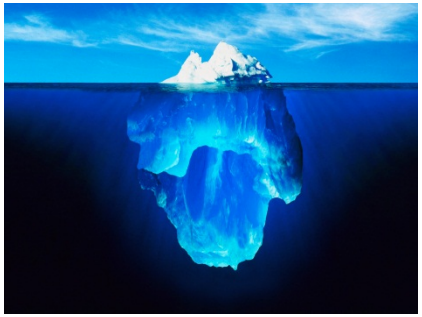
Welcome to CrawFly

Ron Hoy

Friday 6-21

Why Teach w/ Invert Preps



- Most accessible Model System for Human Neurophysiology—dissection skills
- No animal use issues—no protocols
- No Animal care—Your prep is click away—your local pet store or Carolina Biological
- All spikes look alike in the dark
  - Same neurotransmitters—synapsis, gap Js
  - Same circuitry rules (+, -, modul) and architecture
  - One dissection goes a long way: 5 labs or more
  - Tip of the iceburg: crayfish, flies, crickets

Crawgrads

Bruce Johnson—MBL, 1982-83

Bob Wyttenbach—CU 1986

First NSF Crawdad Workshop—1996-98
Shoals Marine Lab 1990s—Bruce & Bob
PKAL—B & B
FUN—B&B

ADI-Cornell Crawdad

Crawdad's Early Footprints

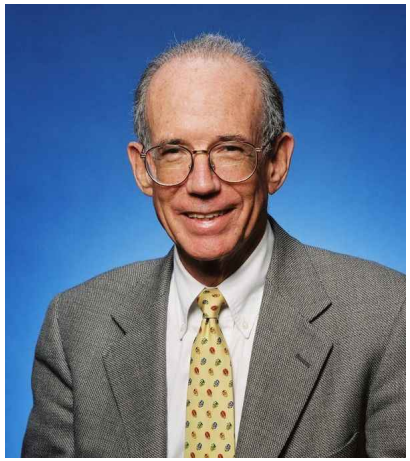
- Woods Hole: Neural Systems & Behavior
- Cornell-
  - Bruce: International workshops

  -B&B: the Pkal

  1996-1998 NSF Crawdad Workshope

Me N' Crawdaddy

- Stanford 1965-1970



-Don Kennedy, Prof., Chairman, Provost, President
-Don & K. Takeda "invented" the crayfish flexor prep as a model motor system
----as Don's grad student, I "invented" the isolated tail prep

1960-1980: Invertebrate Model Systems

- Learning & memory—Aplysia (Kandel et al.)
- Sensory Systems—Bees, flies, crickets, moths
- Motor Systems & Central Pattern Generators
  - crayfish, snails, locusts, more crickets, leeches,
- Cellular, molecular studies but especially for neural network studies of behavior
  - "simpler neural systems—numerically sparse< "20"
  - Big neurons, easy to see and poke w/electrodes & availability of vivid fluorescent intracell. Dyes
  - Concept of the "Identified Neuron."

Age of the Identified Neuron

- Invertebrate Neural Systems = Small Systems
- Small networks, hierarchical networks
- Whole Brain Mapping:
  - C. elegans
  - Benzer's Genetic dissection
- Ph
- ph

Contemporary Neuroscience

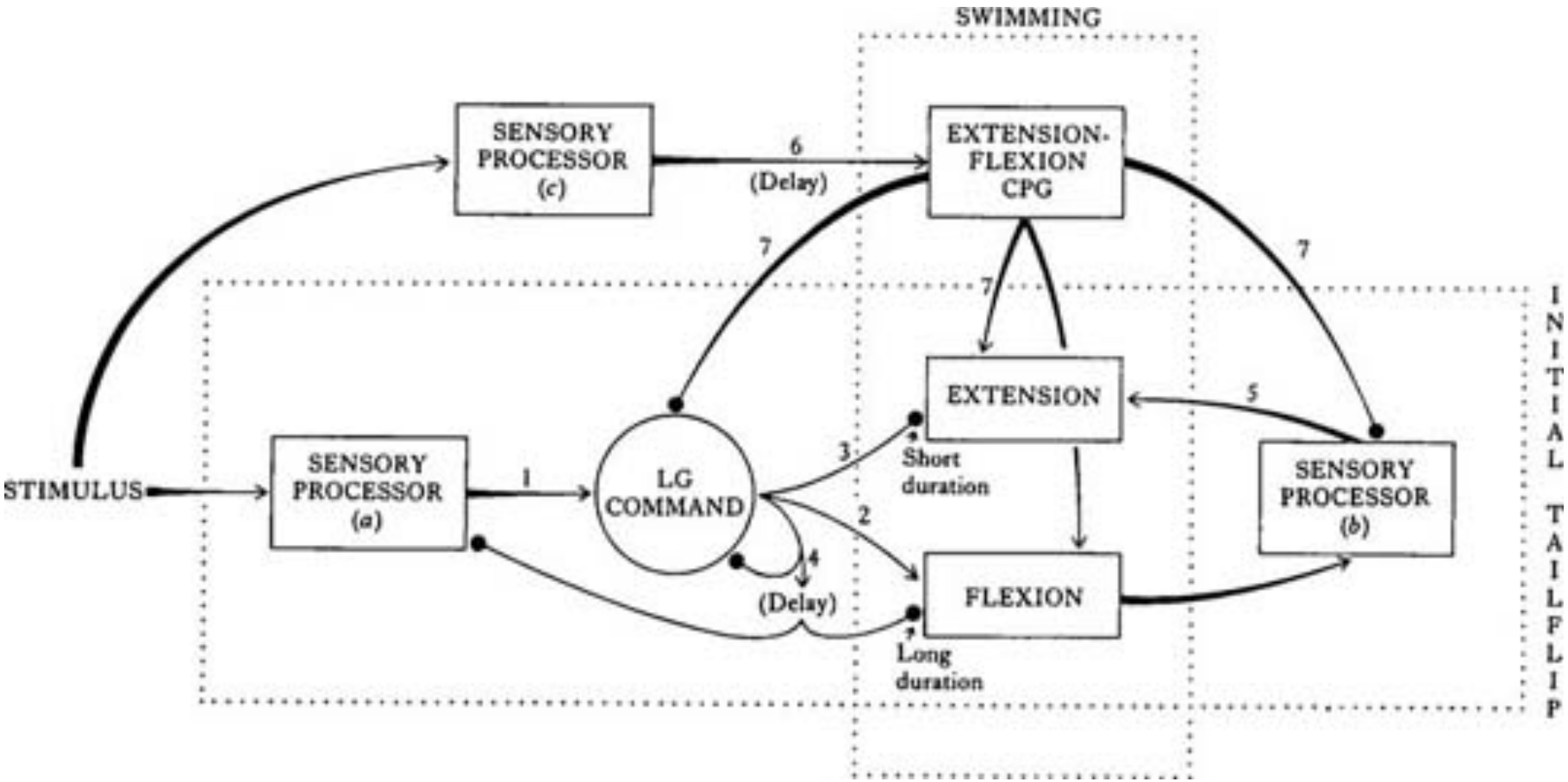
- Rise of cognitive neuroscience in mid-198 mammalian brains back in fashion
- Development of cell & protein-specific probes—antibodies, then RNAs, etc.; transfection
- Rise of computational/systems biology
- But above all, "does the system have genetics?" became the NIH's passkey.
  - The age of optogenetics, brainbow, Clarity
- What about the model systems…?
- Where have all the neuroPHYSIOLOGISTS gone?

