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# Biology

*Dr. Judith Dilts, Interim Department Head*

*Dr. Jon Kastendiek, Graduate Director*

Phone: (540) 568-6225

Web site: <http://www.jmu.edu/biology/biograd.shtml>

## Professors

J. Dendinger, R. Harris, J. Monroe, M. Renfro, B. Wiggins, G. Wyngaard

## Associate Professors

S. Babcock, C. Cleland, W. Cocking, M. Gabriele, S. Halsell, J. Herrick, C. Hurney, D. Jaynes, J. Kastendiek, S. Keffer, C. Lantz, C. McMullen, K. Murphy, C. Rose, K. Slek, R. Wunderlich

## Assistant Professors

A. Bannigan, M. Bechtel, T. Bloss, J. Brown, S. Cresawn, J. Daniel, K. Gobetz, H. Griscom, T. Rife, K. Seifert

## Adjunct Graduate Instructors

E. Doyle, M. Hudy, E. Kancler

## Admission Criteria

Prospective graduate students for the Master of Science degree should have completed an undergraduate major consisting of a minimum of 20 credit hours in biology, including courses covering the areas of organismal biology, cell and molecular biology, ecology, evolution, and genetics. A student may be admitted with deficiencies in one or more of these areas but should be aware that the Graduate Advisory Committee may require the student to make up deficiencies with no credit toward the master's degree. The applicant should have completed a minimum of a year (two semesters) of general chemistry and one semester of organic chemistry. A course in general physics is strongly recommended, especially for those students interested in physiology.

Certain areas of study may require additional background in biochemistry, statistics, calculus or computer programming.

Students are required to submit with their application the Graduate Record Examination General Test scores, three letters of recommendation from individuals who know the student's scientific potential, and a statement of professional goals and interests.

Students typically matriculate only in the fall semester.

Application Deadline: February 15

## Mission

The Department of Biology Master of Science program is committed to providing a strong and unique training plan for advanced students of the discipline that will prepare them superbly for their future career goals. The program takes advantage of the current strengths of the department: basic scientific research and excellent biology pedagogy. Students will develop their intellectual potential by pursuing advanced course work in biology and pedagogy, by participating in mentored teaching experiences and preparing a teaching portfolio and/or by successfully completing a research thesis.

The biology program offers two concentrations in the pursuit of a Master of Science: a thesis concentration based on research and a non-thesis concentration for students whose primary focus is teaching. Both concentrations require a minimum of 30 hours of graduate credit in biology.

### *Research Thesis Concentration*

The thesis/research concentration is for students who wish to continue the study of biology as a scholarly pursuit and who later continue work toward the Ph.D. or work for industry or government. The primary objective of the thesis/research concentration is to enrich the student's subject knowledge and give the student a rigorous experience in research and thesis-writing. Thesis concentration students can also acquire training and experience in teaching. Training in teaching is provided through courses, offered by the biology department, and the mentored teaching of biology laboratories. Thus, students in the thesis concentration not only gain research experience, they also learn to be effective teachers and communicators.

Currently, the biology department has research strengths in the following areas.

- Cell Biology and Genetics
- Comparative and Functional Morphology
- Developmental Biology
- Ecology, Evolution, Behavior and Systematics
- Microbiology
- Neurobiology
- Plant Biology

More information regarding faculty research can be found at the following Web site: <http://www.jmu.edu/biology/biofac.html>.

## Concentration Requirements

### Minimum Requirements<sup>1,2</sup>

#### Credit Hours

BIO 700. Thesis

6

Electives<sup>3</sup>

24

30

1 Students who wish to receive training and mentoring in teaching and who wish to teach biology laboratories are also required to take BIO 600, Effective Teaching I (2 credit) and BIO 601, Mentored Teaching (1 credit).

2 BIO 500, Effective Scientific Communication (2 credits), is strongly recommended for all students. Exemptions require approval of the student's advisory committee.

3 Students must take a total of 15 hours credit hours of 600- and 700- level courses, including BIO 700.

### Teaching Non-thesis Concentration

The non-thesis/teaching concentration is for students who wish to teach, particularly in two year community colleges. The program has two foci: subject training and teacher training. Currently, subject training is concentrated in areas much in demand by community colleges, i.e., anatomy and physiology, microbiology, and general biology. Students are trained in teaching through courses, all taught within the biology department, and through mentored teaching of laboratories and lectures. In addition, each student will prepare a professional teaching portfolio.

