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**Vito J. Potenza.** B.S.M.E. Union, 1980; M.D. Rochester, 1984.

**Gilbert Proper.** B.A. Brandeis, 1983; M.D. Rochester, 1988.

**Gary Ritzel.** B.S. Rochester, 1983; M.S. North Dakota, 1991.

**Stuart B. Sacks.** B.S. Pennsylvania State, 1986; M.D. SUNY (Upstate), 1990.

**Roberta C. Szczurek.** B.S. SUNY (Albany), 1977; M.D. SUNY (Buffalo), 1981.

**David A. Taylor.** A.B. Dartmouth, 1978; M.D. 1982.

**Jaimala Thanik.** B.S. Government College (Hissar, India), 1964; M.B.B.S. Armed Forces Medical College (Poma, India), 1969.

**George C. Turinsky.** B.S. Rensselaer, 1989; M.D. Albany Medical, 1991.

**Balkrishna Venkatesh.** M.B.B.S. University of Bombay, 1969.

**Savitri Venkatesh.** M.B.B.S. Gujarat University (India), 1971.

**Michael E. Villareale.** B.A. Rochester, 1968; Pharm.M. Syracuse, 1977; Ph.D. SUNY (Upstate), 1979; M.D. Monterrey (Mexico), 1983.

**Alison Vogt.** B.A. Williams, 1985; M.D. Dartmouth, 1991.

**Judit S. Wagner.** M.D. University of Budapest (Hungary), 1965.

**Joseph W. Walters, Jr.** B.S. Old Dominion, 1976; M.D. Eastern Virginia, 1979.

**Jeffery A. Wasserman.** B.S. SUNY (Albany), 1983; M.D. SUNY (Buffalo), 1987.

**Kurt J. Weissand.** B.S. Pennsylvania State, 1980; M.D. Rochester, 1984.

**Robert Witriol.** B.S. Brooklyn, 1970; M.D. SUNY (Upstate), 1976.

**Susan T. Wong.** B.A. University of Pennsylvania, 1982; M.D. Albany Medical, 1988.

**Robert J. Young.** B.S. Creighton, 1983; M.S. 1985; M.D. 1990.

**Georgianne Zigarowicz.** B.A. SUNY (Buffalo), 1977; M.D. 1981.

**Clinical Senior Instructor**

**Mehi Mohtashemi.** M.D. Medical School of Isfahan (Iran), 1969.

**Clinical Instructor**

**Paul P. Marocco.** B.S. Union, 1959; M.D. University of Bologna (Italy), 1966.

## DEPARTMENT OF BIOCHEMISTRY AND BIOPHYSICS

The primary emphasis is on advanced degree programs that lead to a Ph.D. in biophysics, a Ph.D. in biochemistry, or a Ph.D. in genetics. Formal graduate course requirements are fulfilled within the first two years in residence and usually include completion of a master's degree. Students may enter the Ph.D. programs from any of the Graduate Education in Biomedical Sciences clusters. Students may pursue research opportunities under the direction of any faculty having primary or secondary appointments in the Department and having space and resources available. The Department provides instruction for the first-year medical school curriculum and plays a major role in the teaching and administration of the curriculum leading to a B.S. with a concentration in biochemistry.

### RESEARCH OPPORTUNITIES

The faculty possess a broad spectrum of research interests, spanning the disciplines of biochemistry, molecular biology, molecular biophysics, and cellular biophysics. There are currently over 40 faculty (primary and secondary appointments) heading active research programs in areas that include: biological energetics, membrane structure and function, hormone receptors and hormone action cells, DNA synthesis and repair, radiation biophysics, RNA processing, regulation of protein synthesis, neurochemistry, gene expression, biological transport, cancer etymology, cancer therapy, protein structure, enzyme function, X-ray crystallography, mineral metabolism, microcirculation, network theory, nuclear magnetic resonance, computational biophysics, electron magnetic resonance, fluorescence spectroscopy, and cell signaling.

### POSTDOCTORAL PROGRAMS

Postdoctoral fellows are an important part of the research efforts of the Department and there are opportunities in virtually all areas. There are postdoctoral training grant programs available in oncology and other disciplines.

## Courses Offered by the Department of Biochemistry and Biophysics

### BCH 402. DNA Replication, Recombination, and Repair

Credit—three hours

Prerequisite: IND 410

Professors Bambara, Phizicky, and faculty

This course focuses on DNA replication, DNA repair, and chromosomal recombination in bacteria, eukaryotic



cells, and viruses. Lectures emphasize the enzyme mechanisms involved in these processes and the structure and regulation of relevant genes. Additional topics include the interaction of DNA replication and repair pathways, and the multiple roles of key enzymes. Reading of original research papers is required.

