

## Medical and Molecular Genetics

### School of Medicine Indianapolis

**Chairperson**

Professor Kenneth Cornetta\*

**Departmental E-mail**[medgen@iupui.edu](mailto:medgen@iupui.edu)**Departmental URL**[www.iupui.edu/~medgen](http://www.iupui.edu/~medgen)

### Graduate Faculty

(An asterisk [\*] denotes membership in the University Graduate School faculty with the endorsement to direct doctoral dissertations.)

**Distinguished Professor**

Bernardino Ghetti\* (Pathology and Laboratory Medicine, Psychiatry, Neurology)

**Chancellor's Professor**

Tatiana Foroud\*

**Professors**

Joe Christian\* (Emeritus), Simon Conway\* (Pediatrics), Mary Dinauer\* (Pediatrics), Michael Econs\* (Medicine), Howard Edenberg\* (Biochemistry and Molecular Biology), David Flockhart\* (Pharmacology), Alan Golichowski (Obstetrics and Gynecology), Debomoy Lahiri\* (Psychiatry), Linda Malkas (Hematology/Oncology), Eric Meslin\* (Medicine), John Nurnberger Jr.\* (Psychiatry), Catherine Palmer\* (Emeritus), R. Mark Payne (Pediatrics), Kimberly Quaid\* (Psychiatry), Terry Eugene Reed\*, Andrew Saykin (Radiology), William Schneider\* (Liberal Arts), Gail H. Vance\* (Pathology and Laboratory Medicine), Ronald Wek\* (Biochemistry)

**Associate Professors**

Sherif Farag (Hematology/Oncology), Anthony Firulli (Pediatrics), Reuben Kapur\* (Pediatrics), Marc Mendonca (Radiation Oncology), Jill Murrell\* (Pathology), Elliot D. Rosen, Weinian Shou\* (Pediatrics)

**Assistant Professors**

Angelo Cardoso (Hematology/Oncology), Nadia Carlesso (Pe-

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diatrics), Rebecca Chan (Pediatrics) David Paul Gilley, Brenda Rose Grimes, Brittney-Shea Herbert, Jeusun Jung, Yunlong Liu (Biostatistics), Anna Malkova (Biology), Nuria Morral\*, Kenneth E. White, Xin Zhang

**Associate Research Professor**

Stephen Dlouhy

**Assistant Research Professor**

Daniel Koller

**Clinical Associate Professors**

Virginia Thurston, Frederick Unverzagt (Psychiatry)

**Assistant Scientist**

Hiromi Tanaka

**Joe C. Christian Professor of Medical and Molecular Genetics**

Kenneth G. Cornetta\* (Medicine, Microbiology)

**Graduate Advisor**

Assistant Professor Brittney-Shea Herbert, Medical Research and Library Building 130, (317) 274-2241

### Degrees Offered

Master of Science in Medical Genetics and Doctor of Philosophy

### Special Program Requirements

(See also general University Graduate School requirements.)

**Admission Requirements**

Bachelor's degree or its equivalent, including two years of chemistry, mathematics through calculus, two years of biology, and one course in principles of genetics. Promising students deficient in one or more areas may be accepted if it appears to the admissions committee that deficiencies can be removed during graduate study. Results of the Graduate Record Examination General Test must be available before applicants can be considered for admission.

### Master of Science Degree

**Course Requirements**

A minimum of 30 credit hours of approved courses, including no more than 7 credit hours of research. At least 20 credit hours must be taken in medical genetics or approved equivalents, including at least four of the following five areas with grades of B or higher: basic human genetics, clinical genetics, cytogenetics, molecular and biochemical genetics, and population genetics. Students in the genetic counseling study track, to

meet requirements to take the certification examination of the American Board of Genetic Counseling, are required to have courses in all five areas plus additional required course work totaling 36 credit hours. Genetic counseling students must obtain a B (3.0) or higher in all core courses.

### **Thesis**

Optional. With approval of the department, a refereed publication or an additional 6 credit hours of nonresearch course work beyond the required 30 credit hours may be substituted for the thesis. Genetic counseling students must choose either a thesis, case report with literature review, or educational project, in addition to the required 36 credit hours.

### **Final Examination**

The student must pass a comprehensive oral or written examination as determined by the student's committee. Under exceptional circumstances, the student may petition the committee to be permitted to take the final examination one additional time.

### **Program Termination**

Academic or research deficiency will result in termination of the student's enrollment in the program.

