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Characterizing The Crawling Mechanism of Larval *Drosophila Melanogaster*

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Abstract

Drosophila melanogaster

- model system for brain function
- small, simple nervous system compared to humans
- similar molecular, cellular, and circuit level mechanisms

Central pattern generators (CPGs)

- compact neural circuits that allow the nervous system to subconsciously perform rudimentary, repetitive movements, possibly controlling basic breathing, walking
- help to understand mechanisms/rules for neural circuit function
- human CPGs are poorly understood, but are well studied in other species, such as cats, lamprey, and zebrafish

Research question: Which interneuron populations compose the CPG that controls *Drosophila* larval muscles during crawling behavior?

Methods

Optogenetics

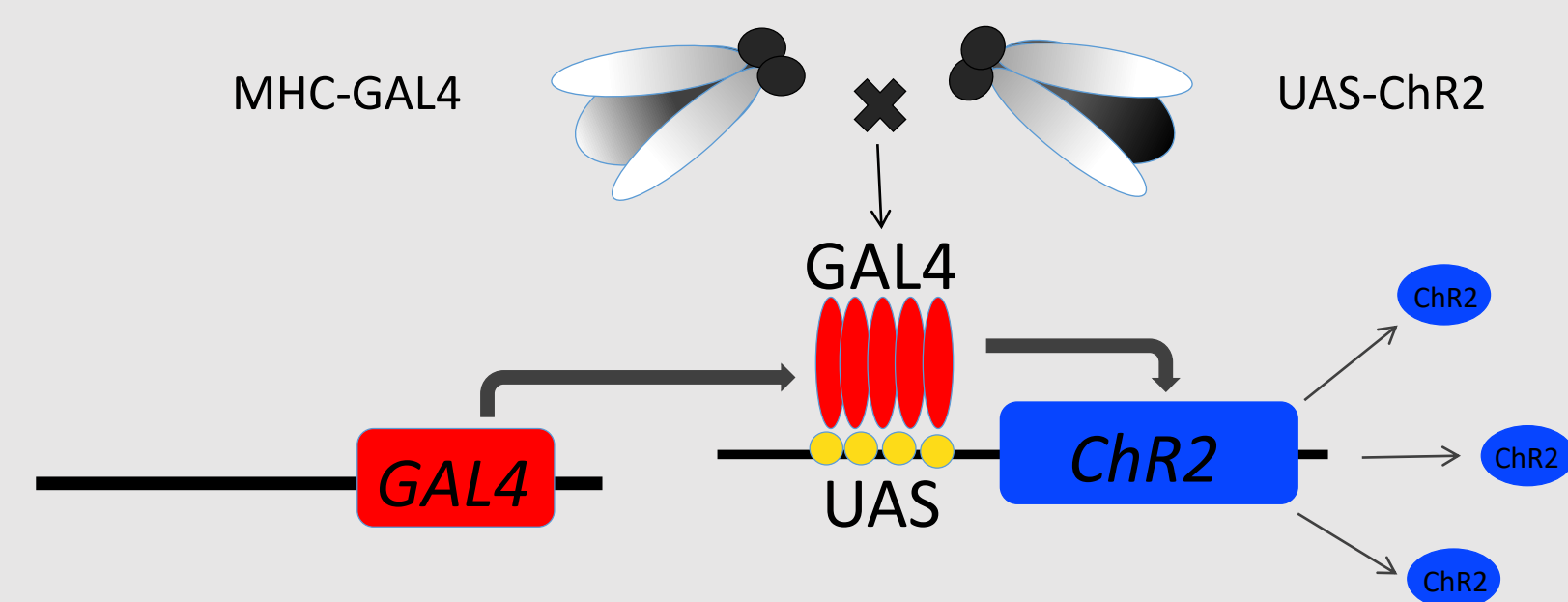


Figure 1. GAL4-UAS Tissue Specific Gene Expression (figure courtesy of MC Decker)