As undergrad teaching preps, they are better than ever!

- Inverts don't have animal rights issues
- Inverts don't raise suspicions of IACUC
- You don't have to maintain expensive mouse colonies
- Many preps can be purchased from suppliers.
- The didactic value of invert preps is gives big bang for the buck
- Especially for systems level neuroscience
- All spikes look alike in the dark!

Universality of Startle Behavior aka Escape Response

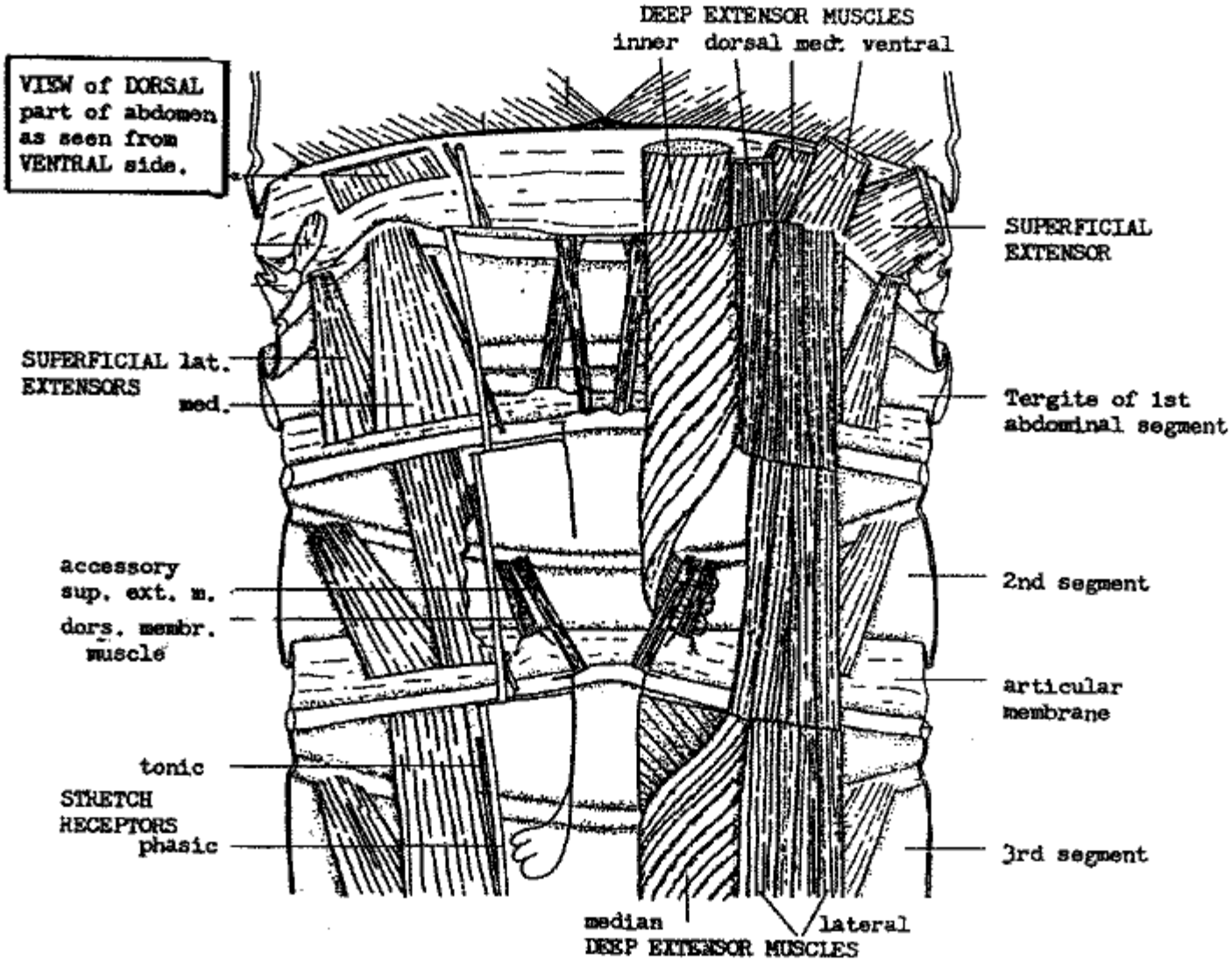
Tail-flip Circuitry model

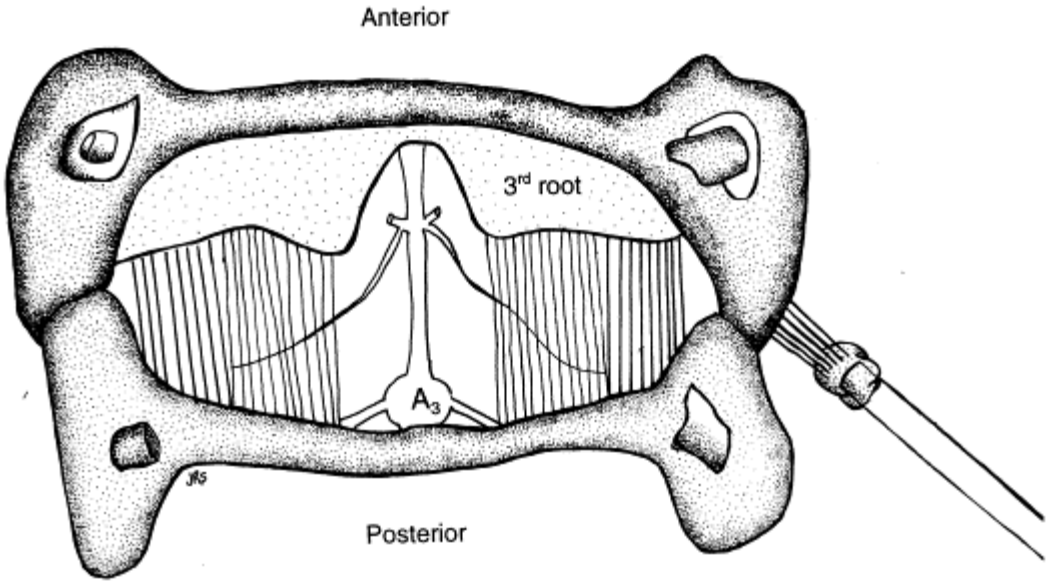


Crayfish Neural Systems as Teaching Preps

- **Motor Systems**: principle of motor antagonism & reciprocity; CPGs; reflexes; spontaneous activity; neuropharmacological modulation; synaptic properties including plasticity (STP, LTP); spatial and temporal summation; hierarchical command structure for behavior with analysis at the level of identified neurons wired in sparse networks; can generate lots of streaming data for computer types; both acute & chronic preps available—for array electrode recording, e.g., etc. etc.
- Sensory Systems: somatosensory, vision, & chemosensory preps are available.

