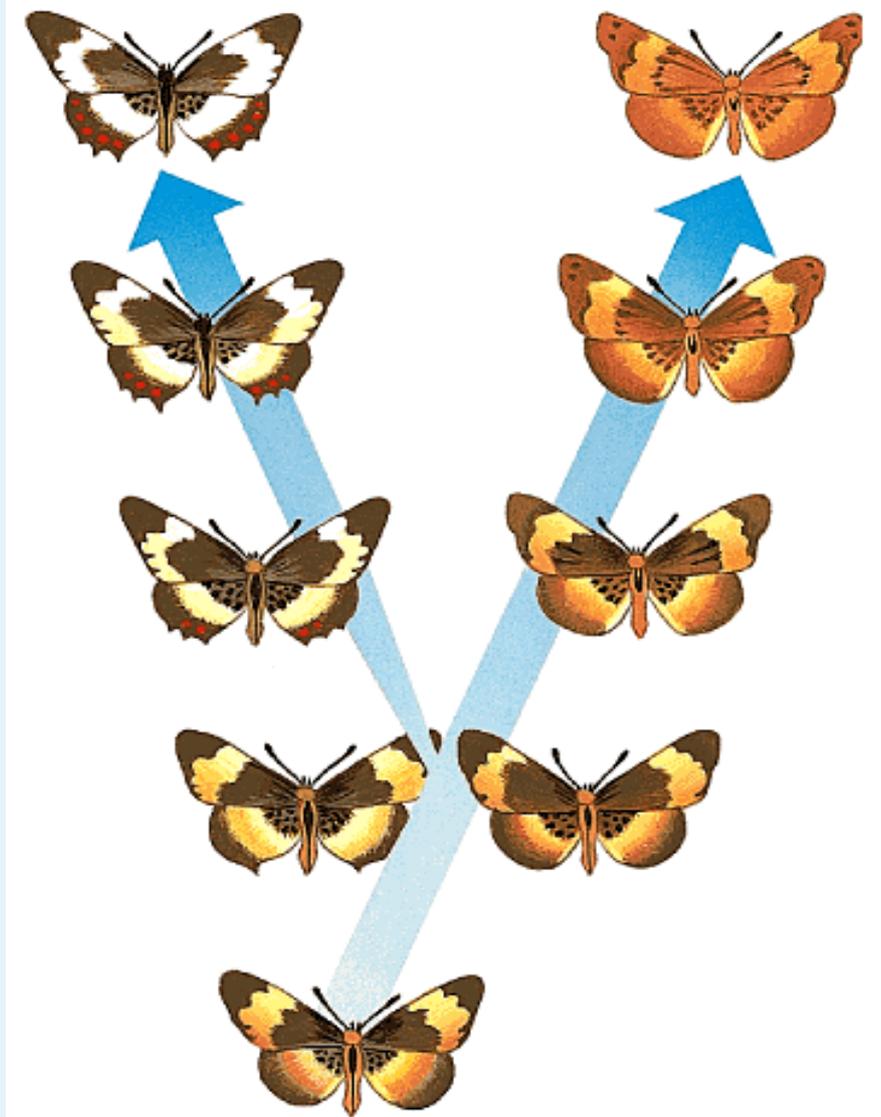


Darwin's Reasoning

- Darwin speculations:
- Could finches have descended from mainland?
- Island speciation?

