# Speciation

Chapter 16

# 16-1 Genes and Variation

- How common is genetic variation?

# Variation and gene pools


- *Gene pool* – all genes present in a population
- *Relative Frequency* – the number of times an allele occurs in the gene pool, compared to other alleles

- *In genetic terms, evolution is any change in the relative frequency of alleles in a population.*

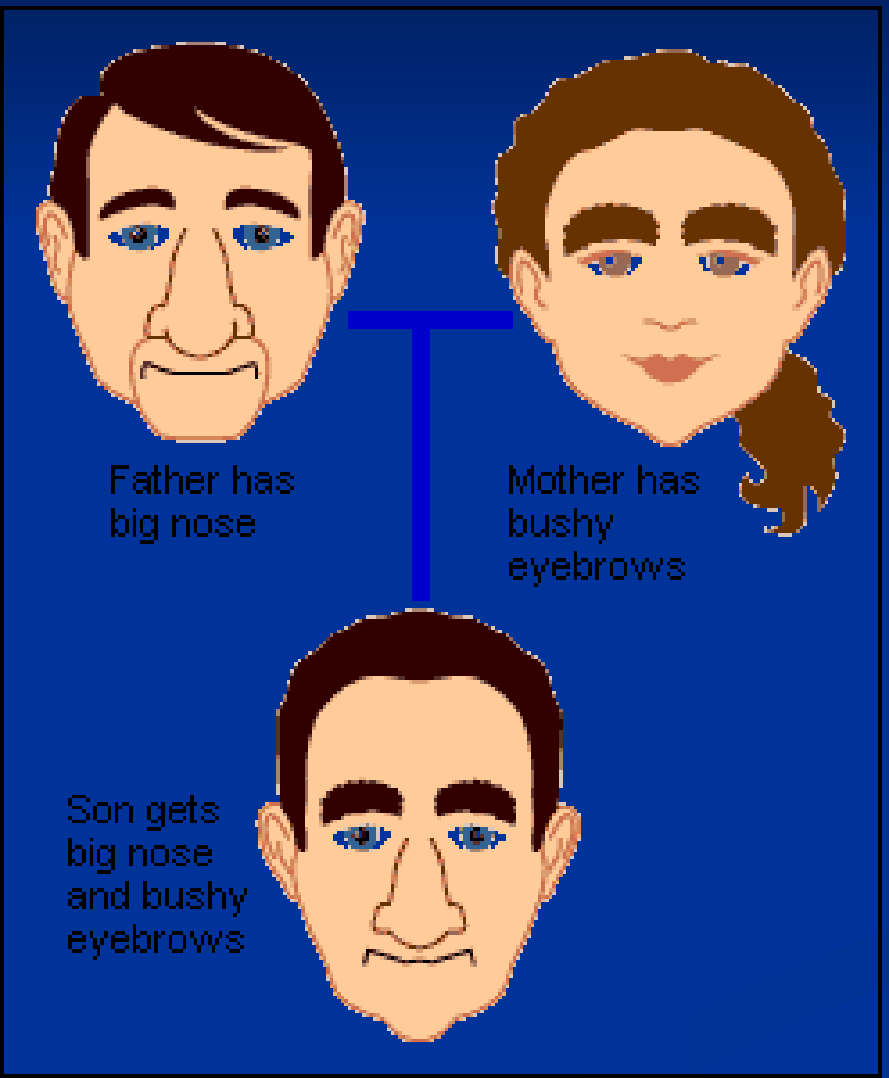
# Sources of Genetic Variation

- Scientists now recognize two main sources of genetic variation
  1. **Mutations**
  2. **Gene shuffli**

# Mutations

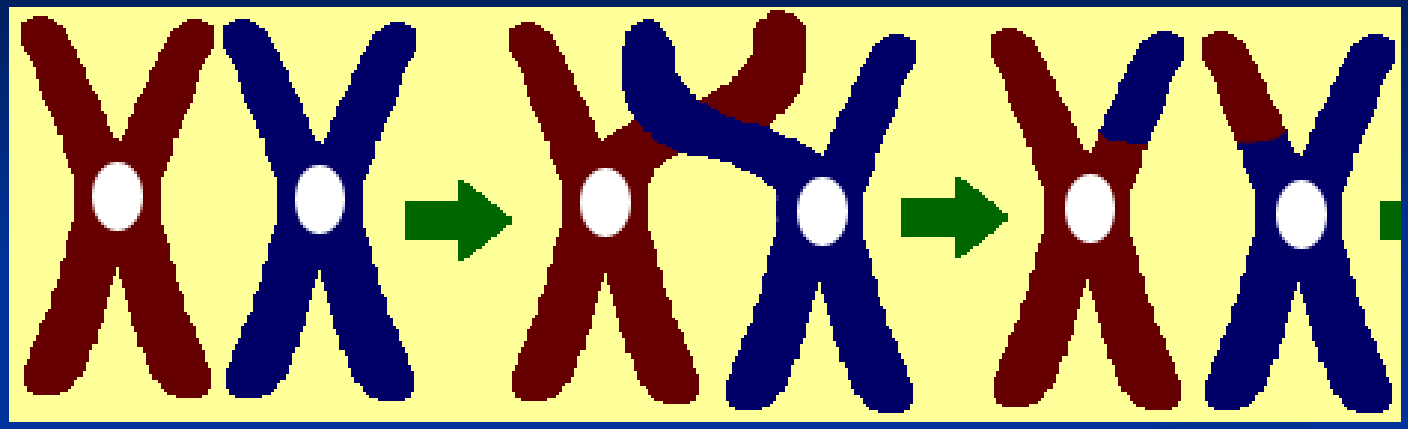
- *Mutations*
  - Any change in a sequence of DNA
  - Occurs Because:
    - Problems with replication
    - Exposure to radiation or chemicals

