(LESS TRANSPARENT)

BIOL 111L
C. elegans Mutant Phenotypes Assignment
Name_____

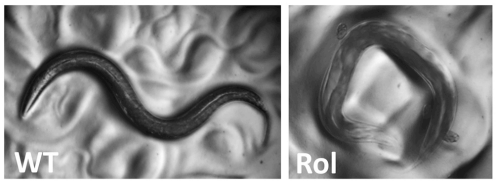
For each mutant, complete the following:

1. How does this mutant differ from the wild type worms you've been observing?
2. Hypothesize: what developmental defect (molecular, structural, physiological) could underlie the phenotype? (It does not matter if you're correct as long as it's a plausible explanation!)
3. Find (& cite) a peer-reviewed study that explains the root cause of the phenotype.

dumpy

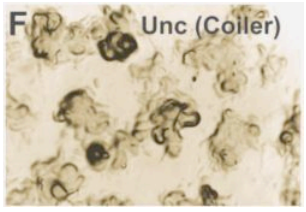
Page, A.P. and Johnstone, I.L. The cuticle (March 19, 2007), WormBook, ed. The C. elegans Research Community, WormBook, doi/10.1895/wormbook.1.138.1, http://www.wormbook.org.

roller



Corsi A.K., Wightman B., and Chalfie M. A Transparent window into biology: A primer on Caenorhabditis elegans (June 18, 2015), WormBook, ed. The C. elegans Research Community, WormBook, doi/10.1895/wormbook.1.177.1, http://www.wormbook.org.

uncoordinated



Félix, M.-A. Oscheius tipulae (August 16, 2006), WormBook, ed. The C. elegans Research Community, WormBook, doi/10.1895/wormbook.1.119.1, http://www.wormbook.org.

bag of worms

Kornfeld, K. (1997). Vulval development in Caenorhabditis elegans. Trends in Genetics 13, 55-61.

(MORE TRANSPARENT)

Transparent Assignment Design: Redesigned *C. elegans* Mutant Phenotypes Assignment

Purpose: The purpose of the exercise is twofold: first, to simulate the process developmental biologists go through in the laboratory when observing a novel mutant, and second, to help you think about downstream physiological effects of loss of function of various genes.

This assignment will help you practice the following **skills**:

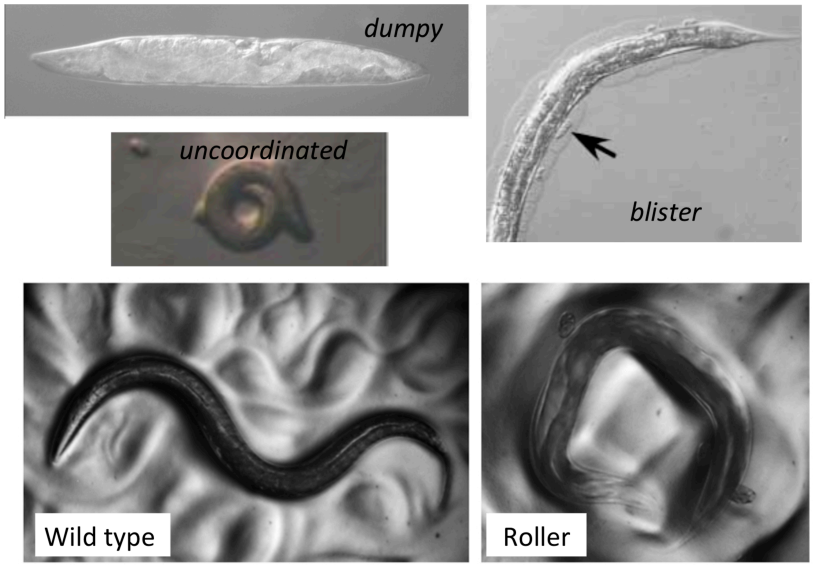
- ✓ Observing and describing a mutant phenotype as compared to wild-type organisms
- ✓ Formulating a hypothesis to explain a biological phenomenon
- ✓ Critical thinking and experimental interpretation
- ✓ Finding, citing, and summarizing research from a peer-reviewed scientific journal

This assignment will help you gain the following **knowledge**:

- ✓ Familiarity with the appearance and physiology of the *C. elegans* nematode
- ✓ Understanding of the functional roles of a variety of organs and tissues of the *C. elegans* nematode
- ✓ Understanding of the links between embryonic development and adult phenotypes

