

# Natural Selection

Mr. Modafferi

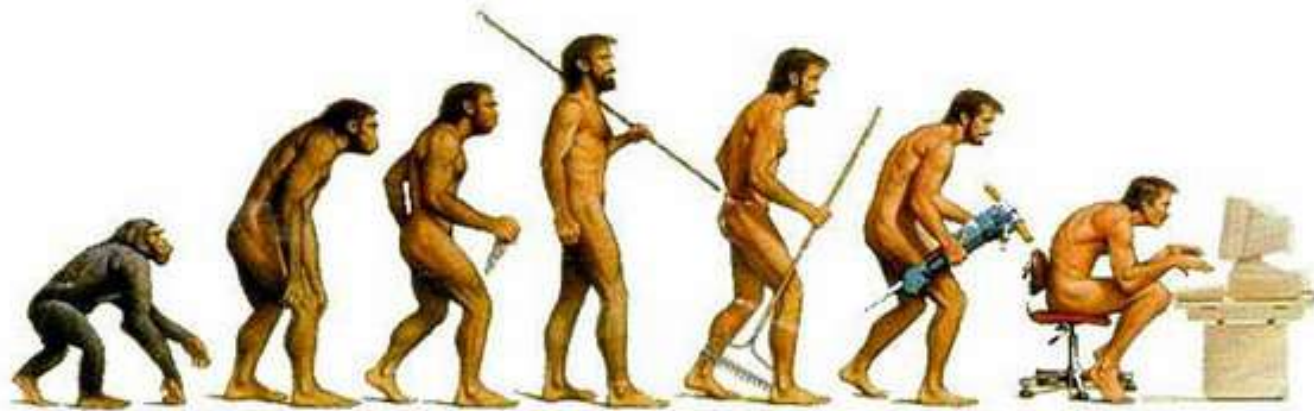
# Do Now

- Define Natural Selection

# Theory of Natural Selection

- Organisms **better adapted** to the environment are “**selected**” and survive, passing on their favorable traits to their offspring

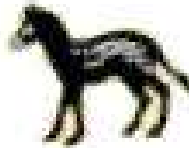
# Species evolve over time



# Example of Evolution:



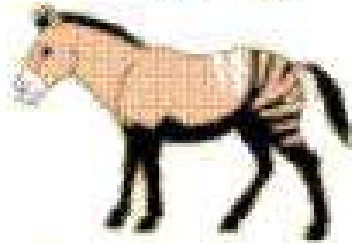
Hyracotherium  
(50 mya)



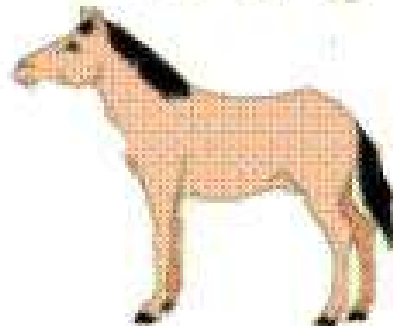
Mesohippus  
(25 mya)



Hipparion  
(8 mya)



Pliohippus  
(4 mya)



Equus  
(recent)

# Think

- What are some reasons for a species to change over time?
- What environment factors would affect a organism's population?



# 6 Points of Darwin's Theory

- 1) **Competition**
- 2) **Overpopulation**
- 3) **Speciation**
- 4) **Variations**
- 5) **Adaptations**
- 6) **Natural Selection**

# Competition

- Organisms compete for a finite supply of the resources
  - Example : food, water, shelter
- Competition keeps the population under control





