The Integrated Biomedical Sciences Graduate Program

AT THE UNIVERSITY OF NOTRE DAME

Cutting-edge biomedical research and training that transcends traditional departmental and disciplinary boundaries **to solve biomedical problems in today's world.**

UNIVERSITY OF NOTRE DAME
College of Science

WE'VE INTEGRATED THE BIOMEDICAL SCIENCES.

The Integrated Biomedical Sciences (IBMS) graduate program at the University of Notre Dame is a unique, cross-departmental Ph.D. program that organizes research and training thematically, rather than according to traditional departmental structures. Our goal is to produce biomedical scientists who are well trained in a variety of disciplines and prepared to address emerging biomedical problems with innovative, unconstrained solutions.

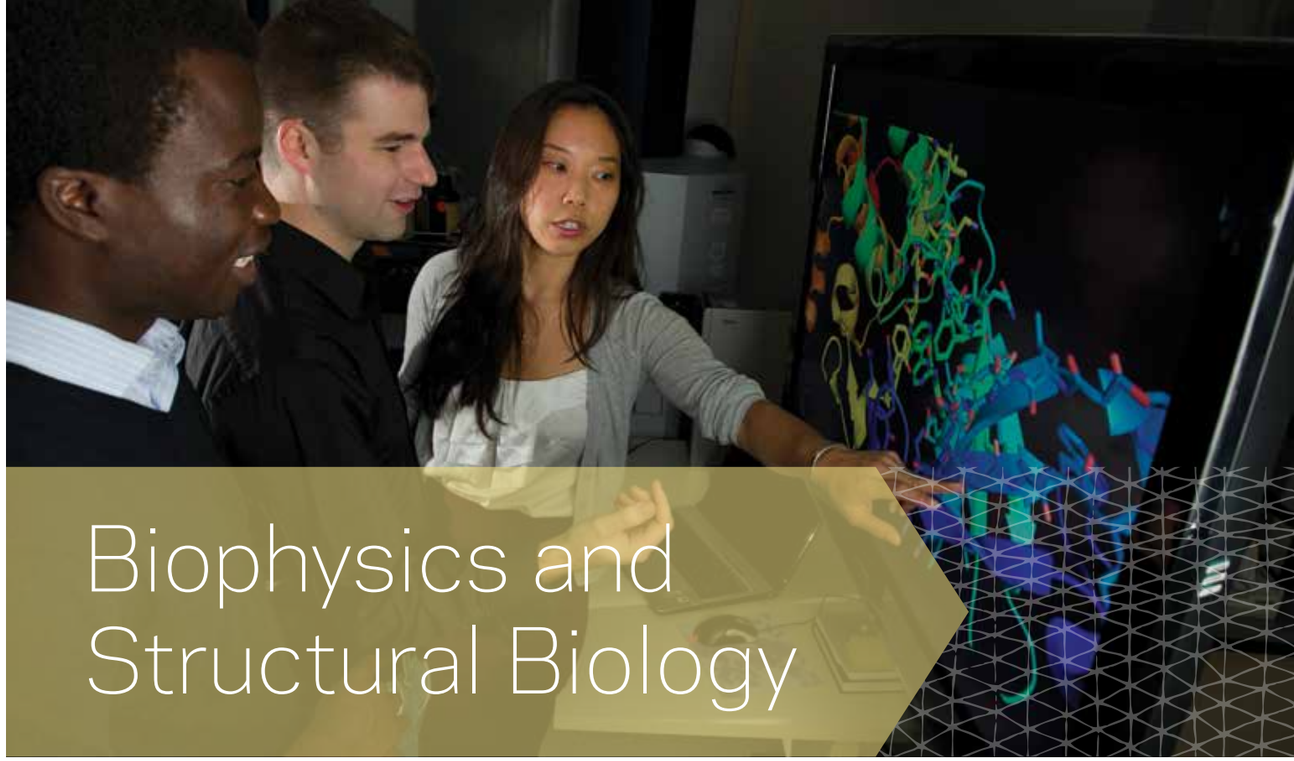
The IBMS program is organized into seven clusters:

- Biophysics and Structural Biology
- Genomics and Proteomics
- Cancer Biology
- Immunology and Infectious Disease
- Chemical Biology and Molecular Pharmacology
- Computational Biology and Bioinformatics
- Molecular, Cellular, and Developmental Biology

After completing research rotations in laboratories in at least two departments, graduate students choose one of these broad areas in which to focus their research, selecting an advisor from one of the more than 50 participating laboratories that best matches their research interests. The cross-departmental nature of the program facilitates interdisciplinary and translational studies, and reflects the diverse areas of research excellence at the University.