## Concentration Requirements

### Minimum Requirements<sup>1</sup>

#### Credit Hours

BIO 600. Effective Teaching I

2

BIO 601. Mentored Teaching

2

BIO 701. Effective Teaching II: Teaching Portfolio

3

Electives<sup>2</sup>

23

30

1 BIO 500, Effective Scientific Communication (2 credits), is strongly recommended for all students. Exemptions require approval of the student's advisory committee. 2 Students must take a total of 15 hours credit hours of 600- and 700- level courses, including BIO 600, 601 and 701.

All students electing to major or minor in biology must have their individual program of study approved by the student's Graduate Advisory Committee and the head of the department. Graduate students planning a program of study leading to the Master of Education degree, offered by the College of Education, may minor in biology with 12 hours of graduate credit in biology if they satisfy the minimum entrance requirements for the Master of Science degree program in biology.

Up to nine hours of graduate credit from accredited institutions may be accepted toward the Master of Science degree, subject to the general regulations and procedures of The Graduate School regarding transfer credit.

Full-time biology graduate students are required to attend and participate in departmental seminars while in residence.

## Course Offerings

### Biology

For a student to enroll in any biology graduate course (except BIO 501), the department assumes the student meets minimal course requirements for entrance into the Master of Science degree program in biology. Permission of the instructor is required if this is not the case.

#### BIO 500. Effective Scientific Communication. 2 credits.

Students will develop skills in effective oral and written communications in the biological sciences. Emphasis will be placed on how to prepare an effective lecture or research seminar, effective use of presentation technologies and effective scientific writing.

#### BIO 501. Workshops in Biology. 1-3 credits.

Concentrated study in particular areas of biology. No credit is allowed toward the Master of Science degree requirements and no more than one workshop may be applied toward a minor in biology.

#### BIO 504. Evolution. 3 credits.

Population change as brought about by mechanisms of organic evolution. Molecular biology is integrated with evolutionary biology and concepts of phylogenetic relationships resulting from the process of speciation are stressed. A seminar/research project is required. Credit may not be earned in both BIO 404 and BIO 504.

#### BIO 513. Human Gross Anatomy with Clinical Applications. (4, 8) 6 credits.

An advanced study of human anatomy with cadaver dissection. Emphasis is given to a clinical perspective and the evolution and development of human structure within a comparative context. *Prerequisite: A rigorous undergraduate course in anatomy. Credit may not be earned in both BIO 413 and BIO 513.*

#### BIO 514. Clinical Anatomy for Occupational Therapists. 4 credits.

This course offers an in-depth study of the structure of the musculoskeletal and peripheral nervous system of the human body. Specific structural and neural pathologies will be examined in regards to impact on occupational performance. Laboratory experiences involving cadaver dissection, skeletal material, models and audiovisual technology will be utilized. *Prerequisite: Admission to the occupational therapy program.*

#### BIO 516. Pathophysiology for Physician Assistants I. 4 credits.

An advanced clinically-oriented study of human physiology and the alterations in body functions that underlie diseases in humans. It serves as a foundation for courses in clinical medicine. *Prerequisite: Admission to the physician assistant concentration.*

#### BIO 517. Pathophysiology for Physician Assistants II. 3 credits.

An advanced clinically-oriented study of human physiology and the alterations in body functions that underlie diseases in humans. It serves as a foundation for courses in clinical medicine. *Prerequisite: Successful completion of all previous courses in the physician assistant concentration or permission of the program director.*

#### BIO 526. Graduate Topics in Biology. 3-4 credits.

Studies in special areas of biology. May be repeated with change in topic or change in subject matter within a topic.

**BIO 540. Functional Neuroscience for Occupational Therapists.** 3 credits.

This course will examine the functional performance of all aspects of the human nervous system. Specific nervous system conditions will be introduced and their impact on occupational performance, performance components and environmental contexts discussed. *Prerequisites: Admittance to the occupational therapy program and satisfactory completion of previous concentration work. Credit may not be applied to the biology major or minor.*

**BIO 542. Immunology.** 3 credits.

A study of the fundamental concepts of immune responses, the properties of antigens and immunoglobins, immunological specificity, and the development and regulation of cellular and humoral immunity. *Prerequisite: A course in microbiology or cell biology or the equivalent. Credit may not be earned in both BIO 442 and BIO 542.*

**BIO 544. Virology.** 3 credits.

A lecture seminar course considering the fundamental principles of basic and medical virology and an analysis of the structure, chemistry and replication of representative RNA and DNA animal viruses at the molecular level. *Prerequisite: A course in microbiology or genetics or consent of the instructor. Credit may not be earned in both BIO 444 and BIO 544.*

**BIO 548. Medical Microbiology.** 3 credits.

This class focuses on microorganisms of medical importance, mainly bacteria and viruses. Lecture follows an organism-by-organism approach. Key topics for each organism include general cell structure, unique structures/functions, epidemiology of the disease that the organism causes, mechanisms of pathogenesis, isolation and identification of the organism, and treatment options. *Prerequisite: Undergraduate general microbiology course or permission of instructor.*

**Bio 549. Contemporary Developmental Biology.** 3 credits.

Discussion-based course on topical issues in developmental biology and how they impact animal evolution, bioethics, human identity and environmental science. A research paper and class presentation is required. Credit may not be earned in both BIO 550 and 549.

