Tips on how to Solve:

Hardy Weinberg Problems

Remember to use the two equations: $p + q = 1$ & $p^2 + 2pq + q^2 = 1$

Remember what the variables represent:

- p = dominant ALLELE **A**
- q = recessive ALLELE **a**
- p^2 = homozygous dominant GENOTYPE **AA**
- 2pq = heterozygous GENOTYPE **Aa**
- q^2= homozygous recessive GENOTYPE **aa**

In a population of 130,000 magical mice, green fur is dominant over orange. If there are 300 orange mice in a population of 130,000, find the following (assume population is in Hardy-Weinberg equilibrium)

STEP 1: Assign the Alleles

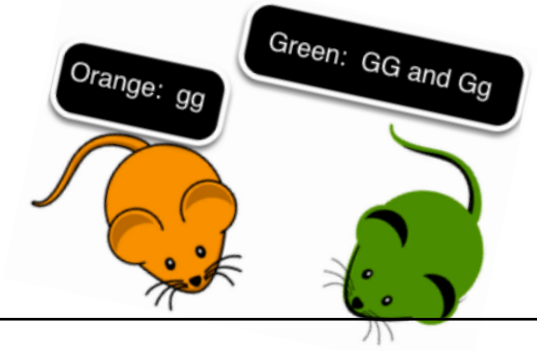
Alleles (versions of a gene)

What is dominant? Green fur….so we will use **"G"**

What is recessive? Orange fur…so we will use **"g"**

Now remember "G" and "g" are only versions of this colour gene

To actually represent colour(the trait) of any sort you will need TWO ALLELES like :



"GG" – green fur (p^2)

"Gg" – green fur (2pq)

"gg" – orange fur (q^2)

STEP 2: Calculate "q"

so….we assigned 'p' to be the frequency of "G" (green allele)

we assigned 'q' to be the frequency of "g" (orange allele)

The key is ALWAYS to try and find what 'q' frequency is…

We know orange fur is a recessive trait (needing **TWO** alleles "aa")

300 out of 130 000 are orange

***** IS "q^2 " NOT "q" *****

q^2 – 300 / 130 000 = **.002**

q - $\sqrt{.002}$ = **.045**

p -

p^2 -

2pq -

STEP 3: Calculate "p"

Once you know what "q" is, then "p" is easy to calculate

ALL YOU DO IS SUBTRACT IT FROM 1 – (because "p" and "q" must equal 1)

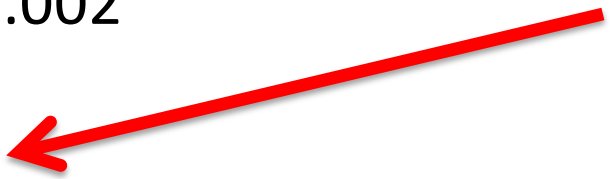
q^2 – 300 / 130 000 = .002

q - √.002 = .045

p - 1 - .04 = 0.955

p^2 -

2pq –



STEP 4: Calculate remaining GENOTYPES

Now you know what "p" and "q" are. Solve the rest

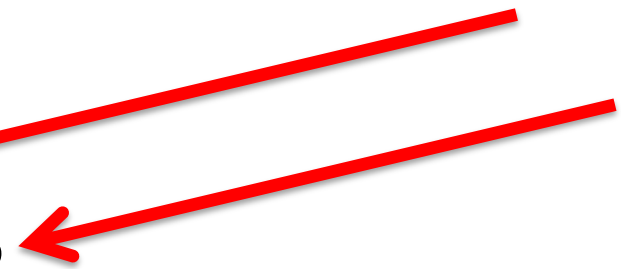
q^2 – 300 / 130 000 = .002

q - √.002 = .045

p - 1 - .04 = 0.955

p^2 - .955 X .955 = 0.912

2pq – 2 X .045 X .955 = 0.086



STEP 5: Calculate numbers of individuals

ITS LIKE CALCULATING GST

We now know ALL the frequencies of alleles and genotypes.

If the question asks you how many individuals are homozygous recessive you would:

Multiply the number of individuals by the frequency…
130000 X .002 = 260 individuals

If the question asks how many individuals are green you would

ADD the green frequencies (AA and Aa) and multiply by the number of individuals
130000 X (.912_.086) = 129740 individuals

q^2 – 300 / 130 000 = .002
q - √.002 = .045
p - 1 - .04 = 0.955
p^2 - .955 X .955 = 0.912
2pq – 2 X .045 X .955 = 0.086

REMEMBER: **Aa** and **AA** will produce the same phenotypes (GREEN)

The Greatest Concern Students Have

How do we know which number is q^2, q, p , p^2 and 2pq in the problem? PRACTICE and EXAMPLES

Examples:

q^2 –
-20% of a population is homozygous recessive……**use 0.20**
-Orange is a recessive trait and 30 out of 75 are orange….. **30 / 75 = 0.4**
-Green is a dominant trait and 16 out of 20 are green….. **4 / 20 = 0.20**

q -
-tall is recessive to short and the tall form of the gene occurs in 30% of the population… **use .30**
-the recessive allele appears in 40 out of 46 individuals… **40 / 46 = 0.87**

p -
-green is recessive to yellow, yellow has a frequency of 0.97… **use .97**
-the dominant allele appears in 20 out of 32 individuals… **20 / 32 = 0.625**

p^2 -
-Red flowers are dominant to yellow. The homozygous dominant frequency is 0.48**…use 0.48**
-80% of flowers have a homozygous dominant genotype…**use .80**

2pq –
-these individuals are CARRIERS…
-these individuals are heterozygous

A population of cats can be either black or white;the black allele has complete dominance over the white allele. Given a population of 1,000 cats, 840 black and 160 white, determine the allele frequency, the frequency of individuals per genotype, and number of individuals per genotype.

STEP 1: ASSIGN THE ALLELES
STEP 2: Calculate “q”
STEP 3: Calculate “p”
STEP 4: Calculate remaining GENOTYPES
STEP 5: Calculate numbers of individuals

$q^2 = .16$: 0.16 x 1000 = 160 white

$q = .4$

$p = .6$

$p^2 = .36$: 0.36 x 1000 = 360 black

$2pq = .48$: 0.48 x 1000 = 480 black