#### **BCH 412. Advanced Topics in Biological Macromolecules**

Credit—five hours

Prerequisite: permission of the course director required  
Associate Professor Dumont and faculty

An advanced biochemistry lecture course intended for senior undergraduate and graduate students. Topics include RNA structure and catalysis, nucleic acid-protein interactions, glycoconjugates, protein purification and analysis, X-ray crystallography, protein folding, ligand binding, crosslinking of macromolecules, membrane receptors and channels, G-proteins, and blood-clotting cascade.

#### **BCH 495. M.S. Research**

Credit—to be arranged

#### **BCH 501–502. Seminars in Biochemistry**

Credit—one hour per term

Faculty

Seminar courses are given each semester; continuous registration is required of all students in biochem-

istry. Seminars are held once a week and are conducted by graduate students. Students are expected to present a summary of the field of their research along with specific work in progress associated with their own thesis project. The topics covered usually include current research in biochemistry in the areas of proteins, enzymes, nucleic acids, lipids, metabolic regulation, hormone action, biochemical genetics, physical biochemistry, membrane biochemistry, developmental biochemistry, and neurochemistry. One hour per week. Spring and Fall.

#### **BCH 509. Readings in Biochemistry and Molecular Biology**

Credit—one hour

Associate Professor Dumont

Selected articles from the current literature will be discussed during class meetings, with emphasis on critical evaluation of experimental procedures and results. Topics to be considered will vary from year to year, depending on the interests of the participants, and may include RNA processing, protein sorting, protein structure, and cellular signal transduction. Students will be required to lead one discussion session per semester. The class will meet for one hour every other week, alternating with the “Genetics of Microorganisms” seminar series, at which attendance will also be required.

#### **BCH 570. Gene Regulation, High Eukaryotes**

Credit—two hours

Associate Professor Hayes

A seminar course meeting once per week (two hours/session) where students read and discuss recent papers on the regulation of gene expression in high eukaryotes. One purpose is to provide familiarity with a variety of contemporary approaches through discussions of their applications. Another aim is to draw comparisons between regulatory mechanisms utilized by hormones, viruses, and other agents that alter gene expression. The discussions will be student-led. Every other Spring (odd years).

#### **BPH 402. Mathematical Methods of Physiology and Medicine**

Credit—three hours

Prerequisite: elementary calculus

Professor Simon

Topics include: Computer modeling, mathematical description of biological and physical systems, analytical and numerical solutions of differential equations, complex number representation, Laplace transforms, Fourier series, partial derivatives. A prior knowledge of elementary calculus is assumed, but much of the material of calculus is reviewed as needed. Classes meet three times a week, and there are a number of short computer laboratory sessions. Fall.

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**BPH 403. Mathematical and Physical Foundations of Biophysics**

Credit—three hours

Professor Simon

Vector analysis, Maxwell's equations, diffusion equations, delta functions, representation of physical and biophysical systems by partial differential equations, multidimensional Fourier series, Fourier and Laplace transforms, matrices.

**BPH 408. Mathematical Methods of Biophysics**

Credit—four hours

Prerequisites: RBB 403 or its equivalent, and permission of the instructor

Professor Simon

Applications of advanced mathematical techniques to problems of classical physics, biophysics, and three-dimensional image reconstruction. Topics include electromagnetic theory, potential calculations, Green's functions, properties of waves, calculus of variations, Fourier transforms, tomography, two-dimensional signal filters and NMR theory. Additional topics chosen by students.

**BPH 411. Methods in Structural Biology**

Credit—four hours

Prerequisites: calculus and physics or permission of the course director

Associate Professor Goldstein and faculty

A practical introduction to the theory and application of the major techniques used in the determination of atomic-resolution structures of biological macromolecules. These include x-ray crystallography, NMR spectroscopy, and computation and modeling methods. The goal is to allow nonspecialists from any discipline to critically read the relevant literature and understand the limitations of these techniques. Spring.

**BPH 509. Molecular Biophysics and Biophysical Chemistry**

Credit—five hours

Prerequisites: calculus-based physics and permission of the course director

Professor Gunter and faculty

This course is designed to show how physical concepts and techniques are used to explore and understand biological phenomena. A major portion of the term focuses on thermodynamics of biological molecules and systems and the structure of proteins and nucleic acids; the remainder covers the structure and physical properties of biological membranes, transport, and enzyme kinetics. Students are expected to have had basic courses in physics, chemistry, and biology, with an in-depth background in at least one of these areas. Fall.

