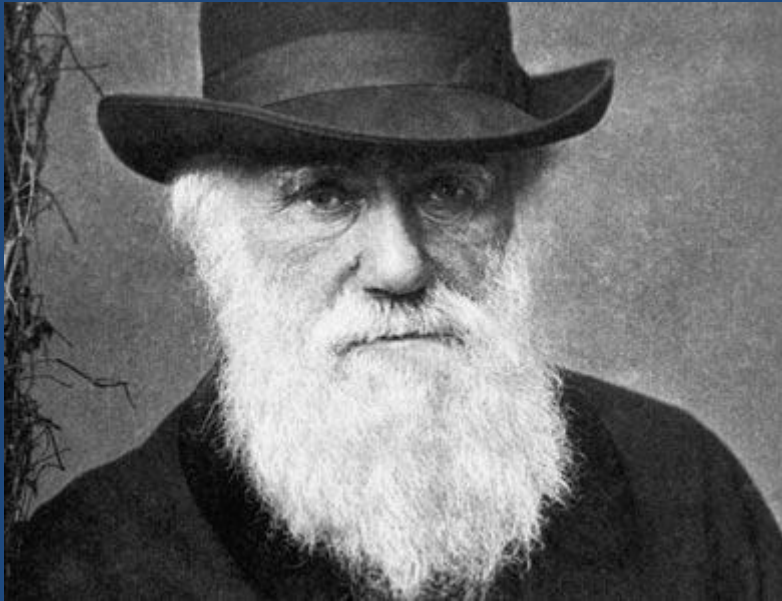


# Lecture 3: History and Development of Evolutionary Theory—Darwin and Beyond

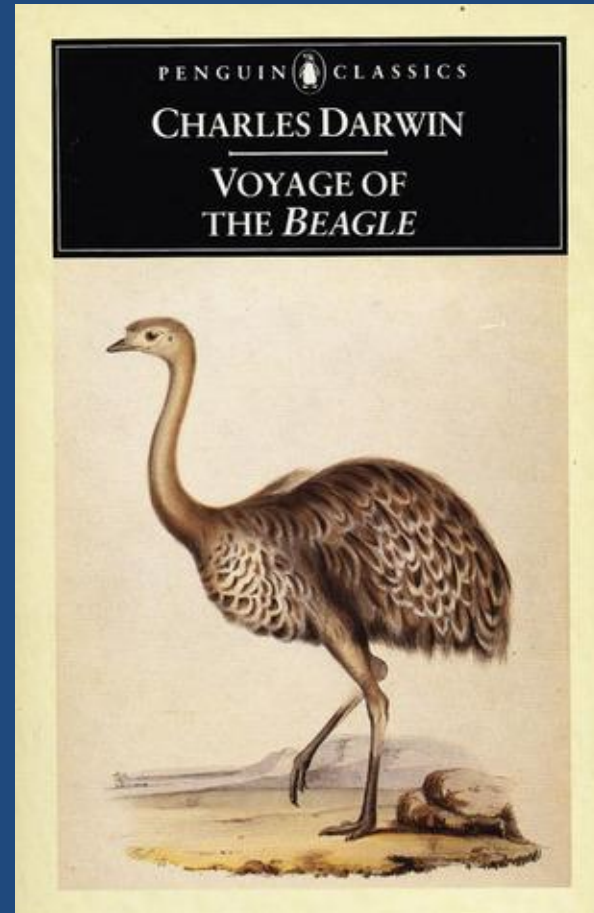
# The Point

- The theory of evolution is an explanatory framework that makes sense of observable facts about the biological world; it explains the diversity of life, the geographical distribution of species, and how species change over time in response to changing environmental conditions.