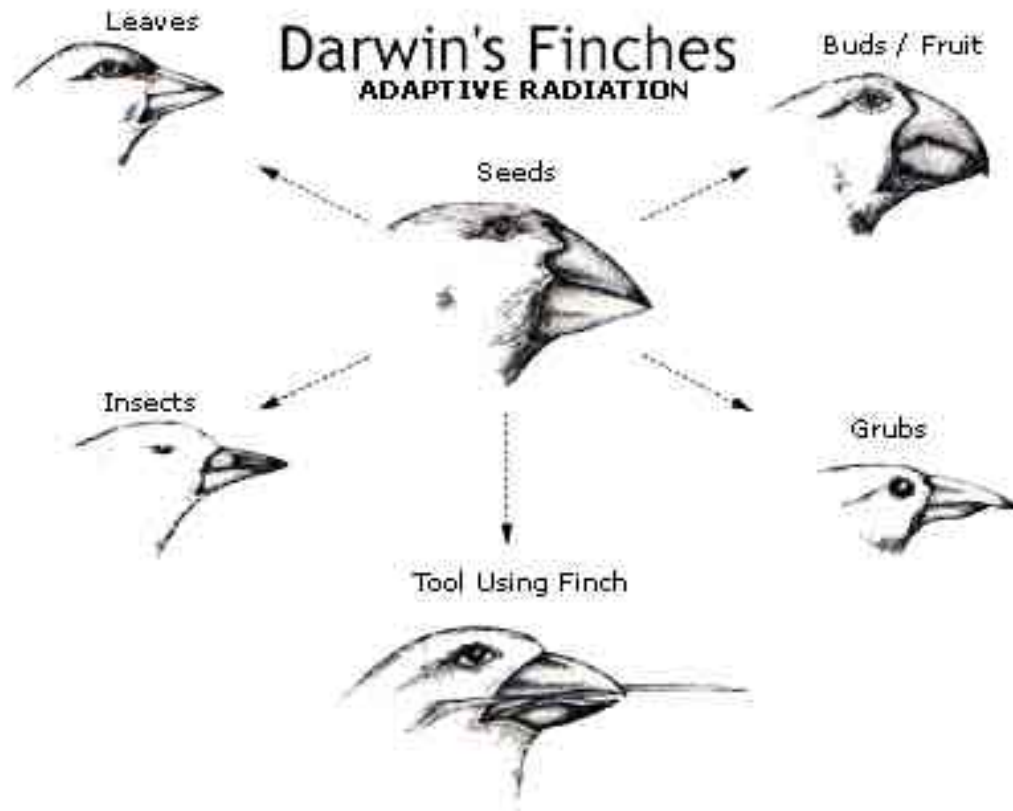
# Overpopulation

- All organisms produce more offspring than can survive



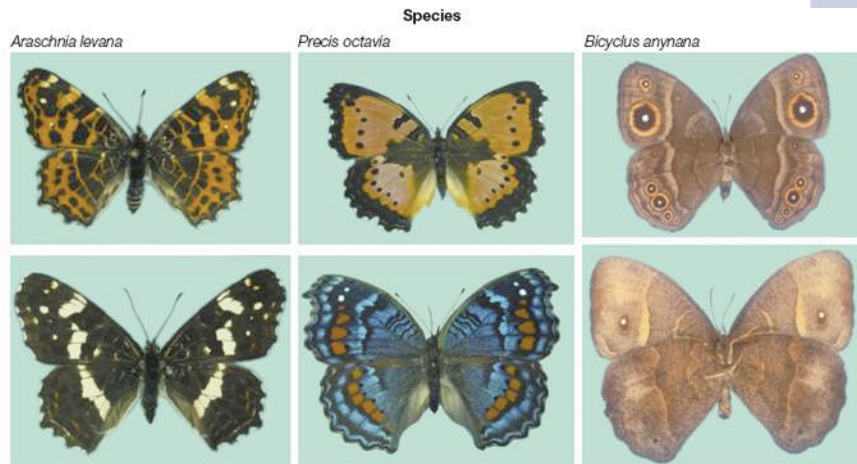
# Speciation = New Species!

- Eventually a new species will develop as variations accumulate in a population over many generations.



# Variations - Differences

- Differences among organisms of the same species
  - Differences in the ability:
    - to get food
    - to escape enemies
    - to find a mate



