

## MOLECULAR BIOLOGY, MICROBIOLOGY, AND BIOCHEMISTRY

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### COLLEGE OF SCIENCE/SCHOOL OF MEDICINE

**Achenbach, Laurie**, Professor *Interim Associate Dean for Research in Graduate Studies, College of Science*, Ph.D., University of Illinois, Urbana-Champaign 1988; 1990. Molecular genetics of metabolic pathways involved in the bioremediation of environmental contaminants; bacterial diversity and evolution; molecular anaerobic microbiology.

**Bartholomew, Blaine**, Professor, Ph.D., University of California, Davis, 1988; 1991. Regulation of gene expression chromatin structure and function, molecular mechanisms of cancer.

**Bartke, Andrzej**, Professor, Ph.D., (Springfield), University of Kansas, 1965; 1984. Reproductive endocrinology; role of prolactin and growth hormone in the control of hypothalamic, pituitary and testicular function; transgenic animals, seasonal breeding.

**Bender, Kelly**, Assistant Professor, Ph.D., Southern Illinois University, 2003; 2006. Metabolic regulation of bacteria involved in bioremediation; small non-coding regulatory RNAs.

**Bhaumik, Sukesh R.**, Assistant Professor, Ph.D., Tate Institute of Fundamental Research (University of Bombay), 1997; 2003. Regulation of eukaryotic gene expression; transcription-coupled ubiquitination and DNA repair; NMR structural studies on proteins and nucleic acids.

**Borgia, Peter**, Professor, Ph.D., (Springfield), University of Illinois, Urbana-Champaign, 1973; 1976. Cloning and characterization of genes for chitin synthesis in *Aspergillus*.

**Brewer, Gregory J.**, Professor, Ph.D., (Springfield), University of California, San Diego, 1972; 1980. Alzheimer's disease, neuron development and adhesion; neurobiology of synaptogenesis; 2-D and 3-D neuronal networks.

**Cao, Deliang**, Assistant Professor, Ph.D., (Springfield), Institute of Molecular Biology (University of Hong Kong), 1996; 2005. Investigation of metabolic pathways and molecular mechanisms of antitumor activity of cytotoxic agents using gene transfer, RNA interference and gene knockout technologies.

**Carpenter, David F.**, Associate Professor, Ph.D., (Springfield), University of New Hampshire, 1972; 2000. Diagnostics for emerging infectious diseases of public health significance.

**Chakrabarty, Subhas**, Professor and *Associate Dean of Basic Sciences, SIU Cancer Institute*, (Springfield), Ph.D., University of Manitoba, 1980; 2005. Molecular mechanisms underlying malignant progression; chemoprevention of cancer; cancer diagnostic and prognostic markers; cancer therapeutics.

**Cho, KyuHong**, Assistant Professor, Ph.D., University of Illinois, 2001; 2007. Regulation of virulence factors as model systems for the virulence gene regulation by *S. pyogenes*; genes which are necessary for the virulence of *S. pyogenes* but who functions are not well known.

**Clark, David P.**, Professor, Ph.D., University of Bristol, 1977; 1980. Genetics and regulation of anaerobic growth in *Escherichia coli*.

**Cooper, Morris D.**, Professor and *Chair, Medical Microbiology, Immunology, & Cell Biology*, (Springfield), Ph.D., University of Georgia, 1971; 1973. Mucosal immune responses of the human fallopian tube to *Neisseria gonorrhoeae* and *Chlamydia trachomatis* infections. Topical microbicide activity against sexually transmitted disease pathogens.

**Davie, Judy**, Assistant Professor, Ph.D., University of California at Berkeley, 1998; 2006. Mechanisms of gene regulation; focusing on myogenin, a transcription factor that controls skeletal muscle development.

**Fix, Douglas F.**, Associate Professor and *Chair, Microbiology*, Ph.D., Indiana University, 1983; 1987. Molecular mechanisms of mutagenesis in *Escherichia coli*.

**Gershberg, Edward**, Assistant Professor, Ph.D., Tel-Aviv University, 1999; 2007. Epstein-Barr virus (EBV)-encoded protein kinase in viral infection. EBV-PK regulation and enzymology and identification of its viral and cellular targets.

