

Problem Set 7 MCDB 4650 For multiple choice questions, there may be more than one answer.

1. (1) You isolate two new loss of function mutations in *C. elegans* which affect the differentiation of sensory neurons. In one mutation, *nos-1*, the worms cannot sense where the food is in their environment. In the second, *yum-1*, they are hypersensitive to their food source. Which of the following regulatory pathways is/are consistent with the results so far?

- a. $\text{nos-1} \dashv \text{yum-1} \dashv \text{food perception}$
- b. $\text{nos-1} \dashv \text{yum-1} \rightarrow \text{food perception}$
- c. $\text{yum-1} \dashv \text{nos-1} \rightarrow \text{food perception}$
- d. $\text{yum-1} \dashv \text{nos-1} \dashv \text{food perception}$

2. (1) If you do an epistasis test and determine that a *nos-1; yum-1* double mutant worm has the same phenotype as *yum-1* (ie, they are hypersensitive to food, which one of the above regulatory pathways is consistent with these results? Explain.

Use the following information to answer questions 3-6. You have isolated a strong loss-of-function mutation in the *lin-15* gene that causes a Muv phenotype. To see if it can be located in the *ras* pathway of vulval development by epistasis tests, you make the following double mutants using other mutations in *ras* pathway genes, and find the phenotypes indicated:

<u>Single mutant phenotypes</u>		<u>Double mutant phenotypes</u>	
<i>let-60</i>	Vul	<i>lin-15; let-60</i>	Vul
<i>mek-2</i>	Vul	<i>lin-15; mek-2</i>	Vul
<i>let-23(gf)</i>	Muv	<i>lin-15; lin-3</i>	Vul
<i>lin-3</i>	Vul	<i>lin-3; let-23(gf)</i>	Muv

- 3. (.5) Just looking at the data for *lin-3*, *lin-15* and *let-23*, establish their order in the pathway. List the most upstream gene first.
- 4. (1) What can you say about *let-60* and *mek-2* and *lin-15* with respect to their order in the pathway and why can you make that conclusion?
- 5. (.5) Which of the following best represents the relationship between *lin-15*, *lin-3*, and vulval fate?
 - a. $\text{lin-15} \dashv \text{lin-3} \rightarrow \text{vulval fate}$
 - b. $\text{lin-15} \rightarrow \text{lin-3} \rightarrow \text{vulval fate}$
 - c. $\text{lin-3} \dashv \text{lin-15} \dashv \text{vulval fate}$
 - d. $\text{lin-3} \rightarrow \text{lin-15} \dashv \text{vulval fate}$
 - e. $\text{lin-3} \dashv \text{lin-15} \rightarrow \text{vulval fate}$
- 6. (.5) Given *lin-15*'s position in the pathway, in which cell or cells is it most likely to be active?
 - a. The VPCs
 - b. The cells of the somatic gonad (e.g. the AC and the VU)
 - c. The VPCs and the cells of the somatic gonad

7. (.5) Remember the role of *bicoid* in *Drosophila* development. If a *bicoid/bicoid* female is mated to a *bicoid/+* male,

- i) $\frac{1}{4}$ of the resulting embryos will die.
- ii) $\frac{1}{2}$ of the resulting embryos will die.
- iii) All the resulting embryos will die.
- iv) The experiment cannot be done because *bicoid/bicoid* females are dead.

8. (1) What phenotype would you expect in a *Drosophila* embryo that develops from an egg laid by a mother that produces no *bicoid* mRNA? Select all possible answers.

- a. the caudal protein would not be present

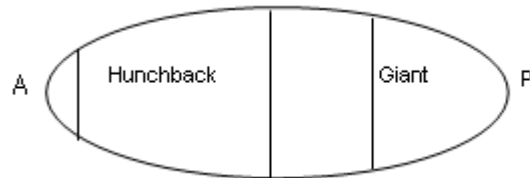
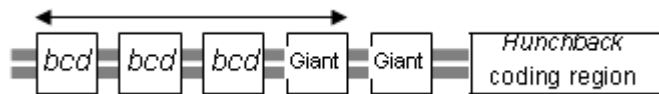
- b. the caudal protein would be uniformly distributed
- c. the nanos protein would not be present
- d. the nanos protein would be uniformly distributed
- e. the hunchback protein levels would be decreased

Use the two diagrams below. A. shows the *hunchback* gene and regulatory region. B. shows where the gap proteins *hunchback* and *giant* are localized in the *Drosophila* embryo.

9. (1) How is hunchback protein ultimately localized to the embryo in the distribution pattern shown in B? Explain the roles of bicoid(*bcd*) and giant in this process.

A.

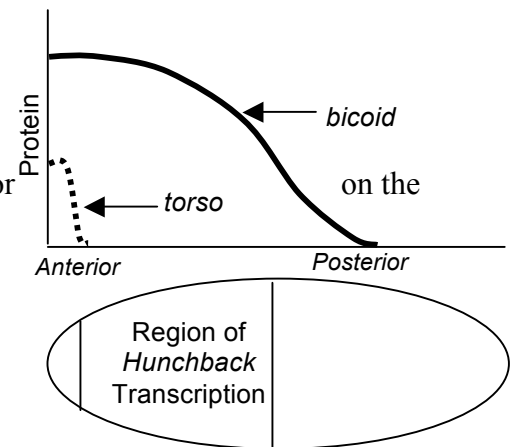
B.



10. (1) The expression of *hunchback* is also regulated by another transcription factor, *torso* (*tor*). Based upon the Anterior/Posterior pattern of *bcd* and *tor* concentration shown in the figure below, is *tor* most likely an **activator** or a **repressor** of *hunchback* transcription? Briefly explain.

11. (1) What would be the outcome of a loss of function mutation in *tor* on the distribution of Hb expression?

- a. Hb would expand all the way to the anterior end.
- b. Hb would expand further to the posterior
- c. Hb would no longer be expressed



12. (1) The previous few questions all relate to the embryonic transcription of Hunchback. Consider the following scenario. In an embryo with genotype Hb-/Hb-, from a Hb-/Hb+ mother, Hb protein is still distributed high at the anterior, and low at the posterior. Explain how the levels of Hb protein can be distributed in this fashion.