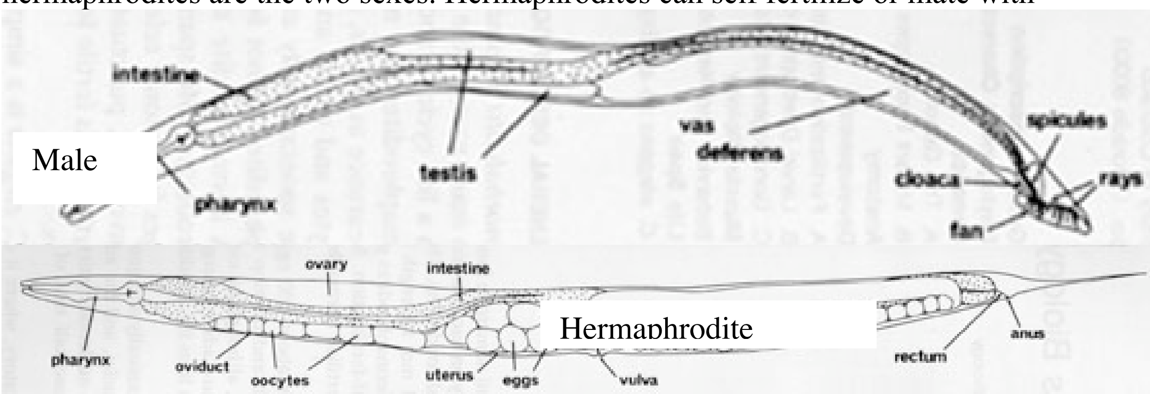
A Scientific Model System: The Nematode Roundworm - *Caenorhabditis elegans*.
(**Adapted from:** www.loci.wisc.edu/outreach/text/model.html, and an undergraduate lab by Chris Li)

A model system is a simpler, idealized system that can be accessible and easily manipulated. The biological insights gained from using model organisms have helped to cure human diseases and improve people's understanding of life. By studying organisms unrelated to humans, insight into scientific and medical concepts can sometimes be more easily achieved. In the last two decades, a nematode, *Caenorhabditis elegans*, has captured the hearts of developmental biologists and geneticists hoping to solve the enigma of cell development and related biological problems, such as aging. Its popularity as a model organism is because it is transparent, thus cells of interest can be observed using a dissecting microscope. It is small (about 1- 1.5 mm) and easy to cultivate, which makes it possible to house large numbers of *C. elegans*. It has a short life cycle (3 days), which makes the production of numerous generations possible. It can be crossed at will. Male and hermaphrodites are the two sexes. Hermaphrodites can self fertilize or mate with



males to produce offspring. Thus, cross or self-fertilization can be manipulated as desired. There are numerous tools available to study *C. elegans*, including different types of antibodies and advanced microscopes. *C. elegans* is the only organism for which the fate of every single cell is known. It is a small animal with only 959 cells (Humans have 100 trillion cells). For each of these 959 cells, we know exactly when they divide, where they move and when they die. We also know the entire wiring pattern of the nervous system. Also, its genome has been completely sequenced. That means we know every about every gene in its nucleus, and every cell in its body. This allows researchers to learn a lot about how genes work to direct what happens to cells, and is INCREDIBLY important to medical science. Because scientists have such a thorough understanding of C. elegans genes, they can create mutants with specific traits that they wish to study.

The Lab:

There will be several Petri dishes of animals available for you to look at. The worms are living in a substance called agar, which is derived from brown seaweeds, and infused with a culture of bacteria. The worms get all the nutrition they need from the agar and bacteria. They are living in their food (and waste)!

Take a look at the wild-type worms through the dissecting microscope. "Wild-type" refers to animals that you might find in the wild, as distinguished from mutants. Make any necessary adjustments to bring the animals into focus. Zoom in as closely as you can. At the front of the animal is a structure called a pharynx which is analogous to your throat. You may be able to see it pumping. You can distinguish between males and hermaphrodites by looking at the tail. Hermaphrodites have a pointy tail, while males have a rounded tail. There are many more hermaphrodites than males. Also, there are worms of all ages and sizes in the agar. Nematodes grow by <u>molting their cuticle</u>, in other words, by casting off their tough outer layer and growing a newer larger one.

1. Describe the way that the wild-type worms move (hint: observe their tracks through the agar):

2. Touch the front of one of the animals VERY gently with a toothpick. How do they react?

Now take a look at some of the mutant strains. Can you figure out how they are different from the wild-type animals? Try to observe the following characteristics:

1. Locomotion – do the mutants move differently? Watch their tracks

2. Activity – are the mutants more or less active than the wild-type? Or the same?

3. Sensitivity to touch – are the mutants more or less sensitive to a touch on the "nose"? Do they respond differently?

4. Size, shape , color – Do you notice anything else that is different about the mutants?

5. Male:Hermaphrodite Ratio – Are there more or less males in any of the mutant strains?

6. How does understanding nematode mutants help us to learn about medicine?

Class: Zoology **Date:** November 5, 2003
Unit: Phylum Nematoda
Lesson Topic: *C. elegans*, mutants and model systems

Objectives

1. The student will improve observational skills.
2. The student will improve microscope skills.
3. The student will learn about the importance of a model system.
4. The student will learn about how mutations in genotype affect phenotype.

Instructional techniques

Lecture, observation, microscope activity

Instructional material

Dissecting microscopes. Toothpicks. Mutant starter kit for *C. elegans* and Petri dishes (available from BU)

Content

Instructor will introduce the concepts of model systems, mutations, genotype and phenotype. Students will pair into groups, depending on the availability of dissecting scopes and Petri dishes. They will first make observations on wild-type worms, and then try to characterize how the mutant strains are different from the wild-type. The instructor will finish with a general discussion on how mutants and model systems such as *C. elegans* can help us to understand biology and medicine.