FLORIDA STATE UNIVERSITY

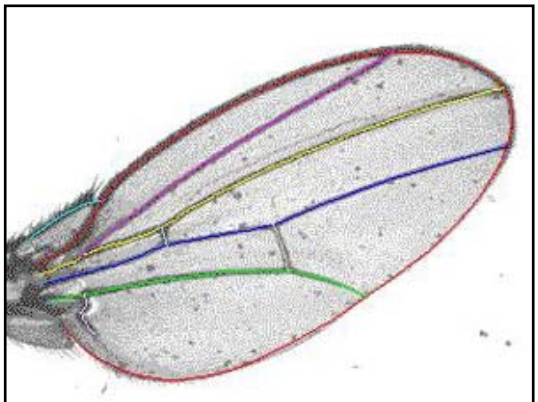
About the IGP Cluster

The first complete genome of an organism was published in 1995. Today the genomes of over 500 organisms have been sequenced and the rate of growth is accelerating. Now, the focus is changing from generating DNA sequence data to understanding how that information is used to build an organism. The challenge for life science research and this cluster-hiring initiative is to elucidate the genetic architecture of life.

Understanding the relationship between genotype and phenotype is the unstated mission of much of modern biology; this cluster will make this focus explicit. Our aim is to connect two traditions for the study of genotype-phenotype relationships: the whole-organism perspective of evolutionary biology, and the molecular genetic perspective of biology. Each is well represented at FSU. The cluster will bring together established and new scientists whose work directly bridges these traditions, thereby building an interactive group that creates synergies and novel opportunities to solve some of biology's biggest mysteries. This unique combination of disciplines and traditions will empower FSU faculty and students to investigate the entire network of gene expression, regulation and function, so that the phenotypic consequences of variation and genetic basis of phenotypes can simultaneously be unraveled.

Composition of the IGP Cluster

We plan to build a group of faculty whose research interests span the range from molecular genetics to evolutionary biology. This will entail simultaneously hiring two somewhat distinct groups of faculty. First, we seek colleagues in the emerging fields that consider the genotype-phenotype relationship from an explicitly evolutionary perspective. Areas of particular interest include fields such as comparative genomics, evolution of development, ecological genetics, and molecular evolution. Second we seek colleagues investigating fundamental aspects of chromatin or RNA–mediated regulation of phenotypic variation, from a primarily molecular and cellular perspective. Targeted areas include chromatin-templated regulation of gene expression, histone modifications and chromatin remodeling, microRNA, small interfering RNA, and other RNA-based systems that affect the expression and inheritance of genes and organismal traits.



The veins of this fruit fly wing have been measured by automated image analysis. This high-throughput capability is an important complement to genomic information. This system is used by David Houle, one of the cluster organizers.

The salient feature that unites the evolutionary part of the IGP cluster is the use of comparative techniques. This extremely powerful methodology can be applied to all levels of organization. At the genomic level, regions that are conserved among species are likely to be functionally important and variation in them a potential cause of disease; less conserved regions may be the key to evolutionary transformations and true novelty. At the phenotype level, the rate of change in a trait suggests whether it is under selection that preserves its form, or selection that changes over time. The cluster will leverage FSU's leadership in phylogenetics and computational methods for the reconstruction of evolutionary history, which provides a basis for comparative studies.

The emphasis of the epigenetic part of the IGP cluster builds on recent breakthroughs in understanding how genetic information is expressed, modified, and passed on during cell division and from one generation to the next. Epigenetic mechanisms are those that produce alternative, heritable states without changing the primary DNA sequence of genes. Recent discoveries of two major epigenetic systems, small regulatory RNAs and the histone modification systems, are focal points. Non-protein coding RNAs (usually small RNAs) have been shown to be potent regulators of genes, and the associated process of RNA interference is being used as a powerful new tool for basic and applied research. Plants and animals deploy RNA-based regulation for many purposes including normal development, viral silencing, and genome maintenance. The histone code refers to an information system in which the histone proteins that form chromatin are decorated with small specific chemical modifications (addition or removal of acetyl, phosphate, or methyl groups, for example). These modifications comprise instructions for chromatin structure and gene regulation and that information

can be epigenetically passed on through cell division. Many of the "writers" and "readers" of the histone code have been genetically and biochemically defined, yet we are far from fully understanding exactly how these epigenetic marks achieve the spatial and temporal specificity required to produce complex organisms, tissues, or cell types from a single genome.

Why FSU?

FSU is well positioned for growth in this area. The IGP cluster builds on a very strong group in ecology, evolution and computational phylogenetics. The Biology Department also has a young group of faculty members with expertise and rapidly growing reputations in molecular genetics, as well as distinguished groups in cell structure and motility, structural biology and sensory neurobiology. The IGP cluster hiring initiative seeks to hire in precisely the areas that bridge the various research foci already present on campus. Creation of this new group will bring interdisciplinary research and new discoveries to bear on many of the exciting and profound problems faced today in biology.

The intellectual grouping of molecular genetics and evolutionary biology will coincide with the administrative and physical grouping of many of the foundational faculty in the new Life Sciences Research Complex, thus quickly capitalizing on FSU's investments in research infrastructure. The cluster is further enhanced by expertise in other departments at FSU such as Chemistry and Biomedical Sciences, where faculty use a variety of techniques to investigate RNA structure, protein polymers and interactions, protein and pathway evolution, chromatin-based epigenetics, and development. The cluster will thus enhance interactions between and within departments while creating a stimulating intellectual atmosphere conducive to graduate education and research excellence.