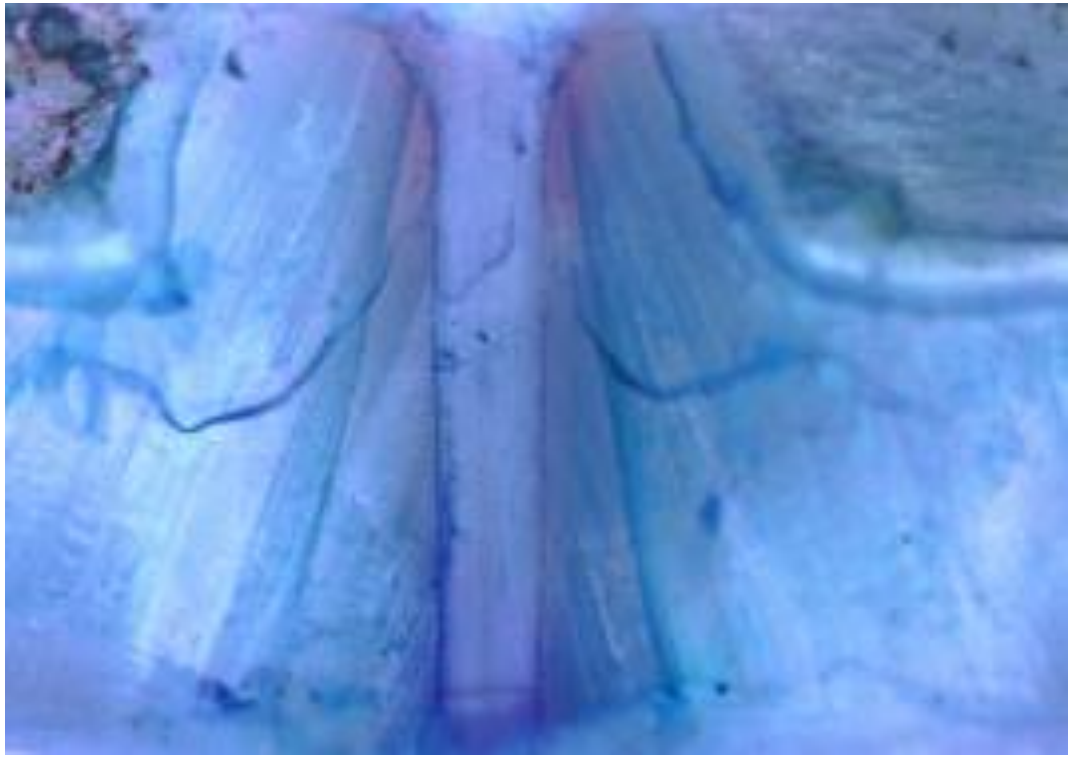
Crayfish Tail Prep—motor system

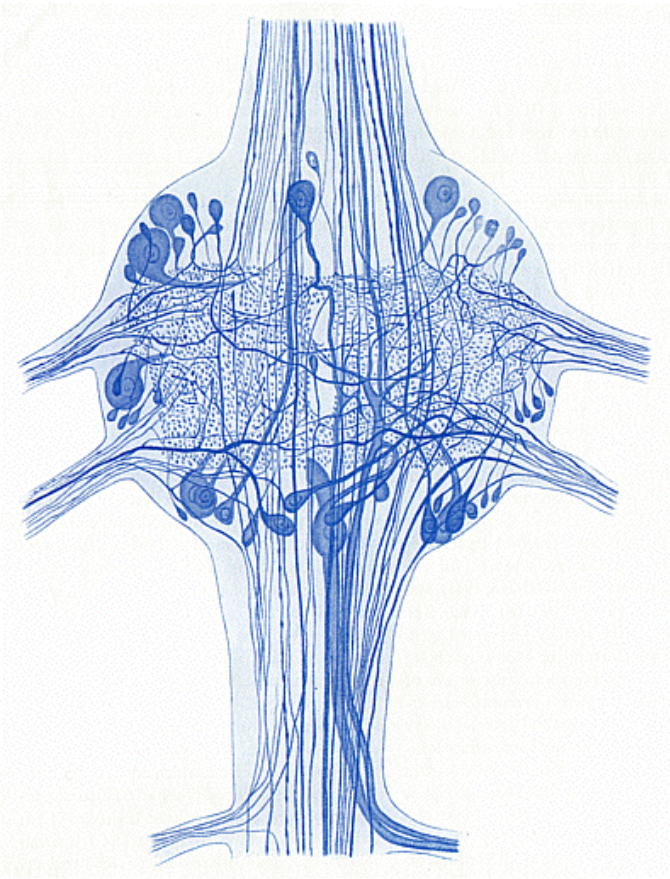



Anterior
3rd root
A3
Posterior

Structure and Function