Task: This exercise asks you to think about a series of *C. elegans* mutants. All of these mutants survive to adulthood, but display phenotypes that are based on underlying developmental defects. For each mutant, examine the images and watch the associated video (linked on Blackboard). Then, answer the following questions for each mutant:

1. Describe the phenotype of the mutant. How does it differ from wild type worms?
2. Hypothesize: How do you think this phenotype arises? (What process or structure might be defective in the mutant? What type of gene/protein function might be missing?) It does not matter if you're correct as long as it's a plausible explanation.
3. Find a peer-reviewed **primary** journal article that explains the true cause of the phenotype (see resources under Criteria for further information). Cite the paper, and describe what the root cause of this phenotype is. Some questions to consider: what is the normal function of the mutated gene? What happens when that gene is mutated? Why does the loss of function create the observed phenotype?



Wild type and roller worms: Corsi A.K., Wightman B., and Chalfie M. A Transparent window into biology: A primer on Caenorhabditis elegans (June 18, 2015), WormBook, ed. The C. elegans Research Community, WormBook, doi/10.1895/wormbook.1.177.1, http://www.wormbook.org.
Dumpy: Page, A.P. and Johnstone, I.L. The cuticle (March 19, 2007), WormBook, ed. The C. elegans Research Community, WormBook, doi/10.1895/wormbook.1.138.1, http://www.wormbook.org.
Uncoordinated: Fernandez, A. G., Bargmann, B. O. R., Mis, E. K., Edgley, M. L., Birnbaum, K. D., & Piano, F. (2012). High-Throughput Fluorescence-Based Isolation of Live C. elegans Larvae. Nature Protocols, 7(8), 1502–1510. http://doi.org/10.1038/nprot.2012.084
Blister: Hiroki Moribe, John Yochem, Hiromi Yamada, Yo Tabuse, Toyoshi Fujimoto, Eisuke Mekada. Tetraspanin protein (TSP-15) is required for epidermal integrity in Caenorhabditis elegans. Journal of Cell Science 2004 117: 5209-5220; doi: 10.1242/jcs.01403

Criteria for Success: As scientists, we should strive for specificity and accuracy. As such, I encourage you to avoid vague descriptions or unclear hypotheses. Note that in the example given below, the student clearly describes the appearance of the worm's movements and how they contrast with wild type, rather than simply stating that it moves aberrantly. Furthermore, her hypothesis (though ultimately incorrect) provides a direct physiological mechanism by which the phenotype could arise. Finally, she identifies the actual underlying cause and cites the related peer-reviewed primary journal article. Note also the citation style used; this is the example you should follow in your own assignment.

> Example answer for *unc-22* mutant (https://www.youtube.com/watch?v=o6g2ZAmCrlo):
> 1. Instead of normal sinusoidal movement, the *twitcher* mutant worm shows uncoordinated movements in which it constantly twitches its head back and forth.
> 2. I hypothesize that there is a defect in the nervous system of the *twitcher* worm, which doesn't allow it to properly control its muscle movements.
> 3. *unc-22* encodes a protein called twitchin, which is required for the normal function of muscle tissue in *C. elegans*. Twitchin interacts directly with the myosin motor protein and therefore is critical for contractile motions of the muscle. In the absence of twitchin (when the *unc-22* gene is mutated), muscle contraction is uncoordinated and therefore the animal twitches.
> Source: Moerman, D.G., Benian, G.M, Barstead, R.J., Schriefer, L., Waterston, R.H. 1998. Identification and intracellular localization of the *unc-22* gene product of *Caenorhabditis elegans*. Genes Dev. 2:93-105.
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> *Reminders regarding peer-reviewed sources*: http://www.wormbook.org is a peer-reviewed online encyclopedia of *C. elegans* development that you may find helpful in beginning your search for information, but note that this is *not* a source of **primary** journal articles. As such, it would not be appropriate to cite as your source, but it is a reputable repository of information and could certainly help you find the right paper to cite! More generally, an excellent way to identify appropriate sources is to use the Gumberg Library website to search the ScienceDirect or Google Scholar databases, as we discussed in class last month. Wikipedia, blogs, and other websites (even if hosted by a university) are not peer-reviewed primary sources. Please stop by office hours if you'd like a quick refresher on how to identify appropriate papers.