

# Biology

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|-----------------------|---|
| James L. Lissemore    | Chair, Molecular Biology; Genetics                                |
| Carl D. Anthony       | Ecology; Behavior; Evolution                                      |
| Rebecca E. Drenovsky  | Botany; Plant Physiology; Plant Ecology                           |
| Jeffrey R. Johansen   | Phycology; Ecology; Systematics                                   |
| Erin E. Johnson       | Microbiology; Innate Immunity; Molecular Biology; Cell Biology    |
| Gwendolyn M. Kinebrew | Cell Biology; Developmental Biology                               |
| Michael P. Martin     | Molecular Biology; Cell Biology; Molecular Genetics & Systematics |
| Ralph A. Saporito     | Chemical Ecology; Herpetology; Tropical Ecology                   |
| Christopher A. Sheil  | Developmental and Evolutionary Morphology; Systematics            |
| Cyrilla H. Wideman    | Physiology; Endocrinology; Cell Biology; Neuroscience             |

The graduate program in Biology prepares students for professional careers or doctoral studies in a variety of biological fields.

The Department of Biology offers courses of study leading to either a Master of Science or Master of Arts degree. Both degree programs provide students the opportunity to increase their knowledge through formal course work. Additionally, the Master of Science degree requires candidates to complete a major research project resulting in a master's thesis.

## **Master of Science (M.S.)**

The M.S. degree is designed for students seeking research experience. Successful candidates must demonstrate the mastery of essential research techniques and the ability to communicate effectively the results of research and scholarship. Minimum requirements for the degree are 30 credit hours, consisting of 24 hours of formal course credit, at least half of which must be from courses numbered above 499, a thesis proposal (BL 598, 1 credit hour), and a research thesis (BL 599, 5 credit hours).

## **Master of Arts (M.A.)**

The M.A. degree consists of 30 hours of formal class credit, at least half of which must be from courses numbered above 499. The M.A. degree does not require thesis research.

M.S. and M.A. students may petition to take up to 8 credit hours of biology-related courses from other JCU departments.

## **Admission Requirements**

- The equivalent of a Bachelor of Science with a major in biology as offered at John Carroll University. Completion of other related majors (environmental science, cell and molecular biology, etc.) will be considered on a case by case basis.
- A completed application form, official undergraduate transcripts, and at least two letters of academic evaluation from former professors.
- Students seeking to enter the M.S. program in Biology are strongly encouraged to contact professors in the department to determine if those professors are accepting graduate students. Contact information and the research interests of Biology faculty can be found on the department website: [www.jcu.edu/biology](http://www.jcu.edu/biology).

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## Other Requirements

All graduate students in the M.S. and M.A. degree programs are required to participate in the Biology Seminar Program on a regular basis during their tenure. The course may be taken once for credit (BL 478, 1 credit).

For any Biology course that is cross-listed at both the 400 level and 500 level, graduate students must take the 500 level course. The 500 level courses require an additional oral presentation or paper beyond the requirements for the corresponding 400 level course.

In addition, all graduate students in both degree programs are required to pass a comprehensive examination, upon completion of the requirements, as follows:

## Master of Science

Oral or written examination consisting of questions that reflect the student's educational experience and thesis and that seek to integrate knowledge across those areas. The examination will be administered by the thesis committee after successful completion of the thesis.

## Master of Arts

Oral and/or written examination is required. Type of examination is decided by the student's examination committee.

In some cases, a student and the committee may feel that an alternative examination would be appropriate. In this case, the Associate Dean for Graduate Studies may be petitioned via the Biology Department chair.

## COURSE DESCRIPTIONS

Many courses offered by the Department of Biology include laboratory and/or field work as an integral part of the course. These are listed separately below, immediately following the corresponding lecture course descriptions; both must be taken concurrently, in a corresponding section and from the same instructor.

**Note:** Students in either the Master of Science or the Master of Arts degree program may apply either one BL 578 or one BL 579 to the degree requirements.

**405. SCIENTIFIC ILLUSTRATION 3 cr.** Instructor permission required; experience in art not required. Three hours of lecture per week. Developing skills of observation and learning how to produce publication-quality illustrations of research results. By the end of the course, students will have developed a concise, but comprehensive, portfolio showcasing various techniques and graphic styles. An additional fee is required for personal illustration materials.

**415. INTRODUCTION TO SYSTEMATIC BIOLOGY 3 cr.** Three hours of lecture per week. The scientific discipline that deals with the identification, naming, description, classification, and organization of extant and extinct biological diversity; this course includes a discussion of philosophy and practice of methods of reconstructing evolutionary history.

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**425. ICHTHYOLOGY 4 cr.** Corequisite: BL 425L. Two hours of lecture per week. Evolution, zoogeography, taxonomy, behavior, and ecology of North American fishes.

**425L. ICHTHYOLOGY LABORATORY 0 cr.** Corequisite: BL 425. Four hours of laboratory per week. Two weekend field trips.

**430. MEDICAL PARASITOLOGY 4 cr.** Corequisite BL 430L. Two hours of lecture per week. All parasitic forms of medical importance will be covered. Emphasis is on parasite biology, clinical presentation, ecology of the disease, and epidemiology. Includes morphology, physiology, and diagnosis.

**430L. MEDICAL PARASITOLOGY LABORATORY 0 cr.** Corequisite BL 430. Four hours of laboratory per week. Laboratory sessions emphasize the diagnostic aspects of parasitic infections and the pathological changes in tissues.

**442. ORNITHOLOGY 4 cr.** Corequisite: BL 442L. Three hours of lecture per week. Biology, taxonomy, ecology, and behavior of birds.