Methylene blue vital stain





Know your anatomy

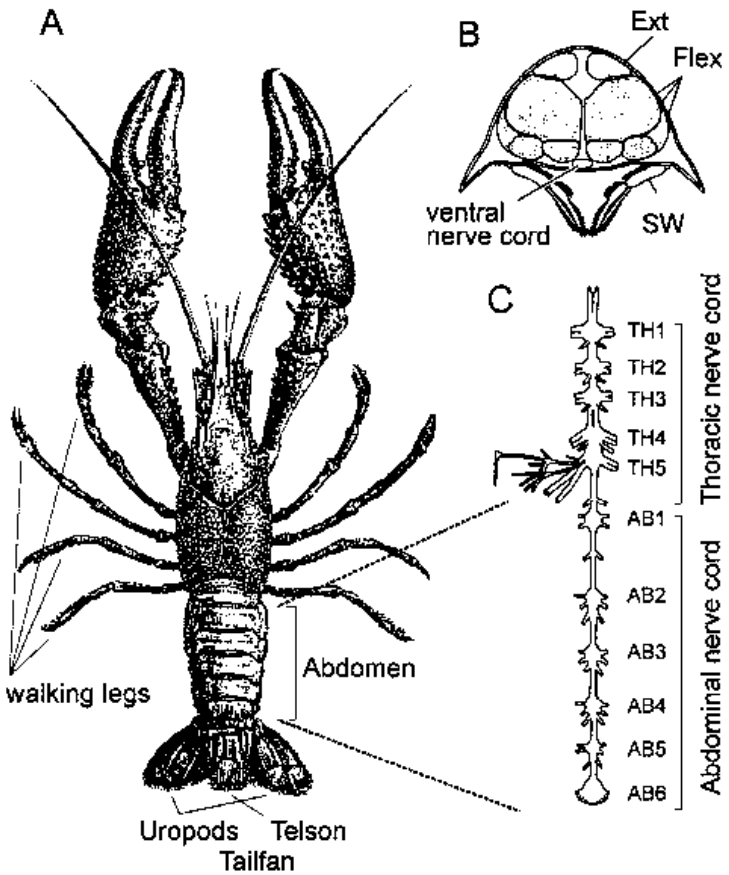
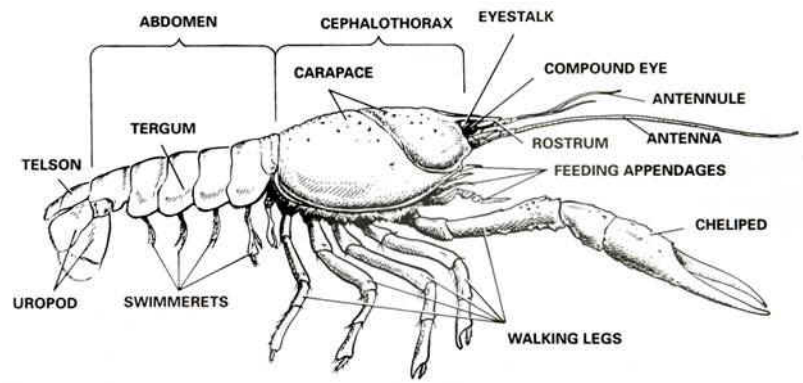
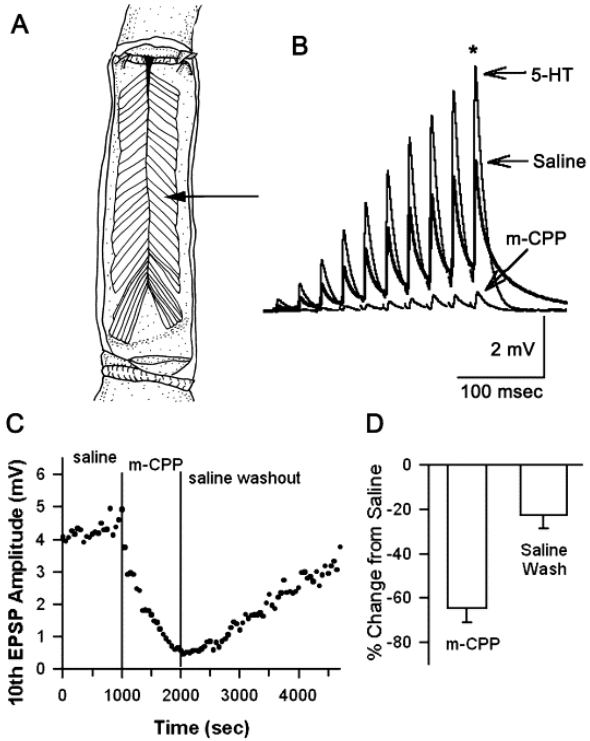


