BIOLOGY (BIOL)

100 Level Courses

BIOL 101: *Biology Freshman Seminar.* 1 credit.
This course is for first-semester freshman with a declared biology major. This elective will serve as a platform for freshman biology students to get practical advice and guidance for how to approach coursework, careers in biology, and professionalism. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Registration Restrictions:
Enrollment limited to students with a class of Freshman.

Enrollment is limited to students with a major in Biology.

Schedule Type: Seminar

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 102: *Introductory Biology I-Survey of Biodiversity and Ecology.* 4 credits.
This survey course introduces students to the evolution of biological diversity on Earth and explores how organisms interact with each another and their environment. Topics include the domains of life, how new species arise, evolution of populations and major topics in ecology and conservation. Survey course suitable for any major. Biology majors may not take after BIOL 200-level or above courses have been taken. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Mason Core: Mason Core, Natural Science with Lab (https://catalog.gmu.edu/mason-core/)

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 103: *Introductory Biology II-Survey of Cell and Molecular Biology.* 3 credits.
This survey of Cell and Molecular biology provides students with an understanding of basic cellular biology and an appreciation of the impact of molecular biology research on current societal challenges. Topics include how life emerged on early earth, cell structure and function, genes and heredity, plus viruses and genetic engineering. Notes: This is a survey course suitable for any major. Biology majors may not take BIOL 103 after having taken a BIOL course at the 200 level or above. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Mason Core: Mason Core, Natural Science Overview (https://catalog.gmu.edu/mason-core/)

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 105: *Introductory Biology II Laboratory.* 1 credit.
Laboratories that cover the chemical basis of life, the structure and function of the cell, Mendelian and human genetics. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Mason Core: Mason Core, Natural Science with Lab (https://catalog.gmu.edu/mason-core/)

Recommended Prerequisite: BIOL 103

Recommended Corequisite: BIOL 103

Schedule Type: Laboratory

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 106: *Introductory Biology I Laboratory.* 1 credit.
Laboratories introduce the scientific method, animal and plant diversity, and how organisms interact with each other and their environment. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Mason Core: Mason Core, Natural Science with Lab (https://catalog.gmu.edu/mason-core/)

Recommended Prerequisite: BIOL 102T

Schedule Type: Laboratory

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 107: *Intro Biology II Lecture.* 3 credits.
Topics include animal (including human) structure, function, homeostatic mechanisms, organ systems, behavior, higher plant systems, and major concepts in ecology. Note: Students are strongly urged to take BIOL 103 prior to BIOL 107. Survey course suitable for any major. May not be taken after BIOL 200-level or above courses have been taken. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Mason Core: Mason Core, Natural Science Overview (https://catalog.gmu.edu/mason-core/)

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 124: *Human Anatomy and Physiology I.* 4 credits.
Introduction to structure and function of body's major organ systems. Note: must be taken in sequence. Does not satisfy the natural science requirement in COS or CHSS. Course requires use of organisms.
Not available for Biology elective credit. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 103

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 125: *Human Anatomy and Physiology II.* 4 credits.
Introduction to structure and function of body's major organ systems. Notes: Does not satisfy the natural science requirement in COS or CHSS. Course requires the use of organisms. Not available for Biology elective credit. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Registration Restrictions:
Required Prerequisites: (BIOL 124[C] or 124[XS]).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 140: *Plants and People.* 3 credits.
An introduction to the interaction of plants and people from a biological perspective and the tools to continue life-long critical evaluation of emerging issues in human nutrition, agriculture, medicine, and global environmental change as they relate to plant biology. Designated a Green Leaf Course. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Mason Core: Mason Core, Natural Science Overview, Encore: Sustainability (https://catalog.gmu.edu/mason-core/)

Specialized Designation: Green Leaf Related Course

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 177: *Introductory Ecology for Environmental Engineers.* 3 credits.
This course introduces ecosystem concepts and applications to natural and managed ecosystems. This course will discuss the natural environment, ecological processes, and human interaction with and management of this environment. Humankind plays a major role in all worldwide environments and there is very little, if any, of the surface of this planet that remains untouched by human actions. Biologists, ecologists, environmental scientists, and policy makers, must provide for the needs of humanity while mitigating negative impacts on the natural environment. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

200 Level Courses

BIOL 213: *Cell Structure and Function.* 4 credits.
For science majors and preprofessionals in life sciences. Introduction to cell chemistry, metabolism, and genetics. Note: for science majors and pre-professionals in the life sciences. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Registration Restrictions:
Required Prerequisites: (BIOL 103[C], CHEM 211[C] or 271[C]).
[C] Requires minimum grade of C.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 214: *Biostatistics for Biology Majors.* 4 credits.
An introduction to statistics used in the life sciences. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Corequisite: BIOL 213

Schedule Type: Lecture, Recitation

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 246: *Introductory Microbiology.* 3 credits.
Introduction to microbial cell structure, physiology, and pathogenicity. Emphasizes control of microorganisms, host-parasite interactions including immunology, and viral and bacterial pathogens. Note: not available for Biology major credit or to students who have BIOL 305. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 124 and 125, one year of general biology, or permission of instructor.

Recommended Corequisite: BIOL 306.

Registration Restrictions:
Students cannot enroll who have a major in Biology.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 295: *Summer Research in Biology.* 1-3 credits.
Students enrolled in this course study life science related topics in an approved research environment during the summer. This course may involve one or more of the following: reading peer reviewed literature, conducting a field or laboratory study, attending scientific seminars and workshops, writing an abstract, preparing and presenting a poster, or writing a research paper. Notes: May be taken for 1 to 3 credits and repeated once for a total of 3 credits. Total limit for BIOL 295 is 3 credits toward 44 credits for BS or BA (as long as the number of 100-200 level credits for the biology areas has not been exceeded). Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). May be repeated within the degree for a maximum 3 credits.
Recommended Prerequisite: Permission of instructor and Biology Program Director.

Schedule Type: Research

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

300 Level Courses

BIOL 300: *BioDiversity.* 4 credits.
This course explores the fundamental principles governing organismal biology while introducing the three domains of life: the Archaea, the Bacteria, the Eukaryotes, plus viruses. Offered by Biology (https://

catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to BIOL 303, BIOL 304.
Registration Restrictions:
Required Prerequisites: (BIOL 213[C], U213 or 213[XS]).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 301: *Biology and Society.* 3 credits.
Biological problems facing society including pollution, cloning, emerging diseases, global warming, and overpopulation. Notes: Not available for biology elective credit. May be repeated if topic is different. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). May be repeated within the term.
Mason Core: Mason Core, Mason Apex (https://catalog.gmu.edu/mason-core/)

Specialized Designation: Topic Varies

Recommended Prerequisite: BIOL 103 and 60 credits, or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 302: *Alternative Careers in Biology.* 1 credit.
This course will explore non-traditional careers that utilize a biology degree. Weekly seminars will allow biology undergraduates to discuss and explore the broad-range of career options that utilize a biology degree with professionals in those fields. Notes: Biology majors only. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Schedule Type: Seminar

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 303: *Animal Biology.* 4 credits.
Emphasizes structure and function of vertebrates, but surveys all animal groups and protozoa. Also covers evolutionary theory, and evolutionary history of major animal groups. Course requires use of organisms. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to BIOL 300.
Recommended Prerequisite: C or better in BIOL 213 or U213 or permission of instructor.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 304: *Plant Biology.* 4 credits.
Introduction to study of plants, their structure, development, nutrition, and ecology. Emphasizes flowering plants, but surveys all groups and their phylogenetic relationships. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to BIOL 310.
Recommended Prerequisite: C or better in BIOL 213 or U213, or permission of instructor.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 305: *Biology of Microorganisms.* 3 credits.
Morphology, physiology, and pathogenicity of certain groups of bacteria, fungi, and viruses; stresses host-parasite interactions. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Corequisite: BIOL 306.

Registration Restrictions:
Required Prerequisites: (BIOL 213[C], U213 or 213[XS]).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Students cannot enroll who have a major in Nursing.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 306: *Biology of Microorganisms Laboratory.* 1 credit.
Laboratory techniques in culturing, staining, and identifying microorganisms. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Corequisite: BIOL 305 or 246.

Schedule Type: Laboratory

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 308: *Foundations of Ecology and Evolution.* 5 credits.
An examination of the principles of ecology, evolution, and the impact of humans on the world around them. Topics will include evolutionary history, biological diversity, and analyzes of interactions among organisms and between organisms and their environment. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to BIOL 308T, BIOL 328, BIOL 338.
Mason Core: Mason Core, Writing Intensive in Major (https://catalog.gmu.edu/mason-core/)

Recommended Prerequisite: BIOL 311

Registration Restrictions:
Required Prerequisites: (((BIOL 213[C], U213 or 213[XS]) and (BIOL 214[C] or 214[XS])) or ((EVPP 108[C] or 108[XS]) and (EVPP 109[C] or 109[XS]) and (BIOL 214[C] or 214[XS]))).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Laboratory, Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 309: *Oceanography.* 3 credits.
Explores the geological, chemical, physical, and biological aspects of the global oceans. For science majors and minors only. May include field trips. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to EVPP 309, GEOL 309.
Recommended Prerequisite: Two of the following lab sciences courses are required for a total of 8 credits: [GEOL 101 + GEOL 103, or 102 + GEOL 104], [EVPP 108 and 109 or 112 and 113 or 210], CHEM 211 and 213, [BIOL 102 or 213], [PHYS 160 and 161 or 243 and 244].