Extracellular Recordings

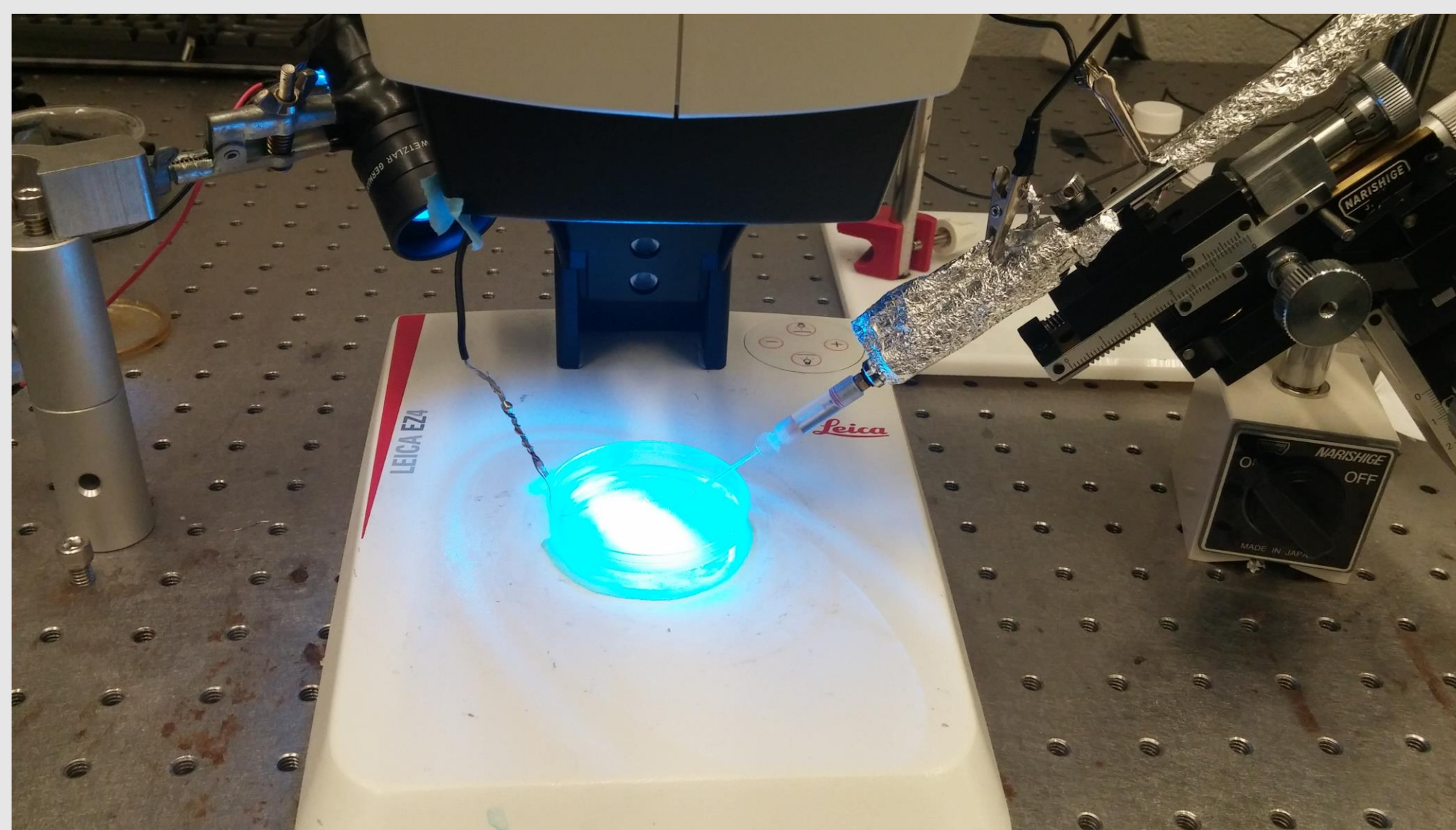


Figure 2. Extracellular recording equipment under dissecting microscope.

