Neurons for male mating in *C. elegans*

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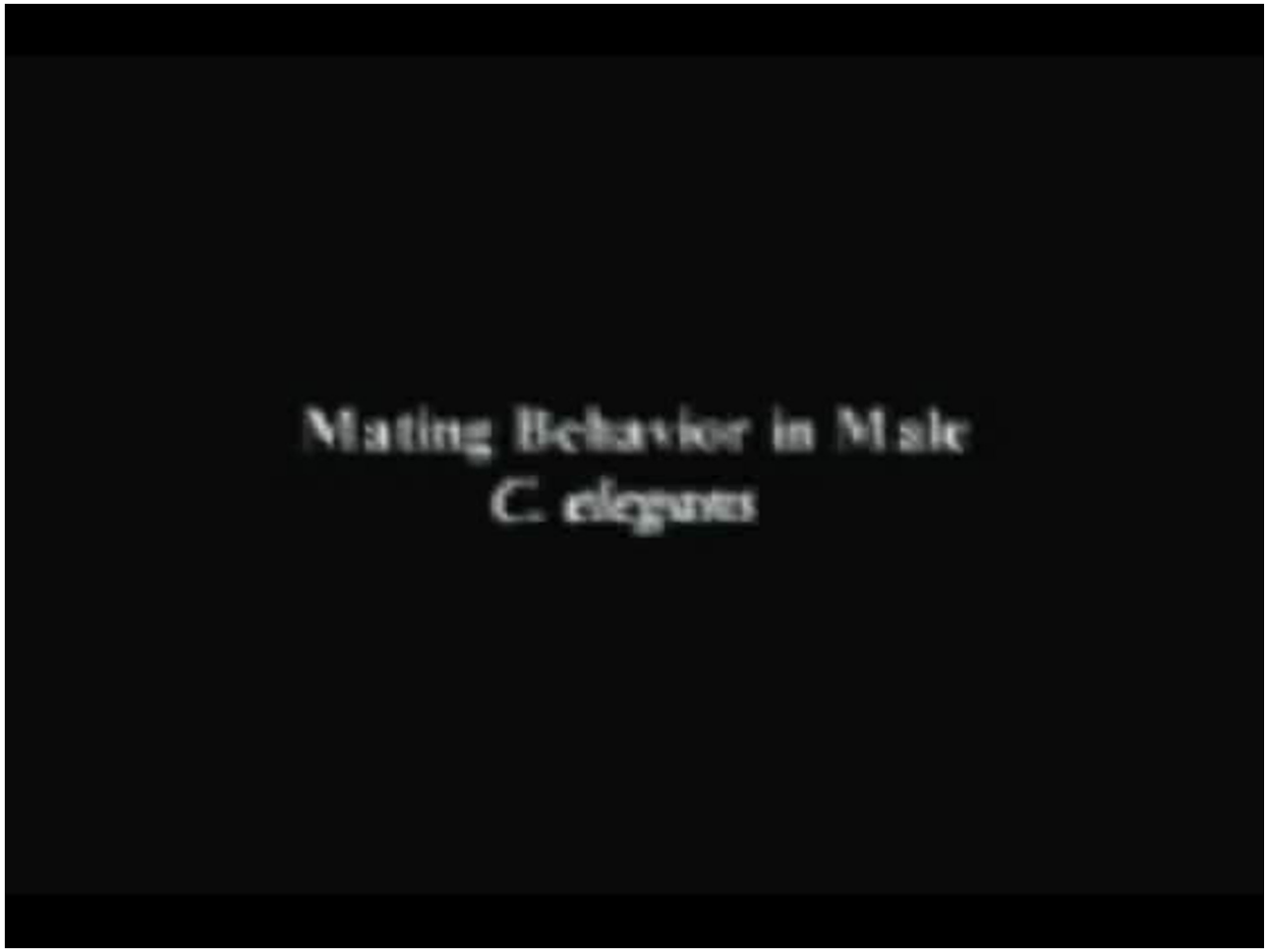
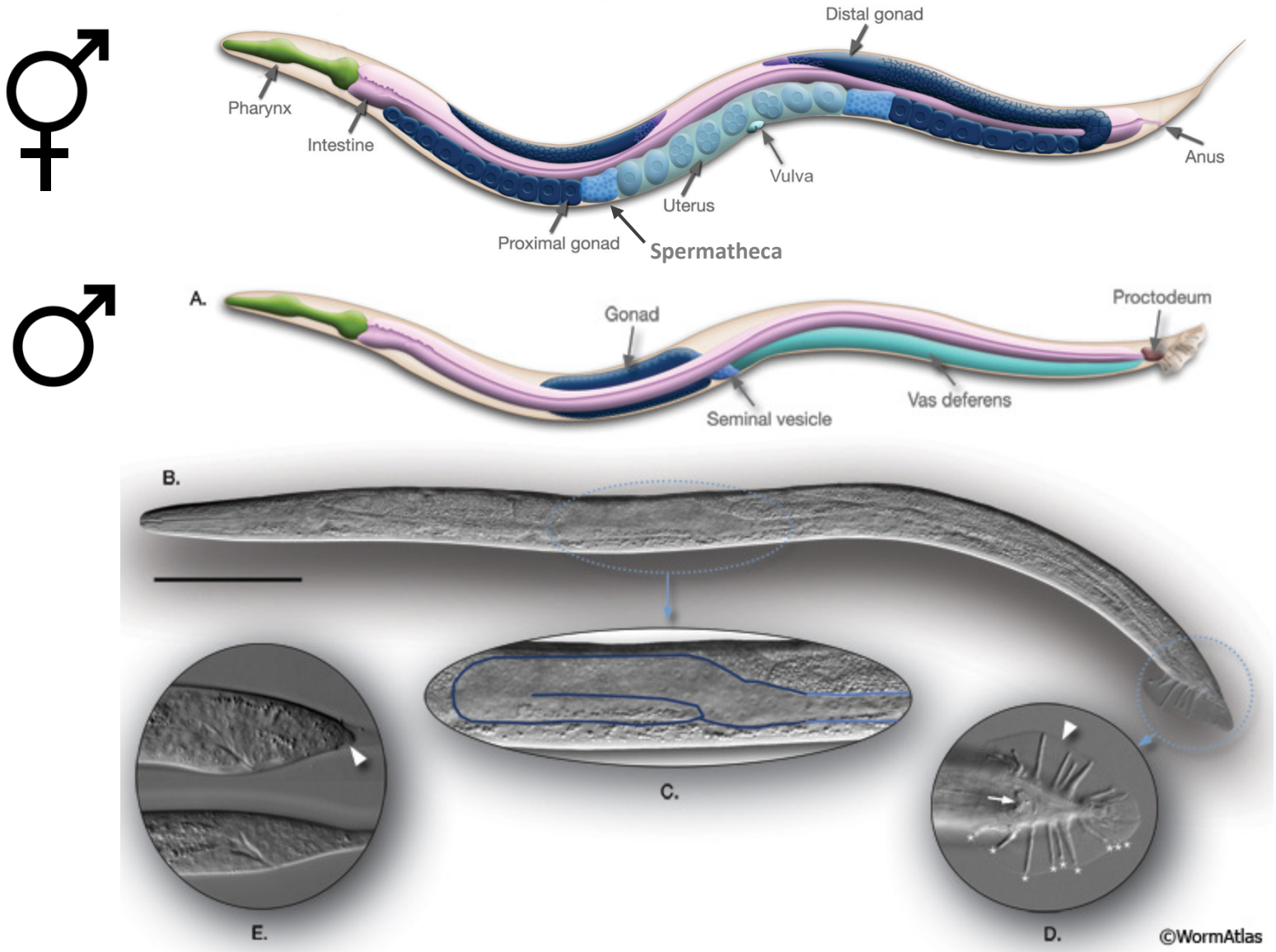
MIT IAP