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 311: *General Genetics.* 4 credits.
Basic principles of heredity and modern developments in this field. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 214.

Registration Restrictions:
Required Prerequisites: (BIOL 213[C], U213 or 213[XS]).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 312: *Biostatistics for Bioinformatics.* 4 credits.
Use of probability and descriptive and inferential statistical techniques in interpreting biological data. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Registration Restrictions:
Required Prerequisites: (BIOL 214[C] or 214[XS]) and (CDS 130[C] or 130[XS]).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Lecture, Recitation

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 314: *Introduction to Research Design and Analysis.* 4 credits.
Introduction to research design in a wide range of biological disciplines. Lecture will concentrate on how to design experiments with proper controls for statistical analysis, as well as obtaining permits and approvals from appropriate agencies. In recitation students will be given data sets to analyze. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Specialized Designation: Mason Impact.

Recommended Prerequisite: BIOL 213, BIOL 214 or 312 or equivalent introductory statistics course, BIOL 311, CHEM 211, 212, 213, 214; Completion of Biology core recommended; Must be enrolled in Biology Research Semester.

Schedule Type: Lecture, Recitation

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 318: *Conservation Biology.* 3 credits.
Introduction to science used to identify species in need of conservation and techniques to manage and protect organisms. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to EVPP 318.
Recommended Prerequisite: BIOL 308 or BIOL 300, or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 320: *Comparative Chordate Anatomy.* 4 credits.
Compares anatomy and morphology of major chordate groups. Lab emphasizes shark, mudpuppy, cat, and rabbit. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 308 or BIOL 310 or permission of instructor.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 322: *Developmental Biology.* 3 credits.
Principles of embryonic development and differentiation in animal species at cellular, molecular, tissue, and whole organism levels. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 213 or U213 and BIOL 311 or L311 or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 323: *Environmental Effects on Embryonic Development.* 1 credit.
This laboratory will explore how environmental factors impact embryonic development of vertebrates. Students will have the opportunity to propose and carry out a small independent project using zebrafish as a model organism. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Schedule Type: Laboratory

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 326: *Animal Physiology.* 3 credits.
General consideration of animal function emphasizing common life problems and methods for solving them. Topics include intercellular

communication (nervous and endocrine), metabolism, water and solute balance, and cardiovascular and respiratory physiology. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: (BIOL 213 or U213), or EVPP 210, or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 331: *Invertebrate Zoology.* 4 credits.
Survey of invertebrate phyla, excluding insects, showing morphology, phylogeny, and general biology of these groups. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 308 or BIOL 300, or permission of instructor.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 332: *Insect Biology.* 4 credits.
Survey of insects including taxonomy, morphology, physiology, behavior, ecology, and economic importance. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 308 or BIOL 300, or permission of instructor.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 334: *Vertebrate Paleontology.* 4 credits.
Vertebrate Paleontology explores the evolution of vertebrates from the early Paleozoic to Recent. The course will cover the systematics, anatomy, paleogeography, and ecology of extinct vertebrates. Discussions will include fishes, early tetrapods & amniotes, dinosaurs, birds and mammals. Lab portion includes paleontology techniques, analysis, and study of fossil specimens and casts. A weekend field trip is included. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to GEOL 334.
Recommended Prerequisite: Any two courses from the following list: GEOL 101 + GEOL 103, GEOL 102, BIOL 103, BIOL 102, BIOL 213, BIOL U213, BIOL 300, or the permission of the instructor.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 335: *Forensic Entomology.* 3 credits.
Explores the use of insects and other arthropods in field of forensic science as it pertains to the investigations of human and animal deaths and abuse, food and other product contamination, thefts, the illegal drug trade and unethical entomological practices. The use and presentation of this information from such investigations in court room proceedings will be discussed. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 213 or U 213 or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 336: *Invertebrate Paleontology.* 4 credits.
Classification, evolutionary trends, and distribution of common invertebrate fossils. May include field trips. Notes: May include field trips. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to GEOL 312.
Recommended Prerequisite: Either GEOL 101 + GEOL 103, and GEOL 102; or BIOL 103 and BIOL 102; or BIOL 213 or U213 and BIOL 300.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 338: *Lab for Fundamentals of Ecology and Evolution.* 2 credits.
This is a writing intensive experience and laboratory for transfer students who have previously taken an equivalent course to BIOL 308 that did not have a lab and did not meet the writing intensive requirements in the biology major. This course is paired with BIOL 308. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Mason Core: Mason Core, Writing Intensive in Major (https://catalog.gmu.edu/mason-core/)

Recommended Prerequisite: Permission of Biology Program Director and faculty coordinator of BIOL 308.

Schedule Type: Laboratory

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 340: *Introductory Botany.* 4 credits.
Introduction to study of plants, their structure, development, nutrition, and ecology. Surveys of many groups of plants and their phylogenetic relationships will be studied. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: 100-level introductory biology and/or BIOL 213.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 344: *Plant Diversity and Evolution.* 4 credits.
Investigates the diversity of vascular plants, including angiosperms, their evolutionary relationships, and the bases of their classification and identification. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.

Recommended Prerequisite: BIOL 308 or BIOL 310, or permission of instructor.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 345: *Plant Ecology.* 4 credits.
Investigates the interaction of plants with their abiotic and biotic environment, native Virginian plant communities and their causes, and global processes affecting plant distributions over geological time. Notes: Three Saturday or Sunday field trips required. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 308 or BIOL 310, or permission of instructor.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 350: *Freshwater Ecosystems.* 4 credits.
Studies physical, chemical, and biological processes in lakes, streams, and wetlands. Lectures, field trips, and lab exercises teach physical and chemical aspects of aquatic systems and life cycles, and adaptations of aquatic organisms. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to EVPP 350.
Recommended Prerequisite: CHEM 211/ 213 and CHEM 212/214 or CHEM 155/156 and BIOL 308 or EVPP 301.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 351: *Conservation Seminar.* 2 credits.
Examines key conservation issues, based on readings and discussions from the primary literature. Teaches professional development skills for scientists in conservation including fundraising, poster presentations, and interpretation of findings for diverse audiences. Develops skills for obtaining internships, jobs, or graduate positions. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). May be repeated within the degree for a maximum 4 credits. Equivalent to CONS 400.
Recommended Prerequisite: EVPP 301 or EVPP 302 or BIOL 308 or INTS 401 (or equivalent course) or permission of instructor.

Schedule Type: Seminar

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 352: *Monitoring and Assessment of Biodiversity.* 4-6 credits.
Assessment, monitoring and conservation of species and habitats. Use tools for sampling species and habitats as well as how to evaluate their effectiveness. Apply this practical, hands-on knowledge to prepare a series of reports and recommendations for future work. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to CONS 404.
Recommended Prerequisite: EVPP 301 or EVPP 302 or BIOL 308 or INTS 401 (or equivalent course) or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 353: *Small Population Management.* 4 credits.
Investigates species vulnerability to extinction and the methodologies of preserving genetic diversity in small populations, both in the wild and in captivity. Teaches modeling and laboratory techniques that promote successful captive breeding, such as hormone analysis and assisted reproductive techniques. Examines captive species in the Smithsonian Conservation Biology Institute to learn husbandry practices and skills from keepers and biologists. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to CONS 406.
Recommended Prerequisite: EVPP 301 or EVPP 302 or BIOL 308 or INTS 401 (or equivalent course) or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 354: *Research in Conservation.* 5 credits.
One-on-one research experience with a conservation practitioner over 5 weeks (about 36 hours per week) on a conservation research project associated with that practitioner's program. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: EVPP 301 or EVPP 302 or BIOL 308 or INTS 401 (or equivalent course) or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 355: *Ecological Engineering and Ecosystem Restoration.* 4 credits.
Provides definition, classification and practice of ecological engineering and ecosystem restoration. Describes general system ecology, ecosystem restoration, and the utilization of natural processes to provide ecosystem services to society and benefits to nature. Provides students with a systems-oriented perspective on environmental studies. Students will study principles in general system ecology and ecological engineering and explore practices in sustainable ecological design by carrying out a hands-on experimental design project with field microcosms/meocosms in a newly established Wetland Mesocosm Compound on the campus. This course will involve a field trip (1-2 days). Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: CHEM 211 and CHEM 213, BIOL 308 or EVPP 301, and PHYS 243.