# Darwin's Theory of Evolution by Natural Selection



<http://media.smithsonianmag.com/images/Charles-Darwin-1880-631.jpg>



# Voyage of the Beagle

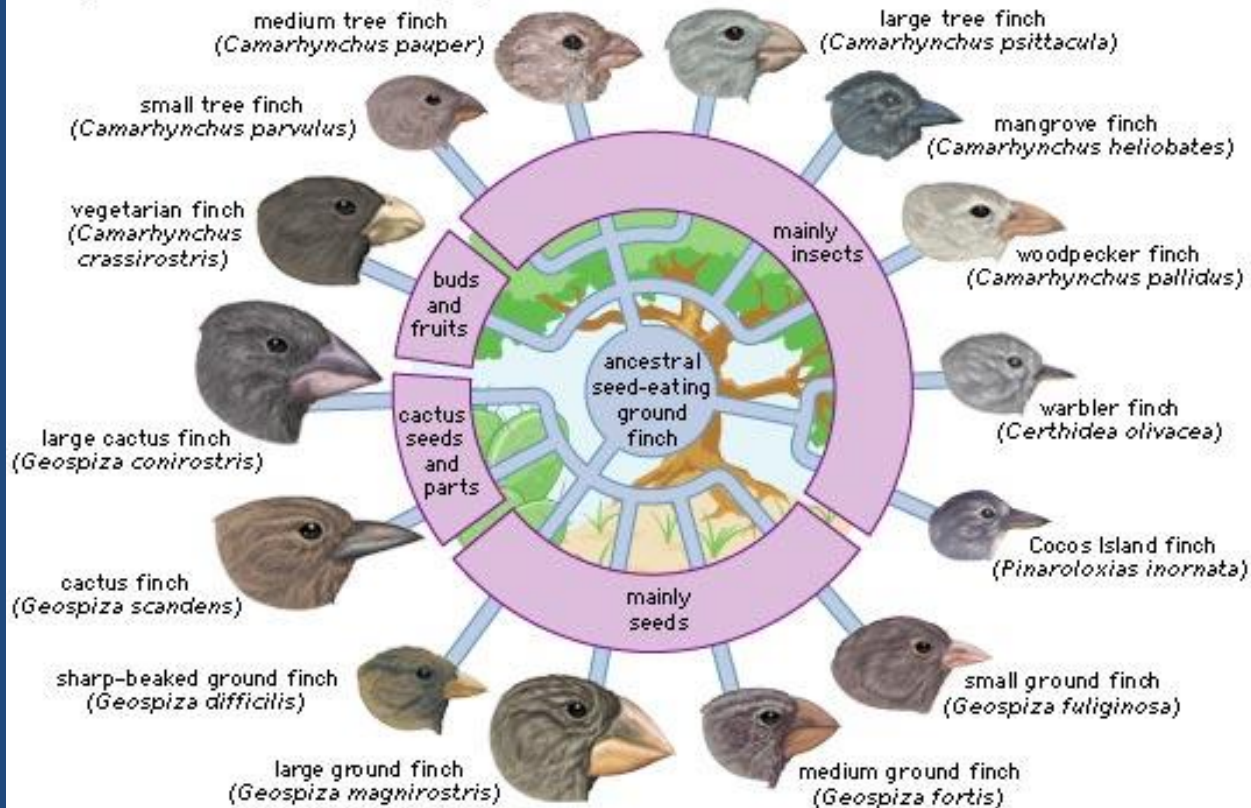


# Voyage of the Beagle

- In 1831, Darwin was hired as the naturalist aboard the survey ship, *HMS Beagle*. His task was to observe and collect specimens of plants, animals, rocks, and fossils throughout the journey. He recorded his observations and later these formed the foundation for his reconsideration of the idea of fixity of species and the development of the theory of evolution by natural selection.

# Darwin's Finches

## Adaptive radiation in Galapagos finches



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[http://www.tokresource.org/tok\\_classes/biobiobi/biomenu/options\\_folder/D2\\_speciation/54911-004-B661673C.jpg](http://www.tokresource.org/tok_classes/biobiobi/biomenu/options_folder/D2_speciation/54911-004-B661673C.jpg)

# Darwin's Finches

- Darwin observed that the 13 species of finch that occupied the various Galápagos Islands were all very similar to each other but differed in their beak size and shape. This ultimately led him to suggest that all of these species of bird were descended from a common ancestor, a common ground finch from South America, that was blown across to the islands and *adapted* to the different environments on the islands. The differences in diet between the finches explain the differences in their beaks.
- This is a classic example of *adaptive radiation*.



# Darwin's Finches

- **Adaptive radiation**
  - Rapid expansion and diversification of organisms into new ecological niches; Occupation of different ecological niches by closely related species
- **Ecological niche**
  - Position within the environment—diet, habitat, activity pattern, etc.



# More Key Terms

- **Evolution**—a change in the genetic make-up of a population over time
- **Natural selection**—the primary mechanism of evolution that refers to changes in the frequencies of certain traits in populations due to differential reproductive success between individuals
- Necessary and Sufficient Conditions for Natural Selection
  - Overproduction of offspring, leading to resource competition
  - Variation within a population with some variants being better able to obtain resources than others
  - Variation is heritable

# More Key Terms

- **Reproductive success**—the number of offspring an individual produces and rears to reproductive age. This represents an individual's genetic contribution to the next generation.
- **Differential reproductive success**—the result of natural selection; some individuals produce more offspring than others
- **Fitness**—a measure of relative reproductive success of individuals. Fitness can be measured by an individual's genetic contribution to the next generation compared to that of other individuals.