## **Doctor of Philosophy Degree**

### **Course Requirements**

A total of 90 credit hours plus dissertation with a minimum of 32 credit hours of nonresearch courses in medical genetics, including G504 or equivalent. Appropriate courses in the Departments of Anatomy, Anthropology, Biochemistry, Mathematics, Microbiology, Pharmacology, and Biology may be accepted for credit toward the major with prior approval of the student's advisory committee. Up to 30 credit hours of nonclinical medical or dental courses may apply toward the Ph.D. degree.

### **Minor**

Must be taken in a field related to the major, e.g., aging, anthropology, bioinformatics, biology, biomolecular imaging, biotechnology training, cancer, cellular and molecular biology, diabetes and obesity, epidemiology, immunology, life science, microbiology, neurobiology, pharmacology, or public health.

### **Qualifying Examination**

Comprehensive written and oral examination. Examination over the minor field at the discretion of the minor field department.

### **Research Proposal**

Written research proposal, presented and defended orally, required for admission to candidacy.

### **Final Examination**

Oral defense of dissertation.

### **Program Termination**

Research or academic deficiency, including two failures of the qualifying examination, will result in termination of the student's enrollment in the program.

## **Courses**

The graduate courses listed below are not all offered in any given academic year. Inquiries on the availability and suitability of any particular course should be directed to the graduate advisor. In addition to those areas indicated by specific course offerings, extensive opportunities for interdepartmental research are also available.

### **General**

**Q580 Basic Human Genetics (3 cr.)** P: General genetics and consent of the instructor. An introduction to the genetics of human traits and heritable diseases. Emphasis will be on general aspects of eukaryote genetics as it applies to humans, but some prokaryote genetics will be included for comparison.

**Q606 Foundations in Genetic Counseling (3 cr.)** Introduction to the principles and practice of genetic counseling. Topics include genetic counseling techniques, prenatal diagnosis counseling, pediatric/adult counseling, and support services.

**Q610 Clinical Genetics Practicum (3 cr.)** P: Consent of the instructor. Methods for obtaining medical and family histories, approaches to evaluation of individuals and families with genetic disorders, and techniques for providing genetic counseling. May be repeated once for credit.

**Q611 Genetics Analysis Laboratory (1-2 cr.)** [Currently inactive] P: Consent of the instructor. Computer storage and retrieval of family data. Use of programs for genetic analysis. Includes analysis of twins, families of twins, and genetic linkage and segregation.

**Q612 Molecular and Biochemical Genetics (3 cr.)** Molecular and biochemical aspects of gene function in various genetic disorders. Emphasis on the DNA lesion when known, on aberrations in the metabolic pathways, and on structural defects. Discussion of hemoglobinopathies, phenylketonuria, storage diseases, and other conditions.

**Q613 Molecular and Biochemical Genetics Laboratory (2 cr.)** The student will learn to perform many of the molecular and biochemical techniques for the determination of genetic markers that can be used for diagnosis, genotyping, and forensic applications.

**Q614 Psychological Aspects of Genetic Counseling (3 cr.)** P: One course in introductory or abnormal psychology. Introduction to theory and research in the field of genetic counseling. Topics include risk assessment, attitude assessment, and decision-making. The social, ethical, and legal aspects of the delivery of genetic services are also covered.

**Q615 Prenatal Diagnosis Practicum (3 cr.)** Training in prenatal genetic counseling. Counseling referrals may include advanced maternal age, abnormal prenatal screening, abnormal ultrasound, or other pregnancy complications.

**Q616 Specialty Clinics Practicum (2 cr.)** P: Consent of the instructor. An overview of the long-term management of patients living with a variety of genetic conditions. Students may provide genetic counseling while in these clinics.

**Q617 Genetic Counseling Practicum (1-2 cr.)** P: Q606, Q610, consent of instructor. Practice advanced genetic counseling skills in a weekly clinic. Develop proficiency in pedigree construction, patient education, and psychosocial assessment/counseling.

**Q620 Human Cytogenetics (3 cr.)** P: Consent of the instructor, basic genetics. Study of chromosome structure and replication, X-inactivation, meiosis, numerical and structural rearrangements in humans, and cytogenetics of malignancies.

**Q621 Human Cytogenetics Laboratory (3 cr.)** P: Basic genetics, Q620, and consent of instructor. Current techniques in human cytogenetics. May be taken concurrently with Q620.

**Q622 Cytogenetics of Malignancies (2-3 cr.)** P: Consent of instructor. This course will examine the biologic implications of cytogenetic abnormalities found in malignancies. Aberrant gene function as a result of cytogenetic abnormalities will be stressed.

**Q625 Introduction to Clinical Genetics (1 cr.)** This class will introduce the students to the broad areas of practice in clinical genetics, the ethical, legal, and social issues involved in the care of patients and families with genetic disorders, and the interface of clinical genetics and genetics research.

