

BMSC 235M. Clinical Neurosciences I: Clinical Aspects (4) Lecture, 10 hours per quarter; discussion, 16 hours per quarter; laboratory, 27 hours per quarter; clinic, 15 hours per quarter. Prerequisite(s): BMSC 234; BMSC 234M; concurrent enrollment in BMSC 235. Covers aspects of anatomy, doctoring, and patient examination. Includes problem-based learning that supports the material covered in BMSC 235. Students using this course to fulfill requirements for the B.S. degree in Biomedical Sciences receive a letter grade; other students receive a Satisfactory (S) or No Credit (NC) grade. **D. Ethell, I. Ethell**

BMSC 236. Foundations of Medicine II (10) Lecture, 93 hours per quarter; discussion, 8 hours per quarter; laboratory, 10 hours per quarter. Prerequisite(s): second-year standing in medical school or the graduate program in Biomedical Sciences or consent of instructor; BMSC 235. Covers the pathophysiology, pharmacology, physical diagnosis and treatment of infectious diseases, clinical hematology and oncology, and epidemiology and clinical reasoning skills. Instruction involves weekly cases and is presented through lectures and discovery in small group discussions, laboratories, and conferences. Students using this course to fulfill requirements for the Ph.D. degree in Biomedical Sciences receive a letter grade; other students receive a Satisfactory (S) or No Credit (NC) grade. **Schiller**

BMSC 236M. Foundations of Medicine II: Clinical Aspects (4) Discussion, 28 hours per quarter; clinic, 42 hours per quarter. Prerequisite(s): BMSC 235; BMSC 235M; concurrent enrollment in BMSC 236. Covers aspects of doctoring and patient examination. Includes problem-based learning that supports the material covered in BMSC 236. Graded Satisfactory (S) or No Credit (NC). **Schiller**

BMSC 237. Gastrointestinal, Endocrine, and Reproductive Health II (13) Lecture, 80 hours per quarter; clinic, 42 hours per quarter; discussion, 34 hours per quarter; laboratory, 18 hours per quarter. Prerequisite(s): second-year standing in medical school; BMSC 236. Advanced clinical perspective of anatomy, biochemistry, pathophysiology, physical diagnosis, and imaging associated with gastrointestinal, endocrine, and reproductive health. Instruction involves weekly cases and is presented through lectures (usually two hours/day) and discovery in small group discussions, laboratories, clinical skills development, and conferences. Graded Satisfactory (S) or No Credit (NC). **Carson, Walker**

BMSC 238. Clinical Neurosciences II (10) Lecture, 74 hours per quarter; discussion, 22 hours per quarter; laboratory, 6 hours per quarter; clinic, 24 hours per quarter. Prerequisite(s): BMSC 237. Covers advanced clinical perspective of neurology, neuropathology, psychiatry, and neuropharmacology that is coordinated with physical and psychological clinical skills development. Involves weekly cases and is presented through lectures, laboratories, small group discussions, conferences, and clinic visits. Graded Satisfactory (S) or No Credit (NC). **Johnson**

BMSC 239. Cardiovascular, Renal, and Respiratory Sciences II (12) Lecture, 62 hours per quarter; clinic, 33 hours per quarter; discussion, 44 hours per quarter; laboratory, 36 hours per quarter. Prerequisite(s): second-year standing in medical school; BMSC 238. Advanced clinical perspective of anatomy, physiology, pathophysiology, physical diagnosis, and imaging in the cardiovascular, renal, and respiratory sciences. Instruction involves weekly cases and is presented through lectures and discovery in small group discussions, laboratories, clinical skills development, and conferences. Graded Satisfactory (S) or No Credit (NC). **Carson, Walker**

BMSC 240. Integrative Human Biology and Disease (3) Discussion, 30 hours per quarter. Prerequisite(s): second-year standing in medical school; BMSC 239. Reviews concepts of human biology and disease covered in BMSC 231, BMSC 231M, BMSC 232, BMSC 232M, BMSC 233, BMSC 233M, BMSC 234, BMSC 234M, BMSC 235, BMSC 235M, BMSC 236, BMSC 236M, BMSC 237, BMSC 238, and BMSC 239. Graded Satisfactory (S) or No Credit (NC). **Shankel**