# Gene Shuffling




- *Gene Shuffling*
  - Cause of most differences
  - The 23 pairs of chromosomes can produce 8.4 million different combinations!

# Crossing Over



- Crossing Over
  - Occurs during meiosis
  - Further increases genetic variation

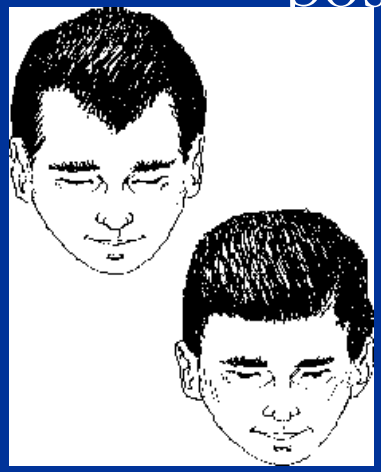
# Genes & Variation

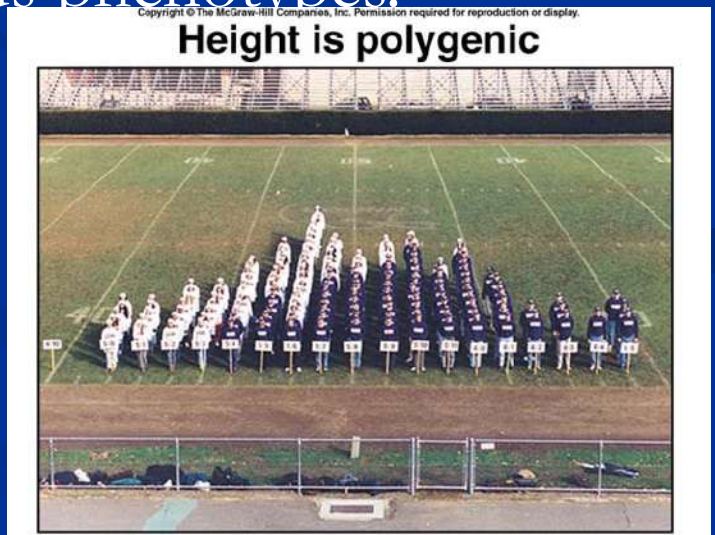
- *Sexual Reproduction*
  - Remember…an organism is successful if it reproduces
  - Can produce many phenotypes, BUT the relative frequency will stay the same

- Think of a deck of cards
  - 52 different cards
  - Chance of an Ace off the top – 1/13 (4/52)
  - Many combinations, BUT the frequency stays the same

# Single-gene & Polygenic Traits

- Single-gene and polygenic traits
  1. Widows peak is a single gene trait – **a single gene** with two alleles
  2. **Polygenic Traits** are controlled by two or more genes
     - This means that a polygenic trait can have many possible genotypes and thus phenotypes.