# Even MORE Key Terms!

- **Selective Pressures**—forces in the environment that influence reproductive success in individuals (includes the physical environment, other species in the area, social environment )
- **Adaptation**—an evolutionary shift in a population due to environmental pressures

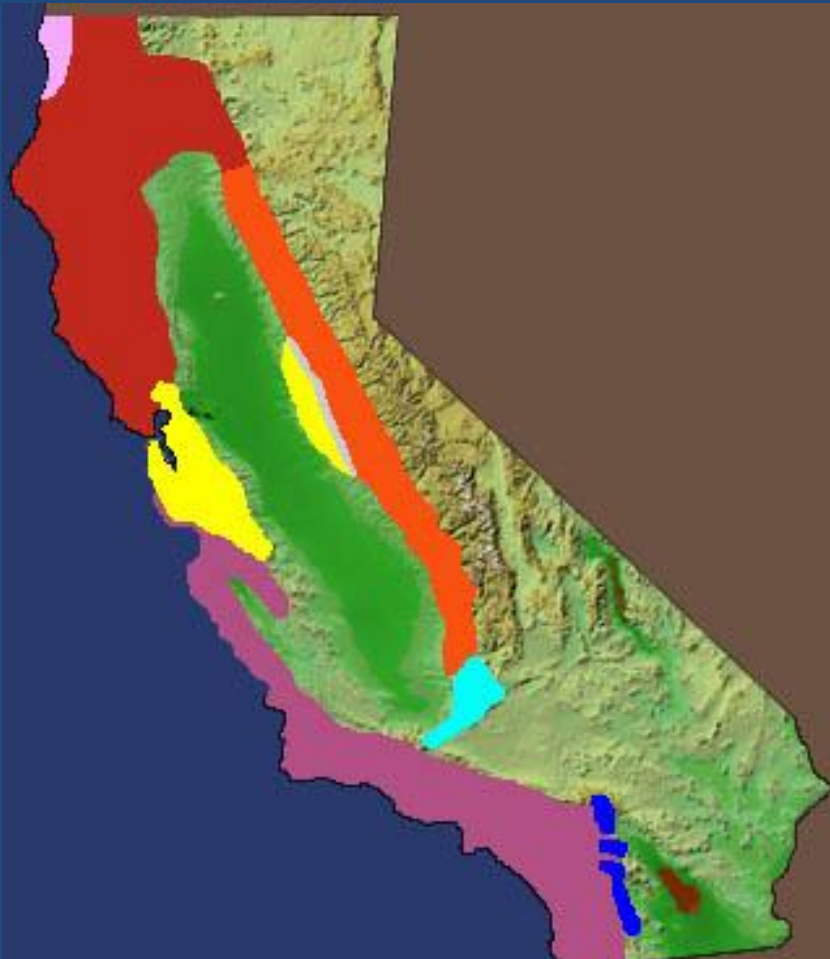
# Key Points about Natural Selection and Evolution

- Natural selection acts on individuals; populations evolve.
  - Natural selection only acts on characteristics that affect reproduction.
- Natural selection is NOT about “survival of the fittest”.
  - It is NOT about which individuals *survive* but which individuals survive to reproduce, produce the most offspring, *and* have the most offspring that *also survive to reproduce*.
  - It’s more like “more offspring for the better adapted”, which is not nearly as catchy.
- The environment determines what traits are beneficial or harmful.