**Gupta, Ramesh**, Professor and *Chair, Biochemistry and Molecular Biology*, Ph.D., University of Illinois, 1981; 1984. Molecular biology of *Archaea*, transcription and RNA processing in extreme halophilic and hyperthermophilic microorganisms.

**Haddock, John D.**, Associate Professor, Ph.D., Virginia Tech, 1990; 1995. Physiology and biochemistry of aerobic and anaerobic bacteria that degrade organic pollutants and naturally occurring aromatic compounds.

**Halford, William**, Associate Professor, Ph.D., Louisiana State University Medical Center, 1996; 2007. Using herpes simplex virus as a tool to understand how viral and host immune factors interact to produce life-long viral infections; devising effective cures for persistent viral infections.

**Hardwicke, Peter M. D.**, Professor, Ph.D., Kings College, London, 1969, 1985. Regulation of calcium transport across membranes by calcium pumps and the sodium-calcium exchanger. Proteolipids, lipids, conjugated trienes and non-myelin sensory nerve antigens.

**Huggenvik, Jodi I.**, Associate Professor; Ph.D., Washington State University, 1985; 1993. Molecular biology of mammalian gene expression and structure/function analysis of tumor suppressor genes.

**Khadori, Nancy**, Professor; M.D., Ph.D., (Springfield), Government Medical College, India, 1972, All India Institute of Med. Sci., 1977; 1989. Microbial adherence and biofilms—study of the microbial adherence to prosthetic devices, factors facilitating and inhibiting adherence to devices.

**Lightfoot, David A.**, Professor, Ph.D., University of Leeds, 1984; 1991. Molecular biotechnology and genomics.

**Madigan, Michael T.**, Professor, Ph.D., University of Wisconsin, 1976; 1979. General microbiology; bacterial diversity, phototrophic bacteria; microbiology of extreme environments; nitrogen fixation.

**Martinko, John M.**, Associate Professor and Director, *MBMB*, Ph.D., SUNY (Buffalo), 1978; 1981. Immunology; biochemistry, molecular biology, and evolution of major histocompatibility complex molecules: antigen presentation in the immune system.

**McAsey, Mary**, Assistant Professor, Ph.D., (Springfield), University of Arizona, 1994; 1996. Mechanisms of action of estrogen, progesterone and apolipoprotein e in the brain; induction of apoptotic cell death by vitamin e succinate in ovarian and cervical cancer; role of placental hormones in diseases of pregnancy.

**Mo, Yin-Yuan**, Associate Professor, Ph.D., (Springfield), Washington State University, 1991, 2003. Tumor drug resistance and tumor cell biology.

**Myers, Walter L.**, Professor, *Emeritus*, Ph.D., (Springfield), University of Wisconsin, 1962; 1973.

**Nie, Daotai**, Assistant Professor, Ph.D., (Springfield), University of South Carolina, 1997; 2005. Molecular and cellular biology of cancer; tumor radiotherapy; tumor metastasis.

**Niederhoffer, Eric C.**, Associate Professor, Ph.D., Texas A&M University, 1983; 1990. Metallobiochemistry; electron transfer;

metalloprotein structure-function, microbial stress responses-virulence factors.

**Parker, Jack**, Professor, *Emeritus*, Ph.D., Purdue University, 1973; 1977.

**Paauz, Mary E.**, Associate Professor, Ph.D., (Springfield), University of Minnesota, 1991; 2000. Molecular and cellular immunology with an applied focus on autoimmune (type 1) diabetes immunopathogenesis and gene therapy. Use and development of transgenic and NOD disease models.

**Rao, Krishna**, Assistant Professor, Ph.D., M.D., (Springfield), University of Washington, 2—2; University of Miami, 1991; 2007. Mammary spindle cell carcinoma, treatment of head and neck cancer.

**Ran, Sophia**, Assistant Professor, Ph.D. (Springfield), Weizmann Institute of Science, 1989; 2003. Tumor angiogenesis and lymphangiogenesis; breast cancer metastasis.

**Schmit, Joseph C.**, Associate Professor and *Emeritus*, Ph.D., Purdue University, 1971; 1976.

**Torrey, Donald E.**, Professor, Ph.D., (Springfield), Southern Illinois University, 1989; 2000. Human reproductive biology; cellular biology of angiogenic growth factors and immune cytokines during pregnancy. Molecular biology of placental gene expression.

