UNIT 5: EVOLUTION
Chapter 11: The Evolution of Populations

I. Genetic Variation Within Populations (11.1)

    A. Genetic variation in a population _____ the chance that some individuals will _____

        1. Genetic variation in populations lead to differences in _____

        2. _____ **selection** acts on **phenotype**

        3. The greater the range in phenotypes, the more likely some individuals can **survive** _____ <u>environment</u>

            a. _____- genetic variation stored in population

            b. Each allele exists at a certain _____ - **gene frequency**

    B. Genetic variation comes from several _____

        1. **Mutation**- random change in organisms _____

            a. can form new _____

            b. Mutations in _____ cells can be passed on

            c. Increases _____ variation in gene pool

        2. **Recombination**- new allele combination form in _____

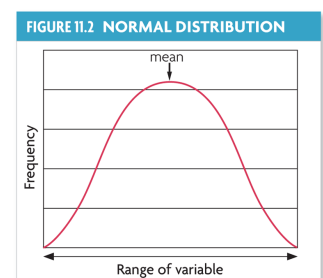   a. _____-new combinations of parents alleles

            b. **Crossing over** increases _____

II. Natural Selection in Populations (11.2)

    A. Natural selection acts on _____ of traits

        1. Normal distribution- gives classic "_____-shaped" curve

        2. Environmental conditions can change and a certain phenotype may become an _____

FIGURE 11.2 NORMAL DISTRIBUTION

B. Natural Selection can change the distribution of a trait in one of three ways

1. **Microevolution**-observable change in _____ frequency of a _____ over time
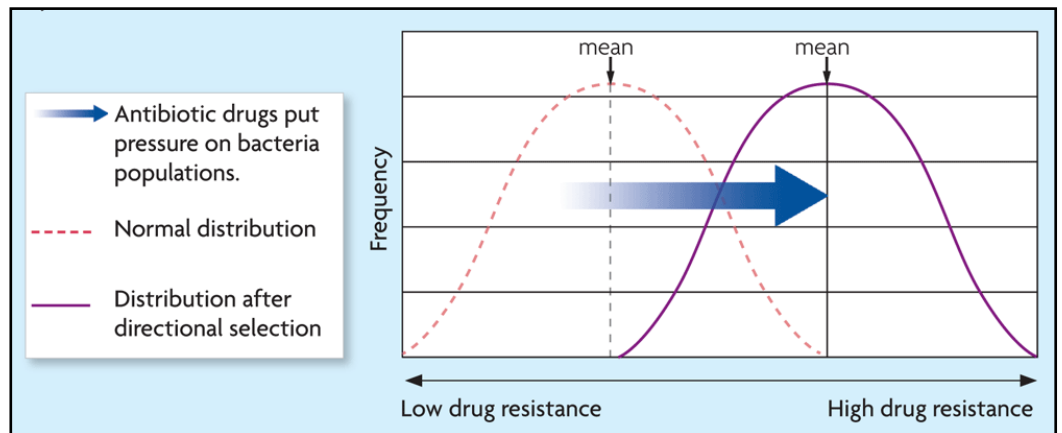
   a. Occurs on _____ scale within single population

   b. Natural selection can change distribution of a trait along ___ paths (directional, stabilizing, or disruptive selection

