Goals of the Systems and Integrative Biology Training Program

The goal of this program is to train doctoral students in contemporary Systems and Integrative Biology. This requires the ability to use state-of-the-art cellular, molecular, genetic and computational tools and to apply them to answer questions of integrative significance. In the past the ability to deduce molecular processes from integrative or organ function approached its limits and attention shifted to more reductionist approaches in which more and more was known about smaller and smaller units. It is now clear that understanding of integrative function requires more than the understanding of all the parts in isolation. The goal of modern Systems and Integrative Biology is to understand how the component parts work together to explain an integrative system functioning within the organism. This requires the ability to recognize emergent properties not predictable from the components and the ability to simultaneously look at biological processes at multiple levels of organization.

Modern SIB received enormous impetus from the development of transgenic and genetically modified mice and the mouse has become the primary animal used in integrative studies. The field has also been enriched by the development of model organisms such as C. elegans and drosophila and the ability to apply comparative genomics.

Mathematics was long a traditional tool for physiological analysis and this has been further developed as computational biology, which includes multiscalar modeling and the analysis of large data sets of gene expression, proteomics and metabolomics. Currently, however, one of the limiting factors for this field is to be able to make accurate and controlled functional measurements in living organisms. Thus, there is a clear national need for researchers trained in Systems and Integrative Biology who are able to work in a complex setting of living higher organisms. This includes many new techniques including genomics, proteomics, metabolomics all of which involve working with large data sets and often require bioinformatics and computational biology. The goal of this training program is to provide students basic knowledge and experience in the above areas, to be able to recognize how different approaches can add to understanding of a problem and to overcome the energy barrier that otherwise would prevent them from extending into these areas in their future careers.

This training program is available to students obtaining their PhD degree from various departments in the medical school, but their proposed mentor must already be one of the named faculty on the training grant. Funding is determined on an annual basis, but typically each student is supported for two consecutive years. We value and encourage students from underrepresented minority or ethnic groups and those with disabilities to apply to our program. However, all students appointed to the grant must be either U.S. citizens or permanent residents.