**Watabe, Kounosuke**, Professor, Ph.D., (Springfield) Kyoto University, Japan, 1981; 1985. Molecular biology of tumor metastasis; regulation of gene expression of tumor metastasis genes

**Weilbaecher, Rodney**, Assistant Professor, Ph.D., University of California, Berkeley, 1997; 2007. Gene regulation, post-translational modifications, telomere biology.

Graduate programs are offered that lead to the Doctor of Philosophy (Ph.D.) and Master of Science (M.S.) in Molecular Biology, Microbiology and Biochemistry. The M.S. degree has thesis and non-thesis options. The non-thesis option M.S. degree has an area of specialization in Public Health Laboratory Sciences. These interdisciplinary programs draw their faculty primarily from the Department of Microbiology (College of Science) and Department of Biochemistry and Molecular Biology (School of Medicine) on the Carbondale campus, and Department of Medical Microbiology, Immunology, and Cell Biology (School of Medicine) on the Springfield campus. Adjunct faculty from the Illinois Department of Public Health (IDPH) Division of Laboratories provide training to students in the public health laboratory setting. The programs are designed to offer advanced training (via lecture, discussion and laboratory) in biochemistry, biophysics, bacteriology, genetics, immunology, microbial physiology, virology, mycology, molecular biology, cell biology, developmental biology, structural biology and public health laboratory science. The Ph.D. and thesis option M.S. programs require laboratory research. The non-thesis option M.S. degree program is designed to prepare students for a career in public health laboratory science and requires substantial training in a public health laboratory setting that is directly relevant to career preparation in that area.

### Admission

Prospective graduate students should have an undergraduate degree in any of the biological, chemical or physical sciences. The applicants are recommended to have completed courses in biology, organic chemistry, physics and mathematics. Strong candidates with deficiencies in any are may be admitted, but such deficiencies may restrict the research areas available to the student and may lead to requirements for additional courses during graduate study. An advisory system in the program (see below) will help students in planning their course of study. Prospective students for the thesis option M.S. and Ph.D. degrees are encouraged to contact program faculty in areas of their research interest. Prospective students seeking admission to the non-thesis option M.S. degree program with an area of concentration in public health laboratory science are encouraged to contact the Chair of the Public Health Science Program committee.

Students may be admitted to the doctoral program with a bachelor's or master's degree. Students in the thesis option M.S. program can be admitted to the doctoral program via accelerated entry or the master's equivalency option by the recommendation of the faculty and approval of the Graduate School.

All application materials should be submitted to the Program Director. This program requires a nonrefundable \$50.00 application fee that must be submitted with the application for Admissions to Graduate Study in Molecular Biology, Microbiology, Biochemistry. Applicants may pay this fee by credit card if applying electronically. Applicants submitting a paper application must pay by personal check, cashier's check, or money order made out to SIU, and payable to a U.S. Bank. Applications for admission to the thesis option M.S. and Ph.D. programs are evaluated by the M.S./Ph.D. Program Admissions Committee and applications for the non-thesis option M.S. degree program with an area of concentration in public health laboratory science are evaluated by the Public Health Science Program Committee. Upon recommendation of the appropriate committee, the application is transmitted to the Graduate School for approval.

The MBMB program requires a grade point average (GPA) of 2.7 (A = 4.0) for admission into the M.S. programs and a GPA of 3.25 in graduate level work for admission into the doctoral program. An excellent record in undergraduate coursework and a strong recommendation of the thesis option M.S./Ph.D. Program Admissions Committee is required for direct admission to the doctoral program after a bachelor's degree.

Applicants are required to submit Graduate Record Examination (GRE) general test scores. Submission of test scores of the GRE advanced (biochemistry, cell and molecular biology or biology or chemistry) examinations is also encouraged.

International students whose native language is not English will be required to obtain at least 550 (paper score) or 220 (computer score) on the Test of English as a Foreign Language (TOEFL) or 6 on the International English Language Testing System (IELTS).

### **Financial Assistance**

Fellowships and assistantships are available through the program and the participating departments for qualified applicants.