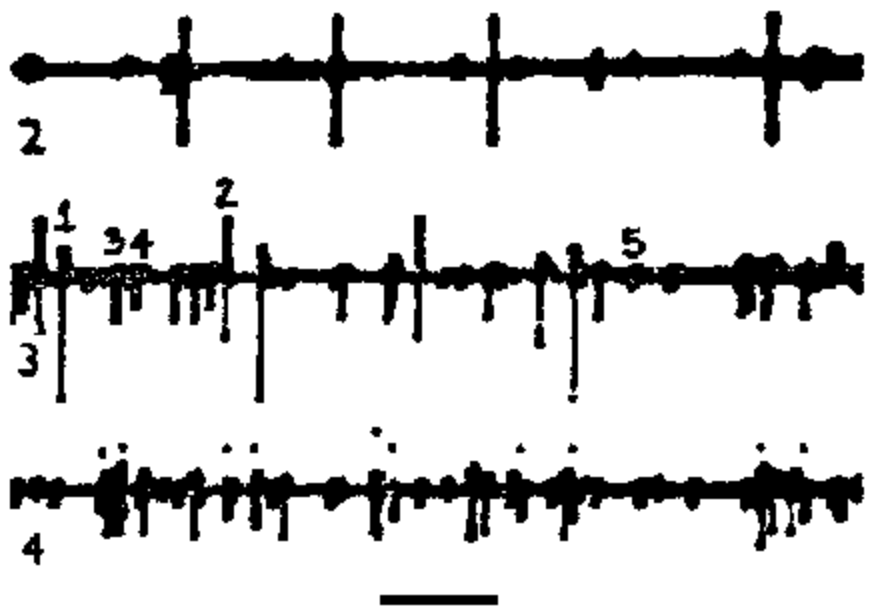
Fig. 1. Motor systems in crayfish. (A) Organization of the thoracic and abdominal motor systems. The legs (for walking), the swimmerets disposed by pair under each of the abdominal segments (for swimming), and the abdomen itself with its last segment differentiated in a telson and two uropods (for escape reaction) represent the three main locomotor and equilibrium systems of the crayfish. (B) Transversal view of the abdomen showing both its flexor (Flex) and extensor (Ext) musculature, as well as a pair of swimmerets (SW) and the ventral localization of the nerve cord. (C) Isolated ventral nerve cord composed of five thoracic (TH1 to TH5) and six abdominal (AB1 to AB6) ganglia. On TH5, the proximal innervation of the left fifth leg is also shown.