Students in the IBMS program have access to all of Notre Dame's vast resources and outstanding research facilities, as well as those at Indiana University School of Medicine–South Bend.

ibms.nd.edu



Biophysics and Structural Biology

Students in Biophysics and Structural Biology use the principles of chemistry and physics to study biological molecules and biomolecular systems ranging in complexity from objects on the atomic and molecular scale to larger assemblies such as membranes and organelles. Research focuses on the architecture, dynamics, and physical properties of biological molecules, with an overall aim of understanding these features in the context of biological function. Scientists in the cluster use a variety of complementary biophysical, biochemical, and computational techniques, including nuclear magnetic resonance, X-ray crystallography, mass spectrometry, and computational simulations. Students learn to approach biological and biochemical questions from the perspective of physics and physical chemistry, gaining an appreciation for how fundamental principles impact and ultimately give rise to biology.

Genomics and Proteomics

Students in Genomics and Proteomics focus their research on the information content of cells—their genomes and the sets of proteins they code for. Ongoing genomic studies range from investigations of genome structure and architecture to comparative genomics of pathogens and model organisms. In proteomics, ongoing studies include comparative analyses of the proteomes of normal and diseased tissues, studies of proteomic changes as a function of cellular differentiation and tissue microenvironment, and development of next-generation proteomic methods. Significant resources exist for high throughput, high volume DNA and protein sequencing and detailed analyses of complex, information-rich biochemical and biological samples. Students in the cluster learn how to identify and quantify changes in gene expression, from the single microRNA level up to global alterations in a proteome.

