# APPLIED SCIENCE (APSC)

**APSC 100 Big Ideas in Applied Science (4 Credits)**
An exploration of significant questions and integrative concepts in Applied Science, their grounding in the process of scientific discovery and application, and their broader relevance to society. Designed for first-year students. Although topics vary, the courses also seek to improve students' communication skills beyond the written word.
*College Curriculum:* C100

**APSC 105 First-year Bioengineering & Design I (1 Credit)**
A $250 per credit fee will apply for students for whom initial enrollment begins in Fall 2025 or beyond. Two#semesters, research-based introduction to bioengineering. Students explore the nature, scope, and multidisciplinary character of the field and learn to apply engineering principles to biological problems and bio-inspired materials/design. Through analysis and discussion of current primary literature and guided activities in research methods (problem framing, experimental design, data analysis, ethics), students develop the skills to participate in faculty-mentored research. Emphasis on scientific reading and communication, computational/analytical tools appropriate to first-year students, and translating biological insight into engineering design propositions. Students enroll each term; the Fall emphasizes foundations and research literacy, while the Spring emphasizes proposal development and executing a mentored mini#project culminating in a poster or brief report.
*Additional fees apply*

**APSC 106 First-year Bioengineering & Design II (1 Credit)**
A $250 per credit fee will apply for students for whom initial enrollment begins in Fall 2025 or beyond. Two#semesters, research-based introduction to bioengineering. Students explore the nature, scope, and multidisciplinary character of the field and learn to apply engineering principles to biological problems and bio-inspired materials/design. Through analysis and discussion of current primary literature and guided activities in research methods (problem framing, experimental design, data analysis, ethics), students develop the skills to participate in faculty-mentored research. Emphasis on scientific reading and communication, computational/analytical tools appropriate to first-year students, and translating biological insight into engineering design propositions. Students enroll each term; the Fall emphasizes foundations and research literacy, while the Spring emphasizes proposal development and executing a mentored mini#project culminating in a poster or brief report.
Prerequisite(s): APSC 105
*Additional fees apply*

**APSC 150 First-Year Seminar (4 Credits)**
An exploration of a specific topic in Applied Science. A grade of C- or better fulfills the COLL 150 requirement. Although topics vary, the courses emphasize academic writing skills, reading and analysis of texts, and discussion.
*College Curriculum:* C150

**APSC 201 Introduction to Materials Science & Engineering (3 Credits)**
Based on fundamental chemistry and physics, this class discusses the structure, properties, processing, and applications of materials. Topics include structure, mechanical, electrical, and thermal properties of materials, as well as their applications.
Prerequisite(s): PHYS 101 or PHYS 101P or CHEM 103 or PHYS 101H
*College Curriculum:* C200
*Domain:* NQR

**APSC 202 Physiology for Bioengineers (3 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment begins in Fall 2025 or beyond. This course introduces the fundamental principles of human and mammalian physiology with an emphasis on systems most relevant to bioengineering applications. Students will explore how biological systems, such as the cardiovascular, respiratory, neural, and musculoskeletal systems, function as integrated, dynamic networks governed by physical and chemical laws. Through lectures, modeling, and data analysis, students will learn to quantify physiological processes and apply engineering approaches to understand and design biomedical solutions. The course bridges biology and engineering, preparing students to understand fundamental physiological processes in complex living systems.
Prerequisite(s): (BIOL 203 ) and (MATH 111 ) and (MATH 112 )
*Corequisite(s):* APSC 202L
*Additional fees apply*

**APSC 202L Physiology for Bioengineers Lab (1 Credit)**
A $250 per credit fee will apply for students for whom initial enrollment begins in Fall 2025 or beyond. This laboratory course accompanies APSC 202 Physiology for Bioengineers and provides hands-on experience with experimental techniques used to study human and mammalian physiological systems. Through guided experiments, data acquisition, and quantitative analysis, students will investigate core concepts in cardiovascular, respiratory, neuromuscular, and regulatory physiology. Emphasis is placed on measurement methods, signal processing, interpretation of biological data, as well as the connection between physiological principles and biomedical device design and use. Students will develop practical skills in instrumentation, experimental design, teamwork, and technical communication through lab reports and structured activities.
Prerequisite(s): (BIOL 203 ) and (MATH 111 ) and (MATH 112 )
*Corequisite(s):* APSC 202
*Additional fees apply*

