* Darwin’s theory of natural selection is a central theme in evolution.
* 4 parts of Natural Selection a. variation b. heritability c. reproductive advantage d. overproduction
* Evolution occurs at the population level, with genes as the “\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_”.

**Why don’t dominant alleles swamp recessive alleles in a population?**

* In 1908, English mathematician Godfrey \_\_\_\_\_\_\_\_\_\_and German physician Wilhelm\_\_\_\_\_\_\_\_\_ came up with the solution.
* Gene frequencies can be high or low no matter how the allele is expressed (a gene is a segment of DNA ha codes for a specific trait.)

**Hardy-Weinberg Principle**

* HWP is a \_\_\_\_\_\_\_\_\_\_\_\_\_ model that describes the changes in allele frequencies in a population.
* When allelic frequencies remain constant, a population is in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* In order for a population to be in genetic equilibrium, 5 conditions must be met:

**5 Conditions**

* 1. Large \_\_\_\_\_\_\_\_\_\_\_\_
* 2. No \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_or \_\_\_\_\_\_\_\_\_\_\_\_
* 3.\_\_\_\_\_\_\_\_\_\_\_\_\_ Mating
* 4. No\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* 5. No \_\_\_\_\_\_\_\_\_\_\_\_\_ selection

If a population is NOT in genetic equilibrium, at least one of the five conditions has been violated.

|  |  |  |
| --- | --- | --- |
| **5 Conditions** | **Violation** | **Consequence** |
| 1. Large Population | Many populations are small. | Chance events can lead to changes in population traits. |
| 2. No immigration or emigration | Organisms move in and out of the population | Populations lose or gain traits with movement of organisms. |
| 3. Random Mating | Mating is NOT random. | New traits don’t pass as quickly to the rest of the population. |
| 4. No Mutations | Mutations occur. | New variations appear in the population every generation. |
| 5. No Natural Selection | Natural Selection Occurs | Traits in a population change from one generation to the next. |

**Hardy Weinberg**

* + Two Equations: p2 + 2pq + q2 = 1 AND p + q =1
  + p = frequency of dominant allele (A)
  + q = frequency of recessive allele (a)
  + p2 = frequency of Homozygous Dominant genotype (AA)
  + (% of Homozygous Dominant individuals)
  + 2pq = frequency of heterozygous genotype (Aa)
  + (% of Heterozygous individuals)
  + q2 = frequency of Homozygous Recessive genotype (aa)
  + (% of Homozygous Recessive individuals)

**Let’s Practice (Example of how to complete the practice problems)**

* If 98 out of 200 individuals in a population express the recessive phenotype, what percentage of the population would you predict to be heterozygotes?
* If 98 out of 200 individuals in a population express the recessive phenotype, what percentage of the population would you predict to be heterozygotes?

(a) I have given you information on the frequency of the homozygous recessive (or q*2*). So start by determining q*2* and then solving for q.

* **q*2* = (98/200) = 0.49 (or 49%)**
* **q = square root of 0.49 = 0.7 (70%)**
* (b) Now that you have q, you can solve for p. Remember there are only two alleles in the population, so if you add the frequency of the two alleles, you have accounted for all possibilities and it must equal 1. So p + q = 1.
* **p = 1-q**
* **p = 1 - 0.7 = 0.3 (30%)**
* (c) Now what is the formula for heterozygotes? Think back to the Hardy-Weinberg equation -- it is dealing with the genotypes of individuals in the population.
* **p*2* + 2pq + q*2* = 1**
* **frequency of homozygous dominant + frequency of heterozygotes + frequency of homozygous recessive = 1**
* **so.....2pq = frequency of heterozygotes**
* **frequency of heterozygotes = 2 (0.3)(0.7) = 0.42 or 42%**
* (d) Now that you have figured out the % of heterozygotes, can you figure out the % of homozygous dominant? Does the % of homozygous dominant, heterozygotes and homozygous recessive individuals add up to 100%? If not, you have made an error. Those are the only three genotypes possible with only two alleles and a simple dominant and recessive relationship.
* **p*2 =* (0.3)(0.3) = 0.09 (or 9%)**
* **p*2* + 2pq + q*2* = 1**
* **0.09 + 0.42 + 0.49 = 1.0**