COLLEGE OF INTEGRATIVE SCIENCES

The College of Integrative Sciences (CIS) aims to equip students with the creative and quantitative skills needed to address current and emerging global challenges in science and technology. These challenges are multifaceted, requiring problem-solving approaches that integrate expertise from multiple perspectives.

The CIS promotes an interdisciplinary and integrative approach to scholarship and learning across mathematics and the life, physical, and behavioral sciences. By encouraging creative synergies among faculty and students of disparate disciplines, the CIS academic structure complements existing departments and has the flexibility to evolve with the needs of an ever-changing world.

Research is key to the CIS. With a faculty mentor, student researchers pursue inquiry-based learning that explores open questions and provides new perspectives. They develop the necessary problem-solving skills and build expertise at the frontiers of science. Through research, students are transformed from consumers into creators of knowledge.

Students interested in the CIS are advised to follow a course of study that emphasizes a core science background, achieved by pursuing a major in one of the departments or programs in natural science and mathematics (NSM). The linked major offered by the CIS combines the intellectual depth in one area (the major) with breadth achieved through courses and research in the linked major.

FACULTY

Manju Hingorani
BS, University of Bombay; PHD, Ohio State University
Professor of Molecular Biology and Biochemistry; Chair, Molecular Biology and Biochemistry; Professor, Integrative Sciences

Barbara Jean Juhasz
BA, Binghamton University; MA, University Mass Amherst; PHD, University of Massachusetts Amherst
Associate Professor of Psychology; Associate Professor, Neuroscience and Behavior; Associate Professor, Integrative Sciences

Daniel Krizanc
BS, University of Toronto; PHD, Harvard University
Professor of Computer Science; Vice-Chair, Mathematics and Computer Science; Professor, Integrative Sciences; Professor, Environmental Studies

Daniel Moller
Assistant Professor of the Practice, College of Integrative Science

Edward C. Moran
BS, Pennsylvania State University; MA, Columbia University; MPHIL, Columbia University; PHD, Columbia University
Professor of Astronomy; Director, Van Vleck Observatory; Professor, Integrative Sciences

Ishita Mukerji
AB, Bryn Mawr College; PHD, University of California, Berkeley
Fisk Professor of Natural Science; Professor of Molecular Biology and Biochemistry; Professor, Integrative Sciences

Brian Hale Northrop

FACTOR

Dana Royer
BA, University of Pennsylvania; PHD, Yale University
Professor of Earth and Environmental Sciences; Chair, Earth and Environmental Sciences; Professor, Integrative Sciences; Professor, Molecular Biology and Biochemistry

Ellen Thomas
BS, University of Utrecht; MS, University of Utrecht; PHD, University of Utrecht
University Professor in the College of Integrative Sciences; Research Professor, Earth and Environmental Sciences

Greg A. Voth
BS, Wheaton College; MS, Cornell University; PHD, Cornell University
Professor of Physics; Chair, Physics; Professor, Integrative Sciences

Michael P. Weir
BS, University of Sussex; PHD, University of Pennsylvania
Professor of Biology; Professor, Integrative Sciences

AFFILIATED FACULTY

Gloster B. Aaron
BA, Oberlin College; PHD, University of Pennsylvania
Associate Professor of Biology; Chair, Neuroscience and Behavior; Associate Professor, Neuroscience and Behavior; Associate Professor, Integrative Sciences

Christopher James Chenier
Digital Design Technologist; Visiting Assistant Professor, College of Integrative Sciences; Visiting Assistant Professor of Art

Frederick M. Cohan
BS, Stanford University; PHD, Harvard University
Professor of Biology; Professor, Environmental Studies; Professor, Integrative Sciences

Karen L. Collins
BA, Smith College; PHD, Massachusetts Institute of Technology
Professor of Mathematics; Professor, Integrative Sciences

William Herbst
BA, Princeton University; MAA, Wesleyan University; MSC, University of Toronto; PHD, University of Toronto
John Monroe Van Vleck Professor of Astronomy; Professor of Astronomy; Professor, Integrative Sciences

