**Mechanisms of Evolution**

*Concept 4: Analyzing the evolution of populations through Hardy-Weinberg (microevolution)*

Chapter 23 in Campbell, pg 155-158 in Holtzclaw

**The Evolution of Populations**

You must know:

* How mutation and sexual reproduction each produce genetic variation
* The conditions for Hardy-Weinberg Equilibrium
* How to use the Hardy-Weinberg equation to calculate allelic frequencies, to test whether a population is evolving.

**Genetic Variation**

If only one allele exists for a particular \_\_\_\_\_\_\_\_\_in a population, that allele is said to be \_\_\_\_\_\_\_\_\_in the gene pool and all individuals are homozygous for that allele.

If there are two or more alleles for a particular locus in a population, individuals may be either \_\_\_\_\_\_\_\_\_\_\_or\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Each allele has a frequency (proportion) in the population.  example: 80% blue and 20% brown.

**Preservation of Genetic Variation**

* **Diploidy** – “hiding” **\_\_\_\_\_\_\_\_\_\_\_\_\_\_**alleles
* **Heterozygote advantage** -Heterozygote genotype has a higher \_\_\_\_\_\_\_\_\_\_\_\_\_\_than either the homozygote dominant or homozygote recessive genotype.
* The specific case of **heterozygote advantage** due to a single locus is known as overdominance.
	+ Ex) sickle cell anemia - malaria

**What alters allele frequencies?**

Three major factors:

1. **Natural Selection – causes adaptive evolution**

Selection results in alleles being passed to the next generation in proportions \_\_\_\_\_\_\_\_\_\_\_\_\_from their \_\_\_\_\_\_\_\_\_\_\_\_in the present generation.

Consistently favouring some alleles over others in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Adaptive evolution** is that which results in a better match between organisms and their environment.

**2.  Genetic Drift -**  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ can also cause allele frequencies to fluctuate unpredictably from one generation to the next, especially in \_\_\_\_\_\_\_\_\_\_\_populations (3:7 Head to Tail vs 30:70 Head to Tail)

* + - **Founder Effect** → when a few individuals become \_\_\_\_\_\_\_\_\_\_\_\_\_from a larger population, this smaller group may establish new population whose gene pool differs from the source population.
		- **Bottleneck Effect**→ a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_in the environment, such as a fire or flood, may drastically \_\_\_\_\_\_\_\_\_\_\_\_\_the size of a population.

A severe drop in the population size can cause the bottleneck effect because the population has passed through a restrictive bottleneck in size.  By chance alone, certain alleles may be \_\_\_\_\_\_\_\_\_\_\_\_\_among

the survivors.

**3. Gene Flow** → transfer of alleles into or out of a population due to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_of fertile individuals or their gametes.

It tends to \_\_\_\_\_\_\_\_\_\_\_the genetic differences between populations.  If it is extensive enough, gene flow can result in neighboring populations combining into a single population with a common gene pool.

**Natural Selection – causes adaptive evolution**

* Relative Fitness - Fitness \_\_\_\_\_\_\_\_\_\_\_\_to other members of the population… (your contribution to the gene pool of the next generation!)
* Three ways natural selection can work:
	+ Directional selection
	+ Disruptive selection
	+ Stabilizing selection

  

In what sense is natural selection more “predictable” than genetic drift?

**Introducing…The Hardy-Weinberg Principle!**

* Clarifies the factors that alter allele frequency
* A non-evolving population is in Hardy-Weinberg equilibrium.

**Conditions for Hardy-Weinberg Equilibrium:**

**The Hardy-Weinberg Formula** *p*2 + 2*pq* + *q*2 = 1 where *p* + *q* = 1

In a certain population of 1000 fruit flies, 910 have red eyes while the remainder have sepia eyes.

* The sepia eye trait is recessive to red eyes.
* How many individuals would you expect to be *homozygous for red eye color*?

**Hint**: The first step is always to calculate *q*2!
Start by determining the number of fruit flies that are homozygous recessive…

Biology 11 pre AP
Lab 8 – Population Genetics and Evolution

Exercise 8A - Ear Lobes!
 - a completely dominant trait

free allele – dominant (A)
attached allele – recessive (a)

Frequency of individuals with free ear lobes: *p2 + 2pq*
Frequency of individuals with attached earlobes: *q2*

|  |  |  |
| --- | --- | --- |
|  | Phenotypes | Allele Frequency based on the H-W Equation |
| Free Ear Lobes*(p2 + 2pq)* | Attached Ear Lobes*(q2)* | *p* | *q* |
| Class Population | # | % | # | % |  |  |
|  |  |  |  |

Discussion:

1. What is the percentage of heterozygous free ear-lobed people in this class?

2. What is the percentage of homozygous free ear-lobed people in this class?

3. Can we tell which of the free ear-lobed people are homozygous and which are heterozygous? Why or why not?