Treatments

- positive control (motor neuron driver: OK371)
- Interneuron line (Cholinergic interneurons: 6793)

Recordings

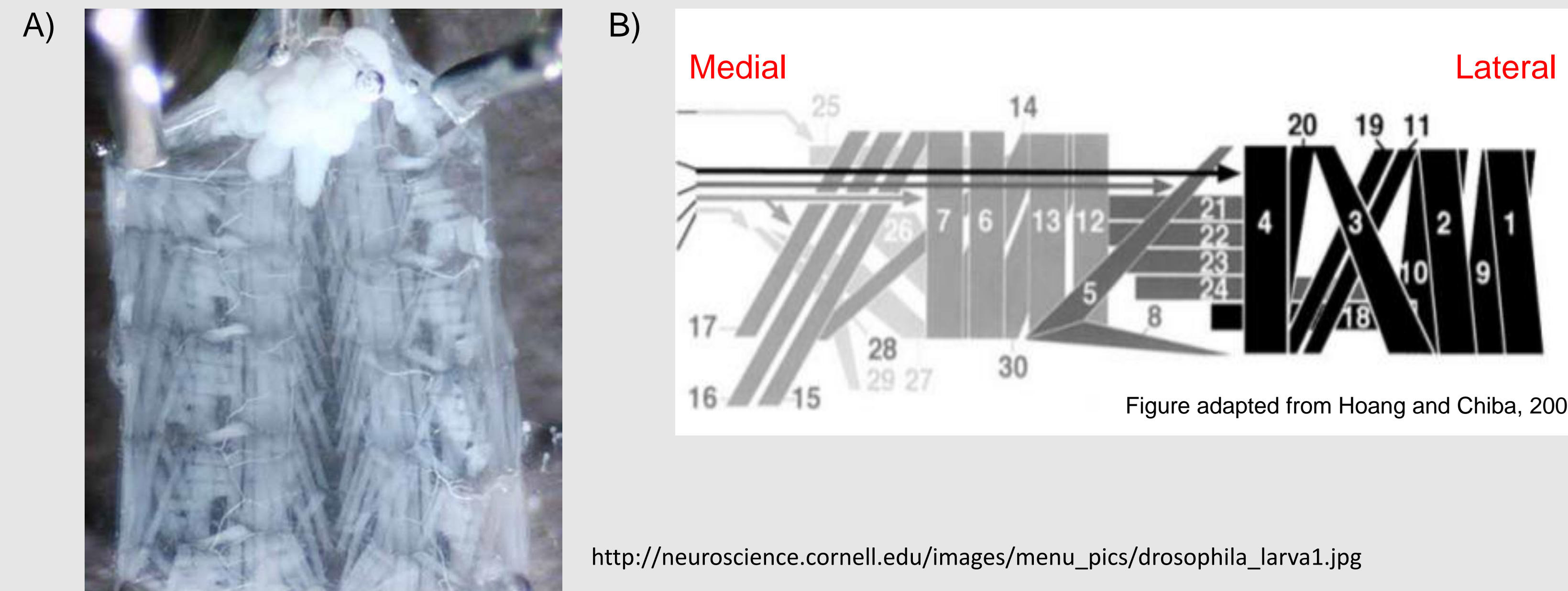


Figure 3. Larval *Drosophila* Body Wall Muscles. **A)** Dissected *Drosophila* larval body wall musculature in dissected layout after cutting along dorsal midline. **B)** Schematic of *Drosophila* muscle groupings, only displaying from midline (Medial) to edge (Lateral). Lateral: Dorsal longitudinal muscles, Medial: Ventral oblique muscles