**APSC 205 Second-year Bioengineering Research & Instrumentation (1 Credit)**
A $250 per credit fee will apply for students for whom initial enrollment begins in Fall 2025 or beyond. Two semesters, research-based introduction to the techniques and instrumentation commonly used in bioengineering. Students study the theory and practical use of microscopy/imaging (e.g., brightfield, fluorescence), analytical and spectroscopic methods, cell and tissue culture, microfluidics, genetic engineering, and thermal/mechanical materials testing. Emphasis is placed on experimental design, data acquisition, measurement, documentation, safety/ethics, and critical reading of current primary literature. Students gain hands-on experience by applying selected methods within faculty-supervised research projects appropriate to the sophomore level.
Prerequisite(s): APSC 105 and APSC 106
*Additional fees apply*

**APSC 206 Second-year Bioengineering Research & Instrumentation (2 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment begins in Fall 2025 or beyond. Two#semesters, research-based introduction to the techniques and instrumentation commonly used in bioengineering. Students study the theory and practical use of microscopy/imaging (e.g., brightfield, fluorescence), analytical and spectroscopic methods, cell and tissue culture, microfluidics, genetic engineering, and thermal/mechanical materials testing. Emphasis is placed on experimental design, data acquisition, measurement, documentation, safety/ethics, and critical reading of current primary literature. Students gain hands-on experience by applying selected methods within faculty-supervised research projects appropriate to the sophomore level.
Prerequisite(s): APSC 205
*Additional fees apply*

**APSC 210 Predictability (3 Credits)**
How do we make quantitative predictions of the future? This course will introduce complex systems, including chaotic and stochastic systems. Mathematical and computational methods for predicting behavior of complex systems will be discussed. Applications will include climate modeling and political and economic forecasting. Students will learn to think critically about predictions encountered in the media.
*College Curriculum:* C200
*Domain:* NQR

**APSC 213 Bioengineering Computation (3 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment begins in Fall 2025 or beyond. Bioengineering Computation provides a unified introduction to linear algebra, statistical analysis, and computational methods within the context of bioengineering. It surveys tools for biological modeling, signal analysis, and engineering design, with an emphasis on translating mathematical concepts into practical techniques applied to real-world engineering problems. Students will develop a working knowledge of vector spaces, matrix operations, linear systems, least-squares methods, and eigenvalue problems, alongside foundational statistical concepts including hypothesis testing, regression, statistical inference, and dimensionality reduction. Through coding-based assignments and applied projects, students gain hands-on experience in scientific computing and the analysis of high-dimensional datasets, such as gene expression profiles or biomechanical signals. The course is designed for students in engineering and the applied sciences. No prior programming experience is assumed; computational skills will be developed throughout the course.
Prerequisite(s): MATH 112 or MATH 132
*Corequisite(s):* APSC 213L
*Additional fees apply*

**APSC 213L Bioengineering Computation Lab (1 Credit)**
A $250 per credit fee will apply for students for whom initial enrollment begins in Fall 2025 or beyond. This laboratory accompanies APSC 213 and focuses on implementing computational and statistical methods used in bioengineering. Through guided programming exercises and structured lab modules, students apply matrix computations, regression, hypothesis testing, and dimensionality reduction techniques to biological datasets. Students gain practical experience in scientific programming, reproducible workflows, and collaborative problem-solving while working with real-world bioengineering data. No prior programming experience is assumed.
*Corequisite(s):* APSC 213
*Additional fees apply*

**APSC 251 Engineering Design (3 Credits)**
Introduction to engineering design with a focus on mechanical systems. Students develop design skills and engineering intuition through hands-on projects, including design-build activities, engineering dissection, and failure analysis. Topics include the design process, mechanical design fundamentals, an introduction to finite element analysis (FEA), and ethical considerations in engineering practice. Projects utilize makerspace tools such as 3D printing and laser cutting and emphasize iterative design through making, testing, and reflection.
Prerequisite(s): PHYS 101P or PHYS 101 or PHYS 101H
*College Curriculum:* C200
*Domain:* NQR

**APSC 301 Mechanics of Materials (3 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment at W&M begins in Fall 2025 or later. Introduction to the concepts of stress and strain applied to analysis of structures. Development of problem solving ability for modeling and analysis of simple structures subject to axial, torsional, and bending loads, and physical intuition of realistic outcomes.
*Additional fees apply*

