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Introduction to the special issue on *C. elegans* male mating behavior

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“Consider the nematode roundworm, the most abundant of all animals. Four out of five animals on Earth are nematode worms — if all solid materials except nematode worms were to be eliminated, you could still see the ghostly outline of most of it in nematode worms.” E.O. Wilson

Reproductive fitness requires strategies to find mates and sire offspring as well as skills to survive in the environment. This special issue focuses on the cellular and molecular mechanisms controlling male mating behaviors in the nematode *Caenorhabditis elegans*. The *C. elegans* hermaphrodite is a self-fertilizing female who produces sperm before switching to oogenesis. The *C. elegans* male must mate in order to pass on his genetic material and he has, in addition to 294 gender-shared neurons (found in both sexes), 87 sex-specific neurons devoted largely to this purpose.

C. elegans sex is determined by X to autosome ratio, with hermaphrodites being XX and males hemizygous for X. Males are rare and arise from nondisjunction of the X chromosome. Jonathan Hodgkin and Sidney Brenner first isolated mutants with the high-incidence of males (Him) phenotype, enabling genetic analysis of sex determination, male development, and male behaviors [1,2]. Sulston *et al* determined the lineage of the male tail and performed the first ultrastructural analysis and rudimentary connectome for the *C. elegans* male nervous system [3]. Liu and Sternberg assigned behavior function to most male-specific sensory neurons [4]. These early seminal papers provide the foundation for the work on which this issue is based.

This issue starts with a paper by **Fagan and Portman**, which opens an overview of the *C. elegans* sex determination pathway. By genetically manipulation of this pathway and sexually transforming individual neurons (for example, feminizing an olfactory neuron in an otherwise entirely male animal), authors provide insight to the role of gender-shared neurons in sexually modulated and sex-specific behaviors. The article by **Arantza Barrios** also addresses how both gender-shared and sex-specific neural circuitries regulate the male's mate searching behavior. Barrios reviews the male's competing drives for food versus sex, and the underlying molecular pathways controlling sex drive in *C. elegans*.

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A connection between stress and reproduction exists throughout the animal kingdom. Depending on environmental conditions, *C. elegans* develops into reproductive maturity or arrests at the stress resistant dauer stage. A category of small molecules called ascarosides regulates both dauer formation and male mating behavior in *C. elegans*. **Srinivasan and Chute** discuss *C. elegans* chemical communication via these ascaroside-based pheromones and their multifunctional roles in reproductive chemotaxis and dauer formation.

The paper by **O'Hagan, Wang, and Barr** focuses on the *C. elegans* polycystins. LOV-1 and PKD-2 are a large receptor and TRP channel, respectively, that localize to cilia of male-specific sensory neurons and function in several aspects of *C. elegans* male mating ritual, including mate search, contact based vulva search, and vulva location behaviors. The human polycystins are mutated in Autosomal Dominant Polycystic Kidney Disease, and authors also explain how *C. elegans* has provided a fundamental understanding of polycystin ciliary localization and function.

The Lints and Garcia laboratories have combined genetics, optogenetics, and calcium imaging to delve into neural circuitry regulating vulva search and intromission behaviors, respectively. **Sherlekar and Lints** describe into the neural circuitry that coordinates the male's contact based search for the hermaphrodite's vulva. Authors convey the image of a worm tango, where the male quickly adjust his movements to match his partner's. Authors discuss the molecules and neural circuits controlling this dance, and once again, find both gender-shared and sex-specific neurons contribute to a sex-specific behavior.

The article by **L. René Garcia** covers male spicule intromission and ejaculatory behaviors, which occur after the *C. elegans* male has successfully located the hermaphrodite's vulva. Garcia also considers the neurotransmitters and channels that regulate sensory-motor actions involved in spicule intromission. Garcia closes with a discussion how aging and nutritional-status impact mating vigor. The *C. elegans* male tail connectome was recently reconstructed by Emmons and colleagues [5]. This wiring diagram and computational advances combined with the *C. elegans* molecular genetic toolkit provide a future framework to understand how sexual behaviors are encoded in an animal's genome and nervous system.

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