UNIVERSITY OF NORTH CAROLINA AT WILMINGTON

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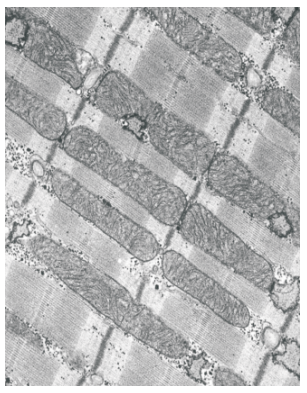
Dr. Kinsey: Physiology and Biochemistry

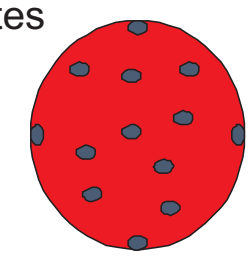
Dr. Kinsey is a marine biologist interested in comparative physiology and biochemistry, in other words: how organisms function internally and the reactions controlling those processes. In particular, he is interested in how cellular processes affect the physical traits of animals. Understanding how biochemistry works in living cells enables researchers to investigate such features as metabolic organization and intracellular diffusion. Much of the effort at the cellular level is directed at understanding muscle energetics. Muscles are of interest due to: 1) the large percentage of an organism's mass they often comprise, 2) their ability to operate both aerobically (when oxygen is readily available) and anaerobically (when oxygen is insufficient), 3) the highly organized internal structure of muscles, and 4) the sequential reactions that occur during contraction and recovery. Our studies of muscle function are then used to define aspects of whole animal behavior, such as the limits to burst escape locomotion or exercise endurance.

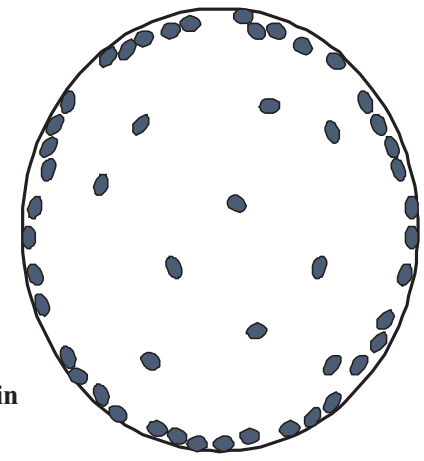


Actin and myosin filaments in muscle and their adjacent mitochondria

Every scientist needs to cut loose

Research performed in Dr. Kinsey's lab often utilizes mice, marine invertebrates (such as crabs and lobsters), and fishes. While not restricted to only these organisms, they are ideal models because of the extreme diversity in structure and function found in their tissues. Invertebrates and fishes are interesting because members of both groups have discrete groupings of muscle type. In other words, they have distinct areas of all red muscle, for sustained swimming, and all white muscle, used in burst escape response (see picture of fish muscle). In addition to the functional differences between the muscle types, there are structural differences that serve to maintain function.





Mitochondrial distribution in red and white muscle fiber

Notice the distinct grouping of red and white muscle in this swordfish

Most cells typically maintain a size range between 10 - 100 µm at their widest diameter. The fiber diameter in the white muscle of adult blue crabs (*Callinectes sapidus*) and several species of fish however, attain diameters exceeding 800µm and 400µm, respectively. This considerable increase in cell size results in an increase in diffusion distances, and therefore an increase in time for molecules, such as ATP (the cell's energy molecule), to diffuse from sites of production (the mitochondria) to sites of utilization (e.g. myosin, the sites of contraction). Behaviorally this increase does not affect burst escape response, which is an anaerobic process. Conversely, it does impact how quickly adult animals that contain these large cells will restore resting values of ATP. The adjacent cartoon of cells and their mitochondria, and the activity associated with this poster, illustrate this phenomenon.

NMR magnet

To examine physiological and/or biochemical processes, we use several experimental techniques that allow us to non-invasively probe metabolism in living cells, including nuclear magnetic resonance (NMR), magnetic resonance imaging (MRI), and confocal microscopy, as well as invasive approaches such as cDNA microarray analysis, spectrophotometric assays, muscle contraction measurement, and electron/light microscopy.

Confocal microscope