

A Novel Physiology Teaching Laboratory Investigating the Mechanisms of Ammonia Excretion across the Gill Epithelium of Marine Crustaceans

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With few exceptions, marine crustaceans are ammoniotelic, excreting nitrogenous wastes primarily as ammonia/ammonium ($\text{NH}_3/\text{NH}_4^+$). This novel teaching lab uses modern scientific research techniques to demonstrate the mechanisms of ammonia excretion in the Dungeness crab (*Metacarcinus magister*). Over a two-week period, students will complete three separate experiments. First, live crabs in a closed environment are used to gain insight into physiological ammonia excretion rates. Next, using isolated crab gills, students will test the gill's ability to actively excrete ammonia against inward directed concentration gradients (up to ten-fold). Lastly, potential mechanisms of ammonia excretion are investigated through exposing the isolated gills to various pharmacological blocking agents including ouabain (Na^+/K^+ ATPase), colchicine (microtubule trafficking), dinitrophenol (ATP synthase uncoupler), azide (cytochrome c), and cesium ions (K^+ channels). These mechanisms have been well characterized in the green shore crab (*Carcinus maenas*), however, they are currently unknown in *M. magister*, giving the student a glimpse into active scientific research. Teaching fundamentals in the context of current research and using modern equipment, provides students with a solid background and better prepares them for today's research environment.

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