

GK-12 Graduate Fellows Program

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Dr. Robert Roer: the physiological approach



My area of research is **physiology**, the study of the mechanisms underlying animal function and performance. My subspecialty is **biomineralization**, which is the means by which many organisms reinforce their skeletons with inorganic minerals like calcium carbonate and calcium phosphate.

One of our principal model organisms for studying biomineralization is the blue crab, *Callinectes sapidus*. Crabs are ideal for this purpose because they molt on a regular basis in order to grow.

As you can see in the specimen pictured to the right, the crab constructs the outer layers of its new exoskeleton (or cuticle) prior to shedding its old one. These layers must remain "soft" until the animal emerges and swells up by absorbing water (as you can see in the crab pictured below). Mineralization of these new layers must, therefore, be inhibited until the appropriate time.



We are interested in the control of this process of mineralization. We want to find answers to questions like: What prevents premature mineralization? Are there changes in the structure of the cuticle after the molt that enables mineralization to occur? Are there differences in the biochemistry of the cuticle between areas that mineralize (e.g. the dorsal cuticle) and those that don't (e.g. the joints)?



In order to answer these questions and to put biochemical and genetic data in a morphological context, we need to use a multidisciplinary approach. We combine the use of molecular techniques, biochemistry, physiology, and microscopy to accomplish this. To this end, I collaborate with Dr. Tom Shafer, a molecular biologist, and Dr. Dick Dillaman, a morphologist and microscopist.

My focus in this collaborative project has been on the enzymes that transport calcium into and out of the cuticle, and the enzymes that might be involved in modifying the cuticular biochemistry to allow mineralization to begin. I use physiological tests to measure the movements of calcium and I use biochemical tests to look for the activity of the enzymes.

We also have used fluorescent antibodies to localize an enzyme that we think removes certain sugars from glycoproteins (the bright green areas in the sections of the cuticle on the right). We think that this process may be involved in the initiation of biomineralization.

