**NOTES—The REST of CH. 11—on the test next Wed!!!**

**Hardy-Weinberg \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Describes Populations that are NOT Evolving**

* Hardy and Weinberg showed that genotype frequencies in a population will stay the same over time as long as **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are met**:

1. Must be a very \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Population (NO genetic drift).

2. No emigration or immigration (NO \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_).

3. No \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (NO new alleles).

4. Must have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Mating (NO sexual selection allowed).

5. No \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (all traits must equally aid in survival).

* Real populations \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ meet all five requirements

**The Hardy-Weinberg Equation is Used to predict Genotype Frequencies in a Population**

* For traits in a simple dominant-recessive systems, biologists can predict genotype frequencies using the Hardy-Weinberg equation.

P2 + 2pq + q2 = 1 🡪 p = frequency of the dominant allele

🡪 q = frequency of the recessive allele.

**In Hardy-Weinberg Equilibrium, the equation ALWAYS equals 1**.

***If*** the equation DOES NOT equal 1, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is occurring.

**There are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Factors that can Lead to Evolution**

1. **Genetic Drift** – allele frequency can change due to chance alone.

2. **Gene Flow** – the movement of alleles from one place to another change the allele frequencies of the population.

3. **Mutation** – new alleles can form through mutations, and these create the genetic variation needed for evolution.

4. **Sexual Selection** – certain traits may improve mating success which cause an increase in that allele frequency.

5. **Natural Selection** – Certain traits may be an advantage for survival so alleles for these traits increase in frequency.

**The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of Populations can lead to Speciation.**

* If gene flow between two populations stops for any reason, the population are said to be isolated. As they adapt to their new environments, their gene pools may change.
* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Isolation** occurs when member of different populations can no longer mate successfully with one another.
* **Speciation** is the rise of two or more species from on existing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Populations can become \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_in several ways.**

* **Behavioral Isolation** is isolation caused by differences in courtship or mating behaviors.

Ex: Fireflies. Male and female fireflies produce patterns of light flashes that attract only their own species.

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Isolation** involves physical barriers that divide a population into two or more groups. These can be rivers, mountains, and dried lakebeds.

Ex: The isthmus of Panama separated aquatic species that then evolved separately.

* **Temporal Isolation** exists when \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ prevents reproduction between populations. Some members of a population may show signs of courtship at different times.

Ex: flowers \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at different times of year.

**Patterns in Evolution**

**Evolution through Natural Selection is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Random.**

* Natural Selection is **NOT** random.
* Individuals with traits that are better adapted for their environment have a better chance of surviving and reproducing than do individuals without these traits.
* Natural selection always pushes traits in an advantageous direction.
* The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_controls the direction taken by natural selection.

**Convergent Evolution**

* Different species often must adapt to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ environments.
* Evolution toward similar characteristics in unrelated species is called **Convergent Evolution**.

Ex: Shark and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are not related yet they have evolved similar tail fins.

**Divergent Evolution**

* When closely related species evolve in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ directions, they become increasing different in **Divergent Evolution**.

Ex: Red Fox and Kit fox: though closely related they have developed different characteristics based on the environment they live in.

**Beneficial Relationships through Coevolution**

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**is the process in which two or more species evolve in response to changes in each other. ( Think “mutualism” from ecology)

Ex: Bees and flowers.

**Evolutionary \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Race**

* Coevolution can also occur in competitive relationships.

Ex: Many plants produce defense chemicals to discourage herbivores from eating them. Natural selection then favors the herbivores who can overcome the effect of the toxins.

Ex: Thick shells and spines of murex snails are an adaptive response to predation by crabs. In turn, crabs have evolved strong claws.

**Species Can become Extinct**

* The elimination of a species from Earth is **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.
* There are two types of extinctions involved in evolution:

1. **Background extinctions** – occur continuously at a slow rate. (usually effect one or few species in a small space).

2. **\_\_\_\_\_\_\_\_\_ Extinctions** – many species are destroyed suddenly. (ice age, meteors).

**Speciation Often Occurs in Patterns**

* There are repeating patterns in the history of life.
* The Theory of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Equilibrium states that episodes of speciation occur suddenly in geologic time and are followed by long periods of little evolutionary change. This opposed Darwin’s theory of gradualism (slow, steady evolution).
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Radiation the diversification of one ancestral species into many descendant species.

Ex: Following the mass extinction at the end of the Cretaceous Period 65 million years ago, Adaptive radiation of mammals occurred.