2. **Directional Selection**- causes _____ in a populations _____ distribution

   a. An extreme phenotype that was once _____ is now more _____

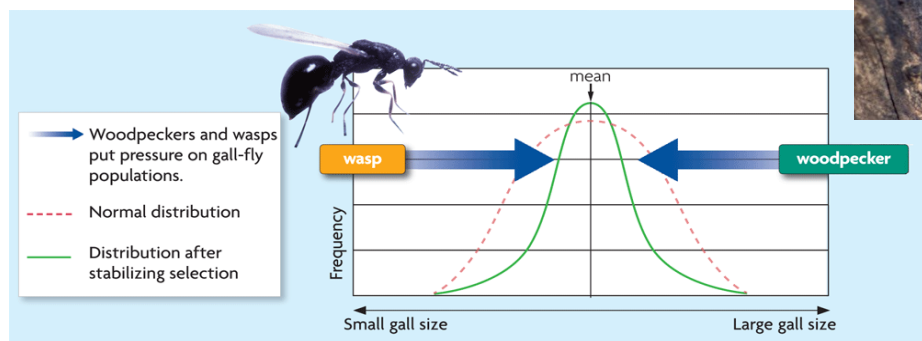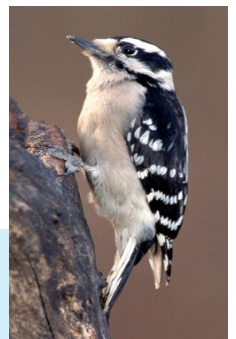   b. Mean value of a trait shifts in direction of the more _____ phenotype

   c. Lead to rise in _____-**resistant bacteria**

Antibiotic drugs put pressure on bacteria populations.

---- Normal distribution

—— Distribution after directional selection

Frequency

mean   mean

Low drug resistance   High drug resistance

3. **Stabilizing Selection**- the intermediate phenotype is _____ and becomes **more common.**

   a. _____ genetic diversity

   b. Extreme phenotypes may be _____

Woodpeckers and wasps put pressure on gall-fly populations.

---- Normal distribution

—— Distribution after stabilizing selection

Frequency

wasp   woodpecker

mean

Small gall size   Large gall size

4. **Disruptive Selection**- occurs when both extremes are favored and _____ are selected against

    a. Intermediate forms selected _____

    b. Can lead to formation of new _____
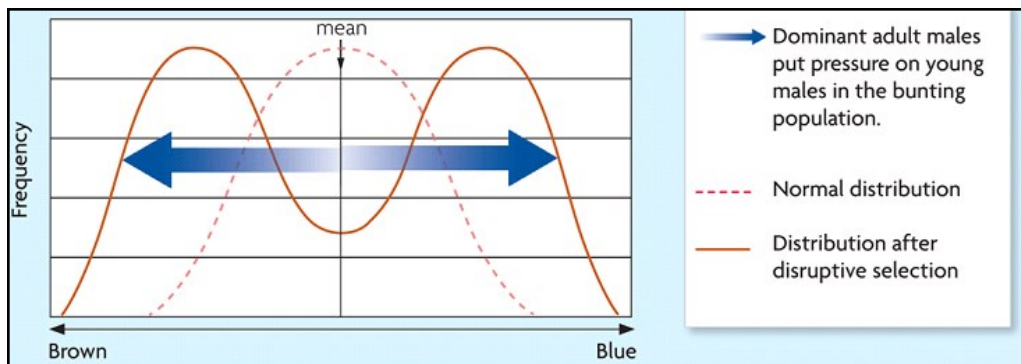
III. Other Mechanisms of Evolution (11.3)

    A. Gene flow is the movement of alleles between populations

        1. **Gene flow**- movement of _____ from one _____ to another

            a. **Increases** genetic variation of _____ population

            b. **Gene flow** between populations keeps gene pools _____

            c. **Less** gene flow can create **genetically** _____ populations

            d. **Lack of gene flow** <u>increases</u> chance that two populations will _____ **into different species**

    B. Genetic drift is a change in allele frequencies due to chance

        1. **Small populations** are _____ _____ to be affected by _____

        2. **Genetic Drift**- changes in allele frequencies due to _____ (Two ways this occurs)

            a. _____ **Effect**- genetic drift that occurs after an _____ (e.g. overhunting)

            b. _____ **Effect**- genetic drift that occurs after a small number of individuals _____ a new area

3. Effects of Genetic Drift

      a. **Lose of _____ variation**- ability of group to _____ to changing environment is _____.

      b. _____ **alleles** may become **more common** in gene pool due to _____ alone

C. **Sexual selection** occurs when certain traits increase mating success

    1._____ can have important effect on evolution of population

      a. _____ make many sperm continuously (value of each relatively _____)

      b. _____ more limited in number of offspring can produce (each investment more valuable, and they want a good return)