**APSC 302 Biomechanics (3 Credits)**
A $250 per credit fee will apply for students who matriculate at W&M in Fall 2025 or later. This course teaches the biomechanics of how forces, motion, and material properties influence the mechanical behavior of biological tissues, organs, and limbs. Students analyze the mechanical behavior of biological tissues and structures using principles of solid and fluid mechanics. Topics include stress and strain analysis, viscoelasticity, kinematics of human and animal movement, joint and muscle mechanics, and the design of biomimetic and prosthetic systems. The course emphasizes quantitative methods including computational modeling, experimental measurement, and data analysis. Through lectures, problem-solving, and laboratory applications, students gain insight into how engineering principles can be applied to understand and improve biological function and performance.
Prerequisite(s): APSC 301
*Additional fees apply*

**APSC 303 Engineering Life: Scientific, Cultural, and Ethical Aspects of Synthetic Biology (3 Credits)**
The course will entail participation in the iGEM (International Genetically Engineered Machine) team and competition over the summer and fall semesters. Students will design and build a novel genetic device and learn about the scientific, ethical, and cultural aspects of synthetic biology.
*College Curriculum:* C30C

**APSC 304 Energy and Thermodynamics (3 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment at W&M begins in Fall 2025 or later. Basic principles involved in energy production, distribution and storage: engines, generators, photosynthesis, fossil fuels, solar energy, photovoltaics, thermoelectrics, geothermal, wind/hydro power, fuel cells, batteries, nuclear energy, and the power grid. Includes the formulation of the first and second laws of thermodynamics; energy conservation; concepts of equilibrium, temperature, energy, and entropy; equations of state; processes involving energy transfer as work and heat; reversibility and irreversibility; closed and open systems; and cyclic processes.
Prerequisite(s): APSC 301
*Additional fees apply*

**APSC 305 Third-year Bioengineering Applications: Professional Development (2 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment begins in Fall 2025 or beyond. Workshop#style course developing professional competencies for bioengineers. Students practice technical communication (briefs, memos, posters, oral presentations), team collaboration, project planning and risk management, and foundational awareness of standards/regulatory context relevant to bioengineering (e.g., ISO/ASTM concepts, basic FDA pathways). Emphasis on data integrity and reproducibility, literature synthesis, and career preparation (résumé/portfolio, networking, interviewing, graduate#school pathways). Deliverables culminate in a polished professional portfolio anchored in bioengineering case studies.
Prerequisite(s): APSC 206
*Additional fees apply*

**APSC 306 Third-year Bioengineering Applications: Ethics and Engineering (2 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment begins in Fall 2025 or beyond. Discussion-driven course on professional, societal, and research ethics in bioengineering. Students analyze real-world cases spanning medical devices and biomaterials, data ethics and privacy (including AI/ML in biomedicine), human/animal research protections (IRB/IACUC concepts), equity and access to healthcare technologies, environmental sustainability, risk/benefit and hazard analysis, and dual-use concerns. Emphasis on ethical decision-making frameworks, stakeholder engagement, and effective communication of ethical justifications in technical settings. Students practice structured case analysis, policy/standards interpretation, and team deliberation, culminating in a concise position paper and oral brief.
Prerequisite(s): APSC 305
*Additional fees apply*

**APSC 307 Biotransport Phenomena (3 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment begins in Fall 2025 or beyond. Biotransport is a key course in bioengineering and biomedical engineering curricula and aligns with learning objectives for ABET (Accreditation Board for Engineering and Technology). This course is being created to teach the fundamental principles of transport phenomena—momentum, mass, and energy transport—in biological systems. Emphasis is placed on applying conservation laws, constitutive relations, and scaling analysis to physiological processes such as blood flow, solute transport, cellular interactions, and organ-level transport. Students will develop quantitative models and apply them to biomedical applications.
Prerequisite(s): MATH 212 or MATH 213
*Additional fees apply*

**APSC 307L Biotransport Phenomena Lab (1 Credit)**
A $250 per credit fee will apply for students for whom initial enrollment begins in Fall 2025 or beyond. This is the 1-credit laboratory class associated with the main lecture class APSC 307 Biotransport Phenomena, which is provides practical experience and training with numerical modeling, simulation, visualization, and data analysis for momentum, mass, and energy transport in biological systems. Through guided computational exercises, short coding assignments, and a final project, students implement and analyze models of diffusion, flow, reaction–transport, and physiological transport processes. The emphasis is on translating transport theory into reproducible computational workflows and on interpreting quantitative results in biological context.
*Corequisite(s):* APSC 307
*Additional fees apply*