Scott G. Holmes
BS, College of William and Mary; PHD, University of Virginia

BA, Middlebury College; PHD, University of California LA
Associate Professor of Chemistry; Associate Professor, Integrative Sciences

Donald B. Oliver
BS, Brandeis University; MAA, Wesleyan University; PHD, Tufts University
Daniel Ayres Professor of Biology; Professor of Molecular Biology and Biochemistry; Professor, Integrative Sciences

Dana Royer
BA, University of Pennsylvania; PHD, Yale University
Professor of Earth and Environmental Sciences; Chair, Earth and Environmental Sciences; Professor, Integrative Sciences; Professor, Molecular Biology and Biochemistry

Francis W. Starr
BS, Carnegie Mellon University; MS, Boston University; PHD, Boston University
Professor of Physics; Director, College of Integrative Sciences; Professor, Integrative Sciences; Professor, Molecular Biology and Biochemistry

Edward C. Moran
BS, Pennsylvania State University; MA, Columbia University; MPHIL, Columbia University; PHD, Columbia University
Professor of Astronomy; Director, Van Vleck Observatory; Professor, Integrative Sciences

Ishita Mukerji
AB, Bryn Mawr College; PHD, University of California, Berkeley
Fisk Professor of Natural Science; Professor of Molecular Biology and Biochemistry; Professor, Integrative Sciences

Brian Hale Northrop
VISITING FACULTY

John Richard Cooley
BA, Yale University; MBA, University of Connecticut; MS, University of Michigan; PHD, University of Michigan
Visiting Assistant Professor of Integrative Sciences

- Undergraduate College of Integrative Sciences Major
(catalog.wesleyan.edu/departments/cis/ugrd-cis)

CIS115 Experiential Design and Application
This course, co-taught with Director of Physical Plant Operations Mike Conte, will allow students to work directly with Facilities employees to design and execute modifications and repairs to existing Wesleyan spaces. The specific projects will change from semester to semester, but could include designing and building informal learning spaces, and planning and carrying out repairs and modifications to mechanical and plumbing systems. Students will learn design and engineering by carrying out projects to improve Wesleyan's facilities. Students must be willing to work with tools and machinery with supervision. The grading in this quarter-credit repeatable course will be based primarily on active participation, and the class meetings will be held on location and at times built around participants’ schedules. The first organizational meeting will be held in the Cady building at 170 Long Lane on Friday, January 27 at 2:50 pm; interested students who cannot attend the first meeting should e-mail the instructors.
Offering: Host
Grading: OPT
Credits: 0.25
Gen Ed Area: NSM-CIS
Prereq: None

CIS121 Wesleyan Mathematics and Science Scholars Colloquium I
This weekly colloquium of participants in the Wesleyan Mathematics and Science Scholars (WesMaSS) Program will provide the participants with a framework for taking full advantage of the educational opportunities in the natural sciences and mathematics available at Wesleyan. Class sessions and assignments are designed to help students to develop effective individual and group study skills, to promote cohort-building, and to navigate the "hidden curriculum" in higher education.
Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: NSM-CIS
Prereq: None

CIS122 Wesleyan Mathematics and Science Scholars Colloquium II
This weekly colloquium of participants in the Wesleyan Mathematics and Science Scholars (WesMaSS) Program will be focused on strategies for success in science and math higher education.
Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: NSM-CIS
Prereq: None

CIS135 Mindfulness
During this course, students will be introduced to various techniques of mindfulness practice and awareness, including sitting meditation and yoga. These modalities are designed to aid in stress and anxiety reduction, and when practiced diligently, may also offer opportunities for greater self-awareness and personal development. The goal is to give students not only a peer community but also a contemplative toolbox that is portable, replicable, and sustainable. Students will gain an
understanding of the roles these practices can play in leading a happier, healthier, and more fulfilling life.

Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: SBS-CIS
Prereq: None

CIS150 The Art of Academic Writing: The Environmental Movement in American History
This writing-intensive course uses primary sources and a Write-to-Learn model to explore the roots of the environmental movement in America. Topics will include artistic explorations of nature, the rise of the conservation movement, legal protections of the environment, and environmental justice. The course will help students understand the rhetorical conventions of different academic disciplines. Readings will include popular literature and scientific papers, and example tasks will require students to master writing for a broad audience.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CIS
Identical With: WRCT150
Prereq: None

CIS160 Life in the Oceans in the Anthropocene and Beyond
Little is known about life in the deep sea, the largest habitat on Earth, even about the largest animals living there, such as the giant squid. Humans, however, are severely affecting even these most remote areas of our planet, and wildlife populations in the oceans have been badly damaged by human activity. We will look at the amazing diversity of ocean life and the disparate building plans of its animals, and see how oceanic ecosystems are fundamentally different from land ecosystems. Then we will explore how human actions are affecting oceanic ecosystems directly, for instance by overfishing (especially of large predators and filter feeders), addition of nutrients (eutrophication) and pollutants, and the spread of invasive species, as well as indirectly, through emission of carbon compounds into the atmosphere. Rising atmospheric CO2 levels lead to ocean acidification and global warming, affecting the all-important metabolic rates of ocean life, as well as oceanic oxygen levels and stratification, thus productivity. We will try to predict the composition of future ecosystems by looking at ecosystem changes during periods of rapid warming in the geological past, and see whether future ecosystems will become dominated by jellyfish, as they were 600 million years ago.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: E&ES160
Prereq: None

CIS170 Introduction to Design and Engineering
This course will provide a hands-on introduction to design and engineering. Students will engage in individual and team projects in a studio environment where we seek to develop a shared practice and understanding of the engineering design process. We will study biological organisms to find inspiration for design of hoppers, swimmers, and climbers. Students will build skills using computer aided design (CAD) software and using tools for fabrication and prototyping including laser cutting and 3D printing. We will also hone skills in identifying which scientific and engineering principles need to be understood to achieve design goals.

Offering: Host
CIS239 Proseminar: Network Analysis
Seminar leaders from physics, political science, psychology, and chemistry, as well as outside speakers, will introduce participants to network analysis and explore its applications across different topics and disciplines. The purpose of the course is to enable participants to use network analysis in their work and facilitated collaborations across disciplinary lines. In addition to the regular class meetings, we will schedule hands-on workshops for participants to become familiar with appropriate software and further develop their computing skills.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Identical With: QAC239
Prereq: None

CIS241 Introduction to Network Analysis
This is an interdisciplinary hands-on course examining the application of network analysis in various fields. It will introduce students to the formalism of networks, software for network analysis, and applications from a range of disciplines (history, sociology, public health, business, political science). We will review the main concepts in network analysis, learn how to use the software (e.g. network analysis and GIS libraries in R), and will work through practice problems involving data from several sources (Twitter, Facebook, airlines, medical innovation, historical data). Upon completion of the course, students will be able to conduct independent research in their fields using network analysis tools.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: SBS-QAC
Identical With: QAC241
Prereq: None

CIS250 Computational Media: Videogame Design and Development
This course examines the interplay of art and science in the development of contemporary video games using "game tool" applications to achieve a variety of purposes. It combines a detailed understanding of computational media, including legal and commercial aspects, with hands-on experience in the creative process. There will be discussions with invited industry leaders in various subject areas. Students will have the opportunity to work as part of development teams and create working prototypes to understand the challenges and rewards of producing video games in a professional context.
Offering: Host
Grading: A-F
Credits: 1.50
Gen Ed Area: NSM-MATH
Identical With: FILM250, COMP350
Prereq: None

CIS251 Data Visualization: An Introduction
This course will introduce students to the principals and tools necessary to present quantitative information in a visual way. While tables and graphs are widely used in our daily lives, it takes skill to deconstruct what story is being told. It also takes a perceptive eye to know when information is being misrepresented with particular graphics. The main goals of the course are for students to learn how to present information efficiently and accurately so that we enhance our understanding of complex quantitative information and to become proficient with data visualization tools. Beginning with basic graphing tools, we will work our way up to constructing map visualizations and interactive graphs.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: HA-ART
Identical With: ARST484
**Prereq:** None

### CIS307 Experimental Design and Causal Inference

The course provides the foundations and statistical thinking to design, collect, and analyze experimental data and introduces appropriate techniques for observational data when causal inference is the objective of the analysis. Throughout the course, we introduce and compare various experimental designs. We will discuss sample size and power calculations as well as the advantages/disadvantages of each of these designs. With observational data, we will explore Difference-in-difference models, propensity score matching techniques, Regression Discontinuity designs etc. This course gives students the opportunity to develop further their computational skills as we learn how to describe, interpret, control, and draw inferences from experimental and observational data.