Mating in *C. elegans*



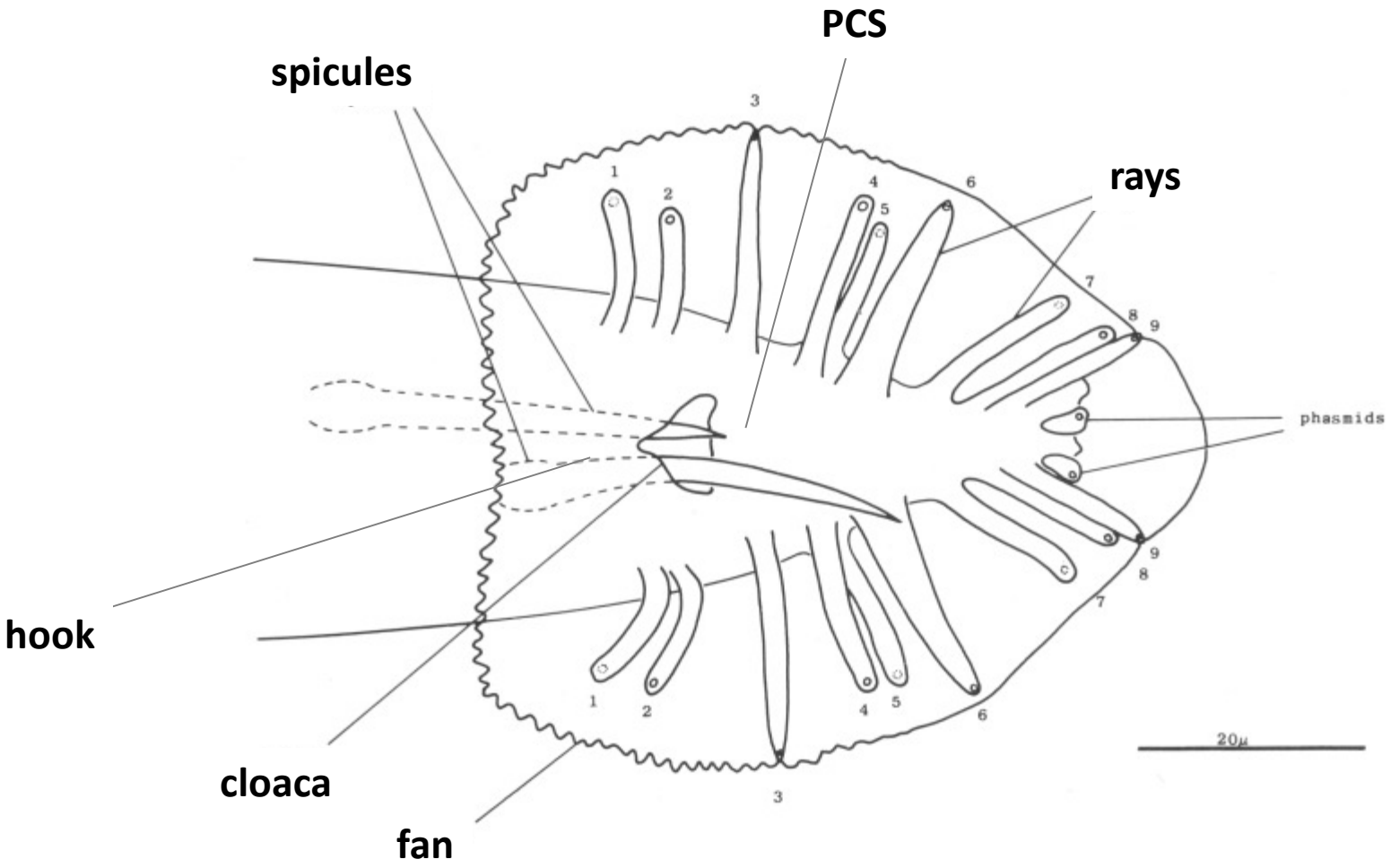
Wormbook.org

C. elegans hermaphrodites vs. males



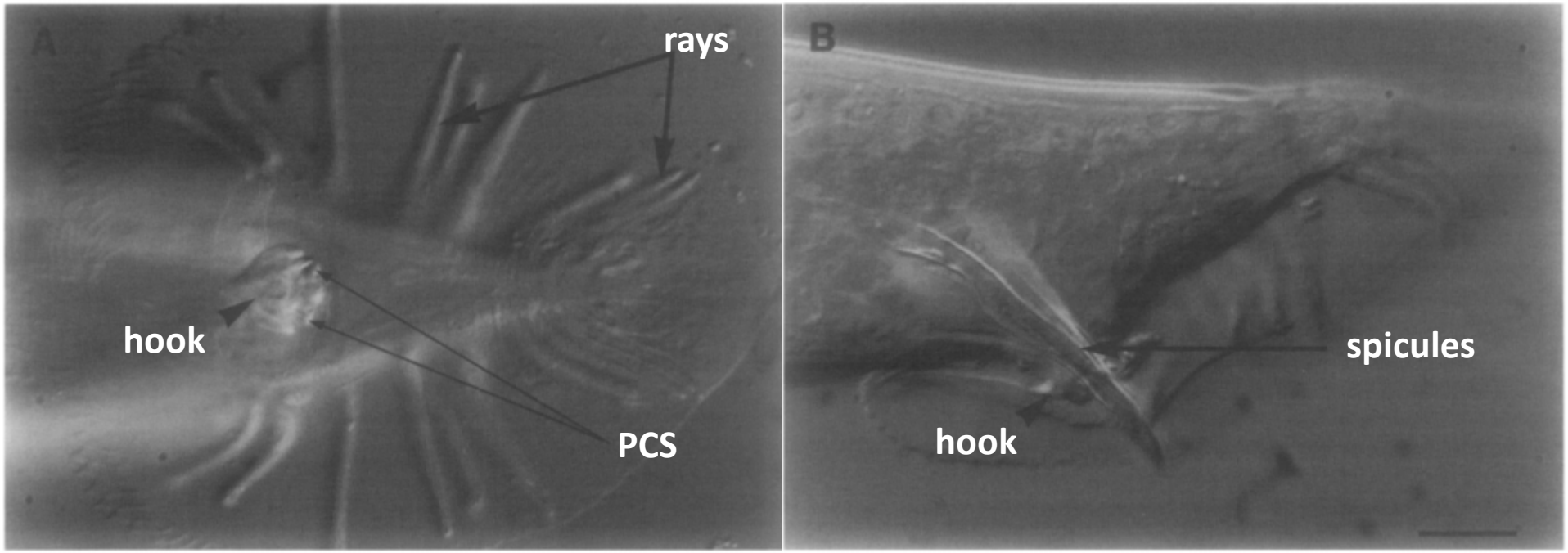
WormAtlas.org

The male tail



Ventral view

The male tail

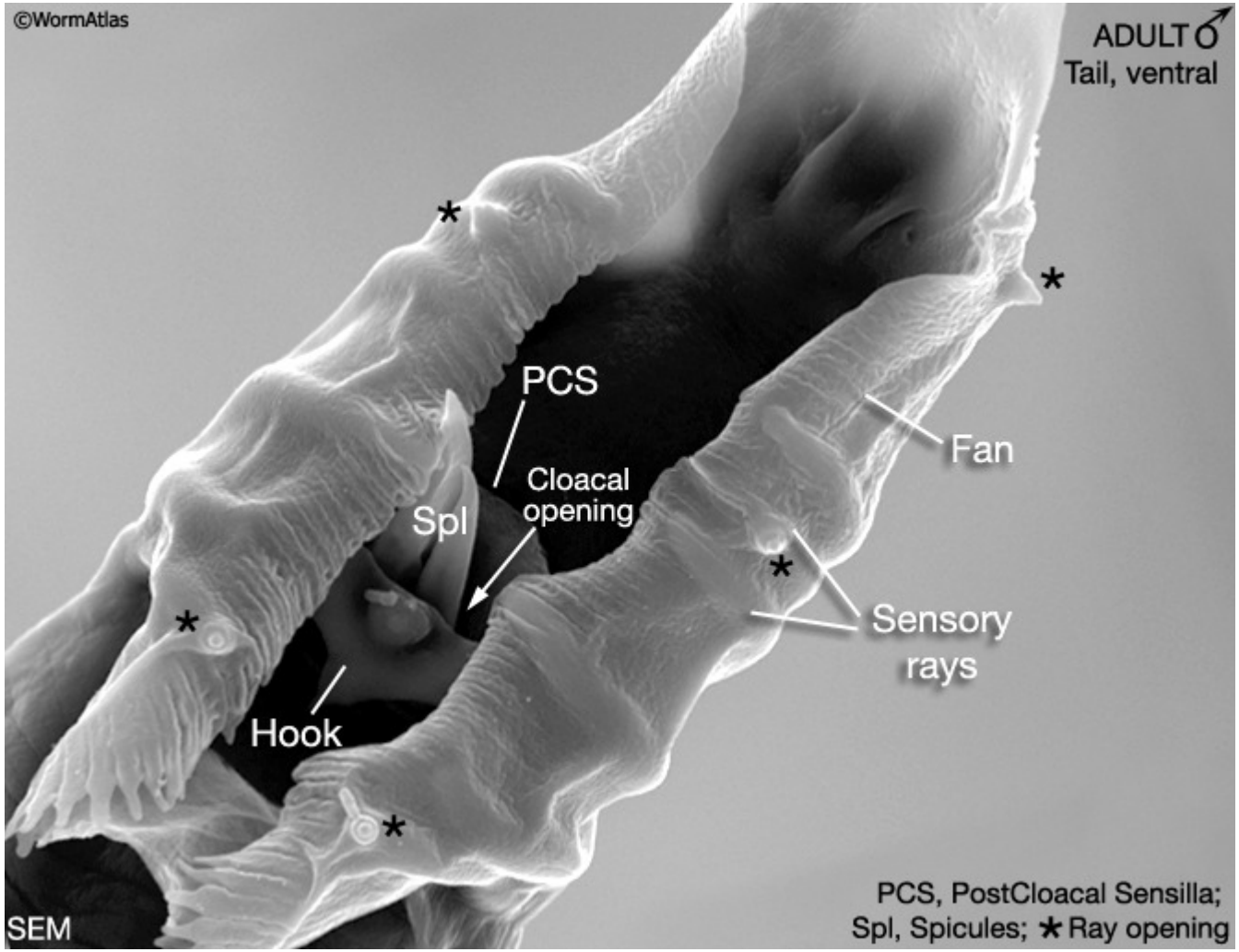