### **Advisement and General Requirements**

For thesis option M.S. and Ph.D. students, the Program Director or the Departmental Graduate Advisors as designates will assist each incoming student with the initial planning of a program of study and will advise the student until a Research Director is chosen. For non-thesis option M.S. degree program students, the Public Health Science Program Committee or its Chair will assist students in the planning of a program of study.

*Research Director and Graduate Committee Selection.* Each student in the Ph.D. or thesis option M.S. program should select a Research Director as soon as possible during the first year. The graduate committee for thesis option M.S. students shall consist of the Research Director (chair), and two additional graduate faculty members. The graduate committee for Ph.D. students shall consist of at least five graduate faculty members to include the Research Director (committee chair), three members derived from participating departments and one member from outside the Program. The Program Director, if not otherwise appointed, is an ex-officio (non-voting) member of every graduate committee. Students in the non-thesis option M.S. degree program with an area of concentration in public health laboratory science program need not choose a Research Director or a Graduate Committee and the Public Health Science Program Committee will plan and monitor student progress through the non-thesis option M.S. program.

*Graduate Committee Functions* (thesis option M.S. and Ph.D. students only). The graduate committee will:

1. plan and approve the student's program of study.
2. review the student's progress in courses and suggest and approve changes in the program of study.
3. evaluate the student's progress in research and make appropriate recommendations.
4. meet and determine, on a yearly basis whether a student is making satisfactory progress and may continue toward a degree. If continuation is denied, the committee must notify the Program Director, in writing, of the reasons for this denial.
5. administer written and oral preliminary examinations to the doctoral student.
6. read and evaluate the student's thesis or dissertation.
7. conduct the required oral examinations.

*Public Health Science Program Committee* (non-thesis M.S. students only). The Public Health Science Program Committee is composed of a Chair and a single member chosen from each of the three departments participating in the MBMB program. The Public Health Science Program Committee will:

1. provide programmatic oversight of the structure, curricular design, content and personnel involved in the non-thesis option M.S. program.
2. review applications from students for admission to the non-thesis option M.S. program and make admissions recommendations to the MBMB Program Director.
3. advise non-thesis option M.S. students in planning a course of study.
4. monitor student progress toward the non-thesis option M.S. degree.

*Formal Course Requirements.* All course requirements of the MBMB degree programs and Graduate School are minimum requirements. Additional courses may be required by the student's graduate committee (thesis option

M.S. and Ph.D. students) or the Public Health Science Program Committee (non-thesis option M.S. students) to meet any deficiencies or to provide proficiency in a specialized area. Certain courses are required of all students, while others meet the requirements of individual student's area of specialization, as determined by the student's graduate committee (thesis option M.S. and Ph.D. students). The Program Director, with the advice of the student's graduate committee or the Public Health Science Program Committee may designate other courses within or outside of the Program to fulfill formal course requirements. Any course (or its equivalent) that meets the requirements of the Molecular Biology, Microbiology and Biochemistry graduate program whether taken at SIUC or at any other institution before admission to the Program need not be repeated. Course equivalency will be determined by the Program Director in consultation with the appropriate committee or member of the faculty.

The formal core course requirements for both the thesis option M.S. and Ph.D. degree can be met by taking either MBMB 451a,b, and 460; or their equivalent. All M.S. and Ph.D. students must take either MBMB 502, Introduction to Research, or MBMB 504, Research Methods, and must also take during each semester in residence 1 hour of MBMB 597, Seminar and Professional Training.

Thesis option M.S. students must take two courses and the doctoral students must take three courses from a list of approved courses for specialization. Only one 400 level course from this list can be used to meet this requirement. Currently this list consists of MBMB 403, 405, 421, 423, 425, 444, 453, 455, 456, 470, 520, 530, 531, 532, 533, 543, 551, 552, 553, 560, and 562. These courses are selected with the approval of the student's graduate committee, Research Director or the Departmental Graduate Advisor. In addition, M.S. students are also required to earn at least 8 hours in research and thesis credit (MBMB 515, 598 and 599; a minimum of 3 and maximum of 6 hours for MBMB 599), prepare a thesis on the research project and pass a final oral examination, which serves as the comprehensive examination.