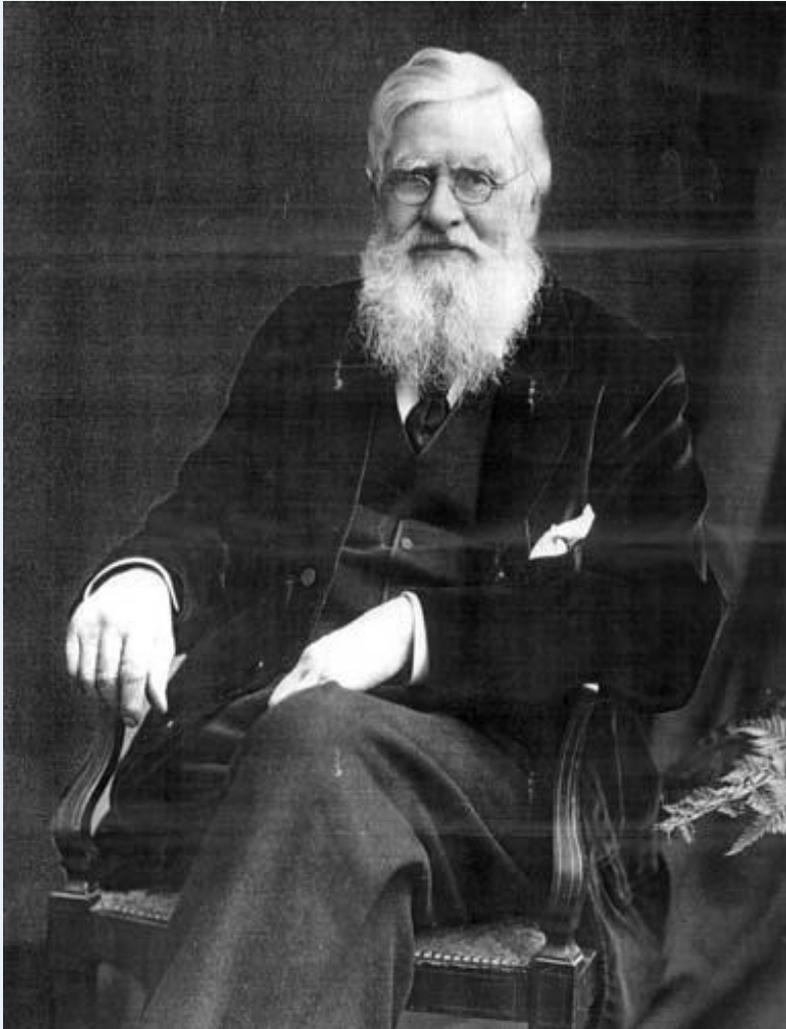


Darwin's Reasoning



Gradual accumulation of adaptations to an environment could lead to new species **OVER LONG TIME PERIODS**

The First Published Work on Natural Selection



- Was not by Darwin!
- Alfred Wallace published first
- This led to Darwin's writing of *The Origin of Species*

The Importance of Strong Research!

- Evolution caught on very quickly among biologists
- Darwin had incredible amounts of evidence and a very logical and coherent theory
- He also was a well respected naturalist
- Darwin was much luckier than Copernicus or Galileo
 - The importance of strong, well documented research and showing your work!

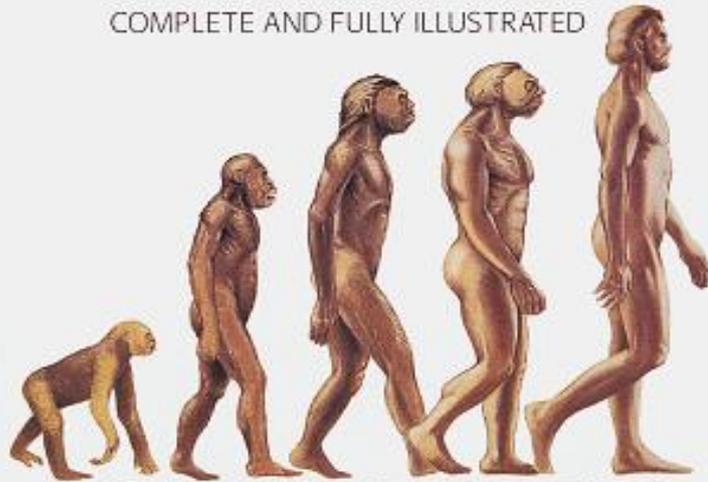
A Note On Theory

- “A scientific theory is an explanation or model used to explain observations or experimental results about an observed phenomenon.”
- Not a haphazard guess. A theory must survive scientific scrutiny, experimentation and review. I.e. the Theory of Gravity
- Very different from a hypothesis

