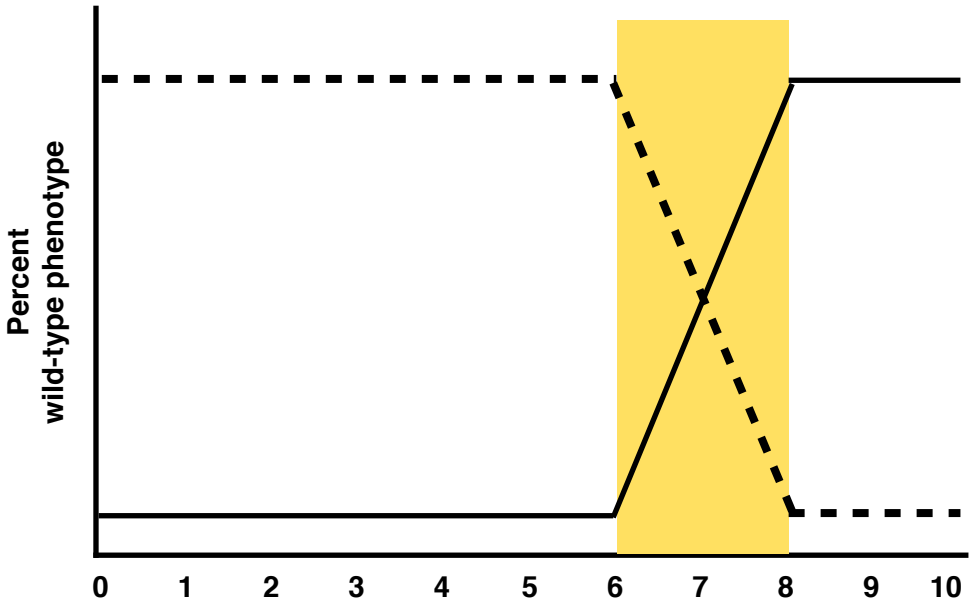
Bio393: Genetic Analysis **Name:**_____
Problem Set #3
Due on Friday, May 5, 3 PM

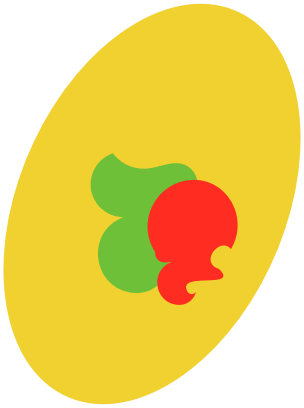
Question 1:
Draw a cross to differentiate between maternal-effect inheritance and cytoplasmic inheritance? Hint: think about multiple generations.

With traits that show cytoplasmic inheritance, every offspring from an affected mother will be affected. The trait will be passed in each generation from mother to child.

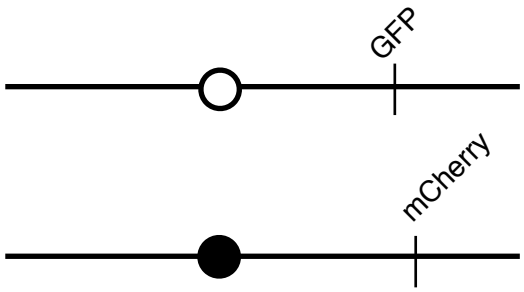
With traits that show maternal-effect inheritance, the offspring's phenotype is dependent on the maternal genotype. Some mothers might not have the alleles that confer the dominant or recessive mutant phenotype so the offspring will be unaffected.

Question 2:
Using a temperature-sensitive allele, you perform upshift and downshift experiments over the course of ten hours with a shift every hour. After the ten hours is complete, you measure the penetrance of the mutant phenotype. You find that the temperature-sensitive period is between six and eight hours. Please draw the upshift (solid line) and downshift (dotted line) on the graph below.

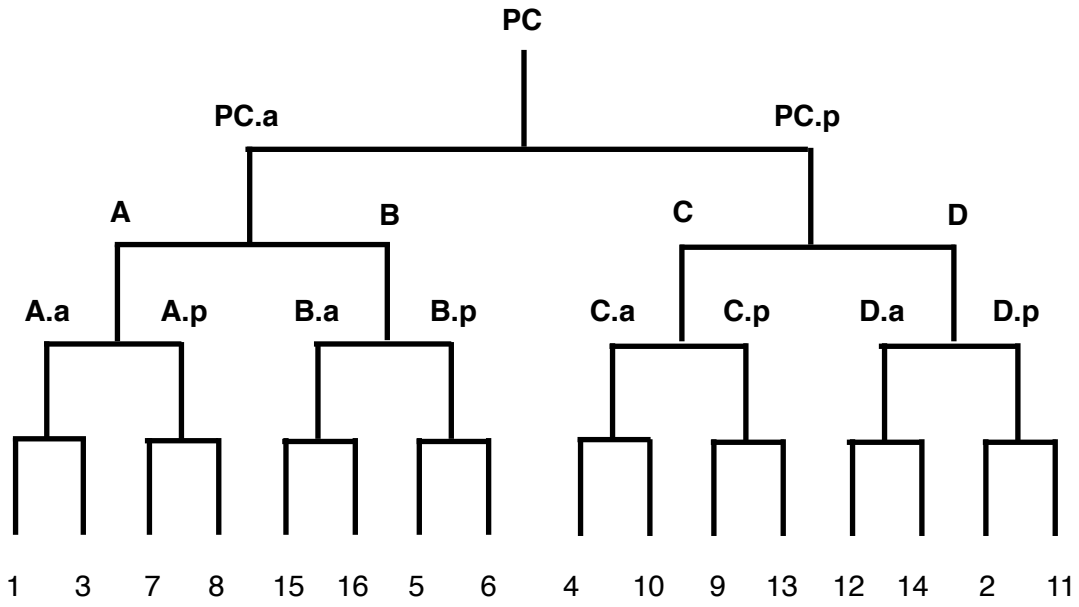




Question 3:
In *Drosophila*, you can generate twin spots using cell-specific markers. In the example below, red ommatidia are homozygous for the mCherry gene, green ommatidia are homozygous for the GFP gene, and yellow ommatidia are heterozygous for mCherry and GFP. Draw out the diploid homologous chromosomes with centromeres demarcated as open and closed circles and locations of the GFP and mCherry insertions that would lead to this mitotic recombination result.