Ventral view

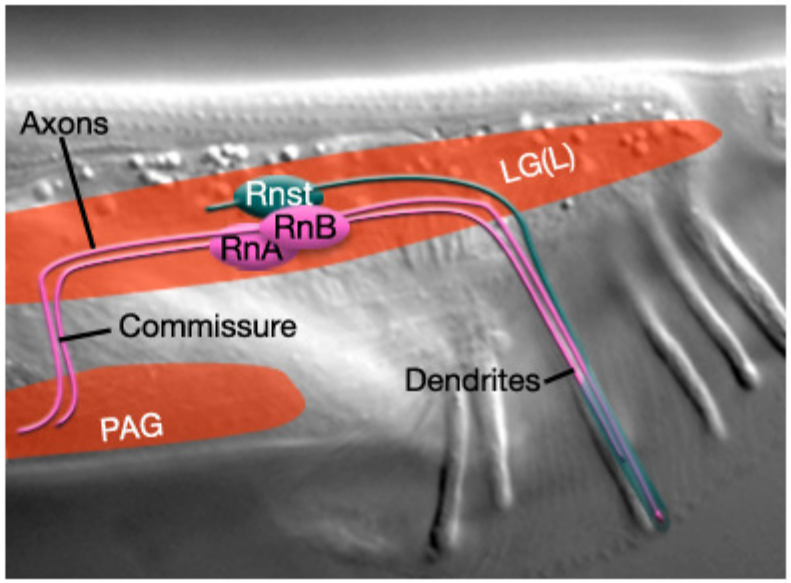
Side view

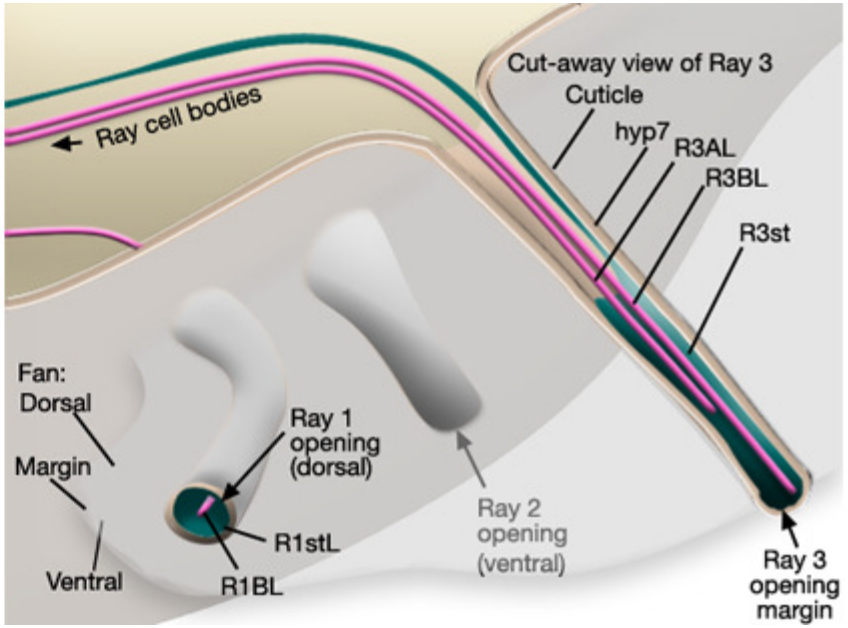
Liu & Sternberg 1995

The male tail



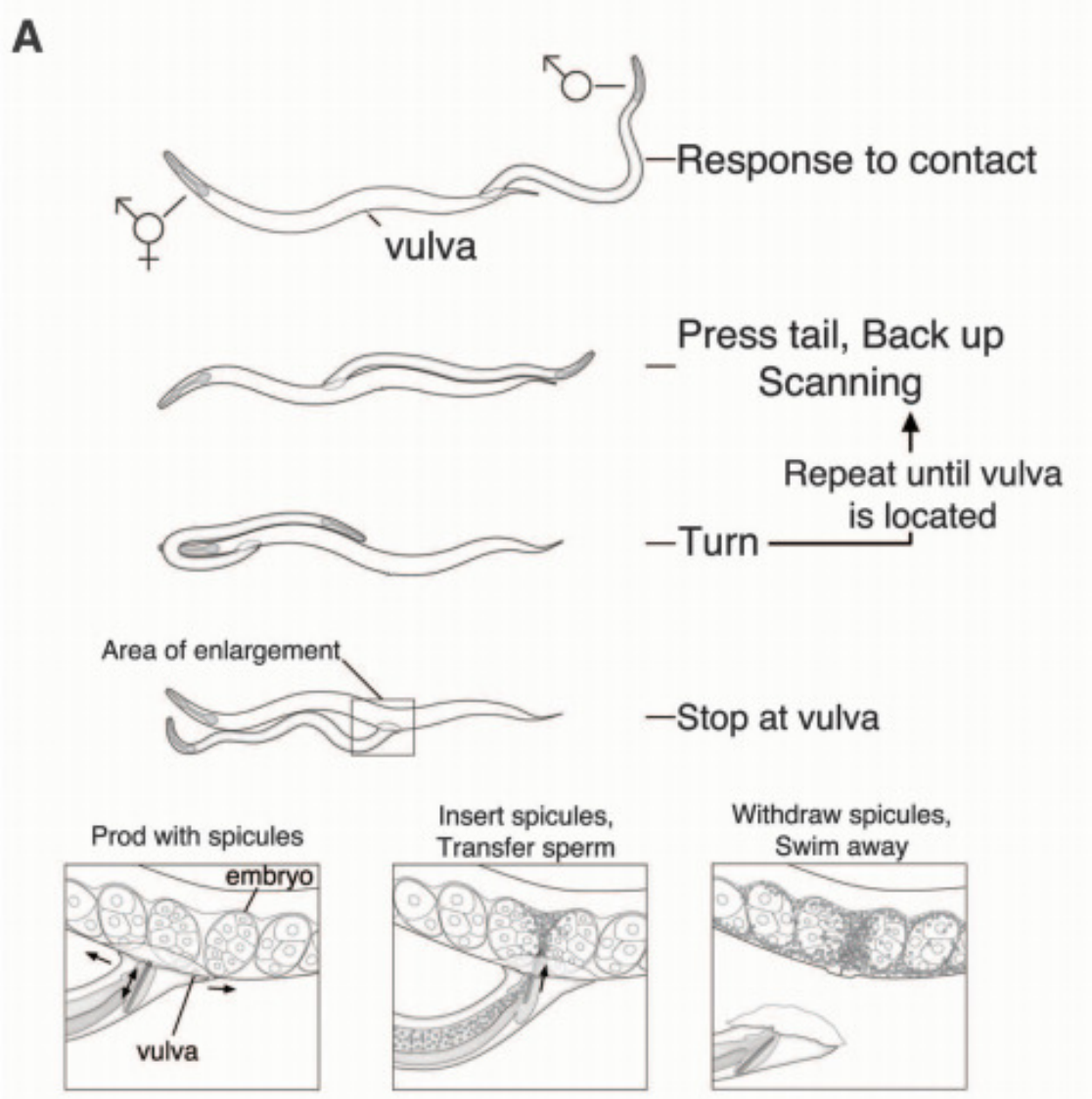
Sensilla are inervated by neural dendrites