**BIO 550. Neurobiology.** (3,3) 4 credits.

Molecular, cellular and network mechanisms underlying behavior will be studied using problem-solving, discussion, lecture and reading of primary literature. Similarities and differences between nervous systems and computers will be explored. Laboratories will utilize contemporary electrophysiology and computer simulation to examine the neurobiology of simple animal model systems. Independent project required. Credit may not be earned in both BIO 450 and BIO 550.

**BIO 551. Ecosystem Dynamics.** (2,4) 4 credits.

Structure and functional dynamics of ecosystems. Basic ecological units, which are comprised of communities interacting with their environment and are themselves components of landscape, are quantitatively examined. *Prerequisite: General ecology. Credit may not be earned in both BIO 451 and BIO 551.*

**BIO 552. Population Biology.** (2,4) 4 credits.

Theoretical and applied aspects of distribution and abundance, population regulation, interactions between populations, and conservation will be studied in selected organisms, including humans. An independent research project will be required. Credit may not be earned in both BIO 452 and BIO 552.

**BIO 553. Microbial Ecology.** (2,4) 4 credits.

The ecology of microorganisms will be covered, emphasizing the study of microbial growth and activity in natural environments. An independent laboratory project is required. *Prerequisites: Introductory ecology and microbiology. Credit may not be earned in both BIO 453 and BIO 553.*

**BIO 554. Biometrics.** 4 credits.

The design of biological experiments and applications of statistical techniques in ecology, cell biology, physiology, behavior, systematics, genetics and evolution. Experiments and data from the biological literatures will be emphasized. Statistical software packages will be used. A seminar/research project involving advanced applications is required. *Prerequisite: MATH 220 or equivalent. Credit may not be earned in both BIO 454 and BIO 554.*

**BIO 555. Plant Physiology.** (3,3) 4 credits.

The physiology of plant cells and organisms emphasizing biophysical and biochemical aspects of plant function including water relations, mineral nutrition, transport phenomena and metabolism. *Prerequisites: General botany and organic chemistry. Credit may not be earned in both BIO 455 and BIO 555.*

**BIO 557. Biological Applications of Geographic Information Systems (2, 4).** 4 credits.

This course will explore the various ways geographic information systems (GIS) can be used to answer biological questions. Students will use GIS software to study applications in ecology, conservation biology and environmental biology. A seminar/research project involving advanced applications is required. No prior GIS experience is required. *Prerequisites: BIO 124 or equivalent.*

**BIO 559. Aquatic Ecology.** (2,4) 4 credits.

Functional relationships and productivity of freshwater communities are examined as they are affected by their physical, chemical and biotic environment. Organisms inhabiting lakes, ponds, rivers, streams and estuaries are studied at the population, community and ecosystem levels. Preparation of seminar topic papers required. Credit may not be earned in both BIO 459 and BIO 559.

**BIO 560. Plant Cell and Tissue Culture.** (2,4) 4 credits.

Theory and practice of growing isolated plant cells, tissues and organs. Independent research project and class seminar expected. *Prerequisites: General botany and chemistry. Credit may not be earned in both BIO 460 and BIO 560.*

**BIO 565. Environmental Toxicology (3,3).** 4 credits.

The study of types, sources and biological effects of environmental pollutants. Class activities will include discussions of the biological effects of a broad range of pollutants. Labs will focus on the use of simulation models, geographic information systems and other software currently used in environmental toxicology for the analysis of environmental data. A presentation/research paper involving advanced applications is required. Credit may not be earned in both BIO 465 and BIO 565. *Prerequisite: BIO 224 or equivalent.*

**BIO 566. Ecotoxicology Seminar.** 3 credits.

Readings and discussions of the ecological effects of environmental pollutants, with a focus on how events at the molecular and cellular level can have consequences at the community and ecosystem level. An independent literature research project is required. Credit may not be earned in both BIO 466 and BIO 566. *Prerequisite: BIO 224 or equivalent.*

**BIO 580. Advanced Molecular Biology. (2,4) 4 credits.**

Cellular constituents and cellular genetics are emphasized at the molecular level. An exhaustive literature review and research proposal is required. *Prerequisite or corequisite: CHEM 342 or equivalent, or permission of instructor.* Credit may not be earned in both BIO 480 and BIO 580.