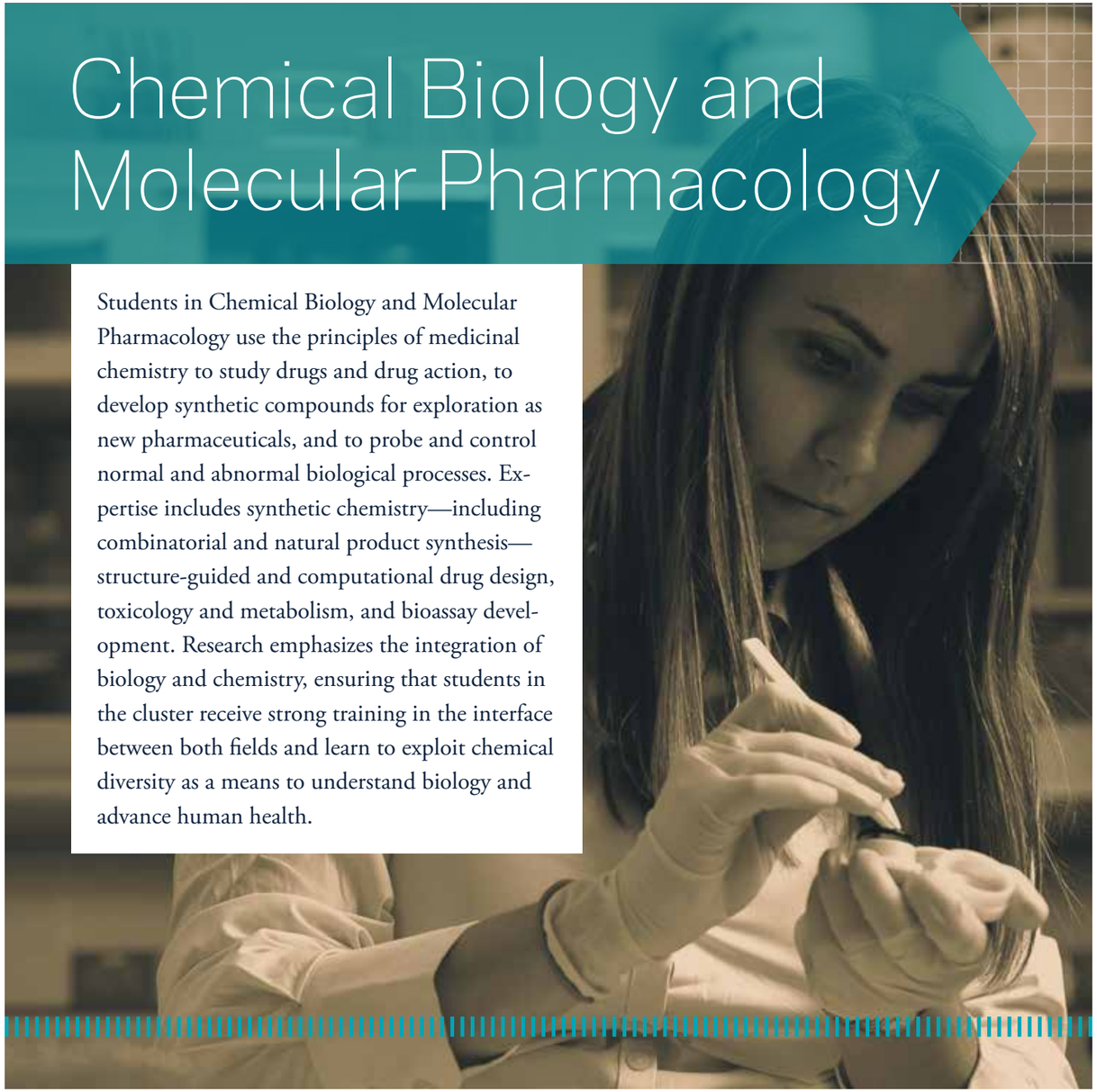
Cancer Biology

Students in Cancer Biology study the onset, prevention, detection, and treatment of cancer. The cluster draws from a diverse range of complementary biomedical fields, including molecular and cellular biology, biochemistry, immunology, pharmacology, structural biology, and chemical biology. Areas of particular expertise include oncogenes and growth factors, cell adhesion and metastasis, the tumor microenvironment, the immune response to cancer, and drug design and development. The Mike and Josie Harper Cancer Research Institute is a focal point for scientists in the cluster, fostering translation of findings from the laboratory to the clinic. While students are trained in a variety of scientific specialties, their studies share the common goal of aiming to understand and eliminate suffering from cancer.