Schedule Type: Laboratory, Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 356: *Landscape and Macrosystems Ecology.* 4 credits.
Detect and characterize patterns in landscapes. Investigate how they form and change over time, and with anthropogenic influences. Models populations and communities across landscapes, and ways of managing them to achieve goals in managing species and ecosystem proceses at local, regional, and continental scales. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to CONS 405.
Recommended Prerequisite: (EVPP 301 and EVPP 302) or BIOL 308 or INTS 401 or equivalent course.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 357: *Ecology Field Skills.* 4 credits.
In this course, you will be introduced to a variety of field techniques used in ecological research through occasional classroom lectures and intensive field activities. You start with an overview of sampling methodologies common to the discipline and progress to hands-on and remote sampling techniques for plants, insects, amphibians, reptiles, birds and mammals. You will become familiar with Virginia's flora and fauna, gain experience in sampling and identifying representative plants, invertebrates and vertebrates, and obtain experience in making observations and characterizing ecological interactions related to population, community, and behavioral ecology. Also, you will maintain a field journal and complete a research proposal following adapted guidelines of Mason's OSCAR program. Come to Front Royal ready to work hard and to spend long days in the field. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 308 or BIOL 300 (or equivalent) or INTS 401

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 374: *Biogeography: Space, Time, and Life.* 3 credits.
A survey of the relationship between the distribution of plants and animals on the earth surface and the physical geography and environmental characteristics. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to GGS 321.
Recommended Prerequisite: One of the following: BIOL 300, GGS 122, GGS 102, or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 377: *Applied Ecology.* 3 credits.
Introduction to ecosystem concepts and their applications to natural and managed ecosystems. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to EVPP 377.
Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 378: *Applied Ecology Laboratory.* 1 credit.
Application of ecosystem concepts in natural and managed ecosystems. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Corequisite: BIOL 377 or EVPP 377.

Schedule Type: Laboratory

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 379: *RS: Ecological Sustainability.* 4 credits.
Introduces the concepts and applications of several important topics relating to ecological sustainability. Focuses on the role of soils in maintaining and managing environmental quality. Teaches students how to understand and interpret scientific data presented in various types of literature covering ecological sustainability. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to EVPP 378, EVPP 425.
Mason Core: Mason Core, Mason Apex (https://catalog.gmu.edu/mason-core/)

Specialized Designation: Green Leaf Focused Course, Research/Scholarship Intensive

Recommended Prerequisite: BIOL 308 or permission of instructor.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 382: *Introduction to Virology.* 3 credits.
An introduction to the fundamental nature of viruses, their classification, morphology, chemistry and their role in human disease. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Registration Restrictions:
Required Prerequisites: (BIOL 305[C], L305 or 305[XS]) or (BIOL L246, 246[C] or 246[XS]).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 385: *Biotechnology and Genetic Engineering.* 3 credits.
Emphasizes theory and applications, including significance and societal implications of biotechnology applied to medicine, agriculture, and environment. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Registration Restrictions:

Required Prerequisites: BIOL 311[C], L311 or 311[XS].
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

400 Level Courses

BIOL 400: *News & Views: Selected Topics.* 3 credits.
Using primary literature published within five years, students will use their written communication skills to convey the exciting, technical aspects of these reports to both a general and scientific audience. This course is the writing-intensive course for the biology major. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to two attempts.
Mason Core: Mason Core, Writing Intensive in Major (https://catalog.gmu.edu/mason-core/)

Specialized Designation: Topic Varies

Recommended Prerequisite: ENGH 302, BIOL 311, and BIOL 300 or BIOL 308

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 401: *Phage Discovery.* 3 credits.
Discovery-based undergraduate research course where students purify phage from soil, use a variety of microbiology techniques, annotate phage genomes and use bioinformatics analyses. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Registration Restrictions:
Required Prerequisites: ((BIOL 305[C], L305, 305[XS], 246[C] or 246[XS]) and (BIOL 306[C], L306 or 306[XS])).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Laboratory

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 402: *Applied and Industrial Microbiology.* 3 credits.
Biology of microorganisms of ecological and industrial significance. Includes food production, spoilage and preservation, fermentation technology, waste disposal, water purification, biodeterioration, and decomposition. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Registration Restrictions:
Required Prerequisites: BIOL 305[C], L305, 305[XS], 246[C], L246 or 246[XS].
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 403: *Techniques in Applied and Industrial Microbiology.* 1 credit.
Lab exercises illustrate basic and applied methodologies, including isolation of commercially useful strains. Discusses production and purification of industrial products. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 213 or U213, BIOL 305 or L305, BIOL 306 or L306; CHEM 211/213, CHEM 212/214; BIOL 402 (concurrent enrollment is permitted) or permission of instructor.

Schedule Type: Laboratory

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 404: *Medical Microbiology.* 3 credits.
Basic principles of infectious diseases caused by bacteria and viruses. Discusses genetics and molecular mechanisms of pathogenicity. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Registration Restrictions:
Required Prerequisites: (BIOL 305[C], L305 or 305[XS]) or (BIOL 246[C], L246 or 246[XS]).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 405: *Microbial Genetics.* 4 credits.
Study of structure and function of bacterial DNA, emphasizing mechanisms of gene transfer, expression and regulation. Introduces DNA repair, mutation, and life cycles of bacteriophage. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Registration Restrictions:
Required Prerequisites: (BIOL 305[C], L305 or 305[XS]) or (BIOL 246[C] or U246) and (BIOL 306[C], L306 or 306[XS]).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 407: *Microbial Diversity.* 4 credits.
Studies effect of microorganisms on ecological and medical phenomena. Stresses evolution of microbial species, biochemical cycling, and species interactions. Laboratory stresses use of cultural, biochemical, and phylogenetic methods to study microbial isolation, metabolism, and identification. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Registration Restrictions:
Required Prerequisites: ((BIOL 305[C], L305, 305[XS] or 246[C]) and (BIOL 306[C], L306 or 306[XS])).

[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 408: *Mushrooms, Molds and Society.* 3 credits.
Provides a modern, comprehensive knowledge of fungal biology including classification, phylogeny, structure, physiology/metabolism, growth and development, genetics, industrial applications including biotechnology, ecological roles including pathogenic interactions with plants, animals, and man. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to EVPP 408.
Recommended Prerequisite: EVPP 108 and 109 and 112 and 113 or EVPP 210 or BIOL 213.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 409: *Medical Mycology.* 3 credits.
Provides the student with current knowledge of both the medical and microbiological aspects of fungal diseases in humans, including the etiologic agents, geographic distribution, epidemiology, transmission, determinants of pathogenicity, laboratory detection, and therapy associated with the major human mycoses. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 213 or U213 with a grade of C or better.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 410: *Biology and Society.* 3 credits.
Biological problems facing society including pollution, cloning, emerging diseases, global warming, and overpopulation. Notes: Does not count as biology elective credit. May be repeated if topic is different. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). May be repeated within the term for a maximum 9 credits.
Specialized Designation: Topic Varies

Recommended Prerequisite: BIOL 103 and 75 credits, or permission of instructor

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 411: *Advanced General Genetics.* 3 credits.
Topics include quantitative genetics, extrachromosomal inheritance, and special techniques such as mutation screening, developmental genetics, cancer genetics, behavior genetics, evolutionary genetics, and ethics of genetic technology. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: C or better in BIOL 311 or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 412: *Phage Genomics.* 3 credits.
Bacteriophages, viruses that infect bacteria, are the most abundant organisms in the biosphere. This course explores the genomes of mycobacteriophages (bacteriophages that infect mycobacteria) using bioinformatics tools. In this course, two mycobacteriophage genomes will be annotated and compared to other sequenced mycobacteriophage genomes. Bioinformatics tools will be used to learn more about bacteriophage protein function, immunity and genome structure. Each student in the course will formulate a comparative genomics question and use learned bioinformatics techniques to answer that question, The results of these experiments will be conveyed in the form of a research paper and oral presentation. This class is designed to give students the opportunity to actively participate in the process of scholarship and research in addition to learning valuable genomic and bioinformatics skills. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 311 or equivalent or permission of instructor.