BMSC 251. Colloquium in Biomedical Sciences (1) Colloquium, 1 hour. Prerequisite(s): graduate standing in Biomedical Sciences or consent of instructor. Specialized discussions by staff and students of current research topics in biomedical sciences. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

BMSC 252. General Seminar in Biomedical Sciences (1) Seminar, 1 hour. Prerequisite(s): graduate standing. Oral presentations by staff and visiting scholars on current research topics in the field of biomedical sciences. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

BMSC 254. Graduate Seminar in Biomedical Sciences (1) Seminar, 1 hour. Prerequisite(s): graduate standing. Oral reports by graduate students on current research topics in biomedical sciences. Students who present a seminar receive a letter grade; other students receive a Satisfactory (S) or No Credit (NC) grade. Course is repeatable.

BMSC 260A. Topics in Translational Biomedical Research (2) F Lecture, 2 hours per quarter; discussion, 18 hours per quarter. Prerequisite(s): consent of instructor or graduate advisor; concurrent enrollment in BMSC 232. A survey of the mechanisms of common human diseases at the molecular, cellular and organ system levels and the multidisciplinary approaches used for their investigation. Instructional components include lectures, discovery in problem-based learning sessions, and independent study. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor. **Byus, Lytle**

BMSC 260B. Topics in Translational Biomedical Research (2) Lecture, 2 hours per quarter; discussion, 18 hours per quarter. Prerequisite(s): consent of instructor or graduate advisor; concurrent enrollment in BMSC 233. A survey of the mechanisms of common human diseases at the molecular, cellular and organ system levels and the multidisciplinary approaches used for their investigation. Instructional components include lectures, discovery in problem-based learning sessions, and independent study. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor. **Schiller, Shyy**

BMSC 260C. Topics in Translational Biomedical Research (2) Lecture, 2 hours per quarter; discussion, 18 hours per quarter. Prerequisite(s): consent of instructor or graduate advisor; concurrent enrollment in BMSC 234 and BMSC 235. A survey of the mechanisms of common human diseases at the molecular, cellular and organ system levels and the multidisciplinary approaches used for their investigation. Instructional components include lectures, discovery in problem-based learning sessions, and independent study. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor. **Lo, Carson**

BMSC 261. Methods in Biomedical Research (1) Tutorial, 3 hours. Prerequisite(s): graduate standing in Biomedical Sciences or consent of instructor. Experimental studies on a specific laboratory technique involved in the study of human disease. Graded Satisfactory (S) or No Credit (NC). Course is repeatable to a maximum of 3 units. **Carson**

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BMSC 290. Directed Studies (1-6) Outside research, 3-18 hours. Prerequisite(s): graduate standing in Biomedical Sciences or consent of instructor. Experimental or literature studies on specifically selected topics under direction of a staff member. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

BMSC 297. Directed Research (1-6) Outside research, 3-18 hours. Prerequisite(s): graduate standing in Biomedical Sciences or consent of instructor. Directed research in biomedical sciences performed prior to advancement to candidacy in preparation for dissertation projects. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

BMSC 299. Research for Dissertation (1-12) Outside research, 3-36 hours. Prerequisite(s): graduate standing in Biomedical Sciences or consent of instructor. Original research in the area selected for the advanced degree. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

Professional Course

BMSC 302. Directed Teaching (2) Practicum, 6 hours. Prerequisite(s): graduate standing in Biomedical Sciences. Supervised teaching in medical school courses. Required for all Biomedical Sciences graduate students. Fulfills the teaching portion of the teaching requirement for the Ph.D.; four units are required for the Ph.D. Graded Satisfactory (S) or No Credit (NC). Course is repeatable to a maximum of 6 units.