# 16-2 Evolution as Genetic Change

- Natural Selection on Single-Gene Traits

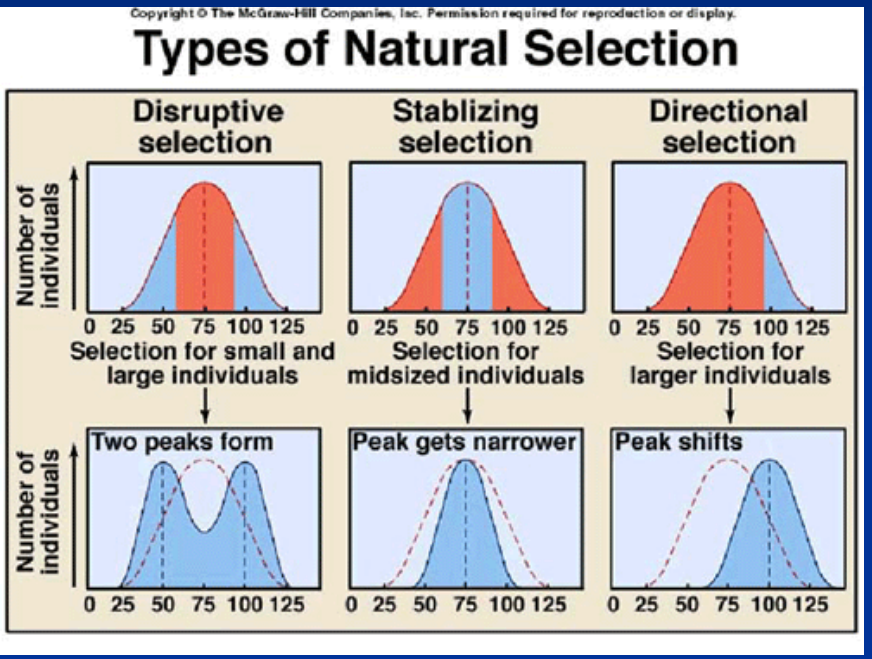
Fig. 1


**Ear lobe attachment**

Fig. 2

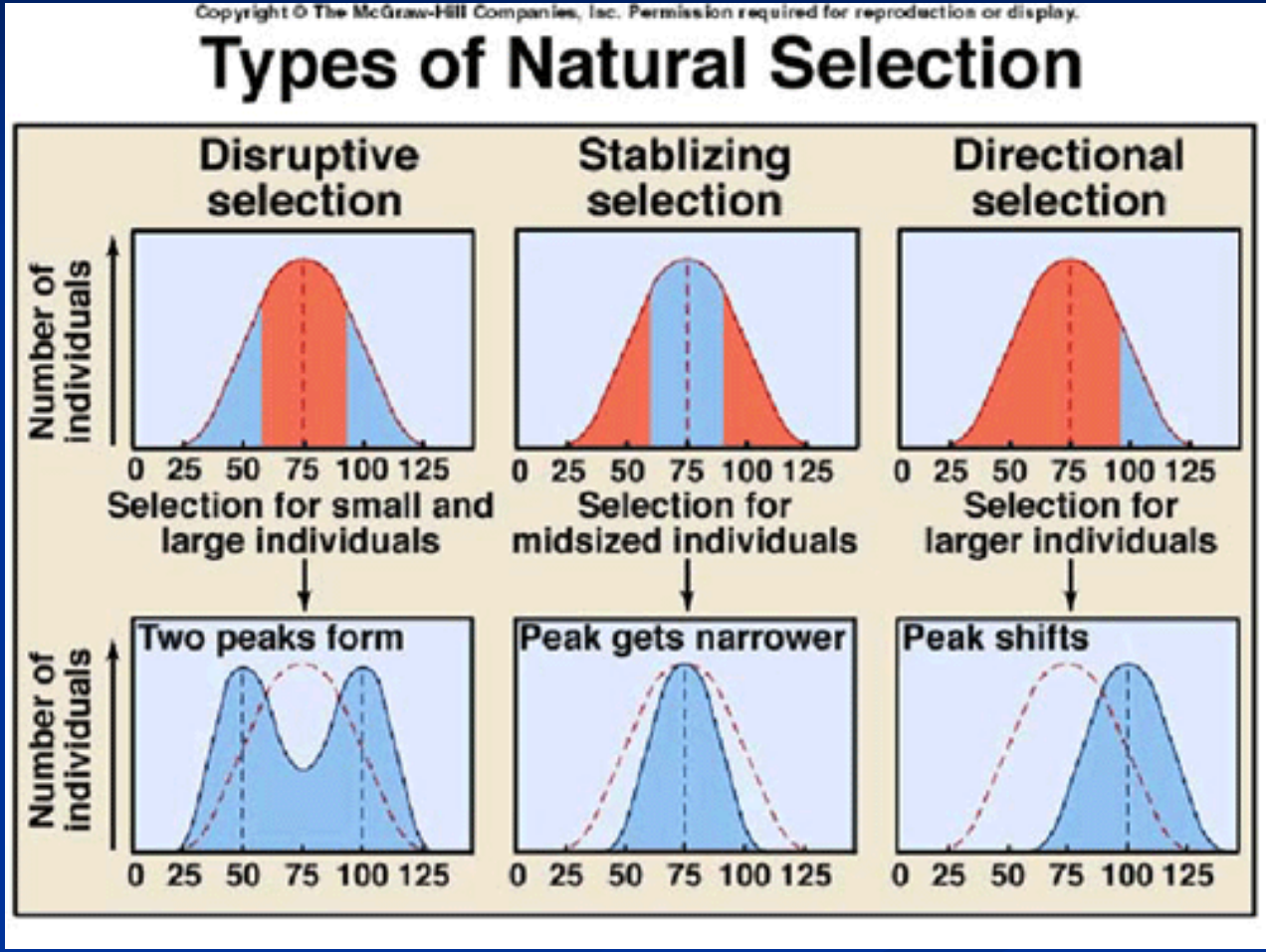
**Tongue rolling**

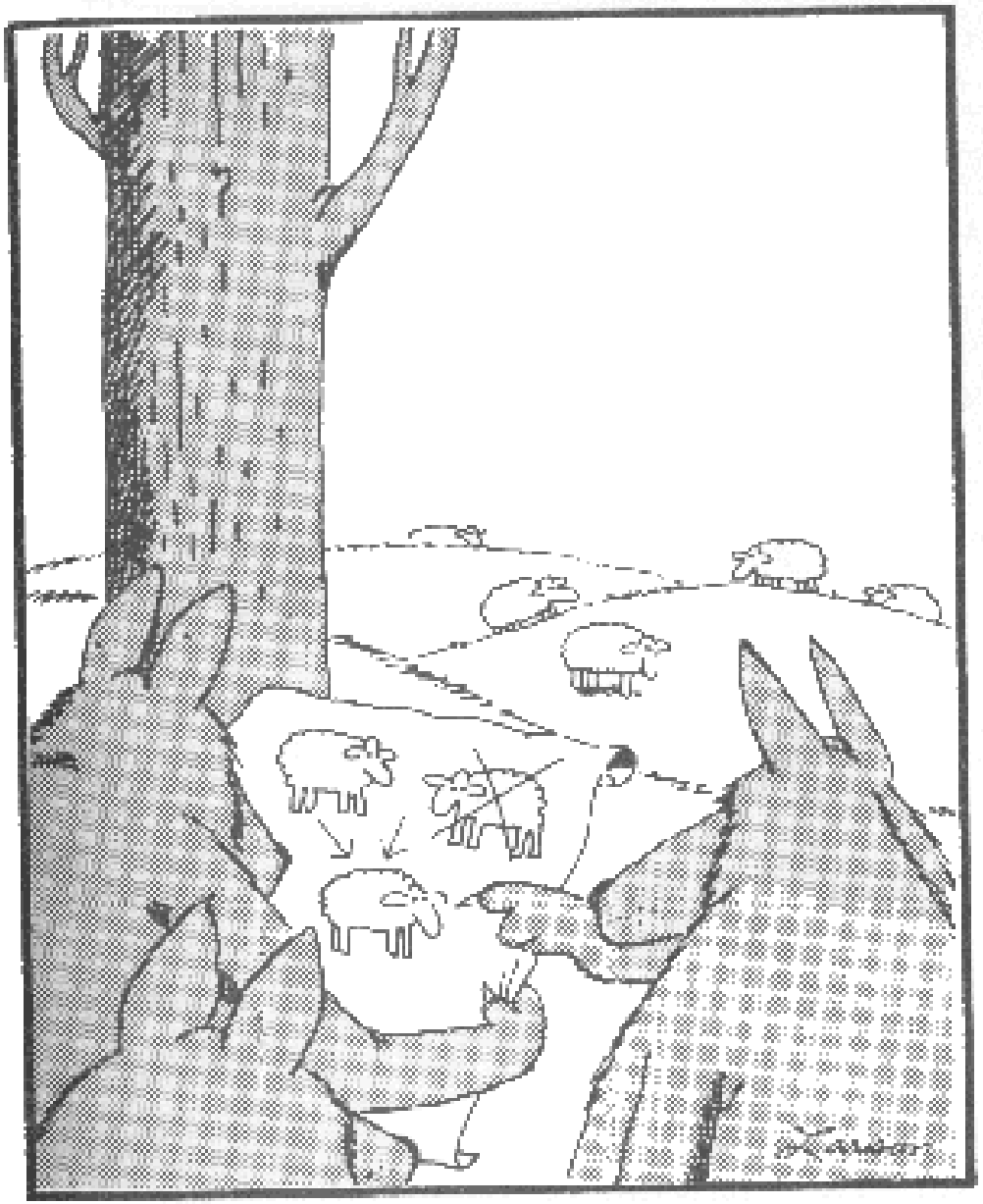
# 16-2 Evolution as Genetic Change




- Natural Selection on Polygenic Traits
  - *Directional Selection*
    - Range of phenotypes shifts
  - *Stabilizing Selection*
    - Organisms in the middle of the curve are at an advantage
  - *Disruptive Selection*
    - Organisms on the edges of the curve are at an advantage

