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Old midterm Qs:

Scarlet, magenta, coral, and white are petal colors of geraniums. Individual plants (not necessarily from pure lines) showing these colors were intercrossed; the results are tabulated as follows, where the abbreviations W (white), S (scarlet), C (coral), and M (magenta) represent the phenotypes:

Cross	Parental phenotypes	Phenotypes of Progeny			
		S	M	C	W
1	S x S	22	0	0	7
2	C x C	0	0	34	11
3	M x C	0	24	11	12
4	S x W	13	0	12	0
5	S x M	14	8	6	0
6	S x C	19	20	0	0

- How many gene(s) are involved in determining coat colour?
- Can you determine an allelic series for this gene(s)? What is it?
- If the magenta parent plant from cross 3 is crossed with the scarlet parent plant from cross 5, what are the phenotypic proportions of the progeny? Show parental and F1 genotypes and phenotypes.

Question 3

Assume that three pairs of alleles are found in *Drosophila* q^+ and q , r^+ and r , s^+ and s . As shown by the symbols, each non-wild-type allele is recessive to its wild-type allele. A cross between females heterozygous at these three loci and wild-type males yields progeny having the following genotypes:

Females:	q^+	r^+	s^+	1010
Males:	q^+	r	s^+	441
Males:	q	r^+	s	430
Males:	q	r	s	39
Males:	q^+	r^+	s	32
Males:	q^+	r^+	s^+	30
Males:	q	r	s^+	27
Males:	q^+	r	s	1
Males:	q	r^+	s^+	<u>0</u>
Males total:				1000

- Explain on what chromosome or chromosomes of *Drosophila* the genes are carried.
- Draw the relevant chromosomes in the heterozygous female parent, showing the arrangement of the alleles. Show your reasoning for this arrangement.
- Calculate the map distance between the genes.

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Loppins (*Loppinus loopy*) are fictitious, but very useful diploid invertebrates with a total of 6 chromosomes in their somatic cells. Of those 6 chromosomes, 4 are autosomes and 2 are sex chromosomes. Like humans, male loppins are XY while females are XX.

The gene that determines loppins' blood type is called *bt* and is on chromosome 1, the gene that determines the presence or absence of eyelashes is called *eye* and is on chromosome 2, and the gene that determines ability to digest cellulose is called *cel* and is on the X chromosome.

bt^A , bt^B ; eye^{WT} , eye^D , cel^{WT} and cel^M are alleles of these three genes.

- a) A female loppin is a triple heterozygous with the genotype bt^A/bt^B ; eye^{WT}/eye^D ; $X^{cel^{WT}}/X^{cel^M}$. Her mother was homozygous for bt^A , for eye^D and for cel^{WT} . Draw a somatic cell of our triple heterozygous female loppin in G1 stage of the cell cycle (that is, before DNA replication). Make sure that the chromosomes are properly drawn and clearly label all the relevant genes and alleles.

- b) What alleles did the triple heterozygous female loppin inherit from her mother, and what alleles did she inherit from her father?

- c) For research purposes you remove three meicytes from the triple heterozygous female, you let them undergo the cell cycle and meiosis, and you analyze the genotype of the gametes that are produced. The first meicyote produces two gametes of genotype bt^A ; eye^{WT} ; $X^{cel^{WT}}$ and two gametes of genotype bt^B ; eye^D ; X^{cel^M} .

The second meicyote produces two gametes of genotype bt^B ; eye^{WT} ; $X^{cel^{WT}}$ and two gametes of genotype bt^A ; eye^D ; X^{cel^M} . Explain what must have happened differently in this meicyote compared to the one in part i) to produce this result. A diagram may be helpful in your explanation.

- ii) The third meicyote produces one gamete of genotype bt^A ; eye^{WT} ; $X^{cel^{WT}}$, one gamete of genotype bt^B ; eye^{WT} ; $X^{cel^{WT}}$, one gamete of genotype bt^B ; eye^D ; X^{cel^M} and one gamete of genotype bt^A ; eye^D ; X^{cel^M} . Briefly explain what must have happened to produce this result. You may refer to previous drawings if you need to.

- iii) If we looked at the gametes produced by 100 different meiocytes from this triple heterozygous female loppin, what are all the genotypes that we would expect to find, and in what proportions? (*Note: 100 different meiocytes will produce a total of 400 gametes*)

3. Wild-type *Drosophila* have smooth wings and long, tapered bristles on their abdomens. You are investigating the inheritance of two genetically controlled mutant phenotypes: hairy wings and forked bristles. The genes and alleles of interest are designated as follows:

h^+ = wild-type allele, wild-type wings
 h^m = mutant allele, hairy wings
 f^+ = wild-type allele, wild-type bristles
 f^m = mutant allele, forked bristles

A pure-breeding female with wild-type wings and forked bristles is crossed to a pure-breeding male with hairy wings and wild-type bristles. The F1 progeny consists of 47 females with wild-type wings and wild-type bristles and 46 males with wild-type wings and forked bristles.

- a) Use the information provided above to determine the relationship (dominance, recessiveness, *etc.*) between the two alleles of each gene, and justify your answer in one or two sentences.
- b) What is the mode of inheritance for these genes? What are the respective genotypes of the pure-breeding female and male? In your answer consider wing structure, bristle shape and sex.
- c) Show how you verified that your explanation matches the data provided.

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- d) F1 individuals (brothers and sisters) are mated to obtain an F2 generation. This F2 generation includes 409 females and 398 males, and you start by analyzing the females:

155 have wild-type wings and bristles
153 have wild-type wings and forked bristles
52 have hairy wings and wild-type bristles
49 have hairy wings and forked bristles.

Determine the genotype of each of the four phenotypic classes listed and show how you verified that your proposed genotypes fit with the data provided.

Based on your explanation in part c), what are the expected phenotypes and their relative proportions/numbers for the 398 F2 males?