Schedule Type: Research

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 413: *Histotechniques.* 3 credits.
Introduces theory and methods for the preparation of tissue samples from animal or plant specimens for examination with light or electron microscopy. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 311 and permission of instructor. May not be combined with BIOL 572 for credit. For Biology majors only. Undergraduate courses in biology and chemistry or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 417: *Selected Topics in Molecular and Cellular Biology.* 1-4 credits.
Study of current topics in molecular and cellular biology. Notes: Topics vary. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). May be repeated within the term for a maximum 8 credits.
Specialized Designation: Topic Varies

Recommended Prerequisite: BIOL 311 or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 418: *Current Topics in Microbiology.* 3 credits.
Study of current topics in microbiology. Notes: Topics vary. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). May be repeated within the degree for a maximum 6 credits.
Specialized Designation: Topic Varies

Recommended Prerequisite: BIOL 305 or BIOL L305.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 420: *Vaccines.* 3 credits.
Immunology, virology, and microbiology of vaccines. Classical and new generation vaccine practices and strategies. Current and future vaccines. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Registration Restrictions:
Required Prerequisites: (BIOL 305[C], 305[XS], 246[C], 246[XS], L305 or L246).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 421: *Genetics of Human Diseases.* 3 credits.
Emphasizes strategies used for identification of genes involved in human genetic diseases. Both monogenic and complex human genetic diseases, as well as principles of genetic screening and counseling, will be presented. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 311.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 422: *Stem Cell Biology and Regenerative Medicine.* 3 credits.
A broad overview of the biological principles governing stem cell populations. The functional roles stem cells play in regulating normal development and contributing to disease-state pathologies. An examination of the therapeutic potential of stem cells through "regenerative medicine." Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 311.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 423: *Biology of Obesity and Weight Loss.* 3 credits.
This course covers the causes and consequences of obesity and weight loss, including the general epidemiology and pathology of co-morbid conditions associated with obesity. The relative contributions of genetic and environmental factors influencing weight gain will be covered as well as recent trends in obesity research. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 213 or U213 or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 424: *Female Reproductive Biology & Health.* 3 credits.
This course is designed for students who have an interest in human female reproductive anatomy and physiology. Material will cover a variety of related topics including an introduction to endocrine system function, anatomy of reproductive system, hormonal regulation of uterine and ovarian cycles, meiosis, fertilization, development of reproductive structures, physiological changes during pregnancy, parturition, postpartum, and with age. Factors that affect fertility and selected pathologies will also be discussed. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Registration Restrictions:
Required Prerequisite: BIOL 213[C].
[C] Requires minimum grade of C.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 425: *Human Physiology.* 3 credits.
Organ system approach to study of homeostasis, including cardiovascular, respiratory, renal, digestive, endocrine, and nervous system functions. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 213 or U213 or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 426: *Mechanisms of Aging.* 3 credits.
A course where students will demonstrate knowledge of cellular and molecular mechanisms which drive the systematic changes that result in aging, and to understand the overall biological processes involved in complex biological systems. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 213 or U213 and BIOL 311 or L311 or equivalent; or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 427: *Disease Ecology and Conservation.* 3 credits.
Presents the trans-disciplinary discipline of conservation medicine, the study of relationships between organism and ecosystem health and

environmental conditions. Topics include infectious and noninfectious diseases, pathogens, processes, and impacts on human, biotic, and ecosystem health, and how to address the consequences of diseases to populations and ecological communities. Notes: This course will co-meet with EVPP 527. Undergraduate students in this course will have separate (shorter) reading and writing assignments and will be graded according to a different rubric than the graduate students. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to EVPP 427.
Recommended Prerequisite: 60 credits and BIOL 213 or BIOL/EVPP 305/306 and BIOL 308 OR EVPP 301, or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 428: *Planetary Health.* 3 credits.
As the pace and scale of human impacts on Earth's natural systems continue to increase, there is growing importance in understanding and quantifying the implications of these accelerating changes for human health. Throughout this course, we will study 'Planetary Health' which addresses the human health impacts of accelerating environmental change through interdisciplinary approaches including environmental science, political science, and public health. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: EVPP 301/BIOL308 or BIOL305/306 or EVPP 305/306 or BIOL/EVPP318 and 60 credit hours; or instructor's permission.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 429: *Biological Foundations of Pharmacology.* 3 credits.
An introduction to the basics of pharmacology that focuses on the human systems of the body and how drugs modulate these systems in order to maintain homeostasis. Disease states will be incorporated in the study of the major drug classes to strengthen the students understanding regarding medication use. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 124 and BIOL 125, or BIOL 430 and BIOL 431, or BIOL 483, or CHEM 463

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 430: *Advanced Human Anatomy and Physiology I.* 4 credits.
Organ system approach to studying the structure and function of the human organism and maintenance of homeostasis. Detailed discussion of anatomical structures and their functions of the endocrine, nervous, muscular, skeletal, and integumentary systems following introduction to the cellular and tissue levels of organization. Topics also include selected pathology for each organ system; current therapeutic interventions are addressed. Notes: Biology 124 is not approved for Biology Majors. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: 60 credits.

Registration Restrictions:
Required Prerequisites: (BIOL 213[XS], U213 or 213[C]).
[XS] Requires minimum grade of XS.
[C] Requires minimum grade of C.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 431: *Advanced Human Anatomy and Physiology II.* 4 credits.
Continued study of the structure and function of the human organism and maintenance of homeostasis. Detailed discussion of anatomical structures and their functions of the cardiovascular, lymphatic, respiratory, urinary, digestive and reproductive organ systems. Topics also include selected disorders for each organ system to illustrate disruption of homeostasis. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Registration Restrictions:
Required Prerequisites: (BIOL 430[C] or 430[XS]).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 432: *Clinical Applications in Human Physiology.* 4 credits.
Select organ systems will be discussed relative to their physiology, pathology and pharmacology. Case study presentations will be an integral part of the class. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Registration Restrictions:
Required Prerequisites: (((BIOL 124[C] or 124[XS]) and (BIOL 125[C] or 125[XS])) or ((BIOL 430[C] or 430[XS]) and BIOL 431[C])).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 433: *Selected Topics in Plant Biology.* 1-4 credits.
Lecture or field course in botany. Topic varies with instructor's specialty. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). May be repeated within the degree for a maximum 8 credits.
Specialized Designation: Topic Varies

Recommended Prerequisite: BIOL 300 or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 435: *Selected Topics in Biology.* 4 credits.
Topics vary with instructor's specialty. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). May be repeated within the degree for a maximum 8 credits.
Specialized Designation: Topic Varies

Recommended Prerequisite: Permission of instructor.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 437: *Ornithology.* 4 credits.
Study of evolution, systematics, physiology, ecology and behavior of birds, emphasizing field work. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 308 or equivalent or permission of instructor.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 438: *Mammalogy.* 4 credits.
Study of evolution, systematics, physiology, ecology and behavior of mammals,emphasizing field work. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 308 or equivalent or permission of instructor.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 439: *Herpetology.* 4 credits.
Study of evolution, systematics, physiology, ecology and behavior of reptiles, emphasizing field work. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 308 or equivalent or permission of instructor.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 440: *Field Biology.* 0-4 credits.
Directed field studies emphasizing ecology and behavior. Topics vary but include design of field manipulations, data collection and analysis, and introduction to organisms of study site. May include field trips. Notes: Students bear cost of required field trips. May be repeated with permission of Biology Program. Total limit of 4 credits. This course does not satisfy requirements of the BA degree or BS degree, which state that students must complete at least one (BA degree) or two (BS degree) upper division courses that include a laboratory. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). May be repeated within the degree for a maximum 4 credits. Equivalent to EVPP 440.
Recommended Prerequisite: BIOL 308 or BIOL 300 or permission of instructor.

Schedule Type: Fieldwork

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 442: *Urban Ecosystems and Processes.* 4 credits.
Overview and introduction of challenges and opportunities that urban environments present to the plants and animals inhabiting cities and the ways that those organisms and entire ecosystems respond. Ecosystem ecology for engineered ecosystems along with reviews om urban metabolism, energy budgets, water cycles, and soil ecology taught. Creating and restoring green infrastructures is discussed. Note: the course will involve students to design and conduct a small-scale green infrastructure experiment/project on the campus. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to EVPP 442.
Recommended Prerequisite: CHEM 211 and CHEM 213 and MATH 113 or equivalent and BIOL 308 and PHYS 243 or permission of instructor.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 443: *Tropical Ecology.* 3 credits.
An introduction to the abiotic and biotic factors that define tropical habitats. The course emphasizes evolution, taxonomic diversity, and plant-animal interactions in terrestrial tropic forests. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Registration Restrictions:
Required Prerequisites: (BIOL 308[C], 308[XS], 300[C] or 300[XS]).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 444: *Tropical Ecology Laboratory.* 1 credit.
An introduction to field-based scientific research. This course focuses on methods for testing hypotheses related to tropical plant and animal biology. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Registration Restrictions:
Required Prerequisites: (BIOL 308[C], 308[XS], 300[C] or 300[XS]).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Laboratory

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 446: *Ecological and Evolutionary Physiology.* 3 credits.
Physiological responses organisms use to survive and reproduce successfully in their ever-changing environments. Responses to temperature, salinity, low oxygen levels and diet will be covered from a phylogenetic and energetic perspective. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 308 or BIOL 300, and BIOL 326 or BIOL 430 and BIOL 431, or permission of instructor.

Registration Restrictions:
Enrollment is limited to students with a major in Biology.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 449: *Marine Ecology.* 3 credits.
Plants and animals of marine environments and physical and chemical conditions that affect their existence. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to EVPP 449.
Recommended Prerequisite: BIOL 308 or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 450: *Marine Conservation.* 3 credits.
Provides an overview of threats to the marine environment, and discusses the scientific, socioeconomic, and political issues behind marine conservation. covers categories of marine pollutants (chemical, biological, and physical contaminants) and their impacts on the marine ecosystem, as well as impacts on humans (health, social, and economic), threats to key marine species (e.g., coral, sharks, turtles, and marine mammals) and initiatives and laws developed to reduce these threats. Scientific and socioeconomic problems that hinder sustainable fisheries management and the science and policy behind the global warming debate are also discussed. The course also provides an overview of marine environmental law and policy issues related to marine conservation policy. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to EVPP 421.
Recommended Prerequisite: BIOL 309 or equivalent, or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 452: *Immunology.* 3 credits.
Topics include structure and function of immunoglobulins, role of cell-mediated immunity, protective role of immune system, and disease and injury related to malfunctions of immune system. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 311.