Biomedical Sciences Graduate Program

Subject abbreviation: BMSC
Division of Biomedical Sciences

Craig V. Byus, Ph.D.,
Dean and Program Director
Program Office, 1001 Batchelor Hall North
(800) 735-0717 or (951) 827-5621
biomed.ucr.edu/graduate

Professors

Peter Atkinson, Ph.D. (Entomology)
Bahman Anvari, Ph.D. (Bioengineering)
Craig V. Byus, Ph.D. (Biomedical Sciences/
Biochemistry)
David A. Eastmond, Ph.D. (Cell Biology
and Neuroscience)
Ted Garland, Ph.D. (Biology)
David A. Johnson, Ph.D. (Biomedical Sciences)
Cindy Larive, Ph.D. (Chemistry)
Xuan Liu, M.D., Ph.D. (Biochemistry)
David Lo, M.D., Ph.D. (Biomedical Sciences)
Manuela M. Martins-Green, Ph.D. (Cell Biology
and Neuroscience)
Dimitrios Morikis, Ph.D. (Bioengineering)
Michael C. Pirrung, Ph.D. (Chemistry)
Edward G. Platzer, Ph.D. (Biology/Nematology)
Paul M. Quinton, Ph.D. (Biomedical Sciences)
Victor Rodgers, Ph.D. (Bioengineering)
Neal L. Schiller, Ph.D. (Biomedical Sciences)
Jerome Schultz, Ph.D. (Bioengineering)
John Y.-J. Shyy, Ph.D. (Biomedical Sciences)
B. Glenn Stanley, Ph.D. (Cell Biology and Neuro-
science/Psychology)
Daniel S. Straus, Ph.D. (Biomedical Sciences/
Biology)
Ameae M. Walker, Ph.D. (Biomedical Sciences)

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Professors Emeriti

Helen L. Henry, Ph.D. (Biochemistry)
Richard A. Luben, Ph.D. (Biomedical Sciences/
Biochemistry)
Anthony W. Norman, Ph.D. (Biomedical Sciences/
Biochemistry)
Michael B. Sterman, M.D. (Biomedical Sciences)

Associate Professors

Monica J. Carson, Ph.D. (Biomedical Sciences)
Margarita C. Currás-Collazo, Ph.D. (Cell Biology
and Neuroscience)
Scott N. Currie, Ph.D. (Cell Biology
and Neuroscience)
Kathryn DeFea, Ph.D. (Biomedical Sciences)
Iryna M. Ethell, Ph.D. (Biomedical Sciences)
Christian Y. Lytle, Ph.D. (Biomedical Sciences)
Morris Maduro, Ph.D. (Biology)

Assistant Professors

Douglas Altshuler, Ph.D. (Biology)
Douglas W. Ethell, Ph.D. (Biomedical Sciences)
Kelly Huffman, Ph.D. (Psychology)
Edward Korzus, Ph.D. (Psychology)
Karine Le Roch, Ph.D. (Cell Biology and
Neuroscience)
Jiayu Liao, Ph.D. (Psychology)
Ernest Martinez, Ph.D. (Biochemistry)
Khaleel Razak, Ph.D. (Psychology)
Wendy Saltzman, Ph.D. (Biology)
Noboru Sato, Ph.D. (Cell Biology and
Neuroscience)
Emma Wilson, Ph.D. (Biomedical Sciences)
Laura Zanello, Ph.D. (Biochemistry)

Graduate Program

The multidisciplinary interdepartmental graduate program in Biomedical Sciences offers graduate instruction leading to a Ph.D. degree or a combined M.D.–Ph.D. degree.

The aim of the graduate program is to provide students with training that crosses traditional boundaries between scientific disciplines and allows them to address modern biomedical research questions. The objective is to train scientists who have a broad knowledge of basic medical sciences, a high degree of expertise in an area of specialization, and effective teaching skills for a medical school or university environment.

The need for scientists who understand the interrelationships of various areas of medical science is readily apparent. For example, it is clearly advantageous for a scientist studying diabetes to understand the disease in depth. This requires a fundamental understanding of endocrinology (hormone secretion and action), cell biology (cell types that produce insulin and upon which insulin acts), biochemistry (insulin-receptor interactions, biochemical pathways regulated by insulin), genetics (hereditary factors in the development of diabetes), immunology (autoimmune mechanisms in diabetes), and anatomy (microvascular pathology). There is a growing need for scientists who can communicate among disciplines so that very effective research collaborations can be developed.

