Bio393: Genetic Analysis **Name:**_____
Quiz #1 - Friday April 15, 2015

Question 1 (2 pts each):

(a) For a cross of two parents heterozygous for both of two unlinked genes, what is the probability that one of the progeny will express at least one of the dominant traits?

15/16 **The probability of expressing at least one of the dominant traits is the same as NOT inheriting both alleles that confer the recessive traits (1/4 for each). Therefore, 1-1/16 = 15/16.**

(b) For the same cross as in (a), what is the probability that one of the progeny will express either but not both of the dominant traits?

6/16 **The probability of expressing one of the dominant traits is 3/4. The probability of inheriting the other recessive trait is 1/4. Therefore, the probability of that genotype is 3/4 * 1/4 = 3/16. Because progeny can have the opposite phenotype, there are two ways 3/16 + 3/16 = 6/16**

Question 2 (4 pts):

A cross between two yellow mutant mice gives rise to the following offspring: two thirds yellow and one third agouti mice. Draw out the cross and make a hypothesis for what could give rise to this phenotypic ratio.

x	Y	y
Y	YY	Yy
y	Yy	yy

Y = dominant; yellow
y = recessive; agouti

The 2:1 ratio can arise if one of the genotypes is lethal.

Mice that have inherited the Y allele will be yellow because the allele acts in a dominant manner. However, mice homozygous (YY) for the yellow allele are not viable because they are recessive lethal. As a result, only heterozygous yellow mice (Yy) survive. yy mice are agouti. Thus, there will be two Yy (yellow) for every one agouti (yy).

Question 3 (4 pts):

Maize (corn) was selectively bred over the past 10,000 years from its wild relative called teosinte. Teosinte and maize can still interbreed. About 70 years ago, the superstar geneticist George Beadle set out to determine how many genes could make teosinte into maize. He crossed pure-breeding teosinte and pure-breeding maize to get hybrid F1 individuals that looked like maize. He then crossed the hybrids to generate 50,000 offspring. About one in 500 of the offspring looked like the teosinte parent. Approximately how many genes control differences between teosinte and maize? Please show your work.

$$\left(\frac{1}{4}\right)^n = recessive$$

$$\left(\frac{1}{4}\right)^2 = \frac{1}{16}, \left(\frac{1}{4}\right)^3 = \frac{1}{64}, \left(\frac{1}{4}\right)^4 = \frac{1}{256}, \left(\frac{1}{4}\right)^5 = \frac{1}{1024},$$

Assume that the differences observed between teosinte and maize are the result traits controlled by individual genes that are unlinked and follow mendelian inheritance patterns. We can estimate the number of genes responsible for parental differences based on the expected frequency of individuals that would be homozygous recessive across all genes. This frequency can be calculated as (1/4)^n, where n is the number of genes. For 4 genes, (1/4)^4 = 1/256; For 5 genes, (1/4)^5 = 1/1,024. Because 1/500 lies between these two numbers, we would estimate that the number of genes underlying parental differences is between 4 and 5 genes.

Question 4 (3 pts):
The haploid chromosome number in cats is 19. Sex is determined by the XY system, as in humans. Answer the following:

(a) How many chromosomes are present in the zygote?

38

(b) How many sex chromosomes are present in a sperm cell?

1

(c) How many autosomes are present in a liver cell?

36

Question 5 (2 pts each):
You perform a selection for mutant *Arabidopsis* plants that can grow in the presence of high salt. You get four mutants (m1-m4). To determine how many genes are mutated, you perform complementation tests and get the following results when plants are grown on high salt.

	m1	m2	m3	m4
m1	Alive	Dead	Alive	Dead
m2	Dead	Alive	Dead	Alive
m3	Alive	Dead	Alive	Dead
m4	Dead	Alive	Dead	Alive

(a) You were lucky that your results were interpretable. What should you have done first?

Check whether the mutant phenotypes are dominant or recessive. If the phenotype is dominant, then you might be confused about a failure to complement.

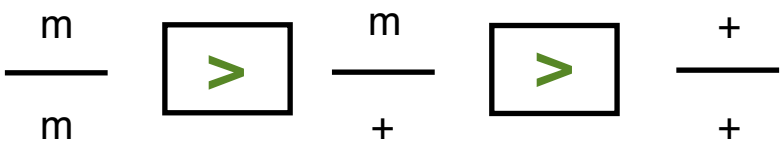
(b) How many genes are there?

2

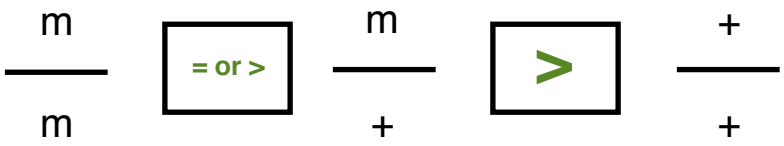
Question 6 (2 pts each):
For the following questions, write the phenotypic relationships that would show the mutation effect in the boxes.

Use > or < symbols to denote when mutant phenotypes will be worse or better (or = equal).

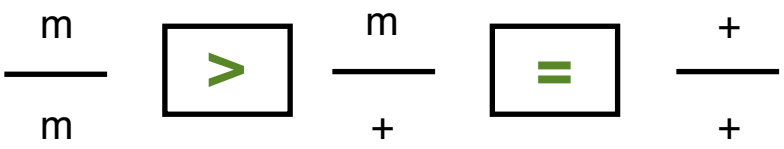
(a) Hypermorph (increase in wild-type function)



(b) Neomorph (altered function)



(c) Hypomorph (partial loss of gene function)



Please go to bio393.andersenlab.org/ to fill out the post-quiz survey.
We are looking to improve the course! Your feedback is appreciated.