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

KEY

Hardy-Weinberg

$p+q=1$ alleles

Easiest Ones

1. In the population of bats, long wings are dominant to short wings. If 20% of the population has short wings, then what is the frequency of the recessive allele?

$\sqrt{.20}$ = recessive trait $= \sqrt{q^2}$

$.45 = q$

q = recessive allele $= .45$

2. In guinea pigs, black hair is dominant over white hair. If 15% of the population has white hair, then what is the frequency of the dominant allele?

$\sqrt{.15}$ = recessive trait $= \sqrt{q^2}$

$.387 = q$

$p+q=1$

$p+.387=1$

$p=.613$

p = dom. allele $= .613$

3. What is the allele frequency of the recessive allele if 40% of the population shows the dominant allele?

p = dom allele $= .4$

$p+q=1$

$.4+q=1$

$q=.6$

q = rec. allele $= .6$

4. 372 turtles express the dominant phenotype in a population of 7,329. What is the frequency of the dominant trait in the population?

$\frac{372}{7,329}$ = dom ph. $=$ $.05$ = freq of dom. trait

5. If the frequency of the dominant allele is 0.5 in a population of sea squirts, then what is the frequency of the homozygous dominant genotype?

p = dom allele $= 0.5$

p^2 = homoz. dom $= (.5)^2 = .25$

Getting Harder…

6. If 32% of the population shows the recessive phenotype, then how many individuals in a population of 550 show the heterozygous genotype?

$\sqrt{.32}$ = rec. ph. $= \sqrt{q^2}$

$.57 = q$

$.43 = p$

$2pq = 2(.43)(.57)$

$2pq = .49 \times 550 =$ 270 hetero individuals

7. In fruit flies the allele for normal size wings is dominant to the allele for vestigial wings. In a population of 1000 individuals, 360 show the recessive phenotype. Calculate the number of individuals you would expect to be homozygous dominant **AND** the number of individuals that would be heterozygous for this trait.

$\frac{360}{1000}$ = rec ph $= \sqrt{q^2} = \sqrt{.36}$

$q = .6$

$p = .4$

$2pq = 2(.4)(.6) = .48$

$\times 1000 =$

heterozyg. $= 480 = 2pq$

$p^2 = (.4)^2 = .16$

$\times 1000 =$

homoz. dom $= 160 = p^2$

8. The allele for unattached earlobes is dominant over the allele for attached earlobes. In a population of 500 individuals, 25% show the recessive phenotype. How many individuals would you expect to be homozygous dominant **AND** how many individuals would you expect to be heterozygous?

$\sqrt{.25} = \frac{\text{rec.}}{\text{ph}} = \sqrt{q^2}$

$.5 = q$

$.5 = p$

$p^2 = (.5)^2 = .25 \times 500 = 125$ homozy. dom.

$2pq = 2(.5)(.5) = .5 \times 500 = 250$ heterozyg.

9. 1 in 1700 US Caucasian newborns have cystic fibrosis. Normal is dominant over cystic fibrosis. What are the allele frequencies and genotype frequencies of the population for cystic fibrosis?

$\frac{1}{1700} = \frac{\text{rec}}{\text{ph}} = q^2 = .0005$

$q = .02$

$p = .98$

$q^2 = .0005$

$p^2 = .9604$

$2pq = .0392$

Toughies

10. In Oompa Loompas, blue skin is dominant to orange. In a population of 4,573 Oompa Loompas, 790 of the blue-skinned individuals were determined to only have blue skin alleles. How many heterozygous Oompa Loompas are present in the population?

$\frac{790}{4,573} = \sqrt{p^2} = \sqrt{.17}$

$p = .42 \quad q = .58$

$2pq = 2(.42)(.58)$

$2pq = .49 \times 4573 =$ 2228 heteroz. indiv.

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

$.91 = \frac{\text{dom}}{\text{ph}} = p^2 + 2pq$

$.09 = \frac{\text{rec}}{\text{ph}} = q^2$

$\sqrt{.09} = \sqrt{q^2}$

$.3 = q$

$.7 = p =$ dom allele

Ready for a REAL challenge??

12. In a population of 2000 individuals, 3200 of the alleles held by them are dominant. How many of these individuals are carriers?

$\frac{3200 \text{ dom alleles}}{4000 \text{ TOTAL alleles}} = .8 = p = \frac{\text{freq of}}{\text{dom alleles}}$

$.2 = q$

(each individual has 2 alleles!)

$2pq = 2(.8)(.2) = .32$

$.32 \times 2000 =$ 640 heterozygous carriers

13. It has been found that a carrier of cystic fibrosis is better able to survive diseases with severe diarrhea. What would happen to the frequency of the "a" (cystic fibrosis allele) if there was an epidemic of cholera or other type of diarrhea producing disease? Would "a" Increase or would it Decrease? Why?

Increase, because being heterozygous is advantageous, thereby saving the recessive allele from being eliminated.