Registration Restrictions:
Required Prerequisites: (BIOL 213[C], U213 or 213[XS]) and (BIOL 305[C], L305, 305[XS], 246[C] or 246[XS]).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 453: *Immunology Laboratory.* 1 credit.
Techniques relevant to BIOL 452, including enzyme-linked immunoabsorbant assay, immunodiffusion, protein electrophoresis, and immune fixation. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 452 (concurrent enrollment is also permitted).

Registration Restrictions:
Required Prerequisites: (BIOL 306[C], 306[XS] or L306).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Laboratory

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 454: *Marine Mammal Biology and Conservation.* 3 credits.
Covers the evolution, biology, ecology, and behavior of marine mammals from polar bears and sea otters to whales and dolphins. Marine mammal conservation and policy is also a major component of the course; several, lecture sessions are devoted to the issue of whaling, threats to marine mammal populations, and recent conservation issues such as marine mammals and noise pollution. The course also includes a number of guest lectures from a variety of international marine mammal experts. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to EVPP 419.
Recommended Prerequisite: BIOL 309 or BIOL 449 or equivalent; or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 457: *Reproductive Strategies.* 3 credits.
Introduction to the research and evolutionary theory of sex and reproduction. Covers topics from the evolution of sex and gender to the evolution of complex reproductive strategies involving behaviors such as mate recognition, courtship displays, territoriality, polygamy, and offspring care. Lectures focus primarily on multi-cellular animals but also include discussions of unicellular prokaryotes and eukaryotes as well as plants. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 307 or 308 and 60 hours.

Schedule Type: Lecture

Grading:

This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 459: *Fungi and Ecosystems.* 3 credits.
Considers impact of fungi on ecosystems in terms of biogeochemical cycling, primary and secondary production, and regulating community structure and populations of individual species through their activities as symbionts and parasites. Discusses role of fungi in ameliorating pollutants produced by anthropogenic activities. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to BIOL 559, EVPP 551.
Recommended Prerequisite: BIOL 308 or BIOL 300 or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 460: *Infectious Diseases Wildlife.* 3 credits.
During this course, diseases of wildlife will be examined with emphasis on causes and mechanisms, pathobiology, ecology and epidemiology and population significance. We will explore methods of diagnosis, control, prevention and outbreak investigation as they apply to management and conservation of wildlife populations. Also, diseases crossing species barriers will be examined. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to EVPP 460.
Recommended Prerequisite: 60 credits and BIOL 308 or EVPP 301 or permission of the instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 465: *Histology.* 4 credits.
Microscopic structure of animal tissues and organs, with emphasis on vertebrates. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 308 or 300.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 468: *Vertebrate Natural History.* 4 credits.
Introduces vertebrates with emphasis on systematic, evolution, life history, behavior and ecology. Laboratory emphasis on identification, taxonomy, and natural history of local vertebrates. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 308 or permission of the instructor.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 471: *Evolution.* 3 credits.
Process of evolution emphasizing role of genetics, properties of populations, and population differentiations. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Registration Restrictions:
Required Prerequisites: (BIOL 308[C] or 308[XS]).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 472: *Introductory Animal Behavior.* 3 credits.
Study of mechanisms, functions, and evolution of behavior. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to CONS 472.
Recommended Prerequisite: BIOL 308 or BIOL 300 or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 473: *Introductory Laboratory in Animal Behavior.* 1 credit.
Field or laboratory study in animal behavior with emphasis on mechanisms, functions, and evolution of behavior. Stresses experimental design and analysis of data. Writing-intensive laboratory. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 472 (concurrent enrollment also permitted).

Schedule Type: Laboratory

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 480: *The Diversity of Fishes.* 4 credits.
This course delves into the biology and ecology of fishes. Subjects of this class include fish anatomy, taxonomy, evolution, habitat adaptations, community dynamics, and ecosystem interactions. The course will also touch on human impacts on fishes, and conservation. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to EVPP 435.
Recommended Prerequisite: BIOL 300 and BIOL 350 or EVPP 350

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 482: *Introduction to Molecular Genetics.* 3 credits.
Basic concepts of structure and function of genetic material at molecular level. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.

Recommended Prerequisite: BIOL 213 or U213, BIOL 311 or L311 or permission of instructor.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 483: *General Biochemistry.* 4 credits.
Structure and function of proteins, carbohydrates, and lipids. Enzymology, and metabolism and its control. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to CHEM 463.
Registration Restrictions:
Required Prerequisites: (BIOL 213[C], U213[C] or 213[XS]) and (CHEM 313[C], L313[C] or 313[XS]).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 484: *Cell Signaling and Disease.* 3 credits.
Expands on the key concepts of eukaryotic cell biology including the cell cycle, the cytoskeleton, celluar transport, the membrane and protein trafficking and cellular signaling. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 483 or permission of instructor.

Registration Restrictions:
Required Prerequisites: (BIOL 311[C], L311 or 311[XS]).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Lecture

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 485: *Cell Signaling Laboratory.* 2-3 credits.
Introduction research method application via techniques of cellular and molecular biology including: tissue culture, western blotting, PCR, microscopy, cellular transfection and transformation. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts. Equivalent to BIOL 585.
Recommended Corequisite: BIOL 484 or permission of instructor.

Schedule Type: Laboratory

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 486: *Molecular Biology and Biotechnology Laboratory.* 2 credits.
Introduction to theory, techniques, and practices used in modern molecular biotechnology laboratories. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Recommended Prerequisite: BIOL 385 or BIOL 482.

Schedule Type: Laboratory

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 489: *Teaching Practicum.* 1-3 credits.
Student gains teaching experience in a lecture, laboratory or field environment under the supervision of a faculty member. Student responsibilities may include a lecturing component, but may also include lab preparation, design of course materials, tutoring and grading. Course may be repeated once. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). May be repeated within the degree for a maximum 3 credits.
Recommended Prerequisite: BIOL 213 or U213, 311 or L311, 60 credit hours and permission of instructor, course coordinator (where applicable) and Program Director.

Schedule Type: Internship

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 491: *Selected Topics in Biology Laboratory Techniques.* 1-2 credits.
Experimental studies using current methods in biology. Provides training for research in various aspects of biology. Topics will depend on the professor teaching the class. The course may be repeated only if the topic is different. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). May be repeated within the degree for a maximum 4 credits.
Specialized Designation: Research/Scholarship Intensive, Topic Varies

Registration Restrictions:
Required Prerequisites: ((BIOL 213[C], 213[XS] or U213) and (BIOL 311[C], 311[XS] or L311) and (BIOL 305[C], L305, 305[XS], 246[XS] or 246[C]) and (BIOL 306[C], 306[XS] or L306) and ((CHEM 211[C] or 211[XS]) and (CHEM 213[C] or 213[XS])) and ((CHEM 212[C] or 212[XS]) and (CHEM 214[C] or 214[XS]))).
[C] Requires minimum grade of C.
[XS] Requires minimum grade of XS.

Schedule Type: Laboratory

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 492: *Senior Seminar.* 1 credit.
Weekly seminar course dealing with recent advances in biology. Topics selected from recent publications in the field. May be repeated for credit. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). May be repeated within the degree for a maximum 2 credits.
Specialized Designation: Topic Varies

Recommended Prerequisite: BIOL 311 and 90 credit hours, or permission of instructor.

Registration Restrictions:
Enrollment is limited to students with a major in Biology.

Schedule Type: Seminar

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 493: *Honors Research in Biology.* 1-2 credits.
Laboratory of field investigation under guidance of faculty member. Notes: Total limit for BIOL 493, 495 and 497 is 6 credits toward the 44 credit hours required for the Biology BS degree and only 3 credits toward the 32 hours required for the BA degree. Combined 493, 495 and 497 may not exceed 4 credit hours in any one semester. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). May be repeated within the degree for a maximum 2 credits.
Recommended Prerequisite: Admission to the Biology Honors Program, permission of instructor and Biology Program Director.

Registration Restrictions:
Enrollment is limited to students with a major in Biology.

Enrollment limited to students in the College of Science college.

Schedule Type: Research

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 494: *Honors Seminar in Biology.* 1 credit.
Weekly seminar course dealing with recent advances in biology. Notes: Topics selected from recent publications in field. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). May be repeated within the degree for a maximum 6 credits.
Recommended Prerequisite: Acceptance into Biology honors program and permission of instructor.

Schedule Type: Seminar

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 495: *Directed Studies in Biology.* 0-2 credits.
Study of a topic not otherwise available to student. May involve reading assignments, tutorials, lectures, papers, presentations, or field study, determined in consultation with instructor. May be taken for 0 to 2 credits and repeated once for a total of 2 credits. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). May be repeated within the degree for a maximum 2 credits.
Recommended Prerequisite: Permission of instructor and Biology Program Director.