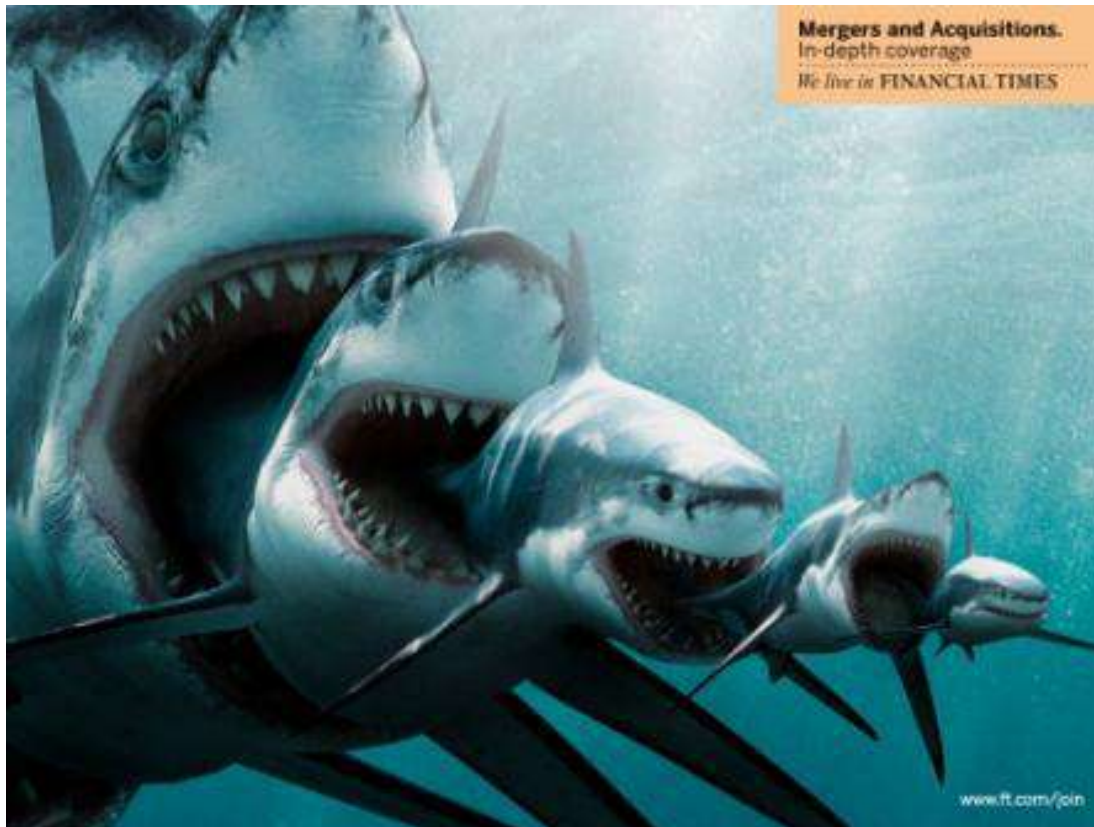
# Adaptation

- Inherited traits that enable an organism to survive



# Natural Selection

- The environment “**Selects**” organisms with optimal traits to be parents of the next generation.
- SURVIVAL OF THE FITTEST



# Do Now

- Please complete “A Close Look at Darwin’s Finches” worksheet

# Rate of Evolution

## 2 Models of Evolution:

- Gradualism
- Punctuated Equilibrium

# Gradualism

- Belief that species arose gradually over time
  - Thousands and even millions of years
- Darwin supported this theory







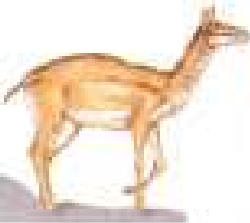










# Punctuated Equilibrium

- States that a species stays the same for extended periods of time
- Then, over the course of a few hundred years rapid changes take place
- PE is **supported by the fossil record** because there are few transitional forms