The formal course requirements for non-thesis option M.S. students with an area of specialization in public health laboratory sciences can be met by taking MBMB 403 or 405, 453 or 455, 451a, 451b, CHEM 431, MBMB 460, 510, 540, 541a and 541b. Non-thesis option M.S. students must also take 1 hour of MBMB 597 (Seminar and Professional Training) during each semester in residence. The Public Health Science Program Committee will make recommendations to the Program Director whether courses taken at SIUC or other universities are equivalent to the program requirements.

*Preliminary Examination and Dissertation for the Ph.D. Degree.* Each student in the doctoral program must pass a preliminary examination and meet the Graduate School residency requirement before being advanced to candidacy. The students can take the preliminary examination after completing the formal course requirements.

The student's graduate committee will prepare and administer a written preliminary examination covering various areas of molecular biology, microbiology and biochemistry, with particular emphasis in the area of concentration declared. This declaration will be done by means of a prospectus of a dissertation composed of (1) a proposal for the dissertation research, (2) biographical information on the candidate, and (3) a list of the courses taken during the candidate's graduate program. The proposal should address the proposed graduate research project, and be written in the NIH (National Institutes of Health) or NSF (National Science Foundation) approved format. The prospectus shall be available to the committee members at least 14 days prior to the date of the examination.

A written examination score of at least 80% is required before a student can proceed to the oral portion of the preliminary examination. Upon satisfactory completion of the written examination, the candidate will meet with the committee as a whole and discuss the prospectus in detail. The committee will then conduct an oral preliminary examination. At this time, the committee may ask in-depth questions about the research project and other areas of molecular biology, microbiology and biochemistry. At least 4 of the 5 committee members must judge the oral performance acceptable for a student to pass the preliminary examination overall. In the event that either the written or oral preliminary examination is failed, a student may request only one re-examination.

Successful completion of both written and oral examinations is required before a student can be advanced to candidacy for the Ph.D. After admission to candidacy, the student must earn at least 24 dissertation credit hours (MBMB 600), prepare and defend a dissertation, and present a public seminar based on the student's research.

### **Courses (MBMB)**

**403-3 Medical Microbiology Lecture.** (Same as Microbiology 403) A survey of the more common bacterial, mycotic and viral infections of humans with particular emphasis on the distinctive properties, pathogenic mechanisms, epidemiology, immunology, diagnosis and control of disease-causing microorganisms. Three hours lecture. Spring semester. Prerequisite: Microbiology 301; or consent of instructor.

**405-3 Clinical Microbiology.** (Same as Microbiology 405) (This course will be offered in Springfield only). A comprehensive course for health science professionals covering the biology, virulence mechanisms and identification of infectious agents important in human disease and host-defense mechanisms. Clinical applications are emphasized. Three hours lecture. Prerequisite: Microbiology 301; or consent of instructor.

**421-3 Biotechnology.** (Same as Microbiology 421) Topics covered will include the genetic basis of the revolution in biotechnology, medical applications including genetic screening and therapeutic agents, industrial biotechnology and fermentation, and agricultural applications. Three hours lecture. Prerequisite: Microbiology 302; or consent of instructor.

**423-3 Geomicrobiology.** (Same as Microbiology 423 and Geology 423) The course will focus on the role that microorganisms play in fundamental geological processes. Topics will include an outline of the present understanding of microbial involvement of weathering of rocks, formation and transformation of soils and sediments, and genesis and degradation of minerals. Elemental cycles will also be covered with emphasis on the inter-relationships between the various geochemical cycles and the microbial tropic groups involved. Prerequisite: Microbiology 301 and Chemistry 210 and 211. Recommended: Geology 220, 221, or 222.

**425-3 Biochemistry and Physiology of Microorganisms Lecture.** (Same as Microbiology 425) Chemical composition, cellular structure and metabolism of microorganisms. Prerequisite: organic chemistry or consent of instructor.

**441-3 Viruses and Disease.** An intensive, lecture-based course in virology which will emphasize principles of molecular virology, the ubiquity of viruses in nature, evolutionary relationships between viruses, co-evolution between virus and host, and the pathogenic consequences of some viral infections (e.g., AIDS, hepatitis, cancer, etc.). Prerequisites: MICR 460 or MBMB 460 or consent of instructor.

