C. elegans: A Model Teaching Organism

By Bruce Nash, PhD
DNA Learning Center (DNALC), Cold Spring Harbor Laboratory

Demonstrating key concepts with model organisms

Figure 1 *C. elegans* N2

C. elegans as a model organism

After distinguishing himself with major discoveries in molecular biology while at Oxford in the early 1960s, Sydney Brenner turned his attention to developmental biology. Working in Cambridge, he and his colleagues wondered how multicellular organisms develop. He looked for an animal that was simple but that had a nervous system and other distinct, differentiated tissues, including epidermis (skin), muscle, and intestine. After careful research, he selected a microscopic roundworm called ***C. elegans***.

Although some roundworms are parasitic, ***C. elegans*** is free-living. These worms grow quickly—from embryo to adult in 3 days—are easy to culture, and can be stored in a freezer. The embryos, larvae, and adults are transparent, making observations of morphology and development in living worms easy.

C. elegans worms have 2 sexes: self-fertile hermaphrodite and male. Males are rare in wild-type populations, but they allow for genetic crosses. However, because the hermaphrodites are self-fertile, most strains can be maintained without time-consuming crosses. Remarkably, almost every cell division during development is invariant, occurring the same way in every worm. Isolating genes and introducing foreign DNA are much easier in worms than in more complicated animals. All of these features make ***C. elegans*** an excellent model for research on how cells divide, develop, and take on specialized tasks in higher (eukaryotic) organisms.

Brenner and John Sulston showed that ***C. elegans*** also has a small, compact genome, which proved to be very important once large-scale sequencing became possible. The ***C. elegans*** genome, which is approximately 1/30th the size of the human genome, was the first genome of a multicellular organism to be entirely sequenced. Once the human genome was also completed, it became clear that 40% of ***C. elegans*** genes have human matches, and that in spite of their difference in size, both the human and ***C. elegans*** genomes contain approximately 25,000 genes.

In 2002, Sydney Brenner, John Sulston, and Robert Horvitz were awarded the Nobel Prize for their pioneering work on ***C. elegans*** and the discovery of genes that control cell death. In humans, these same genes are often mutated in cancer cells. Other ***C. elegans*** researchers have made numerous important discoveries, including those for genes controlling aging, obesity, diabetes, and developmental patterning. They have also made important discoveries in cell biology and neurobiology.

C. elegans in teaching

The same features that make ***C. elegans*** a great model organism for research also make it ideal for teaching. ***C. elegans*** can be grown at room temperature on small petri dishes seeded with the bacteria ***E. coli***. To observe ***C. elegans***, all that is required is a dissecting microscope. With these minimal requirements and a few simple tools, students can observe ***C. elegans*** behavior, development, and mutant phenotypes.

C. elegans can also serve as a gateway into bioinformatics and evolution: the genome sequence and data from ***C. elegans*** research are readily available through online databases. Students can use bioinformatic tools such as the Basic Local Alignment Search Tool (BLAST) to explore ***C. elegans*** genes and their relationships to genes from different organisms.

Bring genetics to life in your classroom with *C. elegans* kits from Carolina

Carolina offers kits to explore ***C. elegans*** in the classroom. Using one of these kits, the Culturing and Observing ***C. elegans*** Kit, students can examine wild-type morphology and development and characterize strains with mutations affecting body morphology. The kit includes everything needed to raise and manipulate ***C. elegans***, making it easy for your students to see how mutations affect this fascinating roundworm. In the kit are wild-type and 2 mutant strains: one that displays a short, "dumpy" phenotype and another that develops blisters in the epidermis.

Related Links:

How to Make a Good Scientific Model

Painted Lady Butterfly 5-Larvae Culture

Free Next Gen Activities