The answers to these questions will be posted on the course web page by March 5. You are encouraged to work through the problems first before the answers are available. Try to work on the problems in small groups.

1. We know that the most common form of color blindness results from an X-linked recessive gene. A couple with normal color vision has a daughter with normal vision and a son who is color-blind. What is the probability that the daughter is a carrier for the color-blindness allele? In other words, what is the probability that the daughter is heterozygous for the trait?

2. In the pedigree below, the shaded symbols represent people affected with a neurological disorder caused by an X-linked recessive allele. Let’s call the normal allele D and the recessive allele d. What are the genotypes of every person in this pedigree?

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   I 1 2
   II 1 2 3
   III 1
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3. The mutation for Bar-shaped eyes in Drosophila has the following characteristics of inheritance.
   a. Bar males x wildtype (round-eyed) females produce wildtype sons and Bar daughters
   b. The Bar females from the mating in part a, when crossed with wildtype males, yield a 1:1 ratio of Bar: wildtype sons and Bar:wildtype daughters.

   What mode of inheritance do these characteristics suggest?

4. In Shorthorn cattle, both red coat color and white coat color are true breeding. Crosses of red cattle x white cattle produce offspring that are uniformly reddish brown but thickly sprinkled with white hairs. This type of coat color is called roan. Crosses of roan x roan produce 1/4 red : 1/2 roan: 1/4 white. What kind of genetic inheritance can explain these results?

5. The tailless trait in the mouse results from an allele of a gene on chromosome 17. A cross of tailless x tailless mice produces tailless and wildtype offspring
in a ratio of 2 tailless: 1 wildtype. All tailless offspring from this cross when 
mated with wildtype produce a 1:1 ratio of tailless to wildtype.

a. Is the allele for the tailless trait dominant or recessive?

b. What genetic mechanism can explain the results of these crosses?

6. If a couple already has a daughter, what is the probability that the next child will be a son? If the couple already had three daughters, what is the probability that the next child will be a boy?

7. Consider three gene pairs, Aa, Bb and Cc, each of which affects a different character. In each case, the uppercase letter signifies the dominant allele. The three genes are located on different chromosomes. Calculate the probability of obtaining:

a. An Aa BB Cc zygote from a cross of Aa Bb Cc x Aa Bb Cc

b. An Aa BB cc zygote from a cross of aa BB Cc x AA bb CC

c. An A B C phenotype from a cross of Aa Bb CC x Aa Bb cc

d. An a b c phenotype from a cross of AA BB CC x AA BB CC

8. In the jimsonweed, purple flowers are dominant to white. When a particular purple-flowered jimsonweed is self-fertilized, the progeny are 27 purple-flowered and 10-white flowered progeny. What proportion of the purple-flowered progeny will breed true? What proportion of the white-flowered progeny will breed true?

9. Continuing with jimsonweed, spiny pods (S) are dominant to smooth (s). Consider pod shape and flower color together. The genes are on different chromosomes. What mix of phenotypes would you expect from the following crosses? See if you can answer the questions using probabilities rather than constructing Punnett squares.

a. PP ss x pp SS
b. Pp SS x pp ss
c. Pp Ss x Pp SS
d. Pp Ss x Pp ss
e. Pp Ss x Pp Ss
f. Pp Ss x pp ss
10. For the following pedigree, which of the following mechanisms can explain the pattern of inheritance of the trait shown in the affected individuals (the dark symbols). Assume the condition is caused by a single gene. Which mechanism do you think is the most likely?

a. Autosomal dominant
b. Autosomal recessive
c. X-linked dominant
d. X-linked recessive

11. We know that human blood type is determined by a three-allele system at a single locus. For the following, state whether the child mentioned can actually be produced from the marriage.

a. An O child from the marriage of two A individuals
b. An O child from the marriage of an A to a B
c. An AB child from the marriage of an A to an O
d. An O child from the marriage of an AB to an A
e. An A child from the marriage of an AB to a B

12. Phenyloketonuria is a caused by a recessive autosomal allele. In the pedigree below, the female (dark circle) in the pedigree is affected with phenylketonuria. If person III-1 and III-2 were to marry (they are first cousins), what is the probability that their child will be affected?