**Part III: Hardy-Weinberg Problems**

**Remember:**

**p = dominant allele / q = recessive allele**

**p2 = homozygous dominant individuals**

**2pq = heterozygous individuals**

**q2 = homozygous recessive individuals**

**p2 + 2pq + q2 = 1**

**p + q = 1**

**1.** Let’s say that brown fur coloring is dominant to gray fur coloring in mice. If you have 168 brown mice in a population of 200 mice then . . . .

 **a.** What is the predicted frequency of heterozygotes? **2pq =** **2(0.6)(0.4) = 0.48**
 **b.** What is the predicted frequency of homozygous dominant? **p2 = (0.6)2 = 0.36**
 **c.** What is the predicted frequency of homozygous recessive **q2= (0.4)2 = 0.16**

 **q = 0.4 p = 0.6**

**2.** The allele for the hair pattern called “widow’s peak” is dominant over the allele for no “widow’s peak”.

In a population of 1,000 individuals, 510 show the dominant phenotype. How many individuals would you expect of each of the possible three genotypes for this trait?

 **q = 0.7**  **p = 0.3** **Homozygous Dominant**: **p2 = (0.3)2 = 0.09 x 100 = 90 individuals**

 **Heterozygous**: **2pq =** **2(0.3)(0.7) = 0.42 x 100 = 420 individuals**

 **HomozygousRecessive**: **q2= (0.7)2 = 0.49 x 100 = 490 individuals**

**3.** In the United States about 16% of the population is Rh negative. The allele for Rh negative is recessive to the allele for Rh positive. If the student population of a high school in the U.S. is 2,000, how many students would you expect for each of these three possible genotypes?

 **q = 0.4** **p = 0.6** **Homozygous Dominant:** **p2 = (0.6)2 = 0.36 x 2000 = 720 individuals**

 **Heterozygous:** **2pq =** **2(0.6)(0.4) = 0.48 x 2000 = 960 individuals**

 **HomozygousRecessive:** **q2= (0.4)2 = 0.16 x 2000 = 320 individuals**

**4.** In certain African countries 4% of the newborn babies have sickle cell anemia, which is a recessive trait. Out of a random population of 1,000 newborn babies, how many would you expect for each of the three possible genotypes?

 **q = 0.2** **p = 0.8** **Homozygous Dominant:** **p2 = (0.8)2 = 0.64 x 1000 = 640 individuals**

 **Heterozygous:** **2pq =** **2(0.8)(0.2) = 0.32 x 1000 = 320 individuals**

 **HomozygousRecessive:** **q2= (0.2)2 = 0.04 x 1000 = 40 individuals**

**5.** In a certain population, the dominant phenotype of a certain trait occurs 91% of the time. What is the frequency of the dominant allele?

**p = 0.7**

**6.** A very large population of randomly-mating laboratory mice contains 25% white mice. White coloring is caused by the double recessive genotype, "aa". Calculate allelic and genotypic frequencies for this population.

 **Allelic Frequencies** **Genotypic Frequencies**

 **q = 0.5** **p = 0.5** **Homozygous Dominant:** **p2 = (0.5)2 = 0.25**

 **Heterozygous:** **2pq =** **2(0.5)(0.5) = 0.50**

 **HomozygousRecessive:** **q2= (0.5)2 = 0.25**

**7.** In Drosophila (fruit fly), the allele for normal wing length is dominant over the allele for short wings. In a population of 1000 individuals, 360 show the recessive phenotype. How many individuals would you expect to be homozygous dominant for the trait.

 **q = 0.6** **p = 0.4** **Homozygous Dominant:** **p2 = (0.4)2 = 0.16 x 1000 = 160 individuals**

**8.** The allele for a widow's peak (hairline) is dominant over the allele for a straight hairline. In a population of 500 individuals, 9% show the recessive phenotype. How many individuals would you expect to be homozyous dominant and heterozygous for the trait?

 **q = 0.3** **p = 0.7** **Homozygous Dominant:** **p2 = (0.7)2 = 0.49 x 500 = 245 individuals**

 **Heterozygous:** **2pq =** **2(0.7)(0.3) = 0.42 x 500 = 210 individuals**

**9.** In a given population, only the "A" and "B" alleles are present in the ABO system; there are no individuals with type "O" blood or with O alleles in this particular population. If 200 people have type A blood, 75 have type AB blood, and 25 have type B blood, what are the alleleic frequencies of this population?

 Frequency of A allele Frequency of B allele

**200 AA - Homozygous (200 x 2) + (75 x 1) (25 x 2) + (75 x 1)**

 **75 AB – Heterozygous 600 600**

**+25 BB - Homozygous**

**300 475 125**

**x 2 600 600**

**600 alleles**

 **0.792 = 0.8 0.208 = 0.2**

**10.** In Mr. Collea’s AP Biology class at North Salem High School, \_\_\_ members of the class cannot roll

 their tongues. The ability to roll your tongue is controlled by the dominant gene “R”. Determine the

 allelic frequencies (p and q) along with the number of individuals you would expect to have each of

 the possible three genotypes for this trait?

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|  | **Phenotypes** | **Allele Frequency Based****on the H-W Equation** |
| **Tongue Rollers**(p2 + 2pq) | **Non-Tongue Rollers**(q2) | **p** | **q** |
| **Class Population** | # | % | # | % |  |  |
|  |  |  |  |
| **North American Population** | 0.45 | 0.55 |  |  |