The Two Major Features of *The Origin of Species*

THE ORIGIN OF SPECIES

COMPLETE AND FULLY ILLUSTRATED

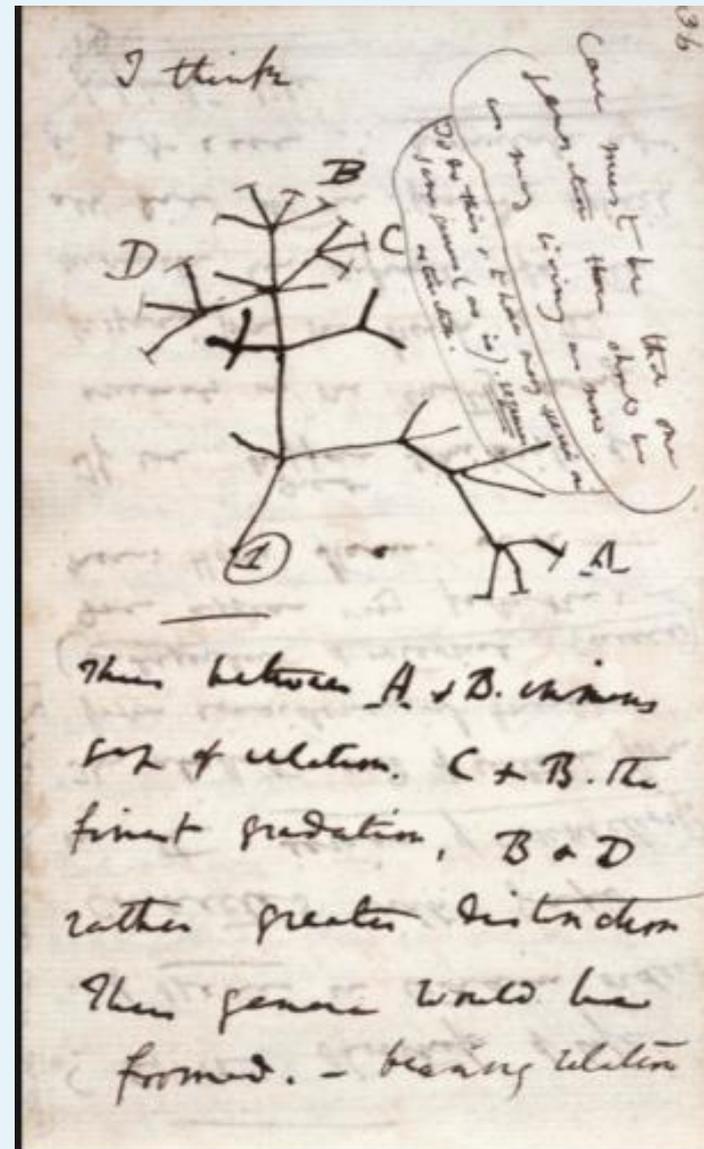


CHARLES DARWIN

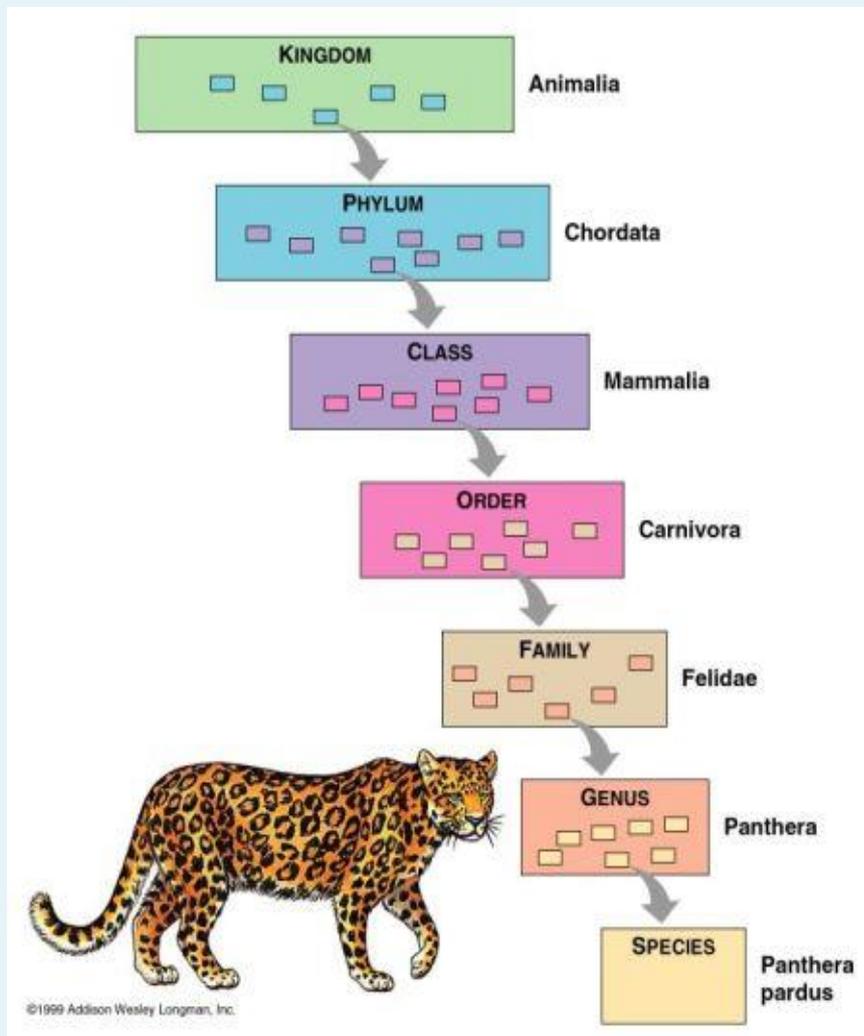
- Descent with Modification
- Natural Selection as the main mechanism

Descent with Modification

- All species originated from a single species
- Over time slight modifications in offspring lead to all of the diversity found on Earth
- The Tree of Life



Taxonomy Fit Darwin's Theory



- Unknowingly, Linnaeus' theories on taxonomy supported Darwin
- Organisms can be grouped based on common ancestors
- More similar organisms are likely to be more closely related

Natural Selection

- Darwin's main focus – the mechanism
- In my humble opinion, the most important theory in all of science

Natural selection, in a nutshell:



Observation 1: Species would increase in population exponentially if every individual reproduced successfully

Observation 2: Populations tend to remain relatively stable

Observation 3: Resources in the environment are limited and cannot support unlimited growth

Inference 1: There is a struggle for survival and reproduction – not everyone succeeds

Observation 4: Individuals within a population are slightly different and make some more **enabled to survive and reproduce**

Observation 5: Many of the differences are heritable

Inference 2: Survival and reproduction depends on genetic traits

Inference 3: Traits that help an organisms survive and reproduce are more likely to become common in the population.

NATURE “SELECTS” WHICH GENES/TRAITS
BECOME COMMON

My Quick Version

Everyone Wants to Reproduce (fitness)

They Don't

They Can't

There is competition

Everyone is different

The differences are genetic

Survival (and reproduction) depends on genes

Adaptive genes survive and become common

Natural Selection Summarized



- Traits that help organisms survive and reproduce become more common
- Thus the population changes over time

NOTE

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WORLD of COW
By Stik



- ONLY traits that help survival or reproduction
- NOT helpful traits or convenient traits
- ONLY acts on traits that are already present

