Bio393: Genetic Analysis **Name:**_____________________

Problem Set #1

Due on Friday, January 12, 3 PM, Cook 3125

Question 1:

You cross AaBBCcddEeFf with AaBbccDdEEFf individuals.

(a) What is the probability of phenotypically aBCDEf individuals?

*aa (1/4) * B- (1) * C- (1/2) * D- (1/2) * E- (1) * ff (1/4) = 1/64*

(b) What is the probability of phenotypically ABCDeF individuals?

*A- (3/4) * B- (1) * C- (1/2) * D- (1/2) * ee (0) * F- (3/4) = 0*

(c) What is the probability of genotypically AaBBccddEeFf individuals?

*Aa (1/2) * BB (1/2) * cc (1/2) * dd (1/2) * Ee (1/2) * Ff (1/2) = 1/64*

Question 2:

On a Friday late night walk, you discover a strange mouse with a kinked tail. Your love of genetics inspires you to investigate this mutant phenotype.

(a) You breed the kinked-tail mouse (a male) with several wild-type females from a laboratory strain and observe that about half the offspring (both males and females) have kinked tails and half have normal tails. What is the nature of the kinked-tail phenotype?

Autosomal dominant. If it were linked to the X chromosome, then none of the male offspring would have kinked tails.

(b) When two of the kinked-tail offspring from part (a) are crossed, what fraction of the resulting mice would you expect to have kinked tails?

3/4 would have kinked tails.

(c) When you cross kinked-tail offspring from part (a), you find that one third of the resulting kinked-tail males produce no sperm and thus are sterile. The other two thirds of the resulting kinked-tail males (and all of the normal-tail males and all of the females) are fertile. Propose a model to account for these findings.

Two possibilities exist: (1) The kinked-tail mutation causes a dominant kinked-tail phenotype and a recessive male sterility phenotype. (2) The kinked-tail mutation is linked to another mutation that causes recessive male sterility. A cross of heterozygous males would yield 1/3 homozygous kinked-tail mutation or the linked male sterility mutation.

(d) An annoying dorm mate of yours informs you that he has isolated a pure-breeding mouse strain in which males produce no sperm but have normal tails. Also, females are phenotypically normal (fertile with normal tails). You explain to your “friend” that this situation is impossible. Why?

It is impossible to make a pure-breeding strain when the males do not make sperm. Each generation could never give rise to the next generation.

Question 3:
A true-breeding *Drosophila* strain with four different recessive traits (a, b, c, and d) is crossed to the true-breeding wild-type strain. The F1 females that result from this cross are then crossed to wild-type males.

♂ (+ + + +) **X** ♀ (a b c d)

↓

♂ (+ + + +) **X** ♀

(a) Many flies of both sexes from this second cross are examined and none show the recessive **d** trait. What does this tell you about the chromosome on which the **d** gene resides?
The d gene must be on an autosome. If it were on the X chromosome then 1/2 of all male offspring would have the d phenotype because they would be hemizygous for d.

A total of 200 progeny from the second cross are evaluated for each of the three remaining traits. The 100 females among the progeny all appear as wild-type (*i.e.* none exhibit any of the recessive traits). For the 100 males among the progeny, eight different phenotypic classes are observed. The phenotypes and numbers of each of the phenotypic classes are given below. For simplicity, phenotypes of the three recessive traits are designated **a**, **b**, and **c**, while the corresponding wild-type phenotypes are designated with a "+".

Phenotype	Number
+ + + (females)	100
+ + + (males)	18
a b c (males)	22
a b + (males)	21
+ + c (males)	19
a + c (males)	6
+ b + (males)	4
+ b c (males)	7
a + + (males)	3

(b) Give as much information as you can about the chromosomal positions of the three markers, a, b, and c. Include in your answer any relevant map distances in cM.
The recombination distance between a and b is 6+4+7+3/100 = 20 cM. The recombination distance between a and c is 21+19+7+3/100 = 50 cM. The recombination distance between b and c is 21+19+6+4/100 = 50 cM. Genes a and b are linked, and c is unlinked to both. It is not known whether c is closer to a or b.

Question 4:
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.

	Y	y
Y	x 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 5:
Consider an individual heterozygous for albinism.

(a) What gamete genotypes would you expect this individual to produce and in what proportions?
The individual is Aa. The gamete genotypes are A, A, a, or a. Each is produced in equal proportions or 1/2 A and 1/2 a.

(b) Diagram how the chromosomes behave during meiosis to explain your answer to (a).
Not all steps are drawn.