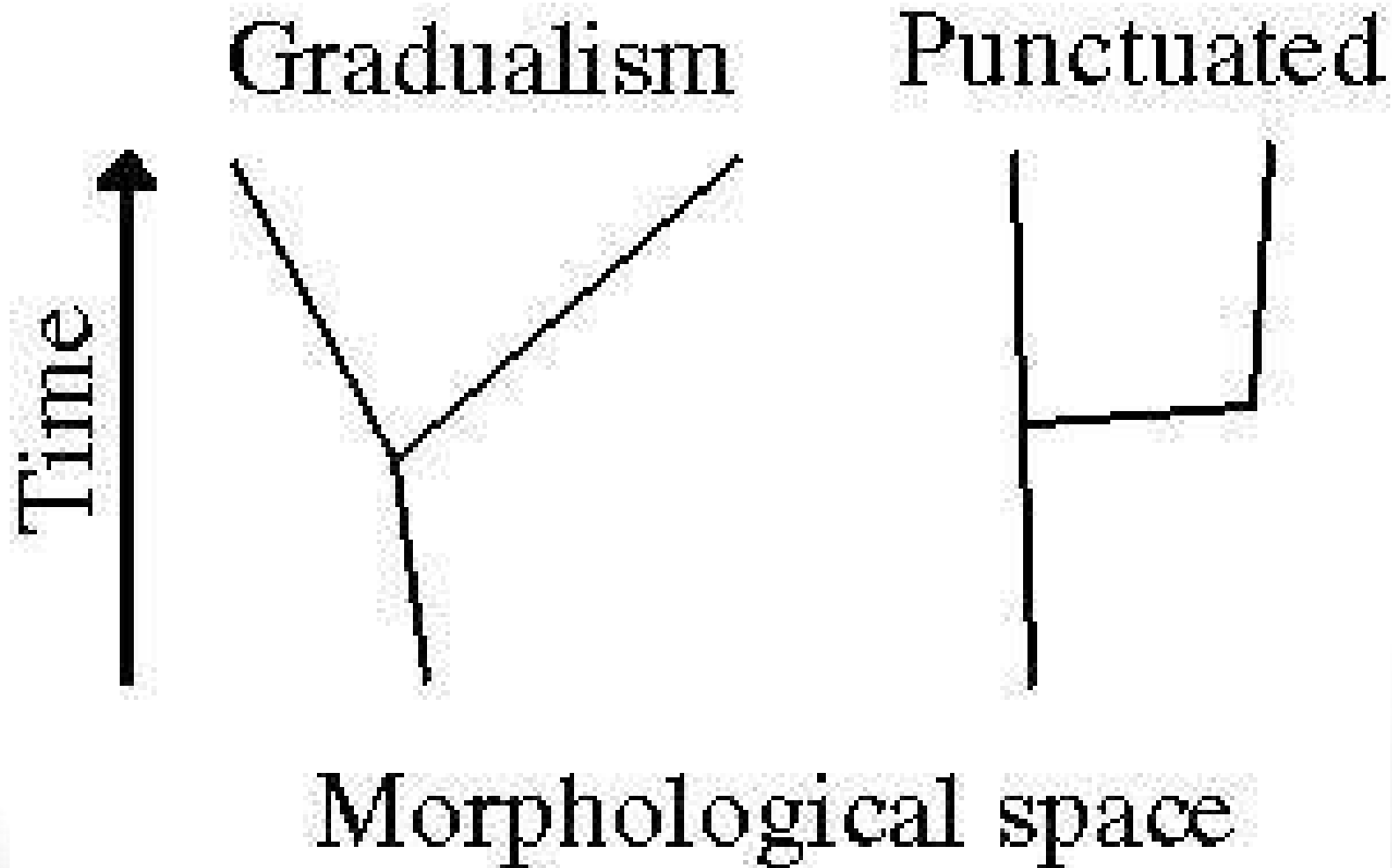
# Punctuated Equilibrium

**Table 15.1**

Fossils are used by scientists to understand how camels evolved.

| Table 15.1 Camel Evolution |   |   |   |   |   |
|----------------------------|---|---|---|---|---|
| Age                        | Paleocene<br>65 million<br>years ago  | Eocene<br>54 million<br>years ago   | Oligocene<br>33 million<br>years ago  | Miocene<br>23 million<br>years ago  | Present   |
| Organism                   |  |    |   |    |    |
| Skull and teeth            |   |   |  |   |   |
| Limb bones                 |   |  |  |  |  |

# Gradualism Vs. PE



# Gradualism Vs. PE

| Gradualism | Punctuated Equilibrium |
|------------|------------------------|
|            |                        |
|            |                        |
|            |                        |

# Question of the Day

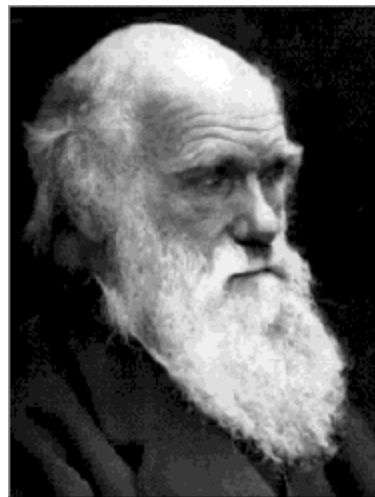
- How would Darwin account for the long neck of giraffes?
- HINT: Think of Natural Selection

# Modern Theory of Evolution

- Evolution happens to populations, not to individual organisms
- The modern theory combines **genetics** with Darwin's findings.

# A Weakness of Darwin's Theory of Natural Selection?

- He does not explain the genetic basis for variations within a species
  - How exactly did the traits get passed onto the offspring?



OH SNAP!