Darwin vs. Lamarck

- **Darwin**

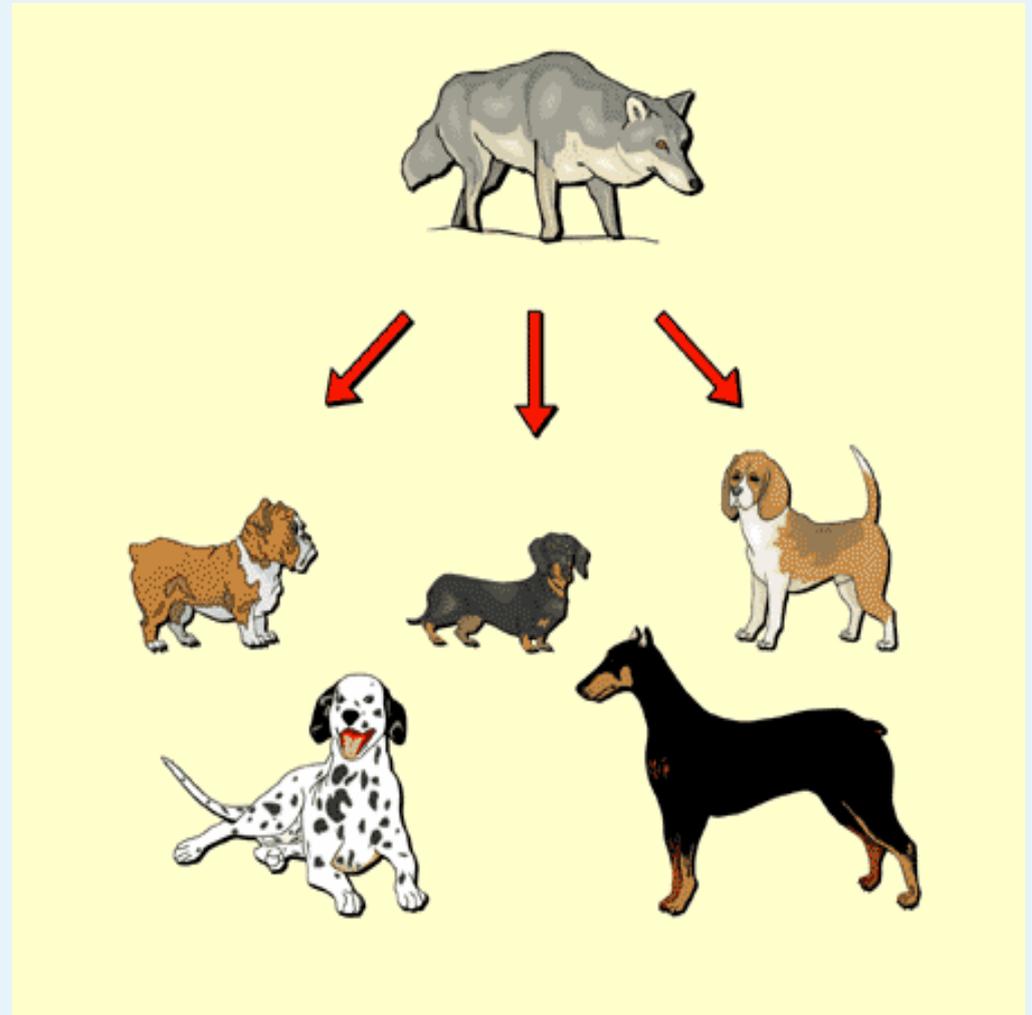
- Adaptation to specific environment
- Only heritable traits
- Natural selection (short giraffes don't make as many babies)

- **Lamarck**

- Progression towards perfection
- Acquired characteristics
- Inner drive by the organism (i.e. giraffe stretches to reach tree)

Artificial Selection

- We've seen this happen with dog breeding
- It seems reasonable that natural selection can change species over a longer period



Darwin saw Natural Selection as Slow and Gradual

- Over many thousands of generations small changes lead to significant evolution
- Evolution takes millions of years and is constant – species are always evolving at a steady rate
- Most debated part of evolution