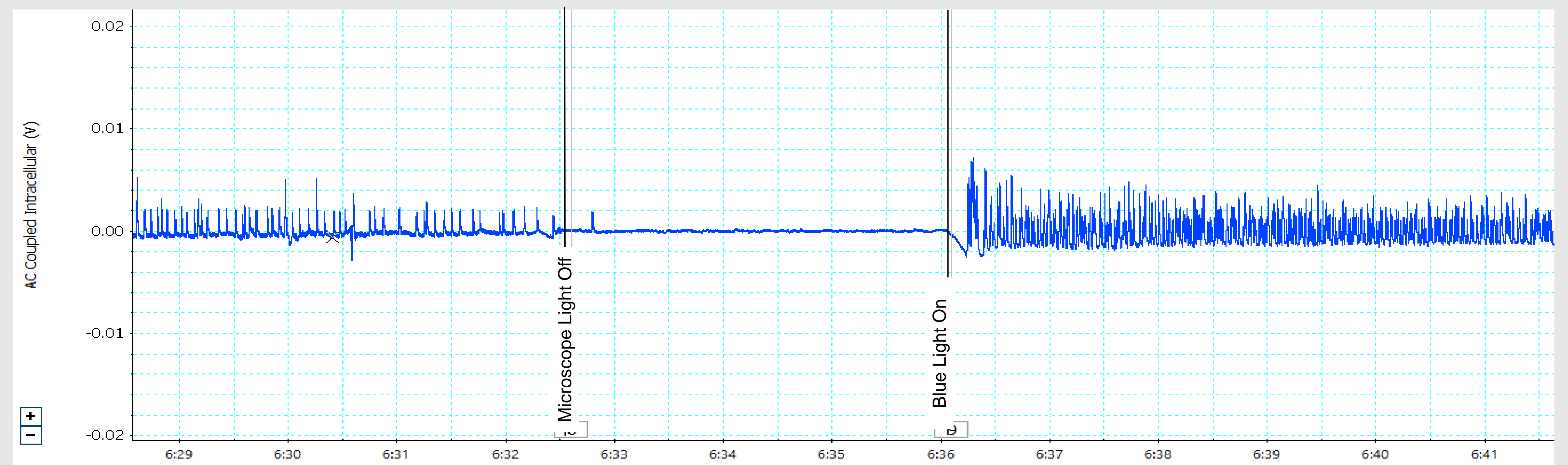


Figure 4. Extracellular Muscle Recordings. Muscle responses obtained from positive control body wall muscles during blue LED light exposure. (Figure courtesy of Shanley Roach).

Expected

Blue LED light stimulation should:

- produce muscle responses in positive controls (OK-371/GAL4-UAS larvae)
- produce muscle responses when **CPG interneuron populations** expressing ChR2 are exposed to blue light
- not produce muscle responses when non-CPG interneuron populations expressing ChR2 are exposed to blue light

Future Directions

- Produce larvae with ChR2 embedded in the membranes of the following interneuron populations:
 - Dopamine and serotonin
 - Tyramine and octopamine
 - Serotonin receptor 1B
 - Glutamate
- Test these groups for muscle responses, alongside positive (OK-371) and negative (no cross) controls.
- Maintain fly populations and prevent mold formation by storing in several different areas, promptly transferring flies to new tubes, and preventing mold from entering new tubes on the bodies of adult flies.

Acknowledgements

Thank you to Dr. Jen Schaefer for allowing me to utilize her lab space and borrow flies from her lines when my lines got moldy.

Hughes, C. L., & Thomas, J. B. (2007). A sensory feedback circuit coordinates muscle activity in *Drosophila*. *Molecular and cellular neurosciences*, 35(2), 383–396. doi:10.1016/j.mcn.2007.04.001

Roach S, Schaefer JE. 2017. Role of cholinergic interneurons in larval *Drosophila melanogaster* crawling behavior. (poster)

Decker MC, Schaefer JE. 2014. Analysis of muscle contraction pattern during *Drosophila* larval crawling behavior. MidBrains Meeting (poster)