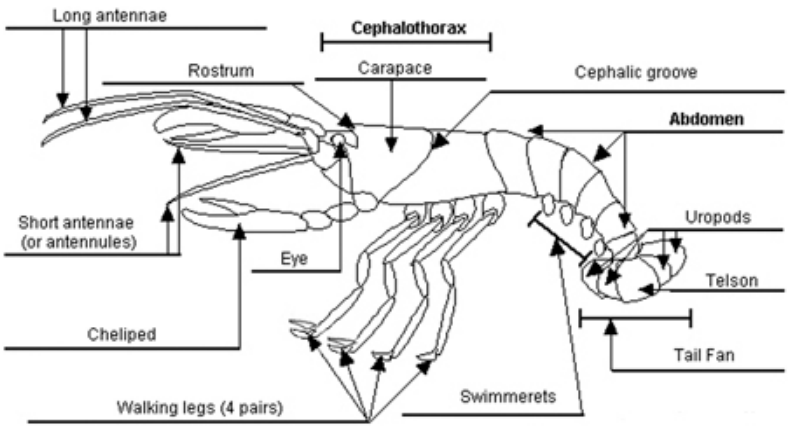


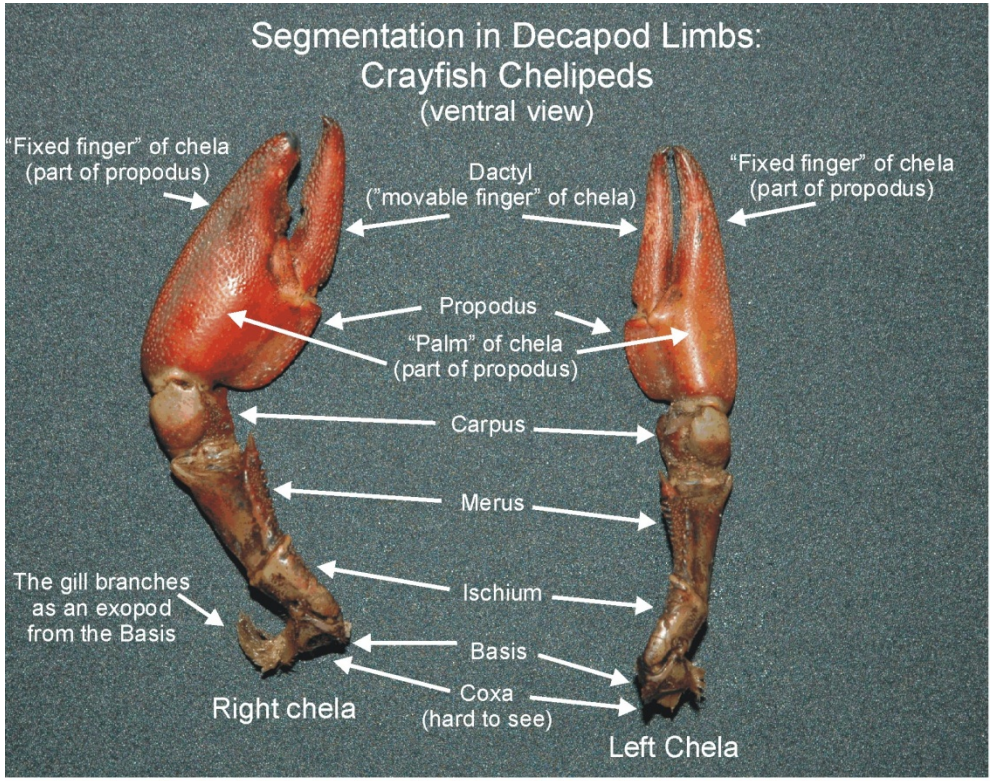
PTP in the crayfish claw…



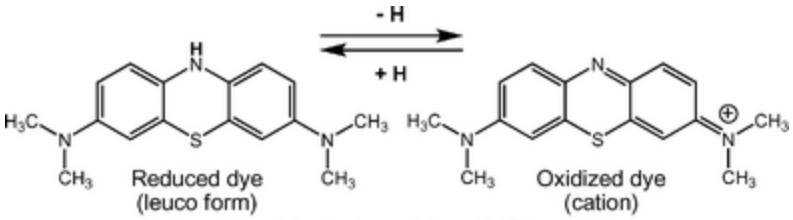
Spontaneous activity in a postural muscle



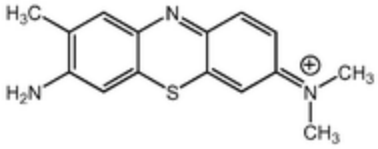




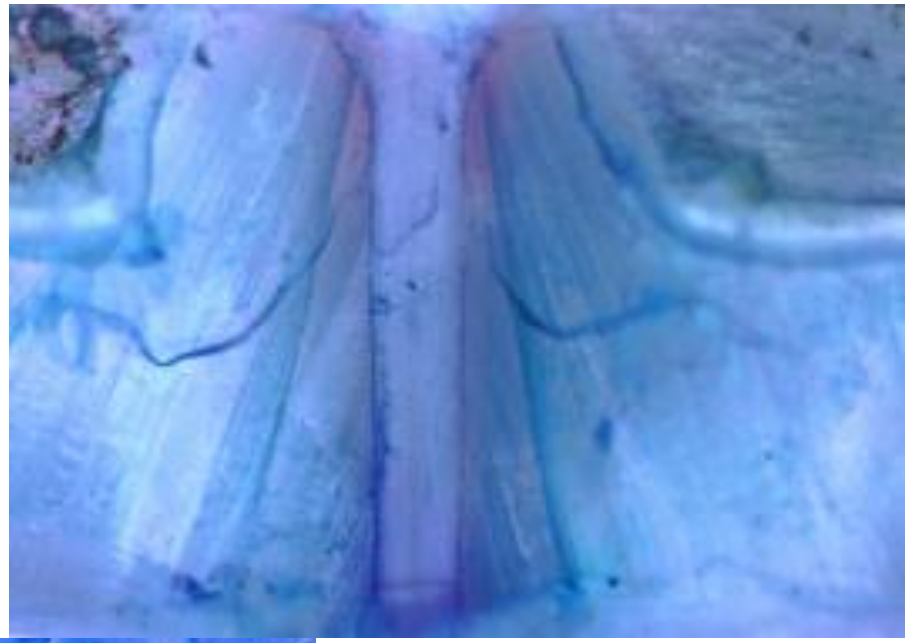
Note how the right chela (on the left in this ventral view) is large and blunt for crushing while the left chela (on the right in this view) is smaller and sharper for cutting