    2. **Sexual selection**- when certain _____ increase _____ **success**

      a. Certain traits can become very _____ over time through sexual selection

      b. These traits for mating success not always adaptive for _____ of the individual

IV. Hardy-Weinberg Equilibrium (11.4)

A. **Hardy-Weinberg equilibrium** describes populations that are _____ evolving

    1. Said genotype frequencies stay the same over time as long as certain _____ are met. (5 conditions)

      a. **Very _____ populations** (no genetic drift can occur)

      b. **No _____ or _____** (no gene flow can occur)

      c. **No _____** (no new alleles can be added to the gene pool)

      d. _____ **mating** (no sexual selection can occur

e. **No** _____ **selection** (all traits must equally aid in survival)

B. The Hardy-Weinberg equation is used to _____ genotype **frequencies** in a population

    1. Used in simple _____-_____ systems

    2. Shows values that would exist in population in _____

    3. Use **equation** (if calculated frequencies match actual frequencies, then population in equilibrium)

$$p^2 + 2pq = q^2 = 1$$

VARIABLES
p = **frequency of allele** T (dominant allele)
q = **frequency of allele** t (recessive allele)
p^2 = **frequency of fish with** TT (dominant homozygous genotype)
$2pq$ = **frequency of fish with** Tt (heterozygous genotype)
q^2 = **frequency of fish with** tt (recessive homozygous genotype)

C. There are 5 factors that can lead to evolution (**populations not in Hardy-Weinberg equilibrium are** _____)

    1. _____ **drift** (allele frequencies change due to chance)

    2. **Gene flow** (movement of _____-emigration and immigration)

    3 _____ (New alleles form through mutation and create genetic _____)

4. _____ **selection** (certain traits improve mating _____)

5. _____ **selection** (certain traits advantageous to survival. Alleles for these traits increase in frequency)

V. Speciation Through Isolation (11.5)

    A. The isolation of populations can lead to _____

        1. **Speciation**- the rise of two or more _____ from one _____ species

        2. _____ **isolation-** when members of **different populations** can **no longer mate successfully** with one another)

    B. Populations can become _____ in several ways

        1. **Behavioral barriers**

            a. **Behavioral isolation**- isolation caused by differences in _____ or _____ behavior)

            b. Chemical scents, courtship dances, courtship songs, sexual signals used to attract _____

        2. **Geographic barriers**

            a. **Geographic isolation**- involves _____ barriers that divide _____

            b. Include mountains, rivers, dried lakebeds,etc.

            c. **Over time** isolated populations become _____ **different**

        3. **Temporal Barriers**

            a. **Temporal Isolation**- _____ prevents _____ between populations

            b. **Reproductive periods** may change and can lead to _____

VI. Patterns of Evolution (11.6)

    A. Evolution through natural selection is not _____

1. **Environment** controls the _____ taken by natural selection

2. The **response of species to environmental challenges** and opportunities is _____ **random**

    a. _____ **Evolution**- evolution towards similar characteristics in unrelated species

    b. _____ **Evolution**- related species evolve in different directions and become increasingly different

B. Species can shape each other over _____

    1. _____- two or more species evolve in response to changes in each other

    2. **Evolutionary arms race**- _____ can occur in _____ relationships

C. Species can become extinct

    1. **extinction**- _____ of a species from Earth

    2. **Background extinctions**- extinctions that occur _____ at very _____ rate

    3. _____ **extinction**- more rare, but more intense

        a.. Can occur on _____ level

        b. Thought to occur due to _____ events (e.g. ice age, asteroid impact)

D. Speciation often occurs in patterns

    1. **Punctuated equilibrium**- _____ of evolutionary activity
        a. Episodes of speciation occur _____

        b. Followed by periods of _____ change

    2. **Adaptive radiation**- Diversification of one _____ species into many descendent species