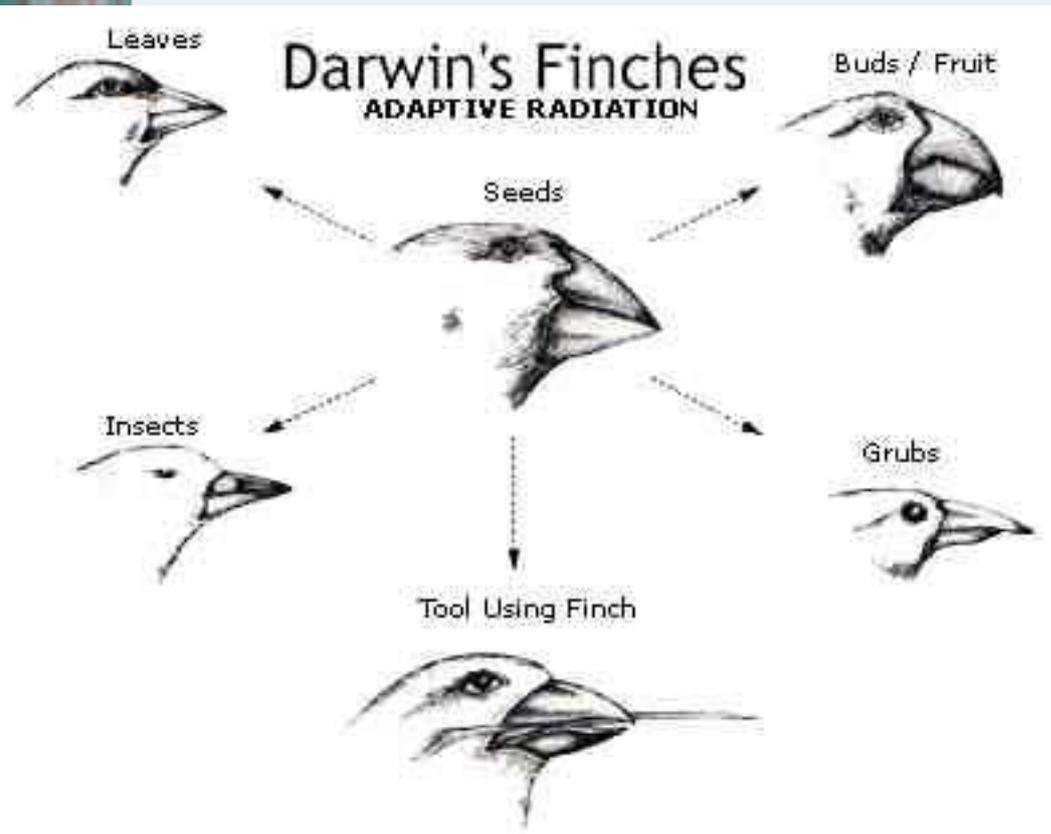
Subtleties of Natural Selection

- Does not create new traits
- Only heritable traits become common
- It's not about individuals trying to survive



Natural selection does not grant organisms what they "need".

Ex. Natural Selection in Darwin's Finches



- Different beaks are suited for different types of seed
- Each beak type became common in an area where those seeds were found
- Natural selection didn't create the beaks

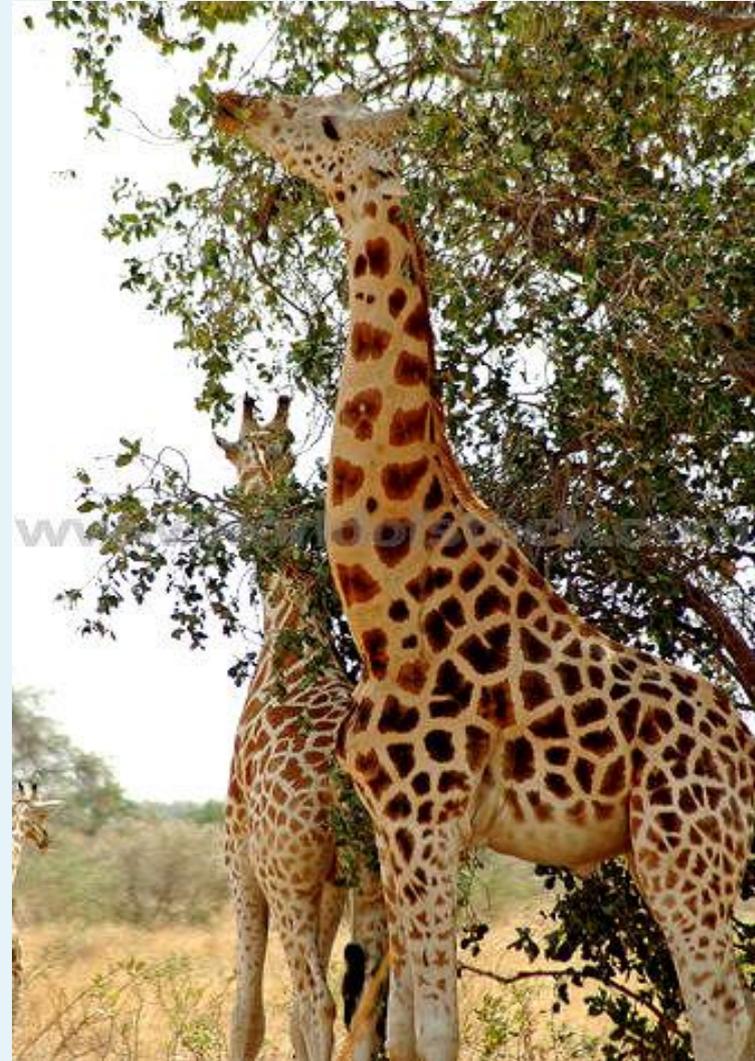
Where Do New Traits Come From?



