Determination of the Differing Responses to CLDH by the Cardiac Ganglion of the American Lobster, *Homarus americanus*.  
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My research this summer focused on the central pattern generator (CPG) of the heart of *Homarus americanus*, the American lobster. CPGs are groups of neurons that display rhythmic bursting without the need for an outside signal. They are capable of changing motor output in response to changing internal or external conditions. The American lobster heart CPG is the cardiac ganglion. While controlling the lobster’s heartbeat, it displays rhythmic bursting even when removed from the lobster’s heart, making it an ideal candidate for experimentation and analysis. The cardiac ganglion is a Y-shaped nerve consisting of nine neurons, four small interneurons that set the pace of bursting, and five large motor neurons that carry signals from the interneurons into the heart to generate a heartbeat (Cooke 2002).

This summer, I studied the differing responses of the interneurons and motor neurons to a particular neurohormone, calcitonin-like diuretic hormone (CLDH). CLDH was originally discovered in cockroaches, but has since been found to be produced by the motor neurons of the American lobster cardiac ganglion. While many peptides and hormones can affect and modulate the cardiac ganglion, CLDH is the only one known to be intrinsically released by the cardiac ganglion itself. It has been found to cause a dose-dependent increase in heart contraction amplitude and frequency in lobster hearts *in vitro* (Christie et al. 2010). Given that CLDH is produced by motor neurons, I examined how it affects the whole cardiac ganglion. I also examined how CLDH affects motor neurons and interneurons separately, using a ligation procedure between the neurons for independent recordings. Through these two goals, I worked to characterize where CLDH acts on the lobster cardiac neuromuscular system in order to provide a deeper understanding of how CPGs sustain life in changing environments.

I studied two parameters throughout my project, burst frequency and burst duration. A burst is caused by a group of neurons firing action potentials simultaneously. In a lobster cardiac ganglion *in vivo*, a burst would result in a heartbeat. Burst frequency is calculated as the reciprocal of burst period, which is found by measuring the time from the start of one burst to the start of the next burst. This correlates to heartbeat frequency in whole lobster hearts. Burst duration is measured as the time from the start of a burst to the end of that burst, and correlates to heart contraction amplitude and duration in lobster hearts *in vivo*. Thus by studying these two parameters, I could compare my data on cardiac ganglia to those known data on whole lobster hearts *in vitro*.

Based on data found in whole lobster hearts, I expected that CLDH would increase burst frequency and burst duration in whole cardiac ganglia (Christie et al. 2010). Furthermore, based on previous research done at Bowdoin College, I expected CLDH to increase burst frequency of interneurons in ligatured cardiac ganglia, while not affecting motor neurons of ligatured cardiac ganglia or burst duration of either motor neurons or interneurons in ligatured cardiac ganglia (Mortimer and Dickinson 2012).

My results were somewhat inconsistent with my hypotheses. I found that 10⁻⁷ M CLDH significantly increased burst frequency in whole cardiac ganglia, but did not significantly affect ligatured interneurons or motor neurons due to a large amount of variability in results. In addition, CLDH did not significantly affect burst duration in any condition, though all data points except two were negative in ligatured motor neurons. These data suggest that CLDH affects cardiac ganglia in a way more complicated than initially expected. This mechanism is not yet clearly understood, and must be researched further in the future to characterize how CLDH affects the American lobster’s cardiac ganglion to produce an increase in heartbeat amplitude and frequency. It is possible that an increase in CLDH concentration is necessary to achieve significant results, or that a less invasive ligation procedure should be examined so as not to damage interneurons or motor neurons in the process of ligation.

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**Literature Cited**