# Population Genetics

- A **population** is a group of organisms that belong to the **same species**; each organism has its distinct genetic make-up
- The **genetic make-up of the population changes over time**, and this allows the population to evolve

Same Species  
Different Genetic  
Make-up





# How does this genetic change occur?

- An **allele** is a form of a specific gene
  - Ex: eye color
- In a population, there are many different alleles

# Cont.

- The total of ALL the alleles present in a population is called the **gene pool**
- Over time, the allele frequencies found in the gene pool change as a result of natural selection
- Therefore, **evolution** is the gradual change of all the allele frequencies found in a population

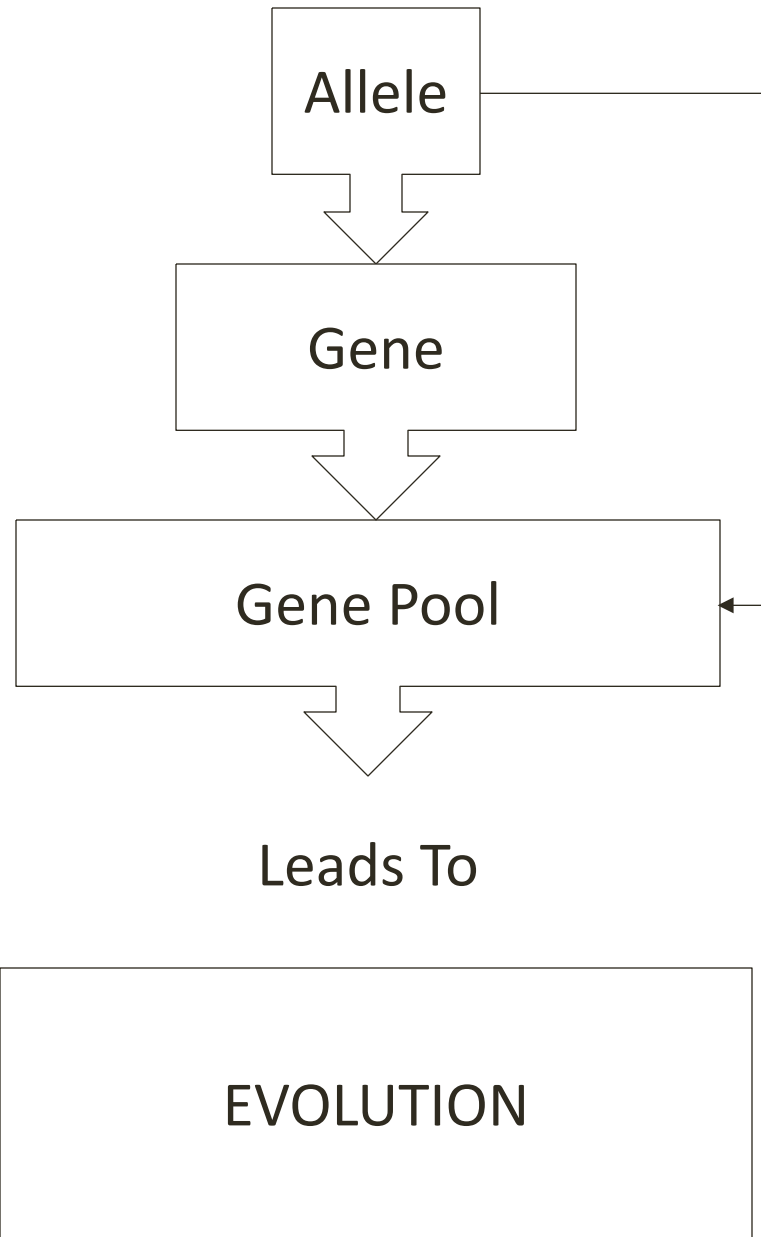
# Gene Pool



# Gene Pool – After Natural Selection



**EVOLUTION!!**



# Exit Slip

- Please write down on a separate piece of paper
  - 3 things you learned
  - 2 things you found interesting
  - 1 question you still have

# Do Now

- How do variations in a gene pool occur?