Cell Biology/Physiology research areas include function of transcription factors in development, disease, and in the promotion of regeneration; fluid and electrolyte pathophysiology in

cystic fibrosis; molecular genetics of human cell response to environmental carcinogens; tumor suppressor genes in malignant melanoma; molecular basis of Down syndrome; factors controlling lymphocyte differentiation; mechanisms of action of cytotoxic lymphokines; physiological aspects of host–parasite interaction; and host defense mechanisms in infectious disease; and mucosal immunity and molecular approaches to vaccine development.

Endocrinology/Pharmacology research areas include regulation and actions of the vitamin D endocrine system; mechanism of action of insulin and insulin-like growth factors; prolactin as a growth factor in health and disease; hormonal and electric field regulation of bone development and growth; and molecular mechanisms for carcinogenesis (glioblastoma, breast and prostate cancer).

Neurosciences research areas include studies of the hypothalamic control of homeostatic and sexual function; molecular mechanisms of neurodevelopment, neuronal death and neurodegeneration with emphasis on the following diseases: Alzheimer's disease, Parkinson's disease, Autism, Fragile X/mental retardation, multiple sclerosis, Huntington's disease, stroke and pathogen-induced encephalitis.

Admission Applicants should have completed an undergraduate degree in one of the physical or biological sciences and must submit scores from the GRE General Test (verbal and quantitative). (GRE requirement not applicable to UCR Biomedical Sciences students applying for the M.D.–Ph.D.) Courses required for admission include one year each of general chemistry, organic chemistry, physics, and calculus and at least two years of biological sciences. Preferred upper-division courses in biology include vertebrate or human anatomy and physiology, embryology, genetics, cell biology, microbiology, immunology, and neurosciences.

Doctoral Degree

The aim of the graduate program in Biomedical Sciences is to train Ph.D. scientists in a specific area of research specialization who also have enough general knowledge in the basic medical sciences to apply their research expertise to unraveling the basis of disease. This approach includes understanding not only pathogenic manifestations of disease but also the normal physiologic state. To accomplish this, the student completes a core and elective curriculum, the latter tailored to the student's research interests.

Core requirements include:

1. BMSC 229: Foundations of Translational Research
2. BMSC 232, 233, 234 and 235: Foundations of Medicine Series
3. BMSC 260A, BMSC 260B, BMSC 260C: Topics in Biomedical Research. The entire 3 quarter series is required in the first year of graduate education.

4. BMSC 261: Methods in Biomedical Research. Enrollment required all 3 quarters of the first year of graduate education.
5. BMSC 252: General seminar in Biomedical Sciences (enrollment required each quarter)
6. BMSC 254: Graduate seminar in Biomedical Sciences (enrollment required each quarter)
7. BMSC 302: (one-quarter requirement, not required of M.D.–Ph.D. students)

Under normal circumstances, each student should complete course work requirements during the first year of studies.

At the end of the student's first full year of residence, the advisory committee for each student evaluates the progress of the student and recommends to the faculty whether the student should continue in the program.

In addition, prior to advancement to candidacy and at the beginning of each academic year, the student presents a written summary of the research progress and plans to the advisory committee. Continuation in the program depends on the advisory committee's positive evaluation of the student's research progress.

Written and Oral Qualifying Examinations Prior to advancement to candidacy, students must complete both parts of a qualifying examination. Part I consists of the preparation of a research proposal, to be written in the form of a grant proposal, including literature review, description of methods and experimental plans for the dissertation. This proposal should outline the research progress of the student to date and delineate the planned dissertation research aims and objectives. Part I is usually completed in the spring quarter of year 2 and no later than the fall quarter of year 3 of a student's graduate training. Part II consists of an oral comprehensive examination administered by a committee of five faculty members, at least one of whom is from outside the program. The student's research advisor does not serve on the oral qualifying committee. The oral comprehensive examination includes examination of the student's knowledge and understanding of material covered in the core courses and in the student's area of specialization. Part II must be completed no later than the end of year 3 of the student's graduate training.