# California Salamander

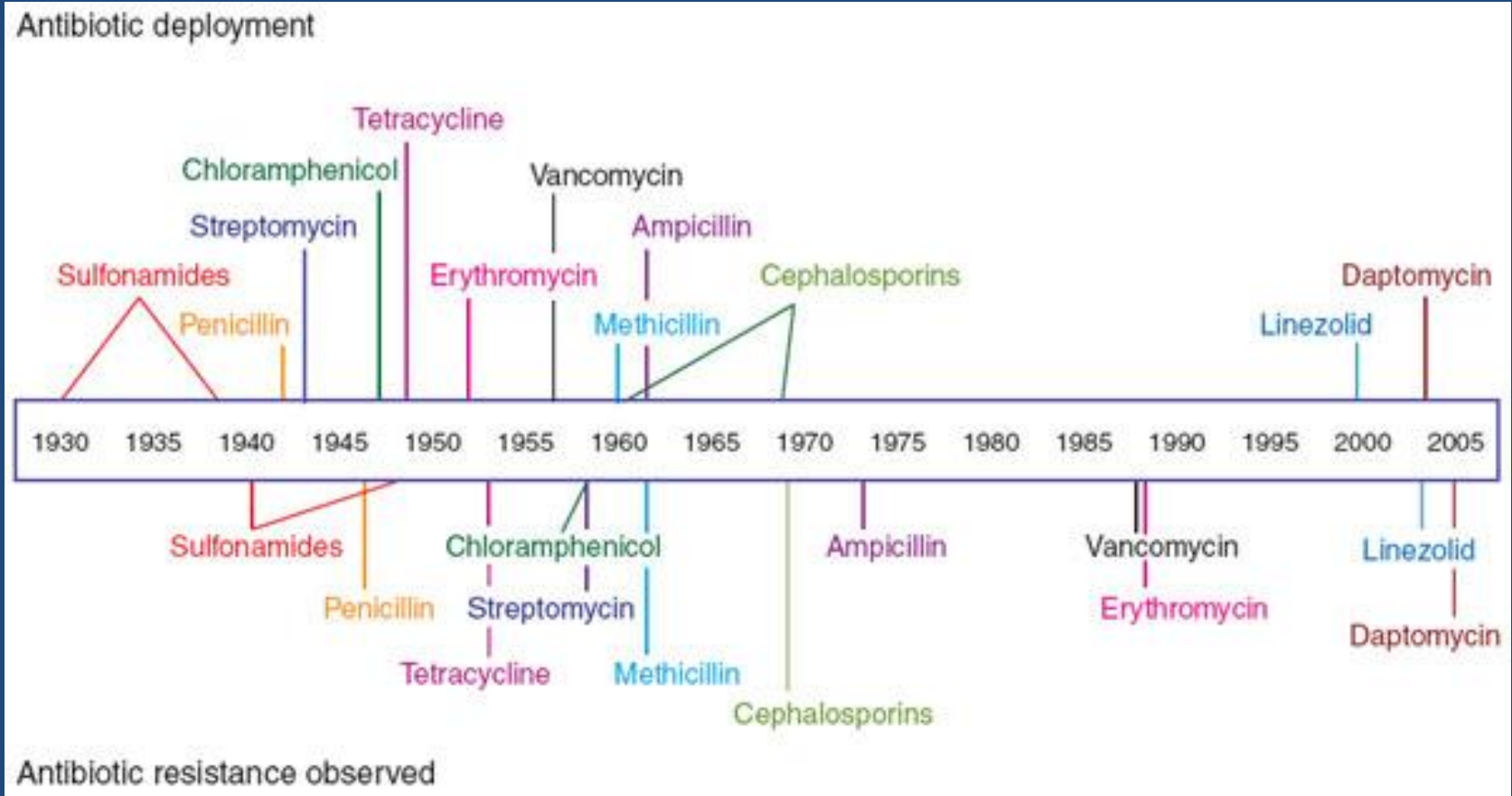
- <http://www.pbs.org/wgbh/nova/evolution/evolution-action-salamanders.html>

# California Salamander



-  *Ensatina eschscholtzii croceater* - Yellow-blotched Ensatina
-  *Ensatina eschscholtzii eschscholtzii* - Monterey Ensatina
-  *Ensatina eschscholtzii klauberi* - Large-blotched Ensatina
-  *Ensatina eschscholtzii oregonensis* - Oregon Ensatina
-  *Ensatina eschscholtzii picta* - Painted Ensatina
-  *Ensatina eschscholtzii platensis* - Sierra Nevada Ensatina
-  *Ensatina eschscholtzii xanthoptica* - Yellow-eyed Ensatina
-  Intergrades

# Evolution In Action





# Evolution in Action

- Using the Grants' work with the finches (Weiner and video) and the sockeye salmon (Weiner) as examples, answer the following questions:
  - What trait is under selection?
  - In both examples, there is a change in the environment. What are the relevant selection pressures from the environment?
  - Under each environmental condition, which individuals in the population are better adapted? How does this lead to differential reproductive success?
  - Using your answers to these questions and the relevant key terms, explain *how* these examples illustrate evolution in action.