**442L. ORNITHOLOGY LABORATORY 0 cr.** Corequisite: BL 442. Three hours of laboratory per week, plus field trips.

**444. ADVANCED ECOLOGY 4 cr.** Prerequisites: Ecology, Statistics; Corequisite: BL 444L. Three hours of lecture/discussion per week. Topics include predator-prey interactions, global change, niche theory, competition, null models, and community assembly rules.

**444L. ADVANCED ECOLOGY LABORATORY 0 cr.** Corequisite: BL 444. Three hours of laboratory per week. Students work in teams on a project of their own choosing. Includes experimental design, data analysis, write-up, and presentation.

**447. ALGAE AS BIOINDICATORS 4 cr.** Corequisite: BL 447L. Two hours of lecture per week. Taxonomy and ecology of freshwater algae with application to monitoring lakes and rivers for water quality. Strong research-learning component.

**447L. ALGAE AS BIOINDICATORS 0 cr.** Corequisite: BL 447. Four hours of laboratory per week. Some weekend field trips will be scheduled. Laboratories based on field collections. Projects included.

**470. MOLECULAR METHODS LABORATORY 3 cr.** Prerequisite/corequisite: Molecular Genetics. Eight hours of laboratory per week. Methods used in analysis of proteins and nucleic acids.

**478. BIOLOGY SEMINAR 1 cr.** One hour per week. Current topics presented by invited guests, faculty, and students.

**479. SPECIAL TOPICS IN BIOLOGY 1-4 cr.** Prerequisites: Consent of instructor. Offered on an irregular basis; topics chosen by instructor. A lecture/discussion course which

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may include a laboratory or field component. For directed readings see BL 578; for student research see BL 579.

**479L. SPECIAL TOPICS IN BIOLOGY LABORATORY 0 cr.** Corequisite BL 479. Two to four hours of laboratory each week.

**510. INFECTION AND IMMUNITY 3 cr.** Prerequisite: Genetics. Three hours of lecture per week. Bacterial and viral pathogens of humans and those aspects of the immune response important in resistance and immunity to infectious diseases.

**520. PLANT PHYSIOLOGY 3 cr.** Three hours of lecture per week. Detailed study of photosynthesis, water relations, mineral nutrition, and hormones in plants with emphasis on current research techniques.

**521. HERPETOLOGY 4 cr.** Corequisite: BL 521L. Two hours of lecture per week. Intensive study of amphibians and reptiles, with special emphasis on classification, ecology, and evolution of North American species.

**521L. HERPETOLOGY LABORATORY 0 cr.** Corequisite: BL 521. Four hours of laboratory per week. Some weekend field trips will be scheduled.

**524. AQUATIC RESOURCES 4 cr.** Corequisite: BL 524L. Two hours of lecture per week. Study of aquatic organisms and their environment. Study of algae, insects, and fish as biological indicators of water and habitat quality in stream, lake, and wetland ecosystems. Impacts of water pollution, acidification, and other anthropogenic disturbances on aquatic systems will be studied.

**524L. AQUATIC RESOURCES 0 cr.** Corequisite: BL 524. Saturday laboratory consisting of field trips and laboratory analysis of aquatic life.

**535. PLANT ECOLOGY 4 cr.** Prerequisite: Ecology recommended. Corequisite: BL 535L. Three hours of lecture per week. Study of the distribution and abundance of plants from organismal, population, and community perspectives. Both seminal and novel research in the discipline emphasized. Students will conduct an in-depth study of plant ecological patterns and process.

**535L. PLANT ECOLOGY LABORATORY 0 cr.** Corequisite: BL 535. Three hours of laboratory per week.

**540. BEHAVIOR 3 cr.** Three hours of lecture-discussion per week. An evolutionary approach to animal behavior with emphasis on recent research.

**559. MOLECULAR CELL BIOLOGY 3 cr.** Prerequisite: Genetics. Three hours of lecture per week. Advanced course in molecular cell biology. Topics include cell signaling, cell cycle control, and intracellular trafficking. Emphasis on current primary literature.

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**560. BIOMETRY 4 cr.** Four hours of lecture per week. Standard statistical tests, T tests, Chi squares, ANOVA, regression, correlation, similarity, diversity, clustering, principal components analysis, and various ordination techniques. Most analytical methods required for analysis of data collected as part of research. Last third of course has strong ecological emphasis.

**565. MOLECULAR GENETICS 3 cr.** Prerequisites: Genetics, Biochemistry. Three hours of lecture per week. Gene and genome analysis; genome organization; structure, replication, and expression of genetic information in prokaryotes and eukaryotes. Emphasis on current primary literature.

**571. IMMUNOLOGY 3 cr.** Prerequisite: Genetics. Three hours of lecture per week. Concepts of humoral and cell-mediated immunity with strong emphasis on the cellular basis of the immune response. Experimental evidence emphasized.

**575. ENDOCRINOLOGY 3 cr.** Three hours of lecture per week. The endocrine glands, hormones, and their mechanisms of action in mammals.

**578. DIRECTED READINGS IN BIOLOGY 1-3 cr.** Directed readings in a specific area of biology. Permission of instructor required.

**579. GUIDED LABORATORY/FIELD RESEARCH 3 cr.** Guided research and study of various areas of biology. Permission of instructor required.

**580. SPECIAL TOPICS IN BIOLOGY 1-4 cr.** Offered on an irregular basis; topics chosen by instructor. A lecture/lab course. For directed readings see BL 578; for student research see BL 579.

**598. MASTER'S THESIS PROPOSAL 1 cr.** To be taken the first or second semester of all M.S. track students. Writing and presenting the thesis to the advisory committee.

**599. MASTER'S THESIS 1-5 cr.** Repeatable up to 5 credits, with recommendation that final 3 credits be completed during the final semester of enrollment. Permission of department chair required.