**APSC 311 Engineering the Cell: A Systems Approach (3 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment begins in Fall 2025 or beyond. This course explores how complex cellular behaviors emerge from interconnected molecular networks and how these systems can be modeled, analyzed, and engineered. The course emphasizes computational and experimental tools for measuring, perturbing, and engineering cellular systems. Through case studies and project-based learning, students develop the skills to design and evaluate engineered cellular systems with applications in medicine, biotechnology, and sustainability.
Prerequisite(s): BIOL 203 )
*Additional fees apply*

**APSC 311L Engineering the Cell: A Systems Approach Lab (1 Credit)**
A $250 per credit fee will apply for students for whom initial enrollment begins in Fall 2025 or beyond. This laboratory course accompanies APSC 311 Engineering the Cell: A Systems Approach and provides hands-on experience with experimental and computational techniques used to measure, analyze, and engineer cellular systems. Students will apply methods such as quantitative fluorescence imaging, gene expression analysis, controlled perturbation of cellular pathways, and computational modeling of regulatory networks. Through structured lab modules and guided projects, students will collect and interpret multi-parameter datasets, compare experimental results with model predictions, and evaluate sources of biological variability. Emphasis is placed on experimental design, reproducibility, data integration, and critical assessment of engineered cellular behaviors. The laboratory reinforces systems-level thinking and prepares students to translate theoretical network models into experimentally testable and engineerable cellular functions analyzed at a systems level.
*Corequisite(s):* APSC 311
*Additional fees apply*

**APSC 327 Introduction to Laser Biomedicine (3 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment at W&M begins in Fall 2025 or later. The course will build a foundation for understanding the use of lasers in biology and medicine. There will be particular emphasis on laser beam interactions with human tissue for diagnosis, therapy, and surgery, with additional attention to optical coherence tomography, two-photon microscopy, fluorescent imaging, optical tweezers, and refractive surgery.
*Additional fees apply*

**APSC 333 Engineered and Biogenic Hierarchical Materials (3 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment begins in Fall 2025 or beyond. Introduction to Biomaterials explores how structure and chemistry at multiple length scales give rise to the remarkable properties of biological tissues and to the performance of synthetic materials used in medicine. The course begins with a materials-science view of biogenic tissues—bone, cartilage, tendon, shell, skin, and other natural composites—emphasizing their hierarchical organization from molecules to organs and the resulting mechanical and functional behavior. Building on this foundation, we then examine engineered biomaterials for medical applications, including metals, ceramics, polymers, hydrogels, and bioinspired materials, and how they interact with cells, tissues, and the immune system. Case studies from orthopedics, cardiovascular devices, soft-tissue repair, drug delivery, and tissue engineering illustrate how principles learned from natural materials inform the design of safer and more effective biomedical implants and devices.
Prerequisite(s): APSC 201
*Additional fees apply*

**APSC 350 Topics in Applied Science (1-3 Credits)**
Selected topics in Applied Science. May be repeated if topics vary.

**APSC 351 Cellular Biophysics & Modeling (3 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment at W&M begins in Fall 2025 or later. An introduction to simulation and modeling of dynamic phenomena in cell biology and neuroscience. Topics covered will include the biophysics of excitable membranes, the gating of voltage- and ligandgated ion channels, intracellular calcium signaling, and electrical bursting in neurons.
Prerequisite(s): (MATH 111 (may be taken concurrently) or MATH 131 (may be taken concurrently)) and (BIOL 203 (may be taken concurrently) or BIOL 225 (may be taken concurrently)) and BIOL 345

**APSC 371 Matroids: The Value of Abstraction (3 Credits)**
Do you see linear (in)dependence all around you? A matroid is a combinatorial structure that abstracts and generalizes the notion of linear independence in vector spaces. Matroid theory is a vibrant area of research that provides a unified way to understand graph theory, linear algebra, combinatorics, and finite geometry. This course is an accessible introduction to matroids and the variety of settings in which matroids arise.
Prerequisite(s): MATH 211 or MATH 109

**APSC 377 Bioengineering and Synthetic Biology (3 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment begins in Fall 2025 or beyond. An introduction to the principles of bioengineering with a focus on the fundamentals of synthetic biology and biomolecular engineering. The course will cover current applications of synthetic biology to health, biotechnology, environment, sustainability, and bio-inspired materials. Emphasis will be placed on hands-on skills in biological circuit/device design and evalution.
Prerequisite(s): BIOL 203
*Additional fees apply*

**APSC 401 Research Applied Science (1-3 Credits)**
Independent experimental or computational research under supervision of a faculty member. Hours to be arranged.