**Offering:** Crosslisting  
**Grading:** A-F  
**Credits:** 1.00  
**Gen Ed Area:** SBS-QAC, NSM-QAC  
**Identical With:** QAC307  
**Prereq:** QAC201 OR PSYC200 OR MATH132 OR ECON300

### CIS310 Genomics Analysis

This course is an introduction to genomics and analysis for students with interest in life sciences. It introduces current applications of genomics techniques, how to build a genomics workflow, and an introduction to statistical analyses in R programming language. This course assumes little or no prior programming experience and will provide hands-on experience in taking raw next-generation sequencing data through a custom workflow and ending with analyses in R statistical software.

**Offering:** Crosslisting  
**Grading:** A-F  
**Credits:** 1.00  
**Gen Ed Area:** NSM-BIOL  
**Identical With:** BIOL310  
**Prereq:** [MB&B181 or BIOL181]

### CIS320 Advanced Academic Writing

This course is designed to help students master the skills needed for thesis-level academic writing. The course uses an example-driven approach emphasizing an iterative revision process, with an emphasis on expository writing skills appropriate for publishable literature. Students will be encouraged to focus on their own independent research work as subject matter of writing exercises.

**Offering:** Crosslisting  
**Grading:** OPT  
**Credits:** 1.00  
**Gen Ed Area:** NSM-CIS  
**Identical With:** CIS520  
**Prereq:** None

### CIS321 Senior Colloquium I: Integrative Sciences

This colloquium provides students the opportunity to discuss and present their research to their peers and mentors, as well as explore current topics of interest to the group. A key goal will be developing students’ presentation skills because this is the primary means of promoting research. Faculty and peers will provide insights and advice. The mentors from the primary department or programs will also be invited.

**Offering:** Host  
**Grading:** Cr/U  
**Credits:** 0.50  
**Gen Ed Area:** NSM-CIS  
**Prereq:** None

### CIS322 Senior Colloquium II: Integrative Sciences

This colloquium provides students the opportunity to discuss and present their research to their peers and mentors, as well as explore current topics of interest to the group. A key goal will be developing students’ presentation skills because this is the primary means of promoting research. Faculty and peers will provide insights and advice. The mentors from the primary department or programs will also be invited.

**Offering:** Host  
**Grading:** Cr/U  
**Credits:** 0.50  
**Gen Ed Area:** NSM-CIS  
**Prereq:** None

### CIS323 Bayesian Data Analysis: A Primer

This course introduces the applied principles of Bayesian statistical analysis. The Bayesian paradigm is particularly appealing in research where prior research and historical data are available on parameters of interest. This course will teach students appropriate techniques for analyzing data of this nature as well as broaden computational skills in R. The course will lay the foundation for Bayesian data analysis that students can use to further develop skills in decision making.

**Offering:** Crosslisting  
**Grading:** A-F  
**Credits:** 0.50  
**Gen Ed Area:** SBS-QAC, NSM-QAC  
**Identical With:** QAC323  
**Prereq:** MATH132 OR ECON300 OR [GOVT367 or QAC302]