Schedule Type: Independent Study

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 497: *Special Problems in Biology.* 1-3 credits.
Lab or field project leading to written report of research. Research and paper completed under instructor's guidance. Notes: Total limit for 495 and 497 combined is 6 credits toward the 44 credits required for BS and 3 credits toward 32 credits for BA. Combined BIOL 493, 495, 497 may not exceed 4 credit hours in any one semester. This course does not satisfy requirements of the BA degree or BS degree, which state that students must complete at least one (BA degree) or two (BS degree) upper division courses that include a laboratory. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). May be repeated within the degree for a maximum 6 credits.
Recommended Prerequisite: 60 credits and permission of instructor and chair.

Schedule Type: Research

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 498: *Research Seminar.* 2 credits.
Seminar discussing current scientific literature and literature related to research project undertaken by student as part of the research semester. Note: Must be enrolled in Biology Research Semester. Registration must be approved by a faculty sponsor and by the Biology Program Director and is limited to students who are enrolled concurrently in BIOL 499. For students in the Biology Honors Program, this course may be used to substitute for one credit of BIOL 494: Honors Seminar in Biology. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Specialized Designation: Mason Impact.

Recommended Prerequisite: BIOL 213 or U213, BIOL 214 or 312 or equivalent introductory statistics course, BIOL 311 or L311, CHEM 211/213-212/214; Completion of Biology core recommended.

Schedule Type: Seminar

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 499: *RS: Research in Biology.* 6-9 credits.
Laboratory or field investigation under faculty guidance. Students will earn 6-9 credits toward the BA or BS degrees in Biology. Note: Must be enrolled in Biology Research Semester. Registration requires successful application and approval by Biology Program and faculty sponsor. Student receiving 9 credits for 499 will not be allowed to use BIOL 440, BIOL495 and/or 497 neither toward the 32 BIOL hours needed for the BA degree, nor toward the 44 BIOL hours needed for the BS degree. This course will satisfy one upper division laboratory requirement for both the BA and BS degrees in Biology. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). Limited to three attempts.
Specialized Designation: Research/Scholarship Intensive

Recommended Prerequisite: BIOL 213 or U213, BIOL 214 or 312 or equivalent introductory statistics course, BIOL 311 or L311, CHEM 211/213-212/214; Completion of Biology core recommended.

Schedule Type: Laboratory

Grading:
This course is graded on the Undergraduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

500 Level Courses

BIOL 501: *Microbial Diversity: An Organismal Approach.* 3 credits.
In-depth study of nonpathogenic microbial world, emphasizing detection, enumeration, and classification of microorganisms; their physiological and evolutionary relationships; and biotechnological applications. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: An undergraduate course in microbiology or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 502: *Adaptation in Biosystems.* 3 credits.
Biological communication networks adapt and maintain robust function in the face of external stress, challenges or assaults. In order to survive, the cell, and the organism, must create meaning from a complex array of external and internal signals, and make decisions as to how it should respond. This class encompasses a novel integrative life science perspective, namely adaptation, or maladaptation, in the face of constant change. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 506: *Selected Topics in Microbiology.* 1-4 credits.
Topic depends on instructor's specialty. Notes: May be repeated only with permission of department chair. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May be repeated within the degree for a maximum 8 credits.
Specialized Designation: Topic Varies

Recommended Prerequisite: BIOL 305 or L305 or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 507: *Selected Topics in Ecology.* 0-4 credits.
Topic depends on instructor's specialty. Notes: May be repeated only with permission of department chair. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May be repeated within the degree for a maximum 8 credits.
Specialized Designation: Topic Varies

Recommended Prerequisite: Course in Ecology and permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 508: *Selected Topics in Animal Biology.* 1-4 credits.
Topic depends on instructor's specialty. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May be repeated within the term for a maximum 9 credits.
Specialized Designation: Topic Varies

Recommended Prerequisite: BIOL 303 or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 515: *Developmental Neurobiology.* 3 credits.
Introduction to developmental neuroscience with overview of embryological development of the nervous system. Topics include gene regulation, directed cellular migration, axonal pathfinding, and the formation and remodeling of specific synaptic connections as well as the molecular and genetic methods that are used to explore neuronal development. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: Completion of 60 hours, including PSYC 372 or BIOL 213 or BIOL U213 and BIOL 310.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 516: *Mammalian Neurobiology.* 3 credits.
Functional anatomy of mammal brains emphasizing regional and systems neuroanatomy of humans. Correlates with material from clinical neurology, where possible. Laboratory component includes brain dissections and clinical correlations. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit. Equivalent to PSYC 531.
Recommended Prerequisite: BIOL 515.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 518: *Conservation Biology.* 3 credits.
Introduction to science used to identify species in need of conservation and techniques to manage and protect organisms. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: BIOL 307 and BIOL 311 or equivalent.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 527: *Conservation Medicine.* 3 credits.
Presents the trans-disciplinary discipline of conservation medicine, the study of relationships between organism and ecosystem health and environmental conditions. Topics include infectious and noninfectious diseases, pathogens, processes, and impacts on human, biotic, and ecosystem health, and how to address the consequences of diseases to populations and ecological communities. Notes: This course will co-meet with undergraduate-level students. Undergraduate students in this course will have separate (shorter) reading and writing assignments and will be graded according to a different rubric than the graduate students. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit. Equivalent to EVPP 527.
Recommended Prerequisite: Knowledge base covered in BIOL 213 or BIOL/EVPP 305/306 and BIOL 308 OR EVPP 301, or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 528: *Planetary Health.* 3 credits.
As the pace and scale of human impacts on Earth's natural systems continue to increase, there is growing importance in understanding and quantifying the implications of these accelerating changes for human health. Throughout this course, we will study 'Planetary Health' which addresses the human health impacts of accelerating environmental change through interdisciplinary approaches including environmental science, political science, and public health. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). May not be repeated for credit.
Recommended Prerequisite: Courses on Conservation Medicine, Evolution, Disease Ecology, One Health or Conservation Biology, or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 532: *Animal Behavior.* 3 credits.
Ecological aspects of animal behavior. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: BIOL 324 or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 533: *Selected Topics in Plant Biology.* 1-4 credits.
Topic depends on instructor's specialty. Notes: May be repeated only with permission of department chair. Offered by School of Systems Biology

(https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May be repeated within the degree for a maximum 8 credits.
Specialized Designation: Topic Varies

Recommended Prerequisite: Course in plant biology or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Special scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 537: *Ornithology.* 4 credits.
Study of evolution, systematics, physiology, ecology, and behavior of birds, emphasizing field work. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: Course in Ecology, or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 538: *Mammalogy.* 4 credits.
Study of evolution, systematics, physiology, ecology, and behavior of mammals, emphasizing field work. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit. Equivalent to EVPP 538.
Recommended Prerequisite: Course in ecology or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 539: *Herpetology.* 4 credits.
Study of evolution, systematics, physiology, ecology, and behavior of amphibians and reptiles, emphasizing field work. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: Course in ecology or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 543: *Tropical Ecosystems.* 4 credits.
Terrestrial, aquatic, and marine ecosystems in tropics, emphasizing plant communities, plant-animal interactions, and role of humans in the tropics. Notes: Field trip to tropics required as part of laboratory. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit. Equivalent to EVPP 543.
Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 550: *Waterscape Ecology and Management.* 3 credits.
Field and laboratory approaches to freshwater ecology with emphasis on study design, sampling methods, laboratory and data analysis, and report writing. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit. Equivalent to EVPP 550.
Recommended Prerequisite: General Chemistry and a course in ecology.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 553: *Advanced Topics in Immunology.* 3 credits.
Comprehensive study of immunologic mechanisms as they pertain to immunologic diseases and transplantation. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May be repeated within the degree for a maximum 6 credits.
Specialized Designation: Topic Varies

Recommended Prerequisite: BIOL 452 or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 555: *Lab in Waterscape Ecology.* 1 credit.
Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit. Equivalent to EVPP 555.
Recommended Prerequisite: BIOL 550 or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Laboratory