**BIO 582. Human Histology. (3, 3) 4 credits.**

This course presents the microscopic structure of cells, tissues and organs to explain normal physiological function and provides a basis for understanding disease mechanisms and altered cellular states. A special research project is required. *Prerequisite: BIO 270 or BIO 290, or equivalent.*

**BIO 584. Comparative Endocrinology. 3 credits.**

This course will study the hormonal regulation of physiological activity in different animals, from the cellular to the whole-organism level. Special emphasis will be paid to recent advances in cellular and molecular endocrinology as well as human endocrine disorders. A special research project is required. *Prerequisite: BIO 270 or BIO 370, or equivalent.*

**BIO 586. Systematics of Vascular Plants. (2,4) 4 credits.**

Study of systematic theory and an overview of the classification and evolution of higher plants with particular attention to flowering plant families. Techniques for plant identification and collection and for construction of phylogenies will be taught in lab. An independent project and presentation will be required. *Prerequisites: General botany and cell biology or equivalents.* Credit may not be earned in both BIO 486 and BIO 586.

**BIO 590. Biomechanics. (3,3) 4 credits.**

A study of the interactions of organisms with their physical environment. Concepts from fluid and solid mechanics are applied to biological form and function. Independent research is required. *Prerequisite: BIO 220 or permission of the instructor.* Credit may not be earned in both BIO 490 and BIO 590.

**BIO 595. Topics in Integrative Biology. 1-3 credits.**

This course will examine the interrelationships of various biological topics with related scientific and mathematical disciplines that are not offered by the biology department. A seminar/research project involving advanced applications is required. Course may be repeated as topics change. *Prerequisite: Permission of the instructor.*

**BIO 600. Effective Teaching I. 2 credits.**

Students will explore effective teaching strategies in the biological sciences. Emphasis will be placed on how to prepare and teach laboratory and lecture courses, including effective instructional technologies and exam preparation. Discussions of teaching experiences and mentor and peer evaluations of the students' teaching skills will be included. *Corequisite: BIO 601.*

**BIO 601. Mentored Teaching. 1 credit.**

Students continue their exploration of effective teaching strategies in the biological sciences as they enter into their first teaching assignment in the department. Students will work under a faculty teaching mentor who will guide the students through their first teaching experience in the Department of Biology. Emphasis will be placed on mentor and peer evaluations of the students' teaching skills. May be repeated for up to two credits for different teaching assignments. *Corequisite: BIO 600.*

**BIO 603. Scientific Presentations. 1 credit.**

A forum for students to present their research and/or teaching materials to their peers and receive constructive feedback on their progress. Presentations may take the form of informal "chalk talks," journal club presentations and/or formal presentations. This course is graded on a satisfactory/unsatisfactory (S/U) basis. May be repeated for up to two credits.

**BIO 615. Managing Anatomy and Physiology Laboratories. 2 credits.**

This course will teach students how to manage an anatomy and physiology laboratory. Course topics will include lab safety, course budgets, the acquisition of supplies, facility layout and design, cadaver maintenance, and the use and maintenance of equipment and inventory control.

**BIO 630. Advanced Graduate Topics in Biology. 3-4 credits.**

Studies in advanced special areas of biology. May be repeated with change in topic or change in subject matter within a topic.

**BIO 660. Graduate Seminar. 1-3 credits.**

Seminar in special areas of biology. May be repeated up to a total of 12 hours with change of subject.

**BIO 670. Developmental Anatomy of Seed Plants. 4 credits.**

A study of the origin, growth, differentiation and maturation of cells, tissues, and organs, and their interrelationships. Emphasis is placed on economically important structures of crop, ornamental and forest plants.

**BIO 697. Biological Research. 1-6 credits.**

Laboratory and/or field research will be conducted under the direction of the Graduate Advisory Committee. The course will emphasize the development of research techniques and data collection. Can be repeated for credit. This course is graded on the satisfactory/unsatisfactory (S/U) basis. Hours do not apply toward 30 hours required for graduation.

**BIO 698. Comprehensive Continuance. 1 credit.**

Continued preparation in anticipation of the comprehensive examination. Course may be repeated as needed.

**BIO 699. Thesis Continuance. 2 credits.**

Continued study, research and writing in the area of thesis concentration. Course may be repeated as needed.

**BIO 700. Thesis. 6 credits.**

Thesis research to be directed by the Graduate Advisory Committee. This course is graded on a satisfactory/unsatisfactory (S/U) basis. *Prerequisites: Unconditional admission status in the graduate program and completion of an approved thesis research proposal.*

**BIO 701. Effective Teaching II: Teaching Portfolio. 3 credits.**

Students will document their teaching background in preparation for the job application process.