**451-6 (3,3) Biochemistry.** (Same as Biochemistry 451 and Chemistry 451) (a) Chemistry and function of amino acids, proteins and enzymes; enzyme kinetics; chemistry, function and metabolism of carbohydrates; citric acid cycle; electron transport and oxidative phosphorylation. (b) Chemistry, function, and metabolism of lipids; nitrogen metabolism; nucleic acid and protein biosynthesis; metabolic regulation. Three lectures per week. Must be taken in a, b sequence. Prerequisite: one year of organic chemistry.

**453-3 Immunology Lecture.** (Same as Microbiology 453) Natural and acquired immunity. Antigens, antibodies and antigen-antibody reactions in vitro and in vivo. Three hours lecture. Principles of molecular and cellular immunology. Particular emphasis is given to molecular mechanisms involved in activation and maintenance of the immune response at the basic science level. The role of the immune system in medical diagnostic procedures and in human health is also discussed. Spring semester. Prerequisite: MICR 403; or consent of instructor.

**455-2 Medical Immunology.** (Same as Microbiology 455). This course will be offered in Springfield only. A survey of the components of the immune system and how they interact with each other to produce responses that are important in the control or mediation of human disease. Two hours lecture. Prerequisite: Microbiology 301; or consent of instructor.

**456-3 Biophysical Chemistry.** (Same as Biochemistry 456 and Chemistry 456) A one semester course in biophysical chemistry intended for biochemists and molecular biologists. Emphasis will be on solution thermodynamics, kinetics and spectroscopy applied to biological systems. Prerequisite: Chemistry 340 and 342, 451a or concurrent enrollment, Mathematics 141 or 150.

**460-3 Genetics of Bacteria and Viruses Lecture.** (Same as Microbiology 460) Genetic mechanisms, mutation, transformation, recombination, transduction, lysogeny, phenotypic mixing and reactivation phenomena. Three hours lecture. Prerequisite: Microbiology 301 and 302; or consent of instructor.

**470-3 Prokaryotic Diversity.** (Same as Microbiology 470) A consideration of the major groups of prokaryotes with special emphasis on their comparative physiology and biochemistry. Prerequisite: Microbiology 301; or consent of instructor.

**480-4 Molecular Biology of Microorganisms Laboratory.** (Same as Microbiology 480) Genetic and biochemical analyses of microorganisms using a variety of techniques in molecular biology, molecular genetics and biotechnology. Six hours laboratory per week plus two hours of supervised unstructured laboratory work in most weeks. Lab fee: \$20. Prerequisite: 302 and one (one concurrent enrollment) in one of the following: 421, 425, or 460.

**481-4 Diagnostic and Applied Microbiology Laboratory.** (Same as Microbiology 481) Enrichment and isolation of medically relevant prokaryotes from natural samples, diagnostic methods for the identification of pathogenic bacteria and infection and the nature of the immune response. Six hours laboratory per week plus two hours unstructured, supervised laboratory work in most weeks. Lab fee: \$20. Prerequisite: Microbiology 301 and 302 and two (or concurrent enrollment in two) of the following: 403, 453, 470.

**502-3 Introduction to Research.** An introductory research course. Students rotate through at least three research laboratories. Lecture and laboratory hours to be arranged. Students can not get credit for both 502 and 504. Prerequisite: acceptance into the Molecular Biology, Microbiology and Biochemistry graduate program.

**504-3 Research Methods.** Problem definition, experimental design and research methods in specific areas of molecular biology, biochemistry and microbiology. Lecture and laboratory hours to be arranged. Students can not get credit for both 502 and 504. Prerequisite: acceptance into the Molecular Biology, Microbiology and Biochemistry graduate program.

**505-1 Special Topics.** Discussion of current research in specific areas of molecular biology, microbiology and biochemistry. One hour of group discussion per week. Prerequisite: consent of instructor.

**510-3 Functions of Public Health System.** This course is an introduction to the concepts and practices of public health at the community, state, and national levels. The course addresses the philosophy, purpose, history, organization, functions, activities and impact of public health practice. The course also addresses a

number of important health issues and problems facing the public health system. Special emphasis will be placed on the role of public health laboratory in public health practice. Discussion questions and case studies are integrated into the course, serving to stimulate student participation in gaining in-depth knowledge about real world public health issues and practice. Prerequisite: Bachelor's degree in Microbiology or other Biology, Chemistry, Physical Science.

