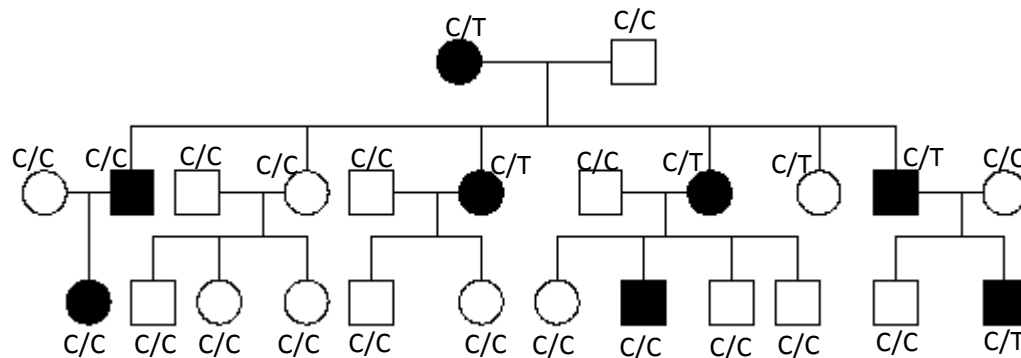Due in class on Monday 2/15/16

Problem 1 (20 points) Below is the pedigree that depicts a rare but mild genetic disease. Adjacent to each individual is the haplotype for a common polymorphism, a C/T SNP on Chr 22.

a) (5 points) What is the most likely inheritance pattern for this disease? Give two specific facts from the pedigree that support your conclusion.

b) (2 points) Is there evidence of linkage between the SNP and the disease allele? Briefly explain your response.

c) (4 points) If there is evidence of linkage, sketch the arrangement of the alleles on chromosome 22 for each of the two grandparents. Use the allele designations D and d for the disease alleles, and C or T for the haplotype.

d) (3 points) Circle the individuals on the pedigree that are recombinants. .

e) (4 points) If there is evidence of linkage, use the information provided in the pedigree to estimate the distance between the SNP and the disease allele in map units.

f) (2 points) The distance between these two genes calculated in part e is likely to be an underestimate. Why?

Problem 2 (15 points) The following cross is performed with two pure-breeding *Drosophila* individuals: a female with normal wings and red eyes (vg+/vg+ · cn+/cn+) and male with vestigial wings and brown eyes (vg/vg · cn/cn). The F1 progeny are testcrossed. What percentage of the offspring from the testcross will be vg/vg · cn/cn if the two genes are:

a) unlinked?

b) so tightly linked that crossing over does not occur?

c) linked and 17 m.u. apart?

Show your work and provide a very brief explanation for your response.

Problem 3: (16 points) In the following cross, the genes are inherited independently except for *C* and *D*, which are tightly linked and show zero recombination: *A/A ; b/b ; c/c ; D/D ; e/e ; F/F* x *a/a ; B/B ; C/C ; d/d ; E/E ; f/f*. These two parents are crossed, and the F1 progeny are self-crossed. What proportion of individuals in the F2 generation will be:

   a) pure breeding?

   b) homozygous recessive for all loci?

   c) *A/a;B/B;c/c;D/D;E/e;f/f*?

   d) genotypically identical to either original parent?

Problem 4 (16 points) In corn plants, the cross Q/Q · r/r · T/T x q/q · R/R · t/t is made. The three loci are linked as follows:

Q/q   R/r   T/t

    6 m.u.   20 m.u.
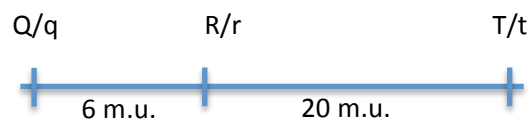
a) (2 points) What is the genotype of the F1 progeny?

b) (6 points) Draw the two chromosomes contained by the F1 progeny.

c) (8 points) A testcross of the F1 progeny is now performed. What percentage of the testcross progeny will be of the genotype qq rr tt? (HINT! You will need to figure out individual recombination frequencies and then apply the product rule!). Explain your reasoning and show your work.

Problem 5 (12 points) Two new mutant lines of a flowering plant have been obtained; one breeds true for blue flower color and the other breeds true for red flower color (wild-type flower color is purple). Consider the following crosses.

1. blue × purple → F_1 all purple → F_2 75% purple; 25% blue

2. red × purple → F_1 all purple → F_2 75% purple; 25% red

3. red × blue → F_1 all purple

The red pigment is a precursor of the purple pigment, the blue pigment is a precursor of the red pigment, and a colorless compound is the precursor of the blue pigment in a linear biosynthetic pathway controlling flower color.

a) Write the genotypes of each of the original parental plants in the three crosses above. (6 points)

b) What phenotypic ratios do you expect in the F_2 of cross 3? Show your work.(6 points)

Problem 6: (10 points) *Drosophila* eyes are normally red. Several purple-eyed strains have been isolated as spontaneous mutants, and the purple phenotype has been shown to be inherited as a Mendelian autosomal recessive in each case. To investigate allelism between these different purple mutations, two purple-eyed pure strains were crossed.

a) If the purple mutations are in different genes (i.e., they are *not* allelic), the phenotypic ratios in the F_1 are expected to be:

A) 100% red.
B) 75% red : 25% purple.
C) 50% red : 50% purple.
D) 25% red : 75% purple.
E) 100% purple.
Provide a brief justification for your response.

b) If the purple mutations are in the same gene (i.e., they *are* allelic), the phenotypic ratios in the F_1 are expected to be:

A) 100% red.
B) 75% red : 25% purple.
C) 50% red : 50% purple.
D) 25% red : 75% purple.
E) 100% purple.
Provide a brief justification for your response

Problem 7 (11 points) In a certain breed of dog, the alleles *B* and *b* determine black and brown coats, respectively. However, the allele *Q* of an unlinked gene is epistatic to the *B* and *b* color alleles, resulting in a gray coat (*q* has no effect on color).

a) What is the phenotype of a *B/b; Q/q* animal? Very briefly explain.

b) If two animals each of genotype *B/b; Q/q* are crossed, what phenotypic ratio is expected in the progeny?