# 16-2 Evolution as Genetic Change

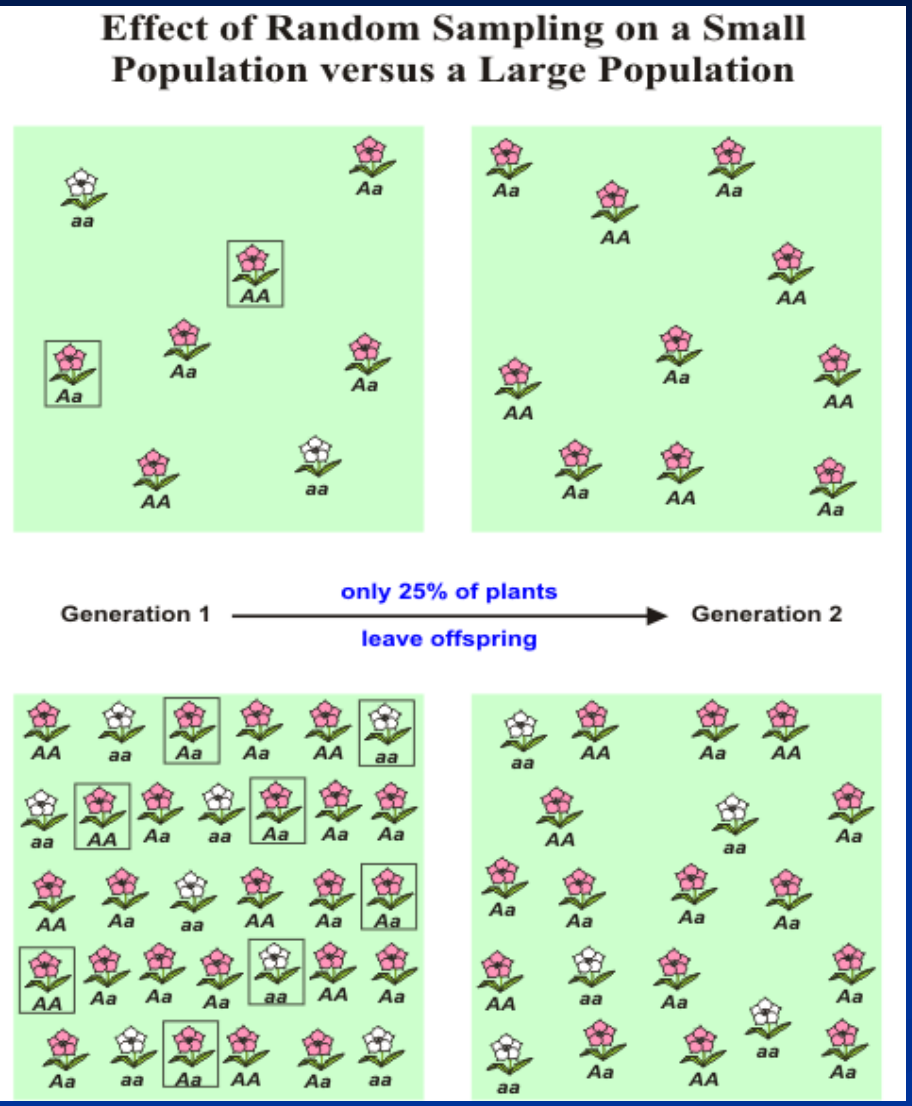




Natural selection at work

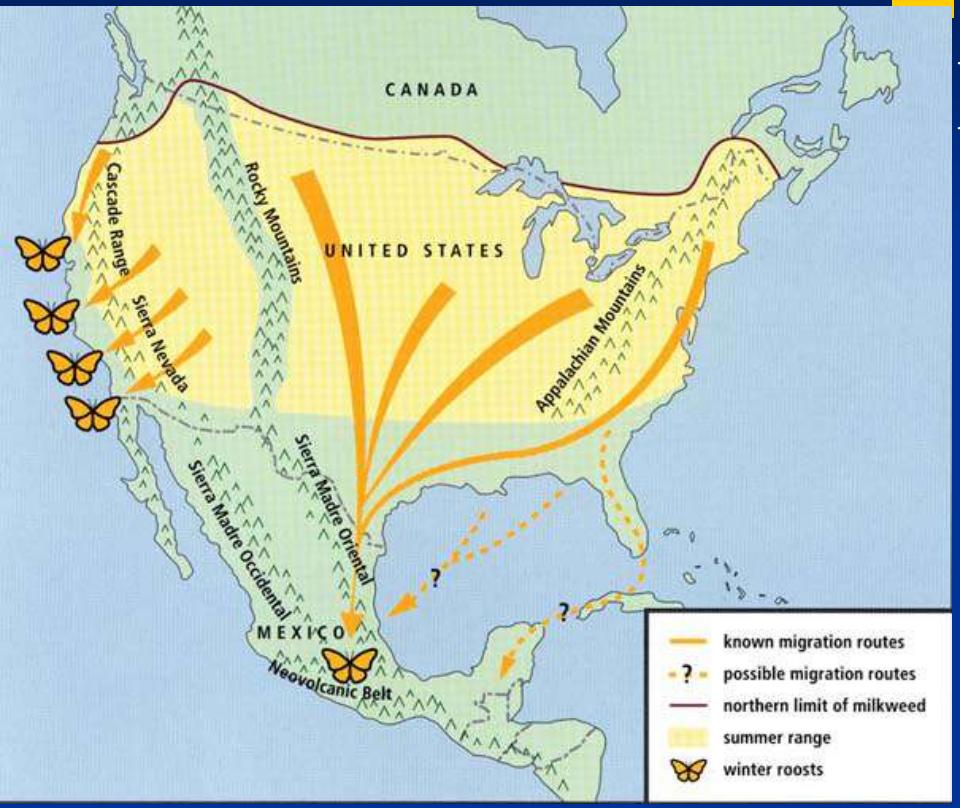
"The Far Side" cartoon by Gary Larson is reprinted by permission of Chronicle Features, San Francisco, CA.