**APSC 402 Research Applied Science (1-3 Credits)**
Independent experimental or computational research under supervision of a faculty member. Hours to be arranged.

**APSC 403 Independent Study in Applied Science (1-3 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment at W&M begins in Fall 2025 or later. Independent study under supervision of a faculty member. Hours to be arranged.
*Additional fees apply*

**APSC 404 Independent Study in Applied Science (1-3 Credits)**
Independent study under supervision of a faculty member. Hours to be arranged.

**APSC 406 Bio-Inspired Design: How to Grow (Almost) Anything (4 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment begins in Fall 2025 or beyond. “How to Grow (Almost) Anything” explores how scientists can engineer, program, and design living systems. It blends foundational biotechnology training with creative design projects that use biological-inspired design to address sustainability, health, manufacturing, and art. The course combines local laboratory experiences performed at W&M with ongoing collaboration with the MIT Media Lab, ending with a final project showcased both locally and in the MIT Global Symposium. Students will engage through science (molecular biology and genetics), design (biofabrication and materials), and ethics (societal and environmental context).
Prerequisite(s): (BIOL 203 ) or (CSCI 141 ) or APSC 251
*Additional fees apply*

**APSC 422 Introduction to Materials Characterization (3 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment at W&M begins in Fall 2025 or later. Science and technology of determining surface and bulk structure and composition of organic and inorganic materials under instrument and ‘in-situ’ conditions. Examples chosen appropriate to class interests.
Prerequisite(s): PHYS 201 or CHEM 103
*Additional fees apply*

**APSC 423 Interface Engineering (3 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment begins in Fall 2025 or beyond. The physical chemistry and mechanics of interfaces is introduced, focusing on how molecular-scale forces and surface phenomena control the behavior of real engineering systems. Students will develop a rigorous understanding of interfacial thermodynamics, surface and interfacial tension, adsorption, wetting, and capillarity, and then extend these concepts to colloidal stability, surfactant self-assembly, emulsions, foams, thin films, and lubrication. The course emphasizes how van der Waals, electrostatic, steric, hydration, and hydrophobic forces give rise to measurable interfacial properties, and how these can be engineered in applications such as coatings, microfluidics, separations, nanostructured materials, and biointerfaces. Case studies link fundamental principles to practical design of interfacial systems in chemical, materials, and biological engineering.
Prerequisite(s): APSC 201 or CHEM 103
*Additional fees apply*

**APSC 424 Supercomputing for Science (3 Credits)**
Introduces computational data skills for scientists with a focus on big-data project management, command-line usage, and pipeline development. Develops competence in interacting with a remote high-performance computing environment. Applies the principles of project organization and reproducibility to create and benchmark analysis pipelines. Develops competence in installing, parsing, and linking novel computational tools.
*Additional fees apply*

**APSC 427 Biomedical Materials and Devices (3 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment at W&M begins in Fall 2025 or later. The class covers the physical and chemical properties of the different types of biogenic biomaterials, biomineralization, and the hierarchical organization of biological materials. The class further addresses polymers, ceramics, and metals for biomedical applications. Functional uses of materials and devices in medical applications, and biocompatibility. Design of multicomponent and multi-functional materials and devices. Implants for cardiovascular, drug delivery, prosthetic, and health monitoring applications, covering hard and soft tissues. Tissue engineering and regenerative medicine.
Prerequisite(s): APSC 201 and BIOL 225 and CHEM 103 and CHEM 103L
*Additional fees apply*

