

This homework is due **Dec. 12**.

The final exam will be given on Thursday, **December 14 at 8:00 am**

HOMEWORK 5

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1. (3 points) You have isolated a new recessive **lethal** mutation in *Drosophila*. You tentatively call the mutation (and the gene it's in) *cyclops*, or simply *cy* (because of the phenotype of the dead embryos, which have a single eye disc primordium). You have mapped *cy* to the X chromosome, and wish to refine its map position further. To do this, you use *crossveinless* (*cv*, which has a recessive phenotype that a crossvein on the wing is missing) and *cut* (*ct*, which has the recessive phenotype that the wings appear to have been cut) as markers. You cross *cy* / *FM7* females (*FM7* is a balancer chromosome for the X which is not lethal but female-sterile) to *cv ct* males, and then allow the resulting phenotypically wild-type heterozygous F1 females (which are *cy* / *cv ct*) to mate with their *FM7* male brothers. The male F2 progeny from this cross fall into the following phenotypic categories.

crossveinless cut wings	879
wild-type wings	56
cut wings with normal veins	57
crossveinless wings without cuts	4

Examine the *Drosophila* genetic map (see pg. 132 of Hartwell, Fig. 5.15, or flybase: <http://flybase.bio.indiana.edu/>) and determine the position of *cyclops* on the **genetic** map (i.e. its location in map units. For example, *cv* is at 1-13.7).

2. (1 point) Use the information from question 1 to infer an approximate position of your gene (*cyclops*) on the **cytological** map (for example, the cytological position of *cv* is 5A13. You will probably need to visit flybase to correlate the two maps.

3. (1 points) Name at least one candidate gene that maps in this region. Explain why your candidate gene might be *cyclops*.

4. (2 points) *Drosophila* larvae that were heterozygous for a null mutation of the *white* gene (*w*) and its wild-type allele (*w*⁺) were irradiated with X rays and then reared to adulthood. When the adults emerged from the pupal cases, a few had white patches in their otherwise red eyes. These patches were otherwise normal in every other way. What caused these patches to develop? Given this observation, do you think it more likely that the product of the *white* gene acts in pigment deposition or in the metabolic pathway for pigment synthesis? Explain. This result does not resolve the issue; just tell us if this result favors one of those two possibilities, and why. It is known that pigments are synthesized elsewhere and then transported to the eyes.

5. (2 points) You repeat this experiment using the same protocols, but this time with *Drosophila* larvae that are heterozygous for mutations in the linked genes *cinnabar* (*cn*) and *brown* (*bw*) and derived from a cross between wild-type and *cn bw* parents. Together, these mutations cause a white eye (you can read about these genes on flybase). Again, larvae were irradiated with X rays and then reared to adulthood. When the adults emerged from the pupal cases, a few had brown patches in their otherwise red eyes, but no white or cinnabar patches were observed. Explain your observations.

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6. (1 point) Which comes first, a mutant ES cell line or a mutant mouse?

- a) The cell line is derived from the mouse.
- b) The mouse is derived from the cell line.

7. (8 points) For each of the following types of animal, indicate First, whether the individual animals are all genetically identical and Second, whether or not the cells present in each animal are homozygous at all or nearly all loci:

- a) Fruit flies from a standard wild-type laboratory strain such as Canton S.
- b) *C. elegans* worms from a standard wild-type laboratory strain such as N2.
- c) mice from a standard laboratory strain such as C57BL/6J
- d) F1 mice from a cross between two inbred lines such as C57BL/6J and 129/SvJ.
- e) chimeric mice derived from wild-type 129/SvJ ES cells and B6 blastocysts.
- f) *Arabidopsis thaliana* from a standard laboratory strain such as Col-0
- g) *Arabidopsis thaliana* from a recombinant inbred line

8. (1 point) Is it possible to exclude paternity by examination of a single locus (examination of the same single polymorphic locus in a child and the presumed father? Explain (If so, how? [give an example of how you could do this]. If not, why not?).

9. (1 point) Is it possible to exclude the possibility that two people are siblings by examination of a single locus (examination of the same single locus in the two individuals that may be siblings)? Explain (if so, how? if not, why not).

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