Research Project, Dissertation and Final Oral Examination After successful completion of the qualifying exam and advancement to candidacy, the student completes the research project, submits a written dissertation, and defends the dissertation in a final oral examination.

Normative Time to Degree 15 quarters

M.D.–Ph.D. Combined Degree

Admission The combined degree is offered to students admitted to the medical school phase of the Biomedical Sciences Program and to exceptional students from other four-year LCME-accredited medical schools. Normally, a student completes the first two years of medical school, and then spends approximately three years in

the Ph.D. part of the program before completing the M.D. degree. However, the track is also offered to students who have completed the M.D. degree. UCR Biomedical Sciences students may apply for admission concurrently with their applications to the medical school phase or any time after acceptance to the medical phase. For these students only, the MCAT is accepted in lieu of the GRE.

Students from other medical schools should apply in the fall of their sophomore or senior year. Applications from sophomores must be accompanied by official permission for an appropriate leave of absence. The GRE requirement is the same as for regular Ph.D. students.

Master's Degree

The Biomedical Sciences Graduate Group offers an M.S. degree. No students are admitted directly into the program for work toward the master's degree. However, a Plan I (Thesis) or Plan II (Comprehensive Examination) M.S. degree is available in special circumstances when work leading to the Ph.D. degree cannot be completed. The student's advisory committee decides whether the master's degree is an appropriate alternative to the Ph.D. degree. This decision may be made at the end of the student's first year of residence or at other times in the student's career, particularly at the time of the qualifying examination.

Course Descriptions

All Biomedical Sciences courses are listed and described under Biomedical Sciences.

Further information regarding graduate studies in Biomedical Sciences may be obtained from the Division of Biomedical Sciences.

Botany and Plant Sciences

Subject abbreviation: BPSC

College of Natural and Agricultural Sciences

Jodie S. Holt, Ph.D., Chair
Department Office, 2132 Batchelor Hall
Graduate Student Affairs (800) 735-0717
or (951) 827-5688
Undergraduate Advising Center
(951) 827-3579; plantbiology.ucr.edu

Professors

Edith B. Allen, Ph.D. *Community/Restoration Ecology*
Julia N. Bailey-Serres, Ph.D. *Genetics*
Xuemei Chen, Ph.D. *Plant Cell and Molecular Biology*
Timothy J. Close, Ph.D. *Genetics*
Darleen A. DeMason, Ph.D. *Botany*
Norman C. Ellstrand, Ph.D. *Genetics*
Exequiel Ezcurra, Ph.D. *Ecology*
Jodie S. Holt, Ph.D. *Plant Physiology*
Anthony H. C. Huang, Ph.D. *Plant Cell and Molecular Biology*

Bai-Lian "Larry" Li, Ph.D. *Ecology*
Carol J. Lovatt, Ph.D. *Plant Physiology*
Adam J. Lukaszewski, Ph.D. *Genetics*
Eugene A. Nothnagel, Ph.D. *Plant Physiology*
Natasha Raikhel, Ph.D. *Ernst and Helen Leibacher Chair; Plant Cell Biology*
Mikeal L. Roose, Ph.D. *Genetics*
J. Giles Waines, Ph.D. *Genetics*
Linda L. Walling, Ph.D. *Genetics*
Shizhong Xu, Ph.D. *Genetics*
Zhenbiao Yang, Ph.D. *Plant Biology*
Jian-Kang Zhu, Ph.D. *President's Chair; Plant Cell Biology*

Professors Emeriti

Charles W. Coggins, Jr., Ph.D.
Arturo Gómez-Pompa, Ph.D.
Anthony E. Hall, Ph.D.
Robert L. Heath, Ph.D. *Plant Physiology and Biophysics*
Lowell S. Jordan, Ph.D.
Charles K. Labanauskas, Ph.D.
Elizabeth M. Lord, Ph.D. *Botany/Developmental Biology*
Rainer W. Scora, Ph.D.
William W. Thomson, Ph.D.
Irwin P. Ting, Ph.D.