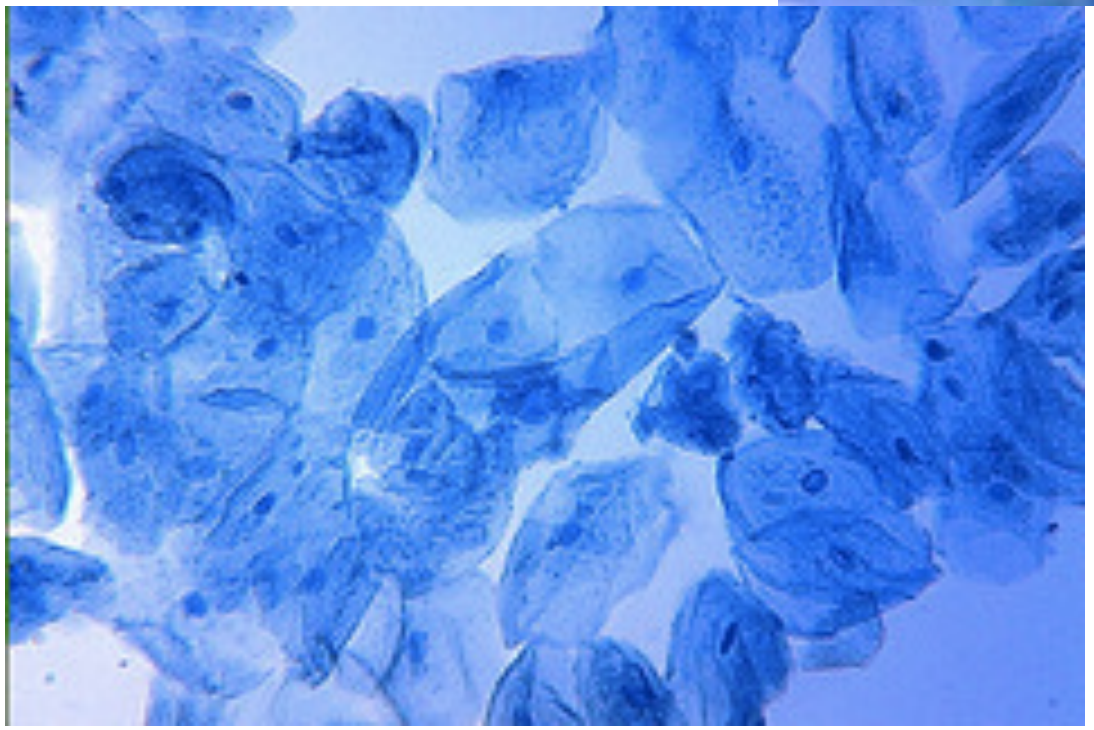


Methylene blue (MB)

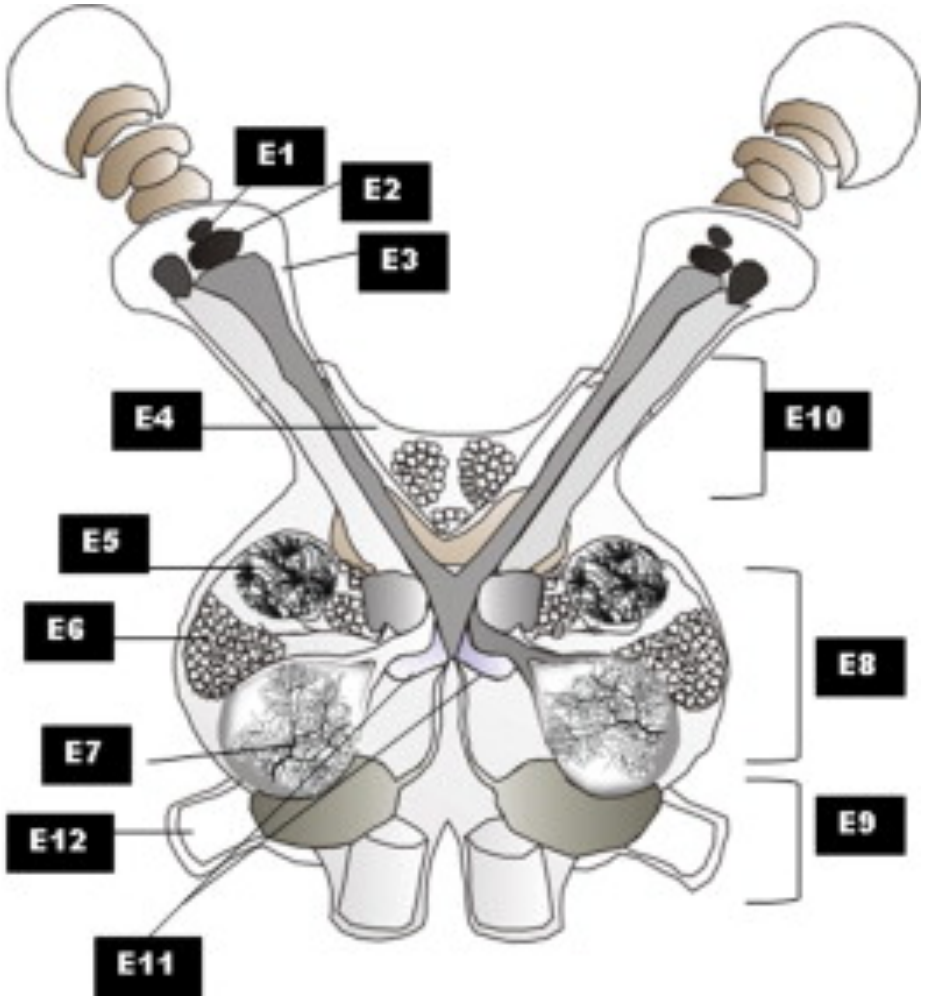


Toluidine blue (TB)