**APSC 428 Scanning Probe Nanoengineering: Visualization and Manipulation of Matter at Atomic Scales (3 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment at W&M begins in Fall 2025 or later. The ability to engineer smaller and smaller structures and devices has enabled great progress across many disciplines ranging from microelectronics to biomedicine. Scanning probe techniques, including scanning tunneling microscopy and atomic force microscopy, have been transformational and inspiring tools to visualize, study, and govern the nanocosmos: they have allowed us not only to image structures of atomic dimensions but also helped us to measure molecular-scale forces and interactions, and they have enabled manipulation, building, and milling of things at the nanoscale. This class covers the fundamental relationships governing the interactions of objects and structures at such small length scales. Connections are made between nanoscale behavior of materials and their practical consequences for everyday macroscale phenomena. Designs, imaging modes and capabilities of the scanning probe microscopes are discussed, as well as their application for nanoengineering and sensing. These techniques are discussed in the context of many other micro- and nanoscale manufacturing methods, which are also introduced. The class includes hands-on computer simulations and a hands-on tour of a state-of-the-art scanning probe microscopy laboratory.
Prerequisite(s): APSC 201 or PHYS 201
*Additional fees apply*

**APSC 429 Optical Microscopy: Fundamentals & Applications (3 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment at W&M begins in Fall 2025 or later. For centuries, optical microscopy has been an essential tool for fundamental research and applications in physical sciences, life sciences, and engineering alike. This course first introduces the fundamentals of optics necessary to rigorously understand the imaging and contrasting mechanisms of optical microscopes and their capabilities. Opportunities, limitations, and practical aspects of optical imaging are then discussed. The course then treats optical microscopes, their different modes of operation, and their application. Some of the latest technological developments and advancements of light microscopy are introduced.
Prerequisite(s): PHYS 101 or PHYS 101P or PHYS 101H or PHYS 107 or CHEM 103 or BIOL 203 or BIOL 225
*Additional fees apply*

**APSC 430 Biofabrication in Tissue Engineering (3 Credits)**
A $250 per credit fee will apply for students for whom initial enrollment at W&M begins in Fall 2025 or later. This course explores the rapidly evolving field of biofabrication, focusing on its application in tissue engineering to design and create advanced tissue constructs. Biofabrication integrates biomaterials, living cells, and cutting-edge fabrication techniques to engineer structures that mimic native tissues and support tissue regeneration. Through lectures, discussions, and critical reviews, students will learn about key methods, including 3D bioprinting, hydrogel fabrication, and decellularization, for developing and selecting bioinks. The course will delve into the interdisciplinary principles of biofabrication, covering material science, cellular biology, and engineering design. Topics include scaffold design, the role of biomaterials such as hydrogels and thermal plastics, and strategies to address challenges like vascularization and mechanical stability. Students will also examine real-world applications in regenerative medicine, from bone and cartilage repair to organoid development, while exploring the future of biofabrication, including emerging technologies and bioink innovations. By the end of the course, students will gain a deep understanding of biofabrication techniques, critical considerations in tissue engineering, and the challenges and opportunities shaping the field's future. This course is designed to engage students from diverse disciplines, including biology, chemistry, and applied science, who are eager to bridge the gap between engineering and biology to address pressing challenges in healthcare and regenerative medicine.
Prerequisite(s): BIOL 203 and CHEM 103 and CHEM 103L
*Corequisite(s):* APSC 430L
*Additional fees apply*

**APSC 430L Biofabrication & Tissue Engineering Laboratory (1 Credit)**
A $250 per credit fee will apply for students for whom initial enrollment begins in Fall 2025 or beyond. Hands-on laboratory accompanying APSC 430/530 in which students design, fabricate, and evaluate tissue-engineered constructs using pneumatic extrusion bioprinters and core biofabrication methods, CAD/toolpath workflows, cell—material handling under sterile technique, and basic characterization. Working in teams on a start-to-finish project, students propose, print, and assess tissue-mimetic scaffolds aligned with regenerative-medicine applications, comparing bioink formulations and scaffold architectures while quantifying print fidelity and flow behavior.
Prerequisite(s): APSC 430 (may be taken concurrently) and (BIOL 203 ) and BIOL 203L and (CHEM 103 ) and CHEM 103L
*Additional fees apply*

**APSC 431 Applied Cellular Neuroscience (3 Credits)**
We examine cellular neurophysiology including membrane potentials, ion channels and membrane permeability, electrical signaling and cable properties, synaptic transmission, neuromodulation, and second messenger systems. We apply these concepts to motor control, homeostatic regulation, special senses.
Prerequisite(s): BIOL 345