- Biologists can explain how variations occur
- The two main sources of genetic variation are:
  - Mutations
  - Gene Shuffling

# Genetic Sources of Variation

- Hugo De Vries introduced the idea of **mutation**
  - **Mutation** – a sudden change in hereditary material
- De Vries added this idea to Darwin's theory of evolution
  - It explained how new traits arose

# Mutation

- Is any change in a sequence of DNA
  - Occur because of mistakes in the replication of DNA or as a result of radiation, or chemicals in the environment
- Mutations can be good and bad
- [http://www.pbs.org/wgbh/evolution/educators/course/session4/explore\\_c.html](http://www.pbs.org/wgbh/evolution/educators/course/session4/explore_c.html)

# Genetic Recombination

- **Genetic Recombination** is the formation of new combinations of alleles during sexual reproduction
  - Traits from your mother and your father
  - Also called gene shuffling

# Genetic Drift

- Genetic drift is a change in the gene pool that is brought about by chance
- There may be certain alleles that only a few individuals have

# Migration

- Movement into or out of a population; **changes the gene pool**
- [http://www.pbs.org/wgbh/evolution/educators/course/session4/explore\\_d.html](http://www.pbs.org/wgbh/evolution/educators/course/session4/explore_d.html)

# Hardy-Weinberg Law - 1908

- States that if a population were to not evolve (exhibit an equilibrium of allele frequencies) then the following must be met:
  - 1) No Mutations – avoids any new alleles
  - 2) No gene flow can occur (no migration)
  - 3) Random mating must occur
  - 4) The population must be larger so that no genetic drift can cause the allele frequencies to change
  - 5) No selection can occur so that certain alleles are not selected for, or against.

# Adaptations and Natural Selection

- Adaptations give some advantage to an organism
- They may be structural or physiological
- [http://www.pbs.org/wgbh/evolution/library/01/2/l\\_012\\_02.html](http://www.pbs.org/wgbh/evolution/library/01/2/l_012_02.html)



# Camouflage

- Camouflage is an adaptation in which the organism has evolved to resemble the environment in which it is found
- These organisms blend in with the background



# Warning Coloration

- Some organisms have evolved bright vibrant colors which signal to predators
- These organisms are usually poisonous, or taste bad to predators



# Mimicry

- Some harmless organisms have evolved to look like dangerous organisms
  - This is called mimicry
- Ex: Monarch butterflies are inedible . Viceroy butterflies are edible, but they look like the monarch



Viceroy butterfly  
(The mimic)



Monarch butterfly  
(The model)



# Do Now

Complete the quiz

# Speciation

- Recall that speciation is the **formation of a new species**
- Each species is found in a **range**, or a particular region in the earth

# Isolation

- Isolation is when members of the same species are prevented from **interbreeding**
- **Geographic isolation** occurs when a population is divided by a natural barrier, such as a river or mountain



*A. harrisi*



*A. leucurus*



# Cont.

- As time progresses, each group will adapt to its environment and a new gene pool will arise
- Ultimately, the two groups will diverge into 2 distinct species, and they will no longer be able to interbreed
- This is referred to as **reproductive isolation**



*A. harrisi*



*A. leucurus*

# Kaibab Squirrel and Abert Squirrel

- A specific example of speciation by geographic and reproductive isolation
- The Grand Canyon acts as a natural barrier
- The 2 squirrels are similar in appearance, but are different species because they cannot interbreed