**BPH 541. Theoretical and Practical Aspects of Isolating Cell Subpopulations**

Credit—two hours

Prerequisites: courses in cell biology and physics and permission of the instructor

Associate Professor Keng

The course objective is to introduce the participants to the biophysical principles and the technical theory for isolating, from heterogeneous cell populations, large numbers of cells that are homogeneous with respect to some important biological parameter. In addition, practical experience is gained with several of the separation techniques available in the Cell Separation Facility of the Cancer Center. The theoretical principles employed in centrifugal elutriation, density gradient centrifugation, unit gravity sedimentation, counter current flow, electrophoresis, and phase-partition separation are discussed. Practical experience with centrifugal elutriation, density gradient centrifugation, and unit gravity sedimentation is obtained.

**BPH 542. Special Topics in Cellular Biophysics**

Credit—two hours

Prerequisites: RBB 541 and permission of the instructor

Associate Professor Keng

It is expected that participants will select a research problem involving the isolation of homogeneous cell populations from heterogeneous cell populations. These research projects may be technically oriented, developing a method for purifying cell subpopulations from solid tissues or tissue cultures; or biologically oriented, answering a biological question for which pure subpopulations of cells are required. Emphasis will be placed on achieving the maximum homogeneity possible for each isolated subpopulation and therefore may involve several sequential purifying procedures and a number of ancillary tests such as autoradiography, flow cytometry, and cell sizing. The ability to do the flow cytometry depends on the participant having successfully completed PTH 501. Each participant will be required to submit a paper or give a short seminar at the end of the course.

PTH 501 is recommended but not required. The course is limited to 10 students. Projects are expected to require at least one experiment every two weeks. Successful completion of RBB 541 and 542 will under most circumstances allow the participant access to the Cell Separation Facility's equipment for their own research programs. Alternate years. Spring.

**BPH 567. Writing Proposals**

Credit—one hour

Professor Lawrence

**BPH 571–572. Seminars in Biophysics**

Credit—one hour

Professor Lawrence

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### IND 408. Biochemistry

Credit—four hours

Professors Phizicky, Dumont, and faculty

This course provides instruction in biochemistry, as it relates to modern molecular biology, and cell biology and physiology. The course represents one of the three “core” courses that have been developed to complement the new GEBS program. Incoming graduate students in all clusters are encouraged to take this course.

### IND 410. Molecular Biology and Genetics

Credit—four hours

Faculty

This course provides instruction in the utilization of genetic information for cellular functions. Topics include DNA replication, recombination, and repair; the synthesis and processing of RNA; and the genetic basis of human disease.

### 595. Ph.D. Research

Credit—to be arranged

The fields open for dissertation research under members of the faculty are listed in the preceding general description. Laboratory space and equipment are available in sufficient variety and depth to accommodate a large range of research interests.

## Faculty of the Department of Biochemistry and Biophysics

**Robert A. Bambara** . . . *Professor of Biochemistry and Biophysics and Chair*, Professor of Microbiology and Immunology and of Oncology. B.A., Northwestern, 1970; Ph.D. Cornell, 1974. NIH Biochemistry Postdoctoral Fellowship, Cornell, 1970–74; Assistant Professor, Biochemistry, University of Rochester, 1977–81; Associate Professor, 1981–84; Associate Professor, 1984–89; Professor, 1989–; Chair of the Department, 1999–.

#### Professors

**William A. Bernhard**. B.S. Union, 1964; M.S. Pennsylvania State, 1966; Ph.D. 1968.

**Thomas R. Clarkson**, and *J. Lowell Orbison Distinguished Alumni Professor of Environmental Medicine*; and Professor of Pharmacology and Physiology. B.Sc. University of Manchester (England), 1953; Ph.D. 1956.

**Helen I. Eberle**, Emeritus. B.S. California State College, 1956; Ph.D. University of California (Los Angeles), 1965.

**Philip J. Fay**, and Medicine. B.S. Ohio State, 1975; M.S. SUNY (Buffalo), 1977; Ph.D. Rochester, 1982.

**Isaac Feldman**, Emeritus. B.S. George Washington, 1941; Ph.D. Illinois, 1947.

**Thomas E. Gunter**. B.S. Massachusetts Institute of Technology, 1960; Ph.D. University of California (Berkeley), 1966.

**Russell Hilf**, and Oncology. B.S. City College of New York, 1952; M.S. Rutgers, 1953; Ph.D. 1955.

**Peter C. Keng**, and *Radiation Oncology*. B.S. Tunghai University (Taiwan), 1968; Ph.D. Colorado State, 1978.

**George Kimmich**. B.S. Cornell, 1963; M.S. University of Wisconsin, 1965; Ph.D. University of Pennsylvania, 1968.

**Philip A. Knauf**. A.B. Boston College, 1963; Ph.D. Rochester, 1970.

**Hartmut Land**, and *Director and Professor of the Center for Cancer Biology*. Diploma University of Konstanz, 1977; Ph.D. University of Heidelberg, 1982.