**515-1 to 6 (1 to 6 per semester) Master's Degree Research.** Individualized laboratory research and training. Graded credit for Master's Degree only. Maximum 6 credit hours. Prerequisite: admission to master's program in Molecular Biology, Microbiology and Biochemistry and consent of instructor.

**520-2 Advanced Microbial Physiology and Control Mechanisms.** The physiology, biochemistry and genetics of microbial regulatory mechanisms. Topics include transport phenomena, catabolite and nitrogen repression, the stringent response, and autoregulatory phenomena. Two lectures per week. Prerequisite: 425; or Chemistry 451a and b, or consent of instructor.

**528-1 to 3 Special Readings in Molecular Biology, Microbiology and Biochemistry.** Supervised readings for qualified graduate students. Prerequisite: consent of instructor.

**530-3 Advanced Cellular Biology.** (This course will be offered in Springfield only). An advanced course based on current literature concerning the cellular biology of eukaryotes. Both students and faculty will make presentations followed by discussion. Topics will include: the cellular and subcellular structure and function of the lower eukaryotes, the biochemistry and biophysics of eukaryotic membrane systems and the higher subcellular functions of mammalian cells. Prerequisite: 400 level course in genetics and in biochemistry or consent of instructor.

**531-3 Molecular and Cellular Biology.** Lecture course in molecular and cellular biological techniques used in the study of organisms; structures and processes involved in genome organization; packaging and replication of DNA; transcription and RNA processing; recombination and transposition of DNA; gene regulation with emphasis on developmental processes; signal transduction; structure and function of cellular components; cell-cell interaction; etc. Prerequisite: Biochemistry 451b or consent of instructor; Microbiology 460 recommended.

**532-3 Methods of Structural Biology.** Lecture course in molecular computer graphics, macromolecular structure prediction, molecular dynamics, applications of NMR and X-ray methods to structural determinations of biological macromolecules; spectroscopic methods including UV, IR, Raman, fluorescence and circular dichroism methods. Prerequisite: Biochemistry 456 or consent of instructor.

**533-3 Advanced Biochemistry.** Lecture course in control mechanisms of biochemical processes, enzyme kinetics, regulation and allostery, coupled systems and energy transduction, membranes, transport, etc. Prerequisite: Biochemistry 451a or consent of instructor.

**540-3 Basis of Public Health Laboratory Practice.** The scientific basis of current laboratory practice of public health science in the areas of microbiology, immunology, molecular biology, environmental chemistry, biochemistry and instrumentation. (to accompany 541a,b) Prerequisite: 510, Bachelor's degree in Biology, Chemistry, Physical Science.

**541A-9 Public Health Laboratory Training.** This course has a laboratory component of approximately 36 hours/week of training in a functioning public health laboratory. The content of the course provides in-depth experience in the scientific basis and use of analytical methods and standard operating procedures that are unique to public health laboratories. This course is designed to train individuals for entry into the practice of public health laboratory science at local, regional or national public health organizations. This course will focus on the scientific basis and current laboratory practice of public health science in the area of microbiology, immunology and molecular biology. Prerequisite: 510, concurrent with 540, Microbiology 301 or equivalent.

**541B-9 Public Health Laboratory Training.** This course has a laboratory component of approximately 36 hours/week of training in a functioning public health laboratory. The content of the course provides in-depth experience in the scientific basis and use of analytical methods and standard operating procedures that are unique to public health laboratories. This course is designed to train individuals for entry into the practice of public health laboratory science at local, regional or national public health organizations. This course will focus on the scientific basis and current laboratory practice of public health science in the areas of environmental chemistry, biochemistry and their associated instrumentation. Prerequisite: 510, 541a, Biochemistry 350 or equivalent, concurrent with 540.

**543-3 Host-Microbial Interactions.** (This course will be offered in Springfield only). A lecture course that deals in depth with mechanisms of symbiosis and other interactions with respect to the biochemistry of microbe and host. Immunological aspects are discussed. Emphasis is placed on molecular mechanisms. Offered alternate years. Prerequisite: 403 or 405 or consent of instructor.