### CIS327 Evolutionary and Ecological Bioinformatics

Bioinformatic analysis of gene sequences and gene expression patterns has added enormously to our understanding of ecology and evolution. For example, through bioinformatic analysis of gene sequences, we can now reconstruct the evolutionary history of physiology, even though no traces of physiology exist in the fossil record. We can determine the adaptive history of one gene and all the gene’s descendants. We can now construct the evolutionary tree of all of life. Bioinformatics is particularly promising for analysis of the ecology and biodiversity of microbial communities, since well over 99 percent of microorganisms cannot be cultured; our only knowledge of these organisms is through the analysis of their gene sequences and gene expression patterns. For example, even when we cannot culture most of a microbial community, we can determine which metabolic pathways are of greatest significance through analysis of community-level gene expression. All these research programs are made accessible not only by breakthroughs in molecular technology, but also by innovation in the design of computer algorithms. This course, team-taught by an evolutionary biologist and a computer scientist, will present how bioinformatics is revolutionizing evolutionary and ecological investigation and will present the design and construction of bioinformatic computer algorithms underlying the revolution in biology. Students will learn algorithms for reconstructing phylogeny, for sequence alignment, and for analysis of genomes, and students will have an opportunity to create their own algorithms.

**Offering:** Crosslisting  
**Grading:** A-F  
**Credits:** 1.00  
**Gen Ed Area:** NSM-BIOL  
**Identical With:** BIOL327, COMP327, BIOL527, COMP527  
**Prereq:** [BIOL182 or MB&B182] OR [BIOL196 or MBB196] OR COMP112 OR COMP211

### CIS331 Videogames as/and the Moving Image: Art, Aesthetics, and Design

Videogames are a mess. As a relatively new medium available on a range of platforms and in contexts ranging from the living room to the line for
the bathroom, they make new but confusing contributions to the meaning and possibilities of the moving image. We will work to understand what games are, what they can do, and how successful games do what they do best. Students will complete game design exercises, create rapid prototypes, playtest their games, and iteratively improve their games with play and their players in mind. They will complete analyses of games and game design projects both alone and in groups and participate in studio-style critiques of one another’s work. Experience with computer programming is helpful but not essential.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: HA-FILM
Identical With: FILM331
Prereq: None

CIS375 Mass Extinctions in the Oceans: Animal Origins to Anthropocene
Geoscientists are debating whether we are living in the Anthropocene, defined as a period during which humans are having a significant effect on atmospheric, geologic, hydrologic, and biospheric earth system processes. There is considerable discussion whether we are indeed affecting the biosphere to such an extent that life on Earth will suffer an extinction similar in magnitude to those that have occurred during earth history. Studies of the fossil record provide unique evidence that is used to evaluate the large extinctions of the past, and compare them to ongoing extinction processes, extinctions rates and patterns, and magnitude. Organisms with hard skeletons are most easily and most abundantly preserved in the rock record. Many of these are invertebrates which lived in the oceans (e.g., clams, sea urchins, corals). In the first part of this course, students will become familiar with the nature of the fossil record, the most common marine animals in the fossil record, and their evolution and diversification. Lectures will be combined with studying fossils. In the second part of the course, possible causes for mass extinction will be considered, together with their specific effects on environments and biota, and these predicted effects will be compared to what has been observed. Potential causes include asteroid and comet impacts, large volcanic eruptions, ‘hypercanes’, and ‘methane ocean eruptions’, and more exotic processes. Students will present in class on these topics, and we will compare rates and magnitude of environmental change with severity and patterns of extinction.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-EES
Identical With: E&ES236
Prereq: E&ES101 OR E&ES115 OR E&ES199 OR ASTR155 OR MB&B181

CIS401 Individual Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CIS402 Individual Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CIS411 Group Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CIS412 Group Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.
Offering: Host

CIS420 Student Forum
Student-run group tutorial, sponsored by a faculty member and approved by the chair of a department or program.
Offering: Host
Grading: Cr/U

CIS423 Advanced Research Seminar, Undergraduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CIS424 Advanced Research Seminar, Undergraduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CIS492 Teaching Apprentice Tutorial
The teaching apprentice program offers undergraduate students the opportunity to assist in teaching a faculty member’s course for academic credit.
Offering: Host
Grading: OPT

CIS520 Advanced Academic Writing
This course is designed to help students master the skills needed for thesis-level academic writing. The course uses an example-driven approach emphasizing an iterative revision process, with an emphasis on expository writing skills appropriate for publishable literature. Students will be encouraged to focus on their own independent research work as subject matter of writing exercises.
Offering: Host
Grading: OPT
Credits: 1.00
Gen Ed Area: NSM-CIS
Identical With: CIS320
Prereq: None