**APSC 432 Applied Systems Neuroscience (3 Credits)**
We explore how behaviors arise due to multiple levels of organization in the nervous system. Topics include: reflexes, central pattern generator networks, neural control of breathing, the neural control of appetite, body weight and obesity, and the neuropharmacology of nicotine addiction.
Prerequisite(s): BIOL 345 and BIOL 447 (may be taken concurrently) and PSYC 313

**APSC 440 Respiratory Neurobiology (3 Credits)**
We examine respiration and the neural circuits that generate and control it. We investigate the physical plant (organs, muscles, etc.) that produces breathing movements to ventilate the lungs, as well as the fundamental tenets of respiratory physiology. Next we move from the physical plant for breathing to its underlying neural circuitry in the brainstem, which predominantly controls the behavior. We examine brainstem respiratory microcircuits at molecular, cellular, and network levels of analysis. Additional material includes sensorimotor integration particularly associated with blood-gas homeostasis, pH regulation, and lung-mechanoreceptor feedback on respiratory control microcircuits. Finally, we examine how the breathing neural control centers interface with the emotional brain, which underlies both the calming and arousing effects of breathing.
Prerequisite(s): BIOL 345 and APSC 351
*College Curriculum:* C400

**APSC 450 Computational Neurosci (3 Credits)**
Computational function of hippocampus, thalamus, basal ganglia, visual cortex, and central pattern generators of hindbrain and spinal cord emphasizing how experiment and theory complement each other in systems neuroscience. Relevant mathematical modeling and computer simulation techniques will be taught.
Prerequisite(s): APSC 351
*College Curriculum:* C400

**APSC 453 Science and Authority (3 Credits)**
Pre-Req: Permission of instructor. (The course is designed for juniors/seniors STEM majors.) Science & Authority considers modern science as source for cultural authority, for better and for worse. Science is a powerful public commodity, but are its presuppositions self-evident? What makes science a legitimate cultural authority? How is the methodology of natural science extended in the human sciences? We will examine misuses of scientific authority and science gone/going wrong, both historical (e.g., tobacco, eugenics, scientific racism) and contemporary (e.g., propaganda, surveillance, fraud, dead-end science). We will evaluate postmodern critiques of science and courageously engage controversial science and society issues, such as science denial, religion-denying scientism, and the tendency of scientific discourse and "objectivity" to justify dominant cultures and preserve the status quo.
*College Curriculum:* C400

**APSC 455 Population Dynamics (3 Credits)**
An introduction to population dynamics and bifurcation theory. Classic population models including the logistic map, predator-prey systems, and epidemic models will be used to motivate dynamics concepts such as stability analysis, bifurcations, chaos, and Lyapunov exponents.
Prerequisite(s): MATH 302

**APSC 457 Computational Materials Design (3 Credits)**
Application of computational methods to the design of materials with desired structure and performance. The methods will span multiple length and time scales, including molecular dynamics simulations, coarse graining methods, Monte Carlo simulations, finite element approaches, stochastic methods for optimization and sampling, and computational thermodynamics to model structural and thermal properties. Ways to connect methods effective at different length scales into coherent, true multi-scale solutions and applications, including experimental validation methods, will be emphasized. Lectures will be complemented by computer labs with hands-on exercises.
Prerequisite(s): APSC 201 and APSC 301 and MATH 302 and PHYS 256

**APSC 460 Topics in Applied Science (1-3 Credits)**
Topics in Applied Science.

**APSC 471 Capstone Engineering Design Senior Project (3 Credits)**
A full-year sequence focused on engineering design processes, professional practices and expectations (e.g. communication, teamwork, and ethics), project management, introduction technical business and entrepreneurial practices, design communication, and an overview of careers opportunities in applied physics and engineering. The centerpiece of the project is a year-long team-based faculty-mentored applied design project. The course includes a 75 minute weekly classroom meeting, weekly team meetings with mentors, and the expectation substantial out-of-class involvement.