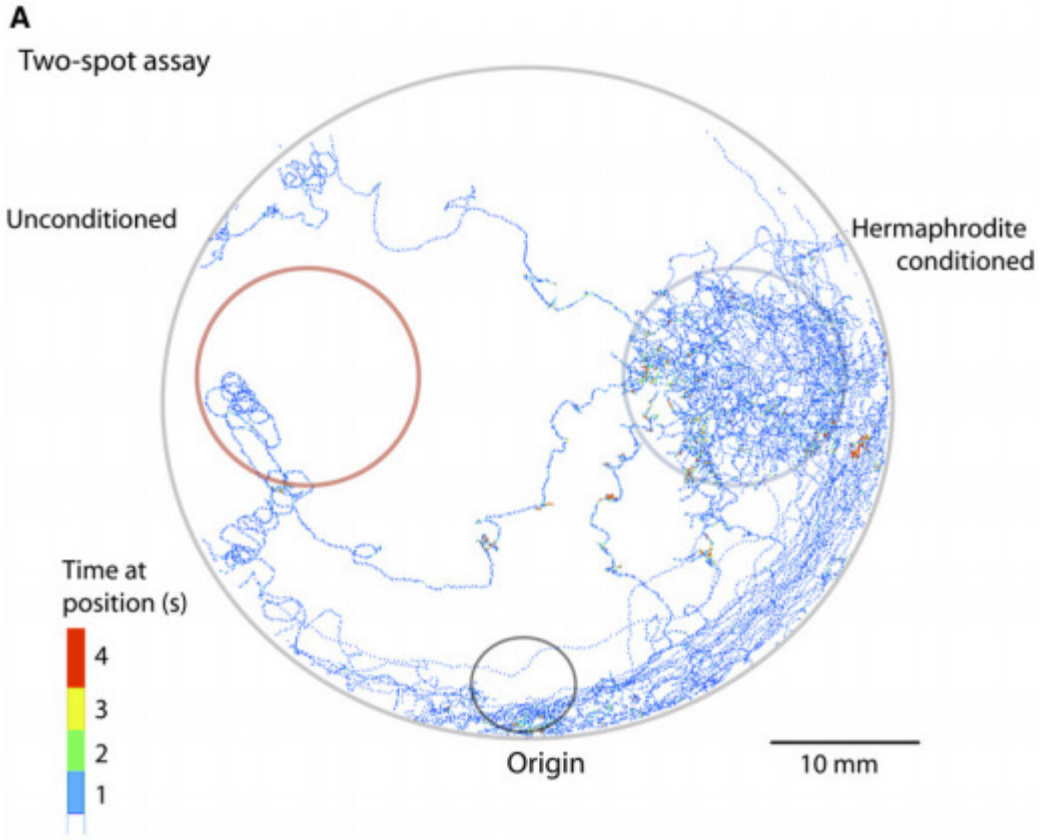
WormAtlas.org

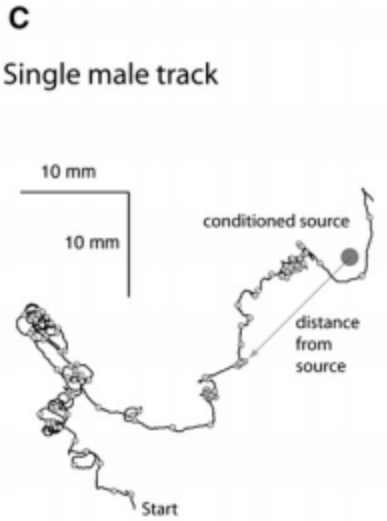
Steps in mating

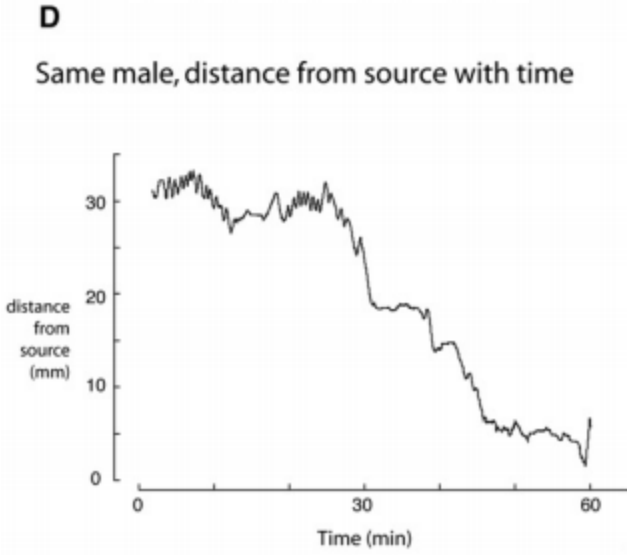


Jarrells..Emmons 2012

Step #1: Males chemotax toward hermaphrodite-conditioned media

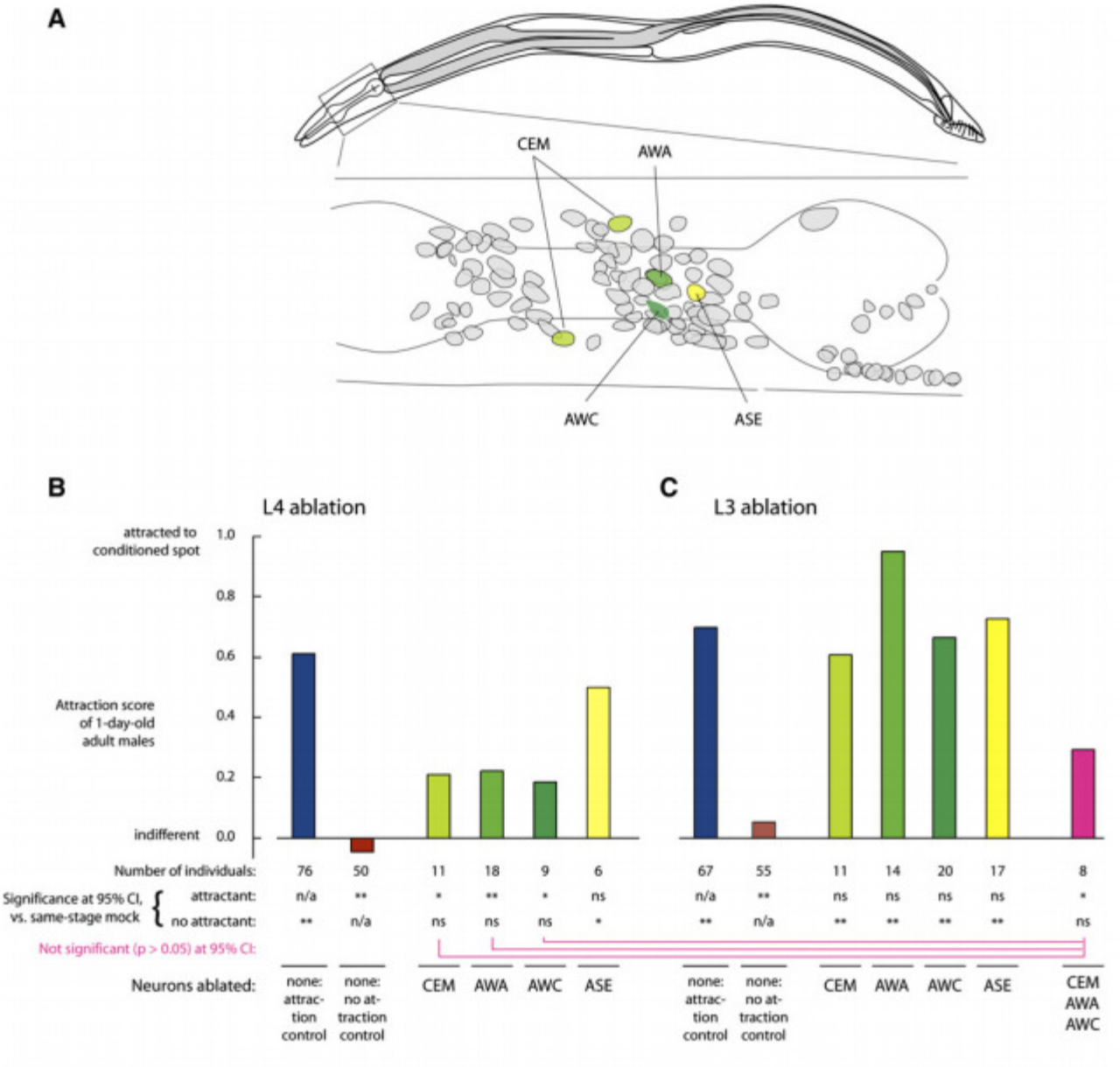






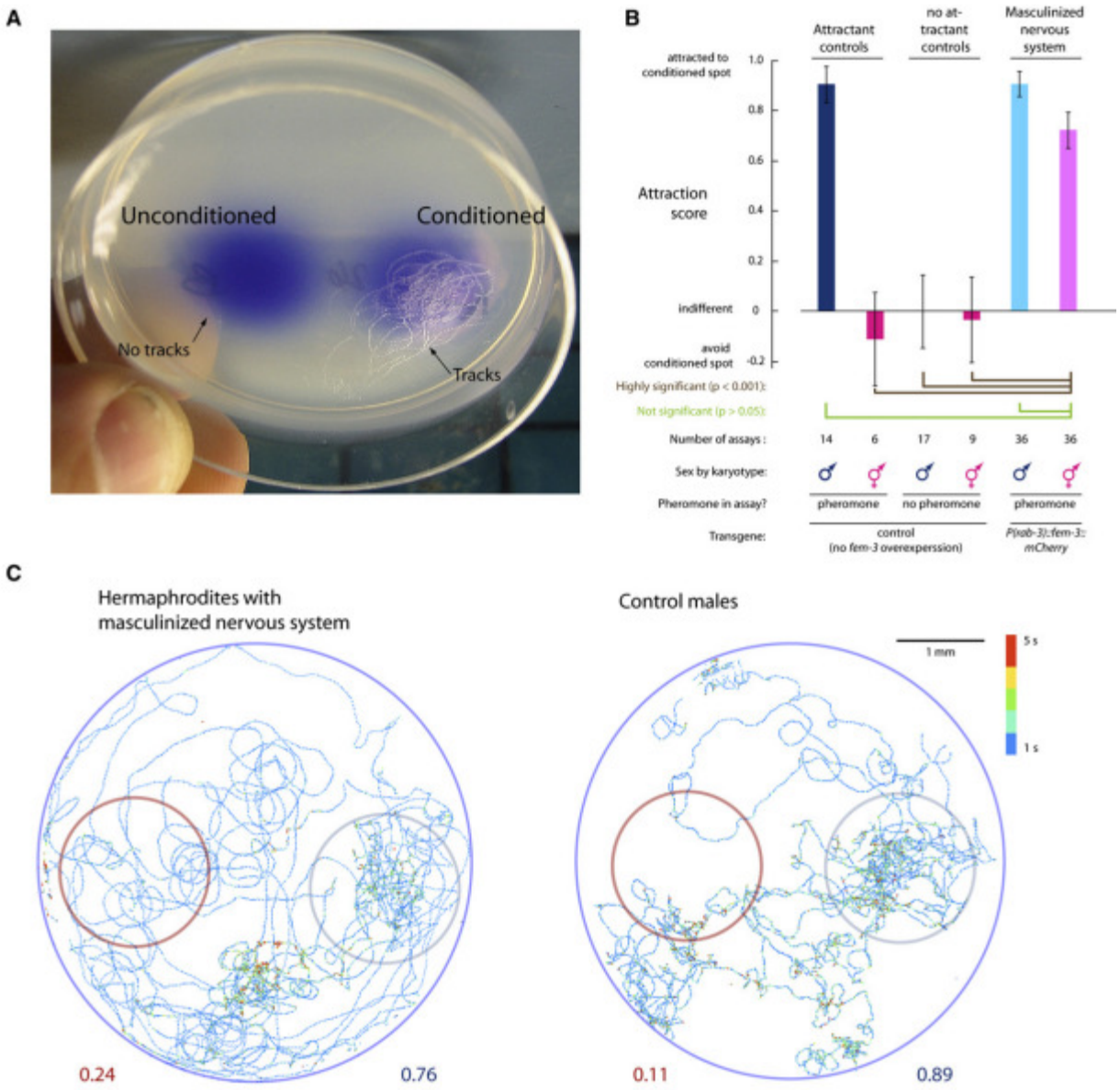
White..Jorgensen 2007

AWC, AWA & CEM are involved in male chemotaxis to hermaphrodite odors



White..Jorgensen 2007

Hermaphrodites with a masculine nervous system are attracted to hermaphrodite odors



White..Jorgensen 2007

Step #2: Structures required for contact response

Table 1. Sensory Ray Ablations by Position of Sensory Opening

Structures Ablated	Effect (removes)	Response to Dorsal Contact		Response to Ventral Contact	
		By Males	By Trial	By Males	By Trial
None	None	10/10	97/100	10/10	98/100
Rays 1, 5, 7	All dorsal pairs	0/10	0/80	10/10	24/24
Rays 2, 4, 8	All ventral pairs	10/10	64/66	10/10	45/45
Rays 3, 9	Both lateral pairs	10/10	52/52	10/10	24/24
Ray 6	Closed pair	10/10	44/44	10/10	21/21
Rays 2, 3, 4, 6, 8, 9	All but dorsal pairs	7/7	46/48	7/7	35/36
Rays 2, 4, 8 plus hook, p.c.s., spicules	All ventral sensilla	8/8[a]	64/64	0/8	0/22
Hook, p.c.s., spicules	All non-ray ventral sensilla	10/10	99/100	10/10	96/100

p.c.s., postcloacal sensilla.

[a] All males exhibited ventral arching of the tail upon dorsal contact with hermaphrodites but did not pursue hermaphrodites following either dorsal or ventral contact.

