

Hardy-Weinberg Principle

The Hardy-Weinberg Equilibrium Principle states that allele and genotype frequencies in a population will remain constant from generation to generation in the absence of other evolutionary influences. In this ideal (non-realistic) situation, we assume:

- No selection, migration, or mutation
- Allele frequencies are equal in both sexes
- Generations are non-overlapping
- Populations are large
- Mating is random

$$p + q = 1$$

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

A gene has two alleles, A and a

p is the frequency of the dominant allele, A

q is the frequency of the recessive allele, a

p^2 is the frequency of homozygous dominant genotype, AA

q^2 is the frequency of homozygous recessive genotype, aa

$2pq$ is the frequency of heterozygous genotype, Aa

Steps for Solving Hardy-Weinberg Equilibrium Problems:

1. Calculate the frequency of the homozygous recessive genotype (q^2):

$$\text{frequency} = \frac{\text{number of recessive individuals}}{\text{total number of individuals in the population}} = q^2$$

2. Find the frequency of the recessive allele (q) by taking the square root of q^2
3. Find the frequency of the dominant allele (p), using the 1st H-W equation

$$p + q = 1 \rightarrow p = 1 - q \quad (\text{NOTE: now you have } q \text{ \& } p)$$

4. Calculate the frequency of the homozygous dominant genotype (p^2).
5. Calculate the number of individuals with the homozygous dominant genotype:

$$p^2 \times \text{total number of individuals in the population}$$

6. Calculate the frequency of the heterozygous genotype ($2pq$).
7. Calculate the number of individuals with the heterozygous genotype:

$$2pq \times \text{total number of individuals in the population}$$

8. Check your frequencies by substituting the values into the 2nd H-W equation.

Your Turn!

A population of squirrels can be either grey or brown; the grey allele (G) has complete dominance over the brown allele (g). Given a population of 2,874 squirrels, 2,292 are grey. Determine the allele frequency, frequency of individuals per genotype, and number of individuals per genotype.

The ability to taste PTC is due to a single dominant allele T. A scientist sampled 356 individuals and determined that 74 individuals could not detect PTC. Determine the allele frequency, frequency of individuals per genotype, and number of individuals per genotype.