**APSC 472 Capstone Engineering Design Senior Project (3 Credits)**
A full-year sequence focused on engineering design processes, professional practices and expectations (e.g. communication, teamwork, and ethics), project management, introduction technical business and entrepreneurial practices, design communication, and an overview of careers opportunities in applied physics and engineering. The centerpiece of the project is a year-long team-based faculty-mentored applied design project. The course includes a 75 minute weekly classroom meeting, weekly team meetings with mentors, and the expectation substantial out-of-class involvement.
Prerequisite(s): APSC 471
*College Curriculum:* C400

**APSC 474 Continuum Mechanics (3 Credits)**
This course covers the basic concepts of mechanics and thermodynamics of continua, including conservation of mass, momentum and energy; stresses and strains; viscous fluids, elasticity and thermal stresses; viscoelasticity and creep; ultimate failure; introduction to plasticity; elastic waves and elastodynamics.

**APSC 480 Directed Research Medical Chemistry and Structural Biology of Neuroimmune Peptides of Marine Origin (3 Credits)**
Directed Research in Medical Chemistry and Structural Biology of Bioactive Marine Compounds A new interdisciplinary capstone course designed to encompass concepts and methods from biology, chemistry, and physics, and investigate structure-function relationships of novel bioactive marine compounds. Macromolecular compounds essential for the immunity of fish species living in the Chesapeake Bay will be featured in research projects designed by students. The process will involve learning relevant concepts in medicinal chemistry and structural biology, and bringing to biochemical and biophysical analysis of neuroimmune peptides that interact with cellular components, such as cell membranes and nucleic acids. The projects will be designed to highlight biochemical and biophysical concepts that are fundamental to structure-function relationships and will provide training in scientific methods such as purification of peptides, reconstitution under native-like conditions, and quantitative analysis of functional and structural properties. Specific methods will include liquid chromatography, circular dichroism, high-resolution solid-state nuclear magnetic resonance. Students will also broaden the scope of their projects by considering the ramifications of their research on our local society. Connections to issues related to the fishing industry, environmental quality, the impact of human activities on marine habitats, and coastal policy will be encouraged.
Prerequisite(s): BIOL 314 or BIOL 414 or CHEM 314 or CHEM 414
*College Curriculum:* C400

**APSC 485 Senior Capstone (3 Credits)**
Independent study including experimental, computational or theoretical research and a substantial thesis. The student will be expected to work closely with an advisor both in the actual research and in preparation of an acceptable thesis. If satisfactorily completed, this course will meet the major writing requirement for self-designed majors.
Prerequisite(s): APSC 401 or APSC 402 or APSC 403 or APSC 404
*College Curriculum:* C400

**APSC 490 Studies in Applied Science (1-5 Credits)**
Advanced or specialized topics in Applied Science. Subjects, prerequisites, credits and instructors may vary from year to year.

**APSC 495 Honors (3 Credits)**
Independent laboratory or computational research in applied science under the supervision of a faculty member. Students are required to write an Honors thesis based on a review of the literature and their research. For College provisions governing the Admission to Honors, see catalog section titled Honors and Special Programs. Students admitted to EPAD Honors will fully participate in a team capstone EPAD project (PHYS/APSC 471 and 472), and in addition will conduct independent research and design work that contributes toward the group project goals. Students are also required to contribute an individual single-authored chapter(s) to the final team report, as well as to present a comprehensive oral examination on their work to an honors committee. If successfully completed, this course will satisfy the College writing requirement. In addition to the EPAD track major course requirements, Honors students will be required to complete two credit hours of independent research during their senior year (APSC401/402 and PHYS455) for their individual research contributions. For College provisions governing the Admission to Honors, see the catalog section titled Honors and Special Programs.

**APSC 496 Honors (3 Credits)**
Independent laboratory or computational research in applied science under the supervision of a faculty member. Students are required to write an Honors thesis based on a review of the literature and their research. For College provisions governing the Admission to Honors, see catalog section titled Honors and Special Programs. Students admitted to EPAD Honors will fully participate in a team capstone EPAD project (PHYS/APSC 471 and 472), and in addition will conduct independent research and design work that contributes toward the group project goals. Students are also required to contribute an individual single-authored chapter(s) to the final team report, as well as to present a comprehensive oral examination on their work to an honors committee. If successfully completed, this course will satisfy the College writing requirement. In addition to the EPAD track major course requirements, Honors students will be required to complete two credit hours of independent research during their senior year (APSC401/402 and PHYS455) for their individual research contributions. For College provisions governing the Admission to Honors, see the catalog section titled Honors and Special Programs.
*College Curriculum:* C400

**APSC 498 Internship (1-10 Credits)**
Research in accelerator science, atmospheric science, polymer science or quantitative materials characterization at the NASA-Langley