# 16-2 Evolution as Genetic Change




- *Genetic Drift* – Random change in allele frequency
- *Founder effect* – when allele frequencies change because of migration

# 16-2 Evolution as Genetic Change

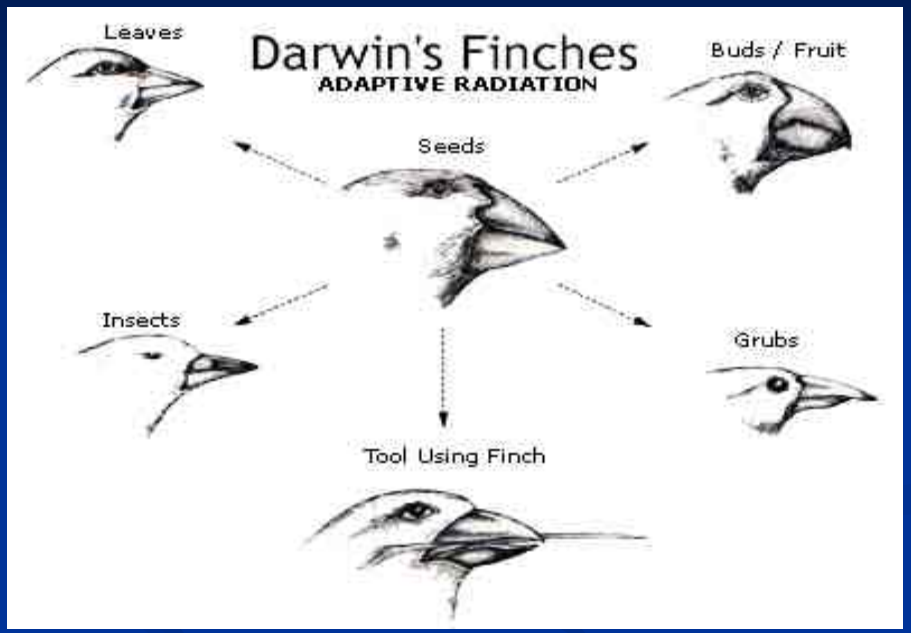



- Evolution vs. Genetic Equilibrium
  - *Hardy-Weinberg principle* – allele frequencies will stay constant unless some factor changes the frequency
    - *Genetic Equilibrium* – when allele frequencies remain constant

# 16-2 Evolution as Genetic Change

- *Five Conditions to Maintain Equilibrium*
  1. Random Mating
  2. Large Population
  3. No Movement into or out of the population
  4. No Mutations

# Darwin's Finches




This is an example of the way in which a species' gene pool has adapted in order for long term survival through their offspring.

# The Peppered Moth

- The Peppered Moth story involves a small scale change in evolution.

# SPECIATION:

## This is the formation of a new species

- Reproductive or geographical isolation affects speciation

# 16-3 The Process of Speciation

- Isolating Mechanisms
  - *Behavioral Isolation*
    - Two populations will not breed because of differences in courtship