**Christopher W. Lawrence**. B.Sc. Wales (England), 1956; Ph.D. Birmingham, 1959.

**Marshall A. Lichtman**, and *Medicine*. A.B. Cornell, 1953; M.D. Buffalo, 1960.

**Mahin D. Maines**, and *Environmental Medicine*. B.S. Ball State, 1964; M.A. 1967; Ph.D. Missouri, 1970.

**Jack Maniloff**, and *Microbiology and Immunology*. B.S. Johns Hopkins, 1960; M.S. Yale, 1964; Ph.D. 1965.

**Lynne E. Maquat**. B.A. University of Connecticut, 1974; Ph.D. University of Wisconsin (Madison), 1979.

**Guido V. Marinetti**. Emeritus. B.S. Rochester, 1950; Ph.D. 1953.

**Leon L. Miller**, and *Medicine*, Emeritus. B.A., M.A. Cornell, 1934; Ph.D. 1937; M.D. Rochester, 1945.

**Terry Platt**, and *Biology*. B.S. University of Chicago, 1964; Ph.D. Harvard, 1972.

**J. Edward Puzas**, and *Donald and Mary Clark Professor of Orthopaedics*, and of *Dental Research*. B.S. Massachusetts, 1971; M.S. Rochester, 1973; Ph.D. 1976.

**Randy N. Rosier**, and *Orthopaedics*, and *Oncology*. B.S. Dickinson, 1972; M.S. Rochester, 1976; M.D. 1978; Ph.D. 1979.

**Alan E. Senior**, and *Oncology*. B.Sc. University of Durham (England), 1964; Ph.D. University of Newcastle upon Tyne (England), 1967; D.Sc. 1988.

**Fred Sherman**, *Marie Curran Wilson and Joseph C. Wilson Professor*. B.A., Minnesota, 1953; Ph.D. University of California (Berkeley), 1958.

**Peter G. Shrager**, and *Pharmacology and Physiology*. B.S. Columbia, 1963; Ph.D. University of California (Berkeley), 1969.

**William Simon**, and *Medical Informatics*. B.S. Carnegie Institute of Technology, 1950; M.A. Harvard, 1952; Ph.D. 1958.

**Richard E. Waugh**, *Pharmacology and Physiology* and *Mechanical Engineering*. B.S. Notre Dame, 1973; Ph.D. Duke, 1977.

**Donald A. Young**, and *Medicine*. B.S. Yale, 1955; M.D. 1961.

**Charles L. Yuile**, Emeritus. B.A. McGill, 1927; M.D.C.M. 1935.

#### Associate Professors

**William Aldridge**, and *Neurobiology and Anatomy*. A.B. Rutgers, 1960; Ph.D. Rochester, 1962.

**Mark E. Dumont**. B.A. Harvard, 1972; M.S. Western Washington, 1975; Ph.D. Johns Hopkins, 1980.

**Barry M. Goldstein**. B.S. Union, 1973; M.S. Rochester, 1976; M.D. 1985; Ph.D. 1982.

**Jeffrey Hayes**, and *Oncology*. B.S. Bowling Green, 1983; M.S. 1986; Ph.D. Johns Hopkins, 1990.

**Shohei Koide**. B.S. Tokyo, 1986; M.S. 1988; Ph.D. 1996.

**Eric M. Phizicky**, *Dean's Associate Professor*. B.S. McGill, 1976; Ph.D. Cornell, 1983.

**Harold C. Smith**, and *Oncology*, and *Pathology and Laboratory Medicine and Environmental Medicine*. B.S. Purdue, 1975; Ph.D. SUNY (Buffalo), 1982.

**Sayeeda B. Zain**, and *Oncology*. B.Sc. Osmania University (India), 1964; M.Sc. 1966; Ph.D. Glasgow University (Scotland), 1971.

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### Research Associate Professors

**Elena P. Bulgac.** M.S. Kharkov (Russia), 1971; Ph.D. Leningrad State (Russia), 1974.

**Peter E. Gibbs.** B.S. Adelaide (Australia), 1973; Ph.D. 1978.

**Elizabeth J. Grayhack.** B.A. Lawrence, 1974; Ph.D. Cornell, 1981.

**Mohammad Salim.** B.S. Karachi (Pakistan), 1967; M.S. 1968; Ph.D. Glasgow (United Kingdom), 1972.

### Assistant Professors

**Ravi Basavappa.** B.S. Duke, 1980; M.S. Clemson, 1983; Ph.D. Chicago, 1991.

**Richard M. Bayer,** part-time. B.S. Rutgers, 1963; M.S. 1965; Ph.D. 1969.

**Fred Hagen,** and Center for Oral Biology. B.S., University of California (Davis), 1981; Ph.D. Calgary (Alberta), 1989.