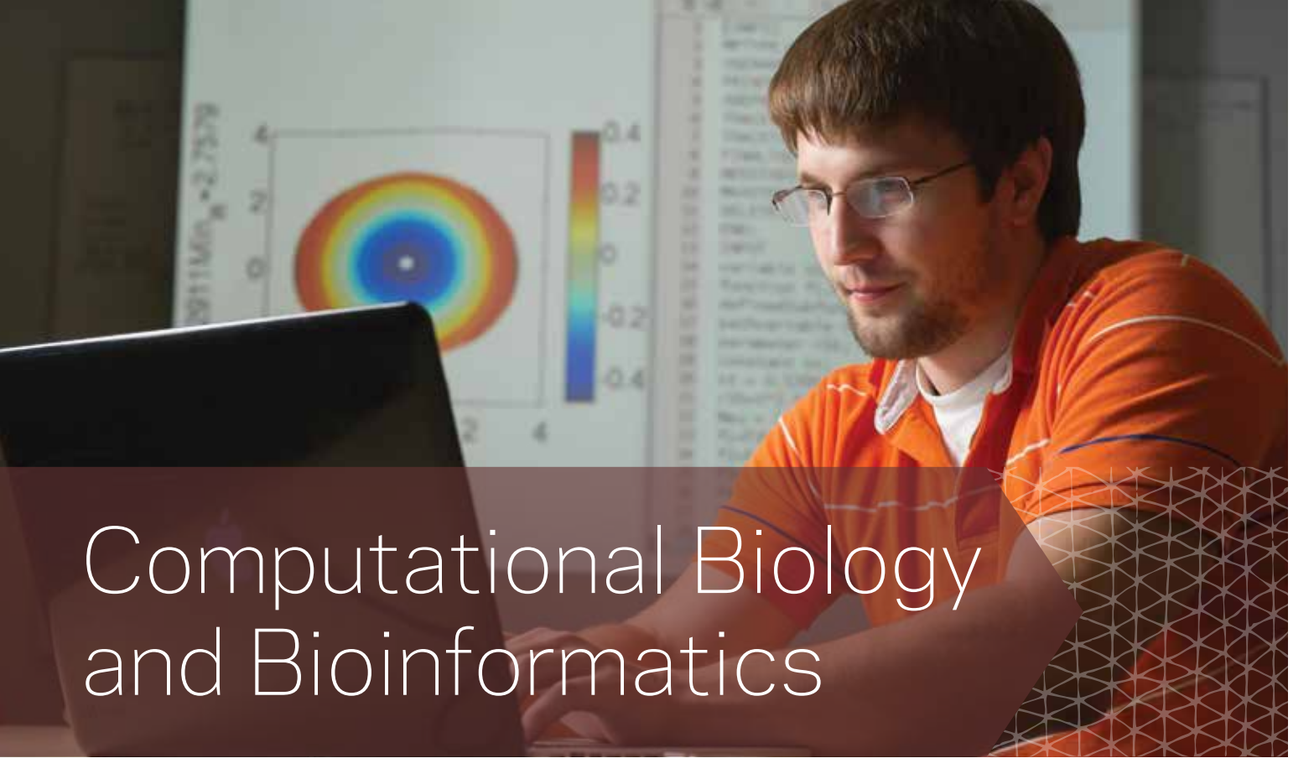
Immunology and Infectious Disease

Students in the Immunology and Infectious Disease cluster employ a range of cross-disciplinary approaches to study the mechanisms of pathogen virulence, the immunological responses required for pathogen control, and the molecular and cellular interactions between host and pathogen. Diseases that affect individuals in low- and middle-income countries such as tuberculosis, malaria, and leishmaniasis are a major research focus for a number of faculty in the cluster. Other studies address autoimmunity, inflammatory diseases, cancer immunology and immunotherapy, and basic immunological mechanisms. Information garnered from the various laboratories has led to research into new vaccines, diagnostics, and drugs. Students in the cluster have the opportunity to use biochemical, molecular, and cellular-based approaches, as well as whole-animal based systems to address their various research questions.

Chemical Biology and Molecular Pharmacology



Students in Chemical Biology and Molecular Pharmacology use the principles of medicinal chemistry to study drugs and drug action, to develop synthetic compounds for exploration as new pharmaceuticals, and to probe and control normal and abnormal biological processes. Expertise includes synthetic chemistry—including combinatorial and natural product synthesis—structure-guided and computational drug design, toxicology and metabolism, and bioassay development. Research emphasizes the integration of biology and chemistry, ensuring that students in the cluster receive strong training in the interface between both fields and learn to exploit chemical diversity as a means to understand biology and advance human health.