Liu & Sternberg 1995

Steps #2 and #4: Structures required for contact response and turning

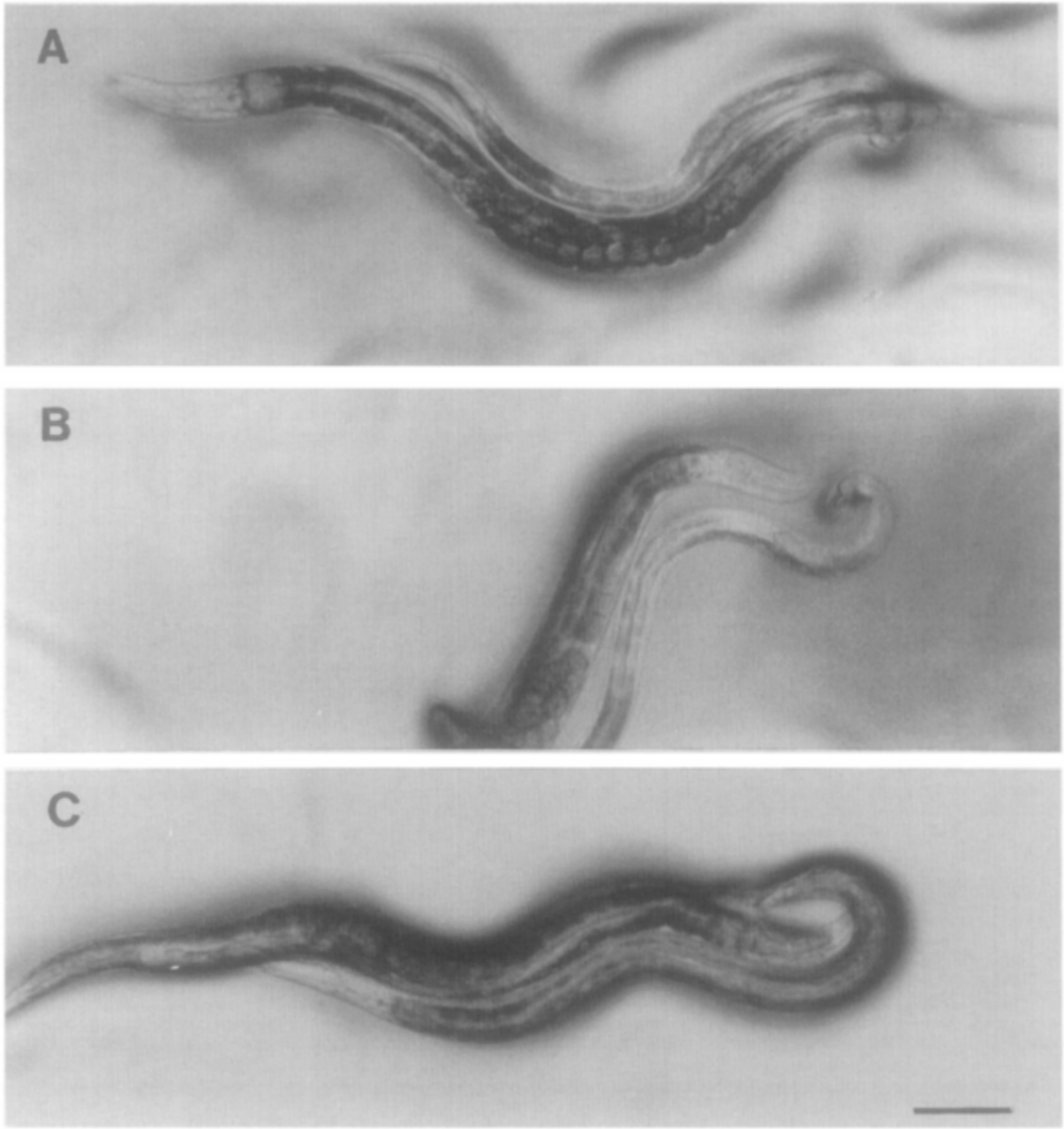
Table 2. Sensory Ray Ablations by Position of Rays along Anterior–Posterior Axis

		Response		Turning	
Structures Ablated	Effect (removes)	By Males	By Trial	By Males	By Trial
None	None	10/10	100/100	10/10	100/100
Rays 1–6	6 most anterior pairs (V rays)	0/10	0/100	NA	NA
Rays 7–9	3 most posterior pairs (T rays)	14/14	140/140	0/14	0/140
Rays 1–3, 7–9	All but 3 middle pairs	10/10	58/62	0/10	[a]
Rays 4–6, 7–9	All but 3 most anterior pairs	10/10	49/49	0/10	[a]

NA, not applicable.

[a] Turning defects were not recorded in these experiments, as it had already been demonstrated that ablation of the T-derived rays eliminated turning. These ablations were done to see whether they had any effect on response.

