

POWERING RESEARCH on MITOCHONDRIAL DISEASE

MITOCHONDRIA ARE SPECIALIZED STRUCTURES THAT EXIST

in all cells except red blood cells. Generally known as the cell's energy factory, mitochondria play a much broader role: from helping in the processes of making hemoglobin, detoxifying ammonia in the liver, metabolizing cholesterol and neurotransmitters and synthesizing estrogen and testosterone. Each year, thousands of children (and, increasingly, adults) are diagnosed with genetic mitochondrial conditions that range from skeletal muscle weakness and exercise intolerance to neurodegenerative diseases, heart disease and liver failure. In addition, mitochondria are increasingly recognized as playing a role in the pathology of diseases such as diabetes and cancer.



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Jefferson's Center for Mitochondrial Imaging Research and Diagnostics—known as the MitoCare Center—investigates mitochondrial energetics, signaling and dynamics to learn how changes in mitochondrial biology cause disease and to identify potential targets for new treatments. Fundamental to MitoCare Center researchers' work is advanced microscopy that—combined with cutting-edge metabolic technologies, genetics and proteomics—enables them to observe mitochondria functioning in both normal and diseased tissues. These capacities also enable Center investigators to create better methods of diagnosing mitochondrial diseases and testing potential therapies.

MitoCare comprises five core research teams, plus an array of associated multidisciplinary teams whose research crosses into mitochondrial biology. The team led by MitoCare director **Gyorgy Hajnoczky, MD, PhD**, the Raphael Rubin, MD, Professor of Pathology, Anatomy and Cell Biology, was among the first to visualize mitochondrial energy metabolism and ion transport in single live cells. This work helped to elucidate fundamental signaling mechanisms that coordinate mitochondrial action with broader cellular function. His team has also been developing live cell imaging capacity that allows bioscientists from many disciplines to study intracellular processes.

MitoCare researchers are also applying the Center's technical capacities to study mitochondria's precise role in specific diseases. For example, **Erin Seifert, PhD**, associate professor of pathology, anatomy and cell biology, is pursuing two NIH-funded studies on the multifaceted role skeletal-muscle cell mitochondria play in the development of disease—including an investigation of how malfunctioning muscle mitochondria can undermine glucose regulation throughout the body, leading to type 2 diabetes. **Shey-Shing Sheu, PhD**, professor of medicine, and **Gyorgy Csordas, MD**, associate professor of pathology, anatomy and cell biology, are working to define the central role that mitochondria play in the development of ischemic heart disease, cardiac arrhythmias, cardiomyopathy and heart failure. And **Dmitry Temiakov, PhD**, associate professor of biochemistry and molecular biology, studies how the process of DNA transcription and replication in mitochondria differs in normal versus cancer cells. ■