Question 4:
You are studying a relative of *C. elegans* named *C. horvitzii*. Just like Bob Horvitz and John Sultan, you want to generate a lineage map of the organism from the zygote the the adult animal. Below is the lineage you have constructed so far.



You need to place cells 1-16 on the lineage. Using ablation to generate the following data:

Ablated cell	Cells that are present
PC.a	2, 4, and 9-14
A	2, 4, 5, 6, and 9-16
A.a	2, and 4-16
B.p	1,2,3,4,7,8, and 9-16
D	1,3,4,5,6,7,8,9,10,13,15,and 16
D.p	1,3,4,5,6,7,8,9,10, and 12-16
C.p	1-8, 10, 11, 12, 14-16

(a) Label the lineage above with cells 1-16.

You have several lineage defective mutants that fail to form certain cells and their direct descendants. Using these mutants, you attempt to discern which cells are needed for the development of particular components of the adult body.

In mutants for lineages A, B, C, and D.a, you always see the tail formed correctly. Mutants for lineage D never have a proper tail.

In mutants for lineages A.p, B, and PC.p, you always see a proper vulva. However, mutants for lineages A and PC.a never have a proper vulva.

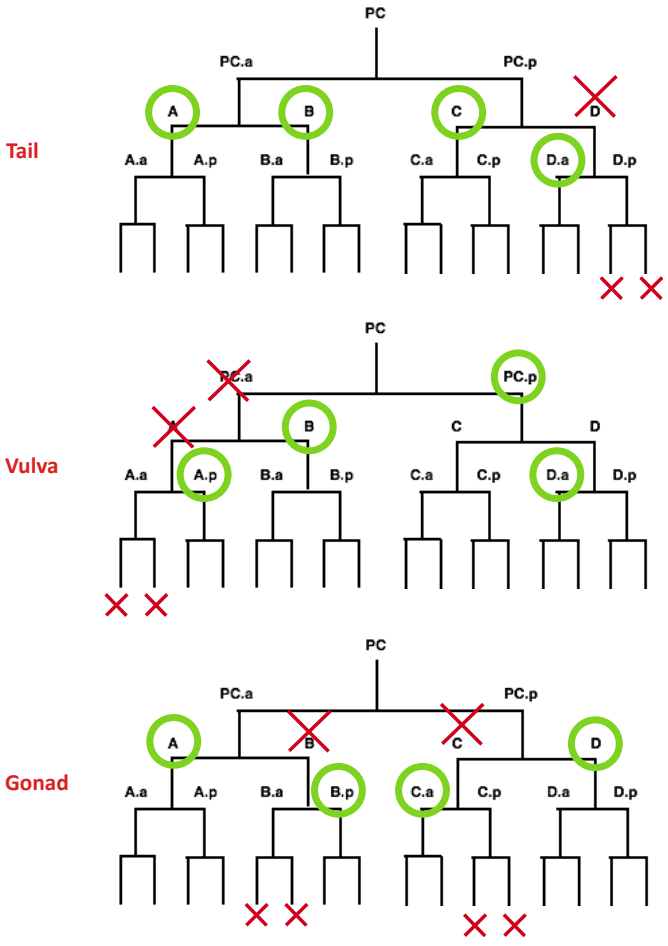
In mutants for lineages A, B.p, C.a, and D, you always see proper formation of the gonad. However, mutants for lineages B and C do not have gonads.

(b) Which cells are responsible for tail, vulva, and gonad formation?

Tail = Dp

Vulva = A.a

Gonad = B.a + C.p



Question 5:
You are interested in the development of a set of cells that make the opening of the secretory duct to the intestine of *Drosophila*. Fourteen cells are arranged in two rings with seven cells in each ring. The cells of the first ring are numbered 1-7 and the second ring 8-14. To investigate the developmental origin of these cells, you induce mitotic recombination in flies heterozygous for a somatic cell marker that you can score. The time at which you induce mitotic recombination is prior to when all 14 cells are formed. When you score for clones homozygous for your somatic cell marker in a large number of flies, you observe the following numbers and patterns of clones:

Cells expressing somatic marker	Number of cases
1,3,5,10	7
8,14	10
2,7,8,9,13,14	4
1,3,4,5,6,10,11,12	4
4,6,11,12	6
8,9,13,14	7
9,13	12
1,10	11
4,11	13
6,12	12
3,5	12
2,7	14
All	2

Say as much as you can about the developmental relationships of the cells that makeup this duct.

It appears that seven precursor cells; each of which give rise to two of the 14 intestinal cells. If all of the cells came from one common precursor, then all or none of the cells would have been labeled. The probability of any one precursor cell being marked is the same as observed from the most abundant two labeled cell classes. These classes also tell us that the precursor cell for each of the cells in the two final rings can contribute cells to either ring. For example, [2,7] came from mitotic recombination in a precursor that contributed to the first ring, but [4,11] came from mitotic recombination in a precursor that contributed to both the first and second rings.