**Steven Pascal.** B.S. Nebraska Wesleyan, 1985; M.A. Kent State, 1989; Ph.D. Florida State, 1993.

**David A. Pearce,** and Center for Aging and Developmental Biology. B.Sc. Bath (United Kingdom.); Ph.D. 1990.

**YiTao Yu.** B.S. Fudan University (China), 1982; M.S. Chinese Academy of Science, 1987; Ph.D. Case Western, 1994.

### Research Assistant Professors

**Gurrinder Bedi.** B.Sc. Panjab University (India), 1968; Ph.D. SUNY (Buffalo), 1981.

**Karlene K. Gunter.** B.S. Massachusetts Institute of Technology, 1961; Ph.D. University of California (Berkeley), 1968.

**Leigh Ann Henrickson.** B.S. St. Mary's College (Notre Dame); Ph.D. University of Iowa, 1995.

**Scott D. Kennedy.** B.A. Minnesota, 1981; M.S. 1984; Ph.D. Rochester, 1988.

**Mesut Muyan.** D.V.M. Ankara (Turkey), 1980; Ph.D. University of California (Davis), 1991.

**Bogdan Polevoda.** MS.D. Kiev State University (Ukraine), 1981; Ph.D. Academy of Science (USSR), 1985.

**Yuriy Razskazovskiy.** B.S. Moscow University, 1980; Ph.D. 1984.

**Mark Sowden.** B.Sc. Warwick, 1987; D.Phil. Oxford, 1990.

**Ina Urbatsch.** M.S. University of Kaiserslautern (Germany), 1987; Ph.D. 1990.

**Hironao Wakabayashi.** M.D. Fukushima, 1988; Ph.D. 1990.

**Joachim H. Weber.** M.S. Hanover (Germany), 1980; Ph.D. Lubeck, 1990.

### Associates

**Akiko Koide.** B.S. University of Tokyo, 1985; M.S. 1987.

**Kermit R. Mercer.** B.S. SUNY (Brookport), 1971.

## DEPARTMENT OF BIostatistics

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The Division of Biostatistics was founded in 1972 and became a Department in 1990. The primary objectives of the Department are threefold: biostatistical research, collaborative research, and education.

The Department conducts a program of teaching and research in statistical methodology oriented toward the health sciences and in statistical theory and stochastic modeling growing out of research in the health sciences. Research interests include: survival analysis, clinical trial design, order restricted inference, analysis of spatial data, asymptotic methods, Bayesian inference, missing data methods, analysis of quantal response data, robust inference, linear models, higher-order approximations, and graphical methods.

The Department maintains a collection of over 1,100 texts and issues of the major statistical journals dating from 1950.

The Consulting Service of the Department provides services ranging from purely advisory activities to complete management of projects. The Consulting Service is staffed by biostatistics faculty assisted by a supporting staff of computer programmers and research associates and is used regularly by faculty, staff, and students from a wide range of Medical Center departments. Expertise is available in the areas of preclinical, clinical, and observational trial design and analysis; survey design; statistical analysis; computing; protocol development; dataforms development; database management; data quality control; and stochastic modeling. The Department of Biostatistics collaborates extensively in medical research—ranging from in-house and/or single center studies to international multicenter clinical trials and observational studies. Biostatistics faculty are currently active in projects in the Departments of Community and Preventive Medicine, Dental Research, Environmental Medicine, Medicine, Neurobiology and Anatomy, Neurology, Pathology and Laboratory Medicine, Pediatrics, and Psychiatry, as well as other units such as the Cancer Center, the Clinical Research Center, and the Rochester Area Pepper Center.

Up-to-date computer hardware and software are available to support biostatistical research and consulting. The Department operates a network of 22 Sun workstations running the Solaris (UNIX) operating system and 21 PCs running Windows NT. All machines have Internet connections. A full range of supporting hardware and peripherals is available. Statistical software includes SAS, S-Plus, SUDAAN, STATA, Minitab, Mathematica, IMSL, StatXact, EaSt, PASS, EGRET, Sigma Plot, LogXact, Deltagraph, and PEST. Other software includes TeX for technical document production, C++, Fortran 90 and Java compilers, SQL Server for database applications, DBMS Copy, and Office 2000.