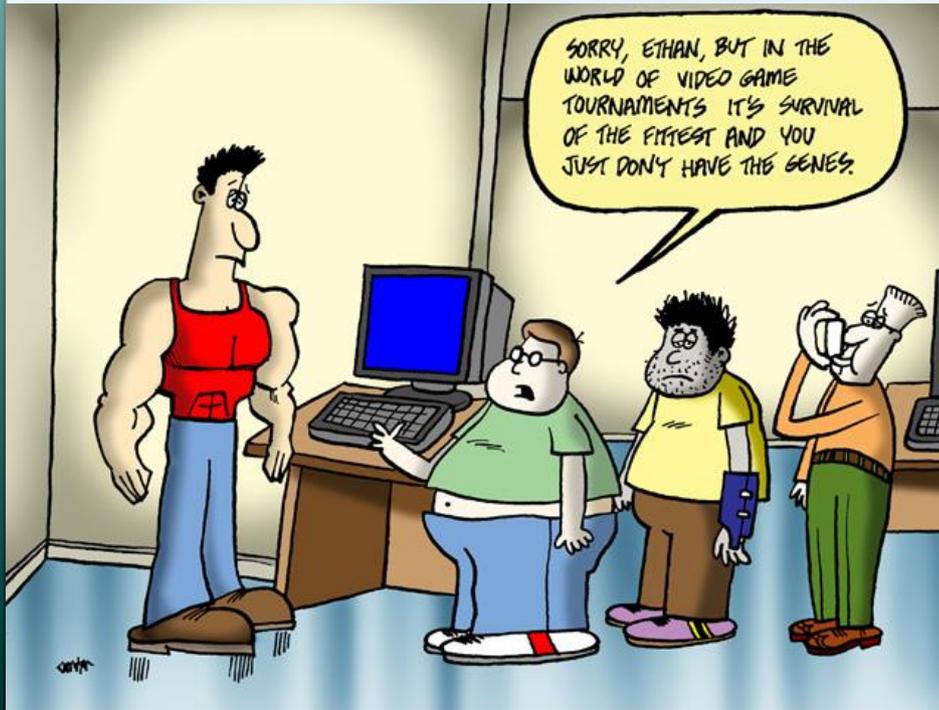
- Mutations!
- Spontaneous accidental changes in an organism's DNA
- Very rarely beneficial, but does occur
- Or new combinations of existing genes

Natural Selection is Well-Documented

- There is very little scientific debate that natural selection occurs
- The questions are more on how quickly it occurs and if other mechanisms can cause evolution



Survival of the Fittest?



- “Fit” means most capable of reproduction
- Does not mean bigger, stronger, faster, smarter
- Survival of the most fit genes/traits

RAFT Assignment

Role: Charles Darwin

Audience: Jean Baptiste Lamarck

Format: You decide (letter, song, poem, tweet, comic, interpretive dance, video etc.)

Topic: Correcting Lamarck on his theory of evolution. In the process thoroughly explain natural selection and descent with modification