Kaibab Squirrel (North Rim)  
*Sciurus kaibabensis*

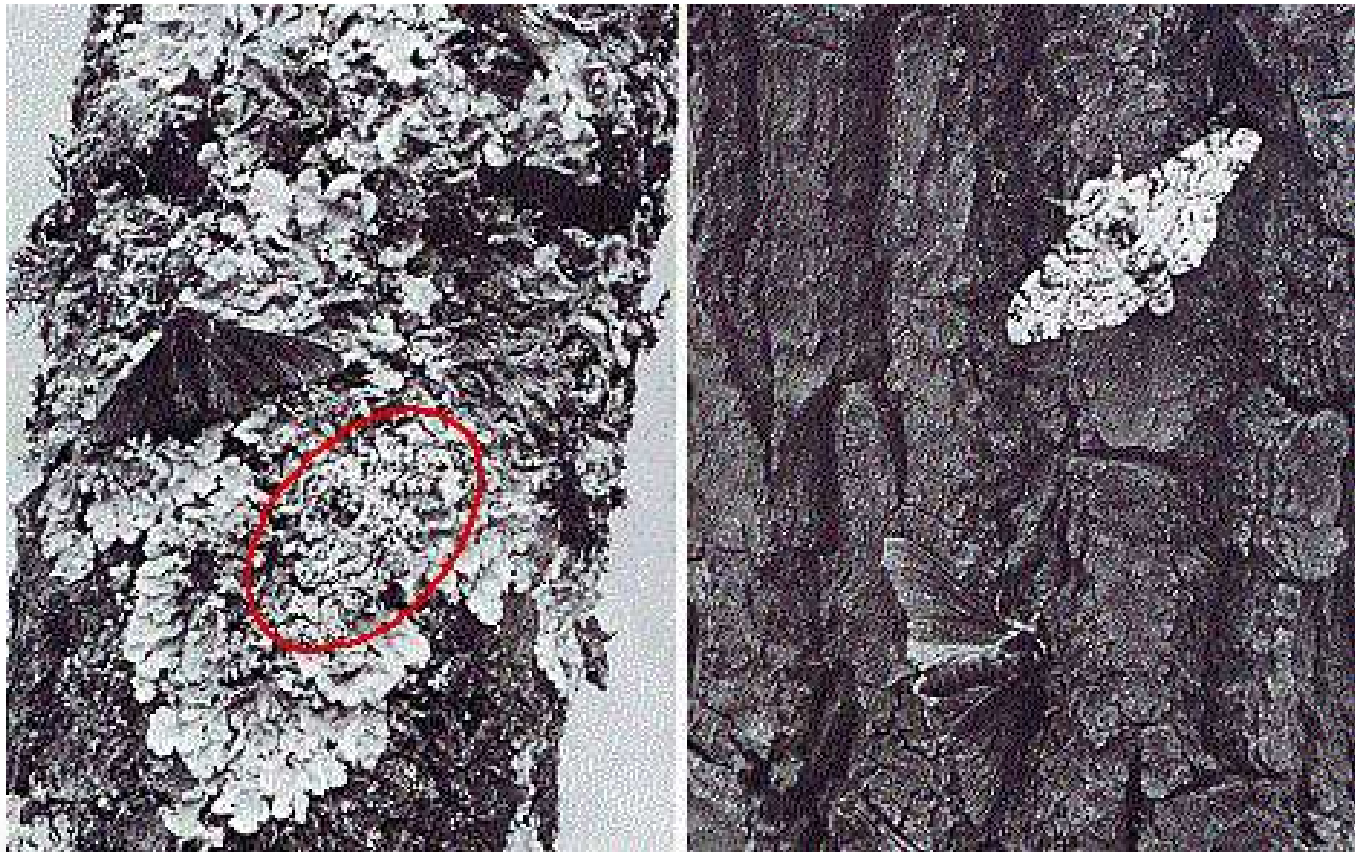


Abert Squirrel (South Rim)  
*Sciurus aberti*



# Observed Natural Selection

- Scientists have had the opportunity to study evolution in action
  - Example: peppered moth, bacteria, and insects



# Industrial Melanism

- Development of dark colored moths in a population exposed to pollution
- In England, before the industrial revolution the light moths were dominant
- During the industrial revolution, pollution caused the bark of trees to become dark, allowing the dark moths to survive

# Bacterial Resistance to Antibiotics

- **Antibiotics usually kill bacteria**
- **Once the use of antibiotics became common, there were some strains of bacteria that were resistant**

# Bacteria Resistance to Antibiotics

- **How did this resistance develop?**
  - **Bacteria developed resistance to it**
  - **In the large population of bacteria, few individuals had a mutation that made them resistant**
    - **By natural selection, the resistant strain survived by natural selection and was able to reproduce**

# Insects Resistance to DDT

- When DDT was first introduced, it was effective in killing insects that attacked crops
- However, a small portion of insects survived

# Continued

- These surviving insects, possessed a natural resistance to DDT
- By natural selection, the DDT-resistant insects survived and produced offspring that were resistant

# Quiz

- Lamarck
- Darwin
- Natural Selection
- Punctuated Equilibrium
- Gradualism
- Allele Frequencies

- <http://www.talkorigins.org/faqs/faq-intro-to-biology.html>



- A gene is a hereditary unit that can be passed on unaltered for many generations. The gene pool is the set of all genes in a species or population.
- The moths' color was primarily determined by a single gene. [gene: a hereditary unit] So, the change in frequency of dark colored moths represented a change in the gene pool. [gene pool: the set all of genes in a population] This change was, by definition, evolution.
- The increase in relative abundance of the dark type was due to natural selection
- Genes mutate. [gene: a hereditary unit] Individuals are selected. Populations evolve.
- Evolution is not progress. Populations simply adapt to their current surroundings. They do not necessarily become better in any absolute sense over time. A trait or strategy that is