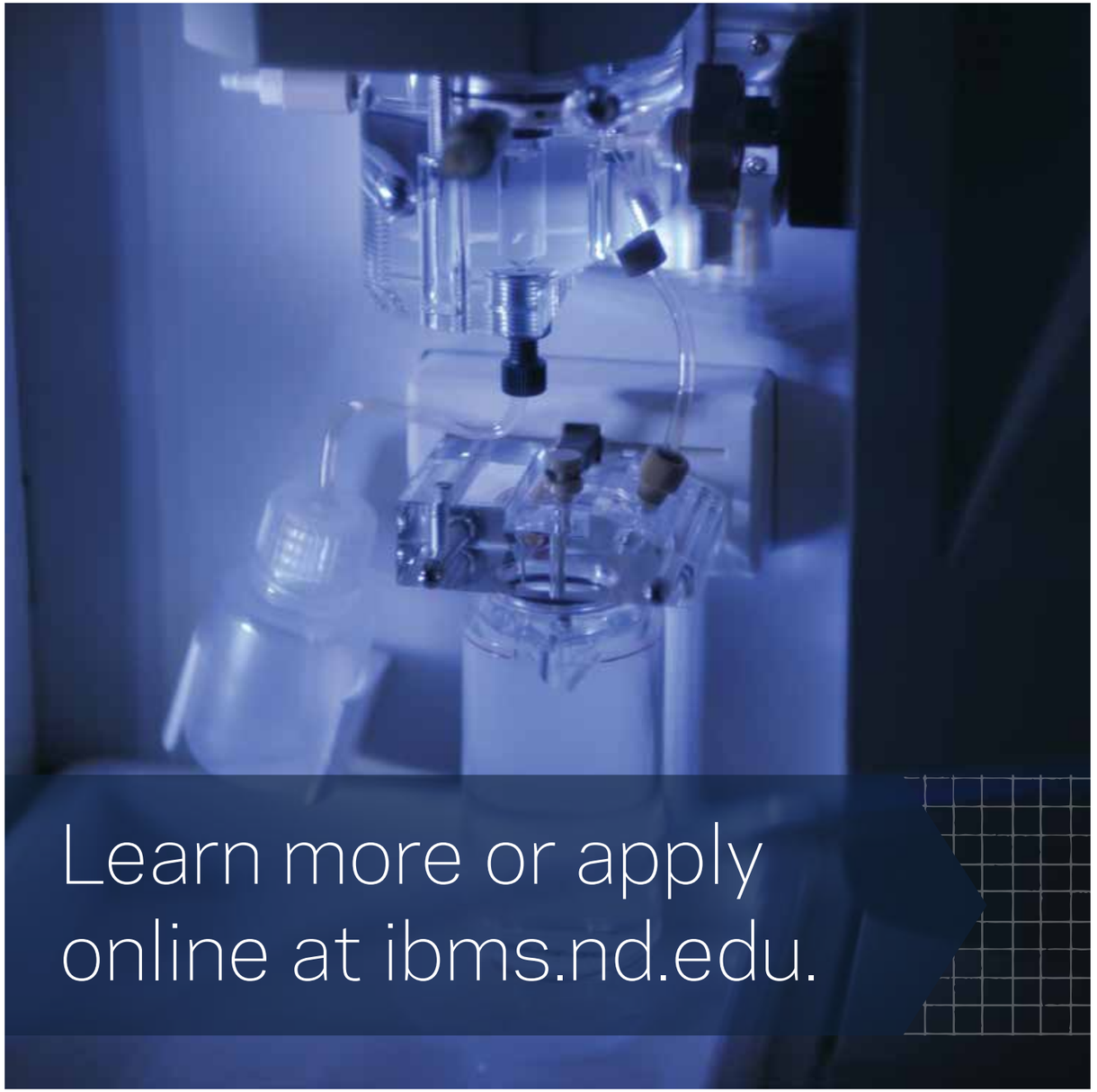


Computational Biology and Bioinformatics

Students in Computational Biology and Bioinformatics study the behavior of biological molecules and biomolecular systems across a range of time and length scales. Studies range from atomic simulations of proteins and other biological molecules to the generation of computational models for processes such as protein folding and interactions, the growth and regulation of the cytoskeleton, and multicomponent and multicellular emergent behavior. Additional studies extract detail from large biochemical datasets, using computational algorithms to identify patterns in gene expression, genome sequences, and metabolic networks. Although their research questions are diverse, students in the cluster share a common goal of addressing key biomedical problems using sophisticated computational algorithms.

Molecular, Cellular, and Developmental Biology

Students in the Molecular, Cellular, and Developmental Biology cluster use multifaceted, experimental approaches to understand the molecular mechanisms of biological processes and their contribution to the function and development of cells, tissues, and organisms. Ongoing research ranges from investigations of fundamental molecular processes—such as regulation of gene expression, intracellular trafficking, cellular homeostasis, and cell division—to studies of cellular differentiation and the development of complex, multicellular biological structures. Students in the cluster will gain an appreciation of the molecular and cellular underpinnings of biological form, function, and development.



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