Associate Professor

Patricia S. Springer, Ph.D. *Genetics*

Assistant Professors

Sean Cutler, Ph.D. *Plant Cell Biology*
Thomas A. Eulgem, Ph.D. *Plant Cell Biology*
Thomas Girke, Ph.D. *Bioinformatics*
Venugopala R. Gonehal, Ph.D. *Plant Cell Biology*
Darrel Jenerette, Ph.D. *Landscape Ecology*
Seung-Chul Kim, Ph.D. *Plant Systematics*
Renyi Liu, Ph.D. *Evolutionary Genomics*
Louis Santiago, Ph.D. *Physiological Ecosystems*
Matthew S.H. "Harley" Smith, Ph.D. *Plant Cell Biology*

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Lecturers

Mary Lu Arpaia, Ph.D. *Subtropical Horticulture*
David A. Grantz, Ph.D.
Agronomy and Plant Physiology
Milton E. McGiffen, Jr., Ph.D.
Vegetable Crops/Plant Physiology
Alan McHughen, Ph.D. *Plant Biotechnology*
Donald J. Merhaut, Ph.D.
Horticulture and Floriculture

Affiliated Emeritus

Junji Kumamoto, Ph.D. (Chemist Emeritus)

Cooperating Faculty

Michael Allen, Ph.D., (Plant Pathology and Microbiology)
Hailing Jin, Ph.D (Plant Pathology and Microbiology)
Isgouhi Kaloshian, Ph.D. (Nematology)
David R. Parker, Ph.D. (Environmental Sciences)
Joel Sachs, Ph.D. (Biology)

Major

The Departments of Botany and Plant Sciences, Plant Pathology and Microbiology, and Nematology participate in an interdepartmental program leading to either a B.A. or B.S. degree in Plant Biology. In addition, these departments and others participate in the Plant Biology Track within the interdisciplinary Biological Sciences major. In this program, students earn a B.S. degree in Biological Sciences. Course requirements for the Plant Biology Track are listed under the Biological Sciences major in this catalog.

Both majors are designed to provide students with basic knowledge in the natural sciences and in their chosen field of specialization.

Courses prerequisite to the major, courses used to satisfy major requirements, and the 16 units (for B.S. degree) related to the major must be taken for letter grades. Students may elect to take other courses on a Satisfactory (S)/No Credit (NC) basis. Refer to the Academic Regulations section of this catalog for additional information on "S/NC" grading.

Information about this program is available from the CNAS Academic Advising Center (1223 Pierce Hall, Monday through Friday, 9 a.m. to noon and 1 to 4 p.m., [951] 827-7294).

Transfer Students

Students planning to transfer to UCR with a major in Plant Biology must have a minimum GPA of 2.7 in transferable college courses and "C" or higher grades in a year sequence of general chemistry and in courses equivalent to our BIOL 005A, BIOL 005B. We also recommend that transfer students complete a year of college calculus before admission. Exceptions may be granted by the faculty advisor.

University Requirements

See Undergraduate Studies section.

College Requirements

See College of Natural and Agricultural Sciences, Colleges and Programs section.

Some of the following requirements for the major may also fulfill some of the college's breadth requirements. Consult with a department advisor for course planning.

Major Requirements

The major requirements for the B.S. and B.A. degrees in Plant Biology are as follows:

1. Life Sciences core requirements (68-72 units)

Students must complete all required courses with a grade of "C-" or better and with a cumulative GPA in the core courses of at least 2.0. Grades of "D" or "F" in two core courses, either separate courses or repetitions of the same course, are grounds for discontinuation from the major.

- a) BIOL 005A, BIOL 05LA, BIOL 005B, BIOL 005C
- b) CHEM 001A, CHEM 001B, CHEM 001C, CHEM 01LA, CHEM 01LB, CHEM 01LC, CHEM 112A, CHEM112B, CHEM 112C
- c) MATH 008B or MATH 009A, MATH 009B (MATH 009C recommended)
- d) PHYS 002A, PHYS 002B, PHYS 002C, PHYS 02LA, PHYS 02LB, PHYS 02LC
- e) STAT 100A
- f) BCH 100 or BCH 110A (BCH 110A is strongly recommended)