**551-3 Advanced Immunology.** A lecture course that intensively considers the most recent developments in antibody structure, antigenic analysis, and antigen-antibody reactions. A special focus will be on the use of immunology as a research tool. Prerequisite: 453 or equivalent, or consent of instructor.

**552-3 Cellular Immunology.** (This course will be offered in Springfield only). A lecture-discussion course covering contemporary aspects of cellular immunology. The cellular nature of immune responses as well as current information on the regulation of such responses will be considered. Topics will include cellular components of an immune response; receptors, recognition and signals; cellular cooperation; immuno regulation; and tolerance and autoreactivity. Prerequisite: 453 or 455 or consent of instructor.

**553-3 Advanced Medical Microbiology and Immunology.** (Offered in Springfield only). A lecture course providing an in-depth analysis of the mechanisms of pathogenesis of bacterial, viral and mycotic infections. Immune mechanisms involved in recovery, development of immunity and infection mediated immunopathology will be covered. Prerequisite: 403 and 453; or 405 and 455; or consent of instructor.

**554-1 to 4 (1 per semester) Evolution Seminar.** Advanced topics in evolutionary biology including genetics & development, evolutionary ecology, phylogeny, paleontology, biogeography, population genetics, molecular ecology, speciation, molecular evolution, and macroevolution. Topics will vary each semester. Seminar format with group discussions and student presentations. Graded S/U. Prerequisite: consent of instructor.

**556-3 Phylogenetics.** An advanced introduction to modern methods of phylogenetic inference, emphasizing both theoretical background concepts and numerical approaches to data analysis. Topics include properties of morphological and molecular characters, models of character evolution, tree estimation procedures, and tree-based testing of evolutionary hypotheses. Prerequisite: consent of instructor.

**560-3 Molecular Oncology.** A lecture-discussion course in molecular and cellular biology of tumor pathogenesis. The lecture covers various aspect of current tumor biology. The in-depth discussion on recent articles will provide students with opportunity to become familiar with front-line research in molecular oncology. 451a and b or consent of instructor.

**562-3 Molecular Genetics.** A lecture and discussion course emphasizing current research and new techniques in replication, transcription, translation, genome organization, gene flow from a general systems viewpoint and regulation. Prerequisite: 460 or consent of instructor.

**570-1 to 15 (1 to 6 per semester) Advanced Topics.** Advanced topics in (a) Molecular Biology, (b) Biochemistry, (c) Microbiology, (d) Immunology, (e) Virology, (f) Structural Biology, (g) Biophysics, and (h) General Cell Biology. Selected topics of current scientific interest to the faculty and students. Specific topic to be covered in any semester will be announced. Prerequisite: consent of instructor.

**580-1 Current Topics in Evolution.** (Same as Anthropology 580, Zoology 580) The Evolution Discussion Group meets weekly throughout the year to discuss current evolutionary literature and the research of participants. All students and faculty with an interest in evolutionary biology are welcomed to participate.

**594-1 to 4 (1 per semester) Systematic Biology Seminar.** Interdisciplinary research topics in systematic biology. Seminar consists of biweekly presentations by visiting or resident researchers, followed by roundtable discussions with seminar participants. Students also participate in a day-long symposium at which they contribute an oral poster presentation. Graded S/U. Prerequisite: consent of instructor.

**597-1 to 15 (1 per semester) Seminar and Professional Training.** Departmental seminars, and other appropriate professional assignments. Graded S/U only. One hour required each semester in residence. Prerequisite: graduate standing.

**598-1 to 66 (1 to 12 per semester) Research.** Graded S/U only. Prerequisite: consent of instructor.

**599-1 to 6 (1 to 6 per semester) Thesis.** Research for Master's degree thesis. Prerequisite: consent of instructor.

**600-1 to 36 (1 to 12 per semester) Dissertation.** Research for Ph.D. degree dissertation. Prerequisite: consent of instructor.

**601-1 (1 per semester) Continuing Enrollment.** For those graduate students who have not finished their degree programs and who are in the process of working on their dissertation, thesis, or research paper. The student must have completed a minimum of 24 hours of dissertation research, or the minimum thesis, or research hours before being eligible to register for this course. Concurrent enrollment in any other course is not permitted. Graded S/U or DEF only.