# Evolution in Action

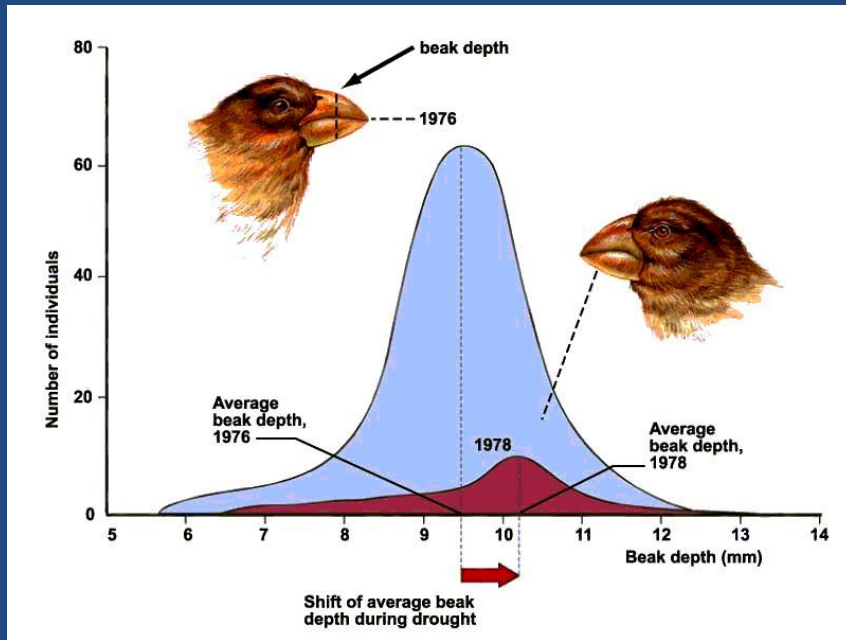


Sockeye Salmon in Weiner Article

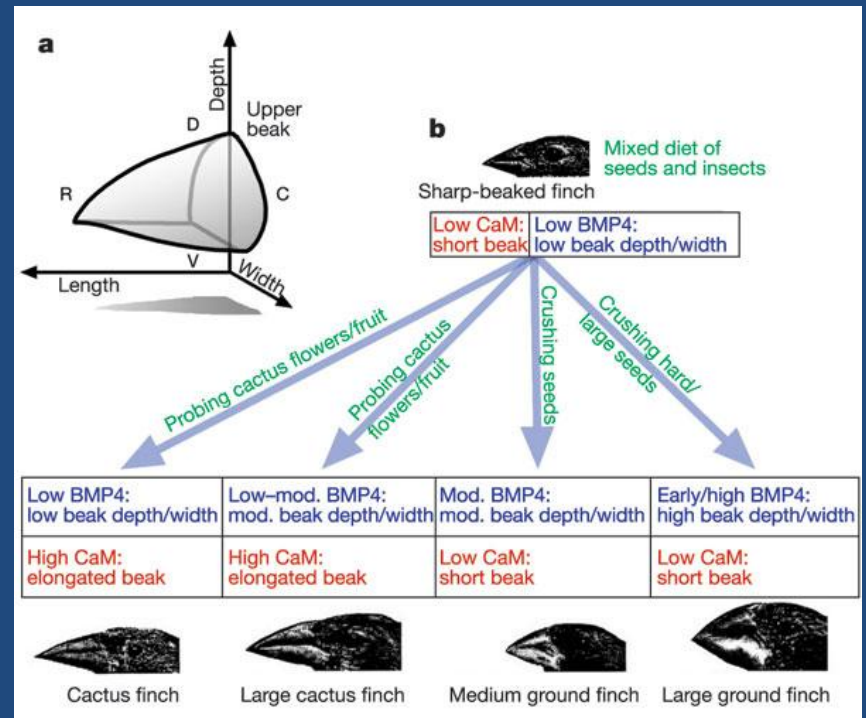
<http://www.sierracollege.edu/ejournals/jscnhm/v2n2/EvolutionAction.html>



# Evolution in Action



<http://www.csus.edu/indiv/l/loom/wk%2015/finches.JPG>



<http://www.nature.com/nature/journal/v442/n7102/images/nature04843-f4.2.jpg>

# Common Origins of All Life

- One of the most powerful predictions of evolutionary theory is that all life shares common origins. That is, everything that is living today the planet Earth shares a common ancestor. Scientists refer to this common ancestor as the Last Universal Common Ancestor (LUCA). In the 3.8 billion years there has been life on earth, there has been *gradual adaptive divergence*, which has led to the great diversity of life on this planet.

# Common Ancestry