Liu & Sternberg 1995



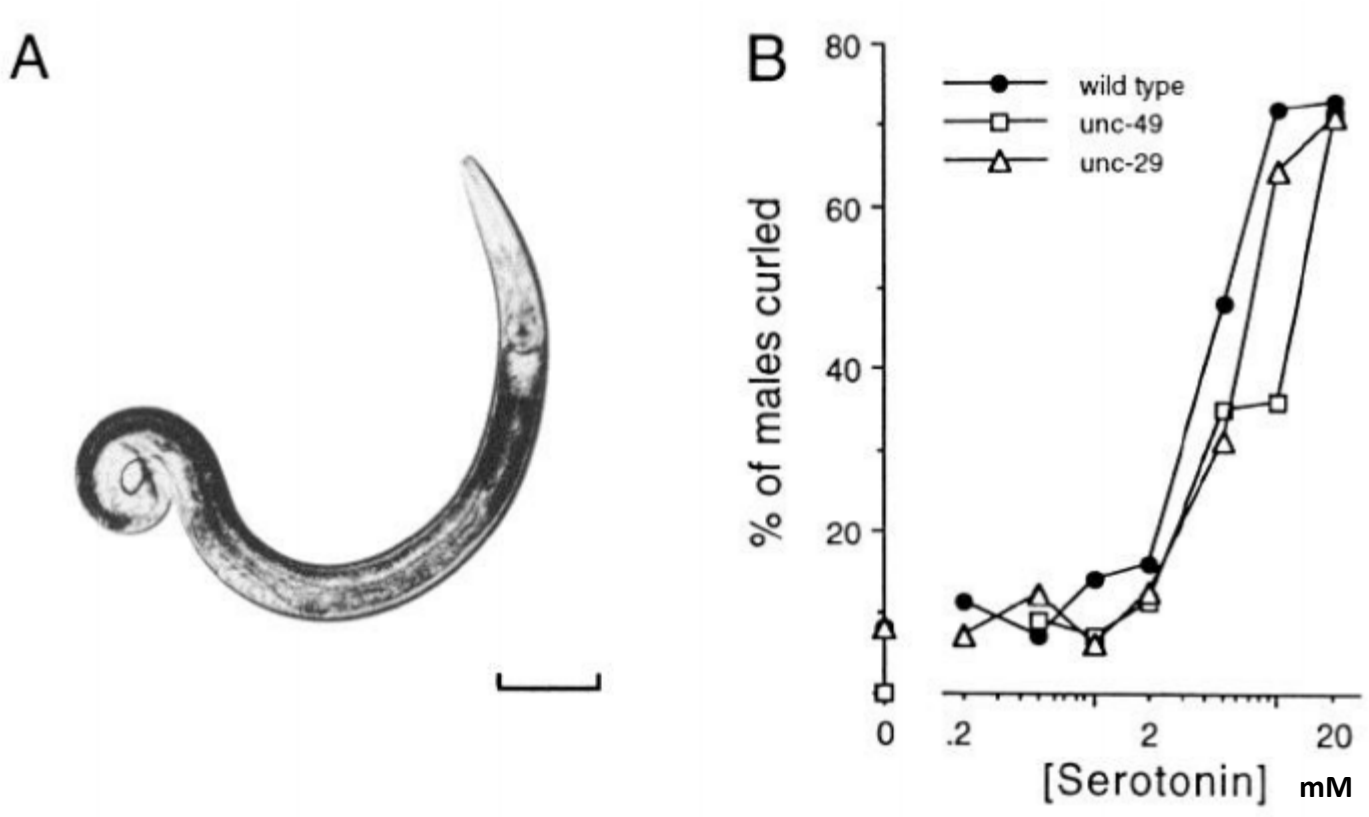
wild-type:
tight turn

Last 3 rays ablated:
late turn

Dopaminergic rays
(5A, 7A, 9A) ablated:
wide, sloppy turn

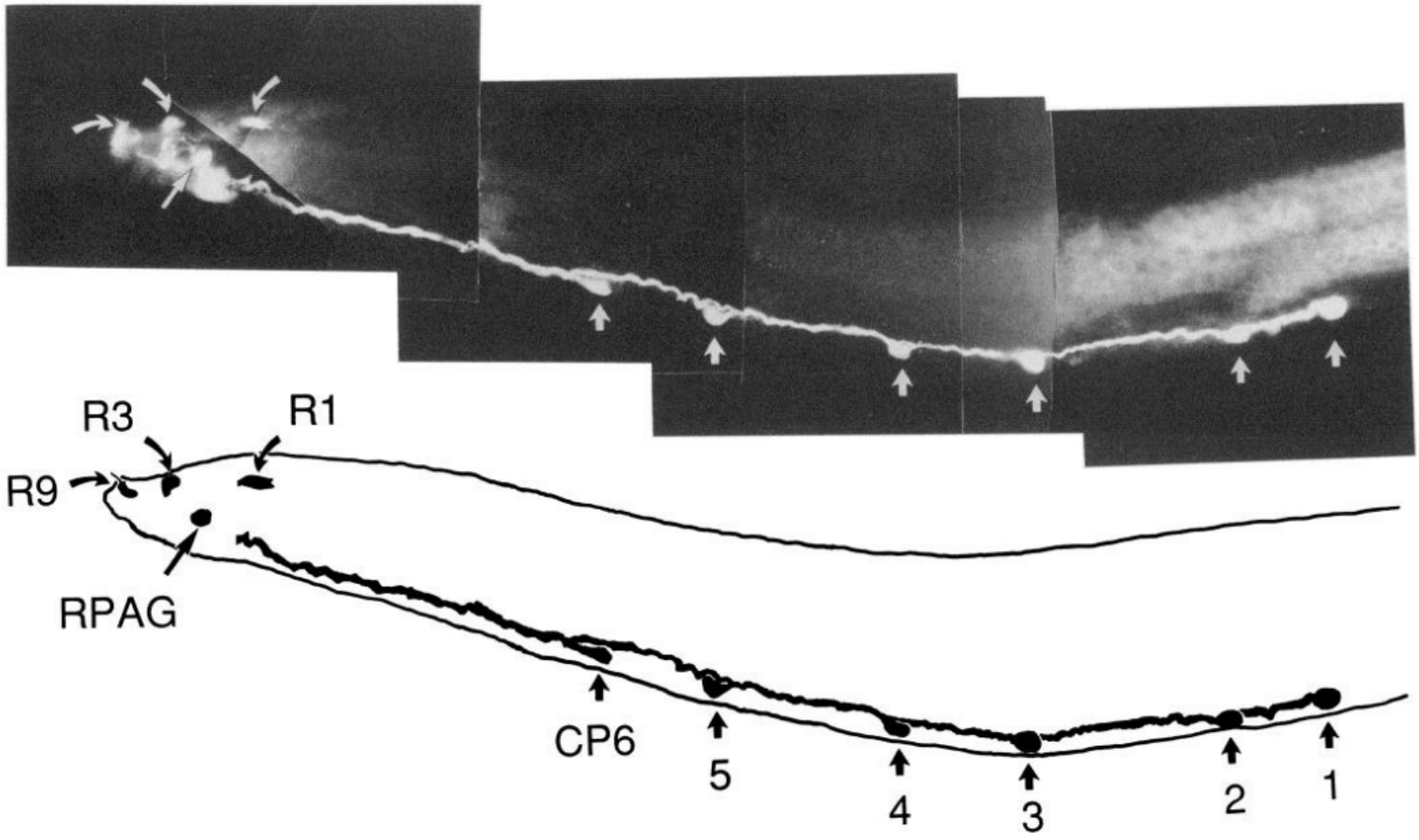
Liu & Sternberg 1995

Exogenous serotonin induces ventral coiling, perhaps by directly contracting muscle



Loer & Kenyon 1993

Serotonergic neurons in the male tail



Loer & Kenyon 1993

Step #5: Locate the vulva

Table 3. Analysis of Vulva Location Behavior

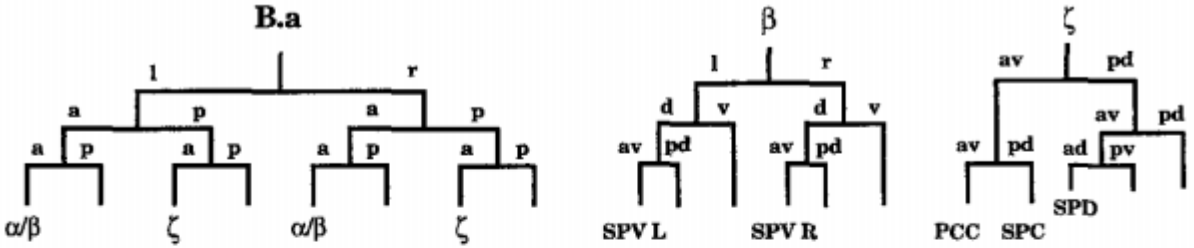
Cell(s) Ablated	Structure(s) Missing	Vulva Location Behavior		Mating Efficiency
		Approximate	Precise	
Observations with Intact Hermaphrodites				
None	None	Stops at vulva	Slow search using spicules	High
P10.p	Hook	Circles hermaphrodite	Finds vulva via slow search	Low
Y.pl/r	p.c.s. (except PCC)	Stops at vulva	No slow search; loses vulva easily	High
Y.pl/r, B.al/rpaaa	p.c.s.	Stops at vulva	No slow search; loses vulva easily	High
P10.p, Y.pl/r	Hook, p.c.s. (except PCC)	Circles hermaphrodite	No slow search	Very low
P10.p, Y.pl/r, B.al/rpaaa	Hook, p.c.s.	Circles hermaphrodite	No slow search	0
B.al/rpa	SPC, SPD, PCC	Stops at vulva	No slow search	0
B.β	SPV	Stops at vulva	Slow search	Very low
P10.p, B.al/rpapap	Hook, SPD	Circles hermaphrodite	Slow search; no spicules	0
Observations with vulvaless hermaphrodites				
None	None	Circles hermaphrodite	No slow search	NA
P10.p	Hook	Circles hermaphrodite	No slow search	NA

Vulva location behavior is divided into two substeps, here designated "approximate" and "precise," as explained in the description of vulva location behavior in intact animals. Mating Efficiency is explained in Experimental Procedures. For observations with intact hermaphrodites, n = 10; vulvaless hermaphrodites, n = 14 (None) or n = 6 (P10.p). p.c.s., postcloacal sensilla.