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 559: *Fungi and Ecosystems.* 3 credits.
Considers impact of fungi on ecosystems in terms of their effects on biogeochemical cycling, primary and secondary production, and regulating community structure and populations of individual species through their activities as symbionts and parasites. Discusses role of fungi in ameliorating pollutants produced by anthropogenic activities. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit. Equivalent to BIOL 459.
Recommended Prerequisite: BIOL 304 and/or a course in microbiology or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 560: *Infectious Diseases of Wildlife.* 3 credits.
During this course, diseases of wildlife will be examined with emphasis on causes and mechanisms, pathobiology, ecology and epidemiology and population significance. We will explore methods of diagnosis, control, prevention and outbreak investigation as they apply to management and conservation of wildlife populations. Also, diseases crossing species barriers will be examined. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit. Equivalent to EVPP 560.
Recommended Prerequisite: Courses on evolution, ecology, zoology and conservation biology or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 561: *Comparative Animal Physiology.* 3 credits.
Detailed study of selected physiological systems of invertebrates and vertebrates, emphasizing current research. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: BIOL 326 or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 562: *Personalized Medicine.* 3 credits.
Covers basic principles of molecular medicine, including the definition and the need for individualized diagnostics and therapeutics. Students

will study the application of proteomics, genomics and bioinformatics as they relate to individualized therapy, and review the major advances in these fields which have relevance to molecular medicine of the future. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: Advanced undergraduate coursework in Genetics and Molecular Cell Biology.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduation Deadline Extended, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 563: *Virology.* 3 credits.
Fundamental concepts of nature of viruses, virus classification, cultivation, and biochemistry. Emphasizes bacteriophage and animal viruses. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: BIOL 482 or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 564: *Techniques in Virology.* 2 credits.
Basic techniques of animal virus propagation, isolation, and quantitation. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: BIOL 563 (concurrent enrollment is also permitted) or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 565: *Medical Microbiology.* 3 credits.
The course explores human diseases caused by medically important bacteria, fungi, parasites and viruses. The mechanisms of disease pathogenesis are discussed, as are their clinical manifestations, diagnosis and treatment. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: Successful (minimum grade of B) completion of the undergraduate curriculum of Enlisted to Medical Degree Preparatory Program (EMDP2)

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to students with a major in Pre-Medical.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 566: *Cancer Genomics.* 3 credits.
Review of modern concepts in cancer biology including taxonomy of human tumors, common cancer syndromes, and genome instability. Genetic and molecular studies of tumor cell proliferation, migration, invasion, and death. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: A course in genetics or biochemistry.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 568: *Advanced Topics in Molecular Genetics.* 3 credits.
Comprehensive study of regulatory mechanisms controlling gene expression in viruses, prokaryotes, and eukaryotes, emphasizing current research. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May be repeated within the degree for a maximum 6 credits. Equivalent to BIOL 668.
Specialized Designation: Topic Varies

Recommended Prerequisite: BIOL 482 or permission of instructor.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 572: *Human Genetics.* 3 credits.
Inheritance of humans emphasizing current problems, including genetic control of metabolic diseases, effects of radiation and chemical agents in environment, and directed genetic change. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: BIOL 311 or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 573: *Developmental Genetics.* 3 credits.
Genetic approaches to problem of eukaryotic development, emphasizing current research on regulation of gene enzyme systems. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: BIOL 311 or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 574: *Population Genetics.* 3 credits.
Genetic structure and dynamics of populations, both real and ideal. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: BIOL 308 and 311, or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 575: *Selected Topics in Genetics.* 1-4 credits.
Different topics in different years, including molecular, developmental, physiological, and classical genetics, emphasizing current problems and research. Notes: May be repeated once with permission of department chair. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May be repeated within the term for a maximum 8 credits.
Specialized Designation: Topic Varies

Recommended Prerequisite: BIOL 311, or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 579: *Molecular Evolution and Conservation Genetics.* 3 credits.
Evolution of genes and gene families at molecular level, including gene duplication and divergence, positive and negative selection, genetic drift, and molecular clocks. Also includes selected applications in conservation genetics, such as molecular phylogenetics and estimates of population size. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: BIOL 311.

Recommended Corequisite: BIOL 471, or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 580: *Computer Applications for the Life Sciences.* 3 credits.
Studies computer use in biological sciences. Combines lectures, supervised exercises on mainframe and microcomputers. Students present seminars on advanced application and complete project using computers to fulfill a major assignment associated with another course or employment. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: 12 hours of biology and one year of college mathematics, or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 581: *Estuarine and Coastal Ecology.* 3 credits.
Emphasizes marine biology of estuarine and coastal habitats of Chesapeake Bay region, and factors affecting distribution and abundance of organisms. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit. Equivalent to EVPP 581.
Recommended Prerequisite: Course in ecology and permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 582: *Estuarine and Coastal Ecology Laboratory.* 1 credit.
Continues EVPP 546/BIOL 546 as the laboratory section focusing on the approach and methods of estuarine research, including analysis and communication of results. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit. Equivalent to EVPP 582.
Recommended Corequisite: BIOL 581 or EVPP 581.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Laboratory

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 583: *General Biochemistry.* 4 credits.
Structure and function of proteins, carbohydrates and lipids, enzymology, and metabolism and its controls. Emphasizes chemistry of nitrogen compounds. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit. Equivalent to BIOL 483.
Recommended Prerequisite: BIOL 213 or BIOL U213, CHEM 313 or CHEM L313, or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 585: *Eukaryotic Cell Biology Laboratory.* 1-2 credits.
Selected topics of laboratory procedures used in the study of eukaryotic cells. Notes: May be repeated one time with permission of program director. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit. Equivalent to BIOL 485.
Recommended Prerequisite: BIOL 484 or BIOL 682 or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Laboratory

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 589: *Teaching Practicum.* 1 credit.
Experience teaching biology in laboratory or in field under supervision of faculty member. Notes: Undergraduate assists instructor. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: Permission of instructor, chair, and course coordinator.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Independent Study

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 591: *Special Topics.* 1-6 credits.
Selected topics focusing on various specialized areas of Biology. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May be repeated within the degree.
Specialized Designation: Topic Varies

Recommended Prerequisite: Permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

600 Level Courses

BIOL 607: *Fundamentals of Ecology.* 3 credits.
Overview of concepts in physiological, population, community, and ecosystem ecology. Restricted to graduate students with little or no background in ecology. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit. Equivalent to EVPP 607.
Recommended Prerequisite: Permission of department.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 608: *Topics in Biology.* 1-4 credits.
In-service course to strengthen and update teacher's knowledge of biology. Topics include organismal biology, cell biology, ecology, microbiology, or genetics. Notes: Not available for credit toward MS in biology, or PhD in environmental science and public policy. May be repeated for credit with permission of department chair. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May be repeated within the degree for a maximum 12 credits.
Specialized Designation: Topic Varies

Recommended Prerequisite: Employment or anticipated employment as a science teacher.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 638: *Sensory Ecology.* 3 credits.
Receiving and interpreting information is critical for life on Earth. However, determining how organisms (including plants, microorganisms, or vertebrates) interpret sensory information and act on it is challenging. By necessity this field focuses on quantification to avoid imposing our own biases, and therefore sensory ecology differentiates from other fields by having a mechanistic, bottom-up, approach. In this course we will study the mechanics of sensory reception, sensory perception, and sensory processes that lead to decisions. Sensory information will be framed within a broader evolutionary context and how it is transmitted. Various sensory modalities and how organisms perceive and act on this information will be discussed. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: BIOL 508 (may be taken concurrently)

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 639: *Community Ecology.* 3 credits.
Community ecology focuses on the interactions between coexisting species and their environment. Students will gain familiarity with concepts in the field of community ecology and focus this knowledge on long term trends of community structure, species interactions, and species survival for application in the larger fields of ecology and conservation biology. Within the context of community ecology students will assess different abiotic and biotic mechanisms, such as climate change, ecosystem disturbance, predator prey relations, and pathogens, to assess how they affect community structure. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). May not be repeated for credit.

Recommended Prerequisite: BIOL 308 or equivalent Ecology course.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 643: *Microbial Ecology.* 4 credits.
Study of relationships between microorganisms and their natural environment, and methodology for observing their natural environment and biochemical activities in that environment. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit. Equivalent to EVPP 643.
Recommended Prerequisite: Course in microbiology or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 644: *Wetland Ecology and Management.* 4 credits.
Emphasizes structure, functions, and ecological processes of created and natural wetlands from an ecosystem perspective. Students will be expected to develop an understanding of hydrologic, physicochemical, and ecological aspects of wetlands and the management of these systems through in-class and field/lab works. Each student is required to carry out an individual research project that involves field and lab works, and write a research paper. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: CHEM 211, 212, BIOL 307, PHYS 106 and 107 or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 645: *Freshwater Ecology.* 3 credits.
Studies biotic and abiotic interactions that affect structure and composition of freshwater ecosystems. Emphasizes research literature. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: EVPP 550 or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 648: *Population Ecology.* 3 credits.
Survey of ecological models and theory. Topics include population growth and regulation; competition; predator-prey, herbivore-plant, and parasite-host interactions; mutualism; and metapopulation ecology. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit. Equivalent to EVPP 648.
Recommended Prerequisite: Course in ecology or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 649: *Biological Resource Management.* 3 credits.
Applies modern ecological theories and methods to biological resource management in developing and developed countries. Explores problems in achieving optimum productivity of specific resources and application of systems analysis. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: Course in ecology, or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 650: *Environment Analysis and Modeling.* 4 credits.
Introduces principles, history, and methodologies of systems ecology, emphasizing development and simulation of ecological models for natural resource/ecosystem management, conceptual and symbolic models, and simulation techniques on microcomputers. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit. Equivalent to EVPP 650.
Recommended Prerequisite: 8 hours of ecology or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 665: *Environmental Hazards to Human Health.* 3 credits.
Health effects of chemical contaminants of air, water, and food resulting from industrialized society. Includes identifying, evaluating, and controlling hazards. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: Courses in animal physiology and organic chemistry, or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 666: *Human Genetics Concepts for Health Care.* 3 credits.
Principles of genetically determined diseases with emphasis on clinical aspects of these diseases, genetic counseling, and laboratory methods used in human genetics. Extended studies students preparing to enter medical or dental school are welcome. Notes: Course in cell or molecular biology. Not available to students who have taken BIOL 572. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: BS degree or enrollment in accelerated MS program. Course in cell or molecular biology.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 667: *Signal Transduction in Cancer.* 3 credits.
Principles of signal transduction in cancer with an emphasis on their biological and clinical implications. The course will explore the role of different signaling pathways in modulating inter and intra-cellular communication, tumor development, and therapeutic interventions. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: At least one Cell or Molecular Biology undergraduate course, or BIOL 566 Cancer Biology, or BIOL 682 Advanced Eukaryotic Cell Biology.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 668: *Advanced Techniques in Molecular Biology.* 4 credits.
Experimental studies using current methods for purification and characterization of biologically important compounds. Provides training for research in molecular biology. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: BIOL 568 or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Laboratory, Lecture