# 16-3 The Process of Speciation

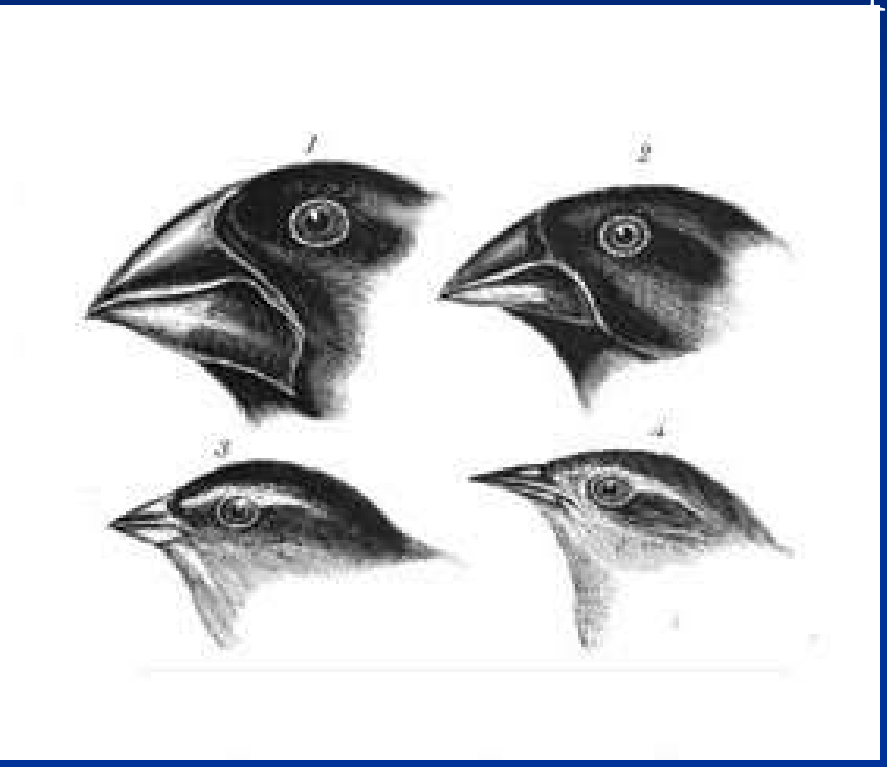

- *Geographical Isolation*
  - Rivers, mountains, or bodies of water separate two populations

# 16-3 The Process of Speciation

- *Temporal Isolation*
  - Different species mate at different times
    - Times of day
    - Times of year

# 16-3 The Process of Speciation

- Testing Natural Selection in Nature

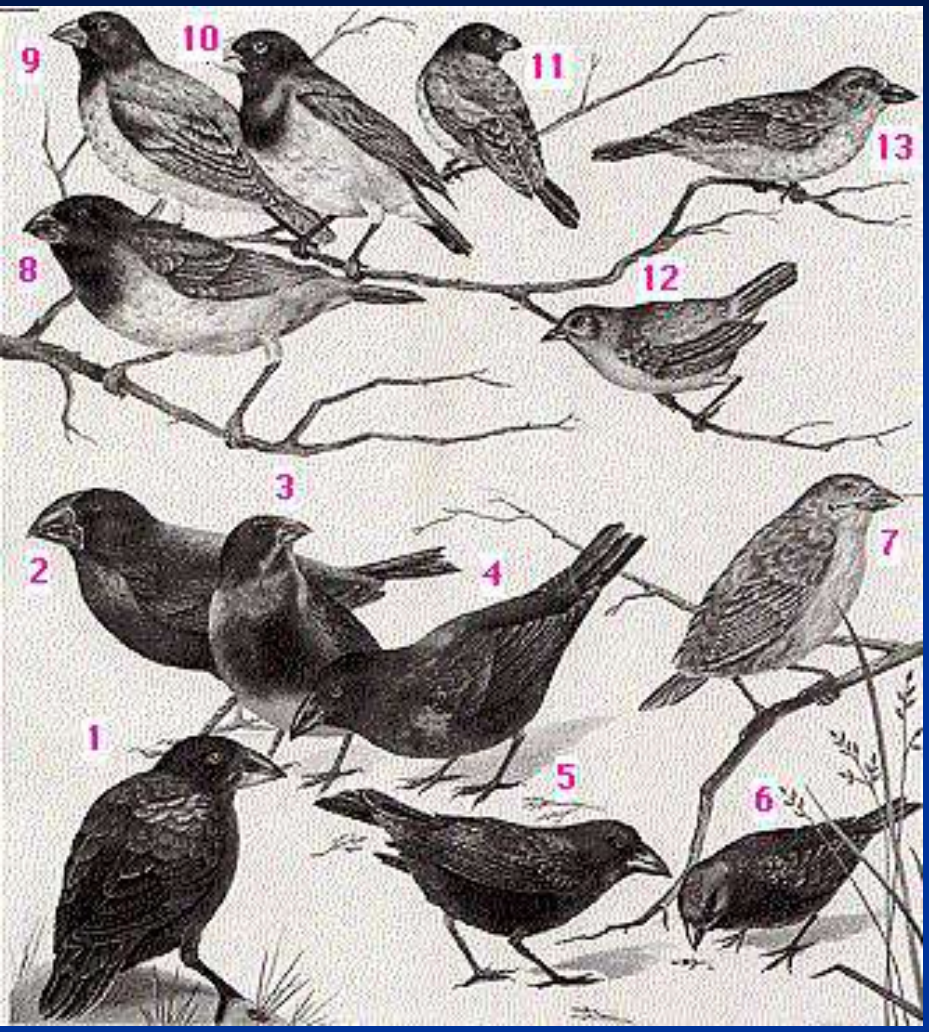


  - Variation
    - Differences in population
  - Natural Selection
    - Which beak is best in a drought?
  - Rapid Evolution
    - Natural selection takes place frequently and sometimes rapidly