Liu & Sternberg 1995

Steps #6 and #7:
Insert spicule into vulva and ejaculate

A

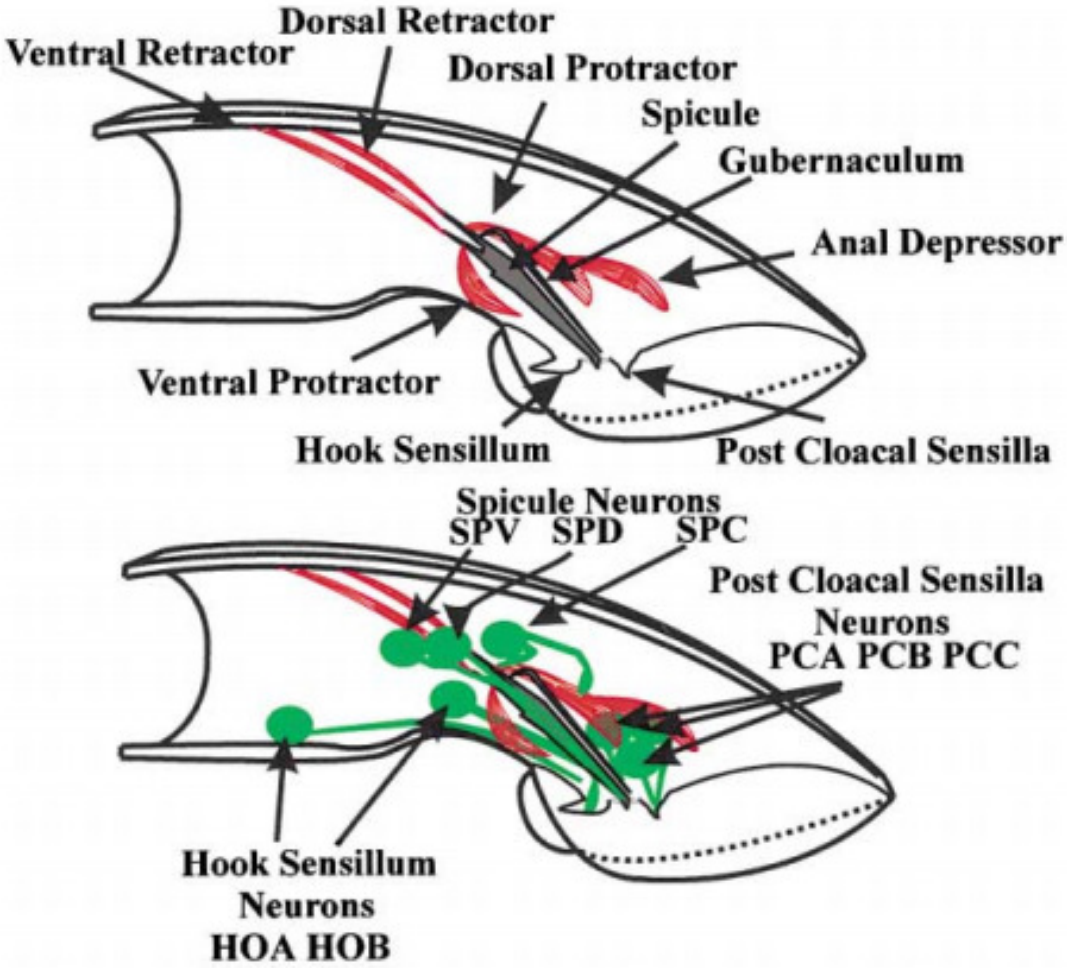


B

Cell(s) Ablated	Neurons Missing	by male	by trial	Defect
none	none	10/10 [a]	30/30 [a]	--
B.a	all	0/10	0/100	no spicule insertion
Bζ	SPC, SPD, PCC, +	0/12	0/120	no spicule insertion
Bζaa	PCC	6/6	18/18	--
Bζap	SPC	0/10	0/100	no spicule insertion
Bζpaa	SPD	2/10	2/95	no spicule insertion
Bζpap	SPsh	5/5	15/15	--
Bζpp	SPso	6/6	18/18	--
Bβ	SPV +	1/12	2/112	no sperm transfer (31/112) premature transfer (79/112)
Bβl/rda	SPV	1/10	1/93	no sperm transfer (17/93) premature transfer (75/93)
Bζap, Bζpaa	SPC, SPD	0/4	0/40	no spicule insertion
Bζap, Bβl/rda	SPC, SPV	0/4	0/40	no spicule insertion
Bζpaa, Bβl/rda	SPD, SPV	0/3	0/30	no spicule insertion

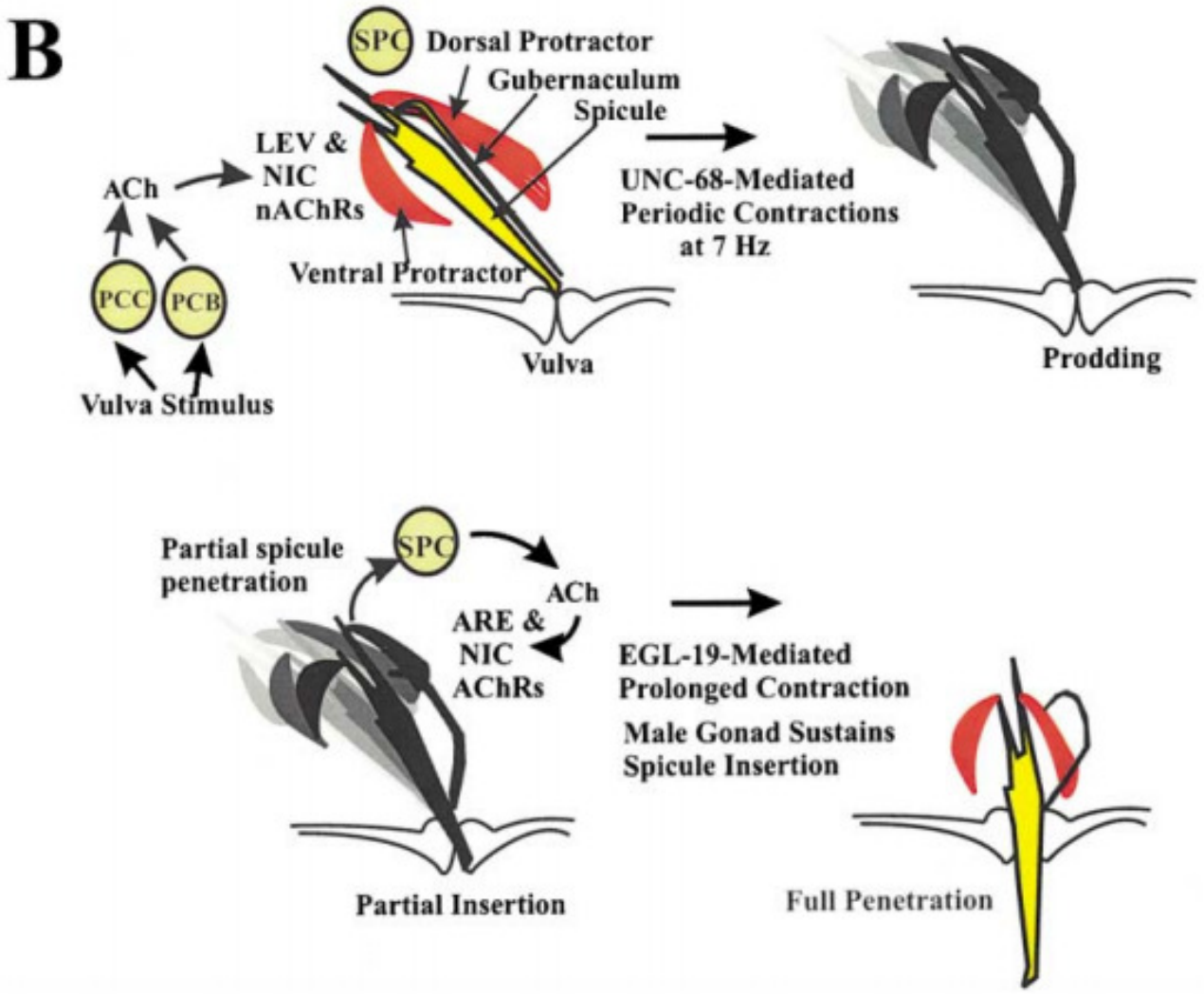
Liu & Sternberg 1995

Muscle structure for spicule protraction



Garcia & Sternberg 2001

Steps for spicule insertion



Garcia & Sternberg 2001