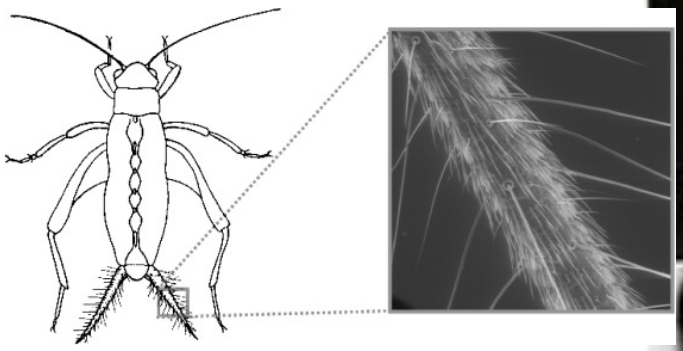


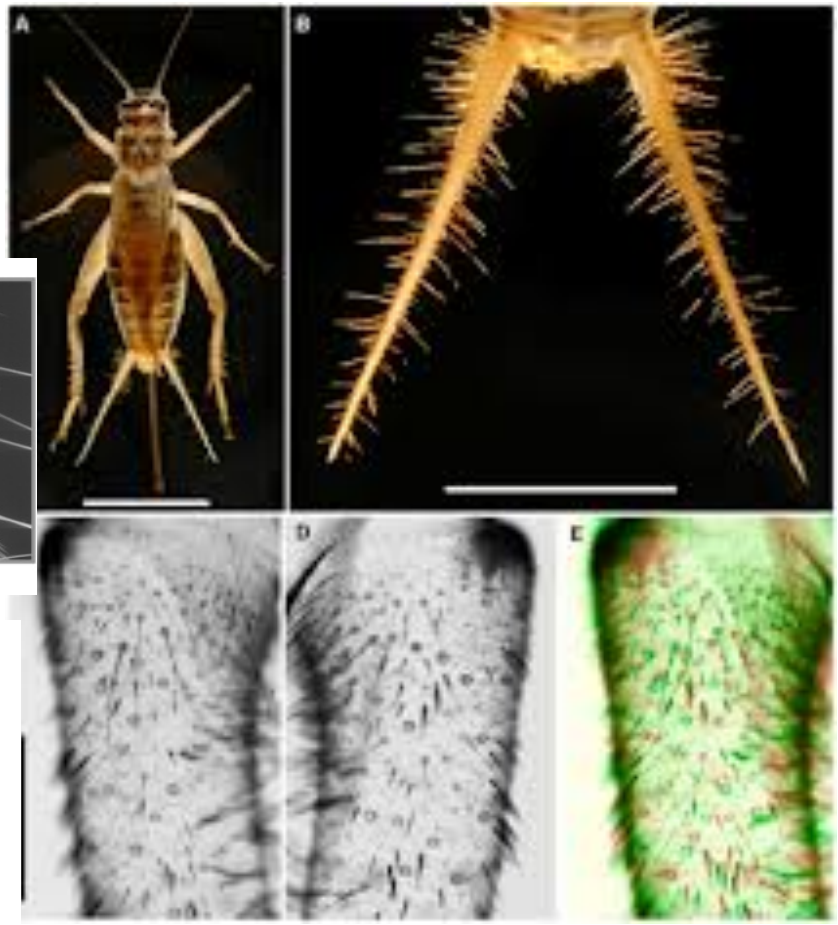


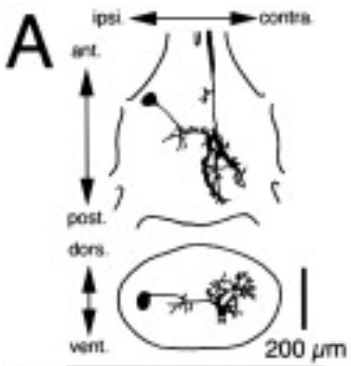
E1, Neurophil I
E2, Neurophil II
E3,Olfactory globular tract
E4,Median protocerebrum
E5, Olfactory lobe
E6, Cluster 10
E7,Accessory lobe
E8, Deutocerebrum
E9,tritocerebrum
E10, protocerebrum
E11, Median and lateral antennular neurophils
E12, Antennal neurophil [

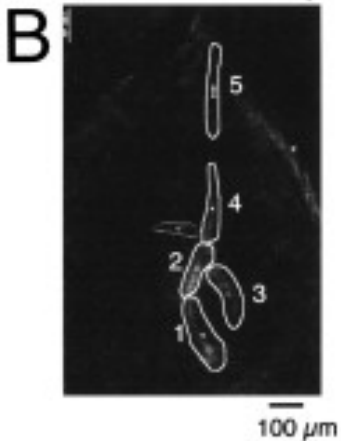


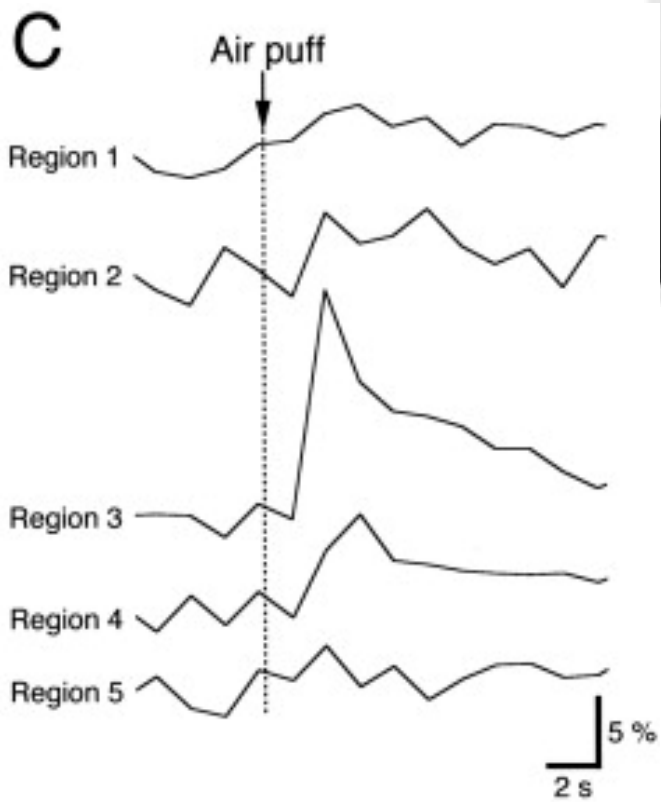
The Cricket Cercal-Giant Axon System











A sensory system for student labs:
--a model for auditory function
--a model for somatosensory syst.
--dirt cheap, buy at any pet shop