Grading:

This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 669: *Pathogenic Microbiology.* 3 credits.
Molecular mechanisms of bacterial pathogenicity and immune response in infectious diseases. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: BIOL 682 or BIOL 744 with grade of B or higher.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 671: *Fundamental Concepts in Evolution.* 3 credits.
This course will provide a basic refresher on basic concepts and mechanisms in evolution and of their applications to different fields, from theoretical biology to applied science. Material used in this course includes a textbook in evolution to cover the basics concepts, a book on the history of evolutionary thinking, and articles focusing on the history, development and application of these concepts. Offered by Biology (https://catalog.gmu.edu/colleges-schools/science/biology/). May not be repeated for credit.
Registration Restrictions:
Required Prerequisites: (BIOL 311[C] and 308[C]).
[C] Requires minimum grade of C.

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 675: *Aerosol Biology.* 4 credits.
Provides students with familiarity with the state of the art aerosol equipment and techniques used in laboratory-based research pertaining to biological warfare or terrorism threats. Emphasis will be placed on biosafety procedures, techniques, and equipment used in conducting experiments with infectious organisms in a contained environment. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: Undergraduate courses in physics, math, and microbiology, and permission of the Director of the Center for Biodefense.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 678: *Cell-Based Assays.* 2 credits.
Focus on 1) basics of eukaryotic cell culture; 2) various cell based assay techniques; 3) Real-Time PCR based functional analysis of the signaling pathways. Students will maintain their cell cultures for the duration of the experiments, perform at least one functional assay and analyze the resultant data. Students are expected to learn the properties and limitations of each cell based assay and should be able to explain their results regardless of the outcome. Each student will be responsible for submitting a written report summarizing the design of their experiments and its results. Each report will include the following sections: Introduction, Methods, Results and Discussion, and a special Troubleshooting section. Notes: A lab fee of $300 will be charged per student for lab supplies. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: Permission of Instructor. 400-level coursework in cell or molecular biology.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment limited to students in the SC-MS-BCB, SC-MS-BIOL or SC-NDG-UNDE programs.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Laboratory

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 680: *Experimental Design and Analysis for the Life Sciences.* 4 credits.
Advanced course in applying probability and statistics to research in life sciences. Examples drawn from environmental, medical, physiological, genetic, and chemical biology. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: Course in biostatistics or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Laboratory, Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 682: *Advanced Eukaryotic Cell Biology.* 3 credits.
Structure and function of biomembranes, cytoskeleton, and transport systems. Also discusses protein trafficking, cell cycle, and cell adhesion molecules. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: BIOL 483, CHEM 313, CHEM 314, or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 685: *Emerging Infectious Diseases.* 3 credits.
Students will gain an understanding of the pathogenesis of emerging and/or re-emerging infectious diseases in terms of immune response and systemic alterations. Factors contributing to emergence and virulence for each pathogen will be emphasized. Epidemiology, disease progression, treatment strategies and/or control measures of identified emerging infectious diseases will be discussed. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: BIOL 213 or U213 and 311 or L311, 482 or equivalent; or permission of instructor.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 689: *Interdisciplinary Tools in the Biosciences.* 3 credits.
Class provides experiential learning of the basic tools necessary for a scientist career development. The tools covered in this class enable conducting biosciences research, namely, identifying unmet needs in science, performing scientific and patent literature search, designing experiments, understanding and applying state of the art –omics technology, performing statistical analysis of data and mathematical modeling, interpreting study results, recognizing and eliminating sources of bias, building knowledge from data, and communicating results of scientific research to peers and to general public. Students will be guided on how to recognize emerging trends in science, and be given the tools to creatively explore these trends, so that their own research will be timely and competitive. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 690: *Introduction to Graduate Studies in Biology.* 1-2 credits.
Required of all new MS students in biology. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 691: *Current Topics in Biology.* 1-4 credits.
Study of current topics in biology as determined by instructor. Topics vary and center on emerging areas of investigation in the biological sciences. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May be repeated within the term for a maximum 8 credits.
Specialized Designation: Topic Varies

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 692: *Seminar in Biology.* 1 credit.
Topics vary. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May be repeated within the degree for a maximum 2 credits.

Specialized Designation: Topic Varies

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Seminar

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 693: *Directed Studies in Biology.* 1-8 credits.
Study of topic not otherwise available in graduate program. May involve any combination of reading assignments, tutorials, lectures, papers, presentations, or laboratory or field study, determined in consultation with instructor. Notes: May not be used to fulfill explicit undergraduate prerequisites for graduate work. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May be repeated within the degree for a maximum 8 credits.
Recommended Prerequisite: Permission of instructor and graduate committee.

Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Research

Grading:
This course is graded on the Graduate Special scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 695: *Seminar in Molecular, Microbial, and Cellular Biology.* 1 credit.
Review and discussion of recent literature in specialized area. Includes student presentations. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May be repeated within the degree for a maximum 6 credits.
Registration Restrictions:
Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Seminar

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

700 Level Courses

BIOL 715: *Microbial Physiology.* 3 credits.
Comprehensive study of functioning of microbial cells, with emphasis on pathogens. Stresses growth, transport, cell-to-cell signaling, biofilm formation, antibiotic resistance, and secondary metabolites. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: An undergraduate lecture/lab course in microbiology, and a course in biochemistry.

Registration Restrictions:
Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 718: *Techniques in Microbial Pathogenesis.* 3 credits.
Laboratory-based class in which students perform current techniques in microbial pathogenesis. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: Admission to the PhD biosciences program, the MS biology program, or permission of instructor.

Registration Restrictions:
Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Laboratory

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 720: *Microbial Metabolism.* 3 credits.
Discussions of catabolic and anabolic pathways of bacterial pathogens and regulation and integration of these pathways. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May not be repeated for credit.
Recommended Prerequisite: An undergraduate lecture/lab course in microbiology and a course in biochemistry.

Registration Restrictions:
Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 745: *Environmental Toxicology.* 3 credits.
Study of nature, distribution, and interaction of toxic chemicals released into the environment. Emphasizes effects on nonhuman biota, detection and fate of chemicals, and implications for government regulation. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-

schools/science/systems-biology/). May not be repeated for credit. Equivalent to EVPP 745.
Recommended Prerequisite: Courses in ecology and physiology, or permission of instructor.

Registration Restrictions:
Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:
This course is graded on the Graduate Regular scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 793: *Research in Biology.* 1-3 credits.
Library, laboratory, or field investigation under supervisor's guidance. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May be repeated within the degree for a maximum 3 credits.
Recommended Prerequisite: 8 hours of graduate hours in BIOL and permission of instructor and chair.

Registration Restrictions:
Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Research

Grading:
This course is graded on the Graduate Special scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 798: *Master's Research Project.* 1-3 credits.
Experimental or theoretical research project chosen and completed under guidance of graduate faculty member. Comprehensive report acceptable to student's advisory committee is required. Notes: Students who take BIOL 793 may not receive more than 6 credits total for both BIOL 793 and 798. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May be repeated within the degree for a maximum 6 credits.
Recommended Prerequisite: Permission of instructor and chair.

Registration Restrictions:
Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Thesis

Grading:
This course is graded on the Satisfactory/No Credit scale. (https://catalog.gmu.edu/policies/academic/grading/)

BIOL 799: *Thesis.* 1-6 credits.
Thesis research under direction of supervisor. Notes: Students who take BIOL 793 may not receive more than 6 credits total for both BIOL 793 and 799. Offered by School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/). May be repeated within the degree.
Recommended Prerequisite: 8 graduate hours in BIOL and permission of instructor.

Registration Restrictions:
Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Thesis

Grading:
This course is graded on the Satisfactory/No Credit scale. (https://catalog.gmu.edu/policies/academic/grading/)