# 16-3 The Process of Speciation

- Speciation in Darwin's Finches
  - Founders Arrive
    - How did the finches get to the Galapagos Islands?
  - Separation of Populations
    - How did they become separated?

# 16-3 The Process of Speciation

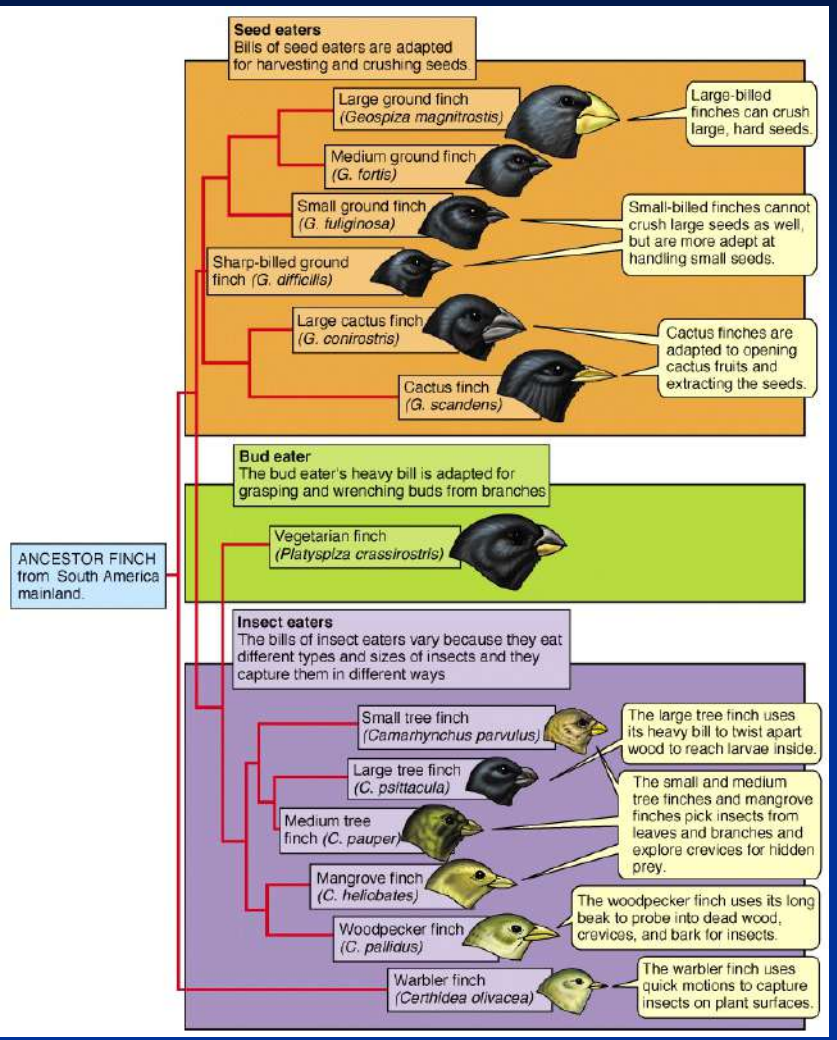



- Changes in the Gene Pool
  - How did they become individual species?

# 16-3 The Process of Speciation

- Reproductive Isolation
  - If a small beak bird moves back to the first island will it mate with a big beaked bird?

# 16-3 The Process of Speciation




- Ecological Competition
  - What happens to the birds that are different that don't have to compete for food?
- Continued Evolution
  - How did we get all of the 13 species?

# 16-3 The Process of Speciation

- Studying Evolution Since Darwin
  - Limitations of Research
  - Unanswered Questions

# Ch. 16 Vocabulary

1. Gene pool
2. Relative frequency
3. Single-gene trait
4. Polygenic trait
5. Directional selection
6. Stabilizing selection
7. Disruptive selection
8. Genetic drift
9. Founder effect
10. Hardy-Weinberg principle
11. Genetic equilibrium
12. Speciation
13. Reproductive isolation
14. Behavioral isolation
15. Geographic isolation
16. Temporal isolation