Caenorhabditis elegans competence center

Caenorhabditis elegans is an excellent model organism for studying the genetics of development and neurobiology. Its genome is entirely sequenced and the fate of every cell is known throughout development. Also, the complete nervous system connectivity has been determined.

Description

Caenorhabditis elegans is a free-living nematode (one of the roundworms), about 1 mm in length, and lives in a temperate soil environment. Members of the species have many of the same organ systems as other animals including humans. *C. elegans* is used as a model organism in research. Specimens are cheap and easy to maintain in the laboratory. *C. elegans* has been especially useful for studying cellular differentiation, and was the first multicellular organism to have its genome completely sequenced (in the actual meaning of the word "completely"). The finished genome sequence was first published in 1998, contains approximately 100 million base pairs and a bit more than 20.000 genes, whereby more than 40 % are orthologous to human genes.

From a research perspective, *C. elegans* has the advantage of being a multicellular eukaryotic organism, which is simple enough to be studied in great detail. Being transparent, all its internal structures can be viewed by live microscopy during all stages of development, which has allowed the mapping of the developmental fate of every single somatic cell (about 1000). These patterns of cell lineage are largely invariant between individuals, in contrast to mammals where cell development from the embryo is more dependent on cellular cues.

In addition, *C. elegans* is one of the simplest organisms with a relatively complex nervous system. In the hermaphrodite, this comprises 302 neurons whose pattern of connectivity has been completely mapped, and proven to be a small-world network. Research has explored the neuronal mechanisms responsible for many of *C. elegans*' interesting behaviors, including chemotaxis (smell and taste), thermotaxis, mechanosensation, and male mating behavior. Interestingly, *C. elegans* neurons fire no action potentials.

In 2002, the Nobel Prize for Physiology and Medicine was awarded to Sydney Brenner, H. Robert Horvitz and John Sulston for their work on the genetics of organ development and programmed cell death in *C. elegans*. In 2006, the Nobel Prize for Physiology and Medicine was awarded to Andrew Fire and Craig Mello for their discovery of RNA interference and gene silencing by double-stranded RNA in *C. elegans*. In 2008, the Nobel Prize for Chemistry was awarded to the *C. elegans* researcher Martin Chalfie and to two other researchers for their discovery and development of the green fluorescent protein (GFP).

Infrastructure/Methods

The observation that a large number of genes is conserved between humans and the worm (among them many disease-related genes) has enticed the scientific community to further explore the possibilities of *C. elegans* as a model organism to study novel genes. In this context, RNA-mediated interference (RNAi), a phenomenon extensively used as a tool in *C. elegans* research to remove the function of a gene of interest, as well as the straightforward mutation of genes, are crucial applications in the study of the function of novel genes. Other "highlight" methods and techniques include the facile construction of transgenic worm lines, live light and fluorescence microscopy, functional genomics and bioinformatics applications, and automated (FACS-like) live worm-sorting for large-scale screens.

In the laboratory of Peter Swoboda they focus on neurobiology and developmental biology, with specific interests in the development of sensory structures and behaviors, as well as in neuronal physiology and its impact on nervous system function and aging. RNAi, gene mutations (including CRISPR/Cas9 designer mutations), GFP expression, antibody staining, behavioral assays are used to study gene function.

Practical information

Please check our **research group web site** and contact us for any further information.

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