**Q626 Fundamentals of Biochemical and Molecular Genetics (1 cr.)** Introduction to the concepts of molecular and biochemical genetics with emphasis on examples of pathogenesis of human disease.

**Q627 Fundamentals of Human Cytogenetics (1 cr.)** An introduction to the principles of human cytogenetics with applications in basic genetics, including the clinical consequences of chromosomal abnormalities.

**Q628 Fundamentals of Population Genetics (1 cr.)** Introduction to the broad areas of population genetics and gene discovery.

**Q630 Population Genetics (3 cr.)** P: Basic genetics. Basic probability and Bayes theorem, as applied to genetic counseling. Effects of mutation and selection on the survival of alleles in a population; consequences of consanguinity and inbreeding; methods of analysis including segregation and linkage including nonparametric methods; quantitative genetics such as twin studies, and heritability.

**Q631 Quantitative Genetics (2 cr.) [Currently inactive]** P: G651 and G652 or equivalent. Inheritance of human quantitative traits, partitioning of phenotypic variation, estimation of genetic variance and heritability, methods of analyzing resemblance among relatives including nuclear families, twins, and half-siblings.

**Q640 Special Topics in Human Genetics (1-3 cr.; 9 cr. max.)** A continuing, nonrepeating series of lectures on newer advances in human genetics; discussions in specific areas of human genetics not currently available to all students. Additional credits may be obtained by study of a specific area under individual tutelage.

**Q642 Dermatoglyphics (2 cr.) [Currently inactive]** P: Consent of instructor. Formation, development, classification and variation of finger, palm, and footprint patterns (dermatoglyphics) in humans; interpretation of results of quantitative and statistical techniques utilized in the study of the inheritance of dermatoglyphic traits, variation in twins, and applications in clinical genetics.

**Q660 Medical Genetics Seminar (2 cr.)** P: Basic genetics. Topics chosen from aspects of medical genetics not extensively treated elsewhere. Various phases of research in medicine from a genetic and clinical point of view. Students may receive credit during each semester of residence on the Medical Center campus.

**Q730 Methods in Human Genetics (3 cr.)** P: Basic genetics, differential calculus, and Q630 or equivalent. Sampling methods employed in study of human genetics; methods for analysis of segregation, linkage, mutation, and selection with family data collected under various forms of ascertainment.

#### **Q800 Medical Genetics Research (cr. arr.)**

#### **Graduate**

**G504 Introduction to Research Ethics (2 cr.)** Introduction to the basic concepts of research ethics. The course will cover historical development of concern with ethics in science as well as practical information needed by students working in the science today. Format will be lecture and discussion.

**G651-G652 Introduction to Biostatistics I-II (3-3 cr.)** Data description, sampling variation and distributions, interval estimation, and tests of hypotheses involving binomial, normal, t, F, and  $\chi^2$  distribution; one-way analysis of variance, bivariate regression and correlation, higher order experimental designs, and associated analysis of variance; use of statistical analysis programs on computer.

**G724 Molecular Cancer Genetics (1 cr.)** An introduction to cancer focusing on genetics. Topics include causes and effects of chromosome instability (including centromere/telomere failures and chromosomal translocations), epigenetic changes and genetic risk factors during cancer progression.

**G725 Gene Transfer Approaches to Clinical and Basic Research (Gene Therapy) (1 cr.)** A lecture-based course of basic principles involved with the transfer and expression of genetic material. Focus on technical aspects of each vector system, followed by applications to human diseases/experimental animal models. Practical understanding of non-viral and viral gene transfer to utilize these techniques in research studies.

**G726 Developmental Genetics (1 cr.)** This introductory course focuses on the genetic basis of mouse development. It covers the principles of embryogenesis and explores the mechanism of morphogenic signaling and transcriptional control of body plan and tissue differentiation. Special emphasis will be placed on the role of developmental genetics in understanding human disease.

**G727 Animal Models of Human Disease (1 cr.)** This class explores advantages and limitations of animal models of human disease. Topics include models for diabetes, psychiatric disorders, cancer, osteoporosis, polycystic kidney and cardiovascular disease. The goal of the course is to provide a framework for students to select experimental animal models in their future research careers.

**G746 Chromosome Instability and Disease (1 cr.)** Exploration of the mechanisms of chromosome instability and the clinical impact of this problem. Topics will include chromosome structure and function and how failures in these functions promote chromosome instability in meiosis and mitosis. Other topics include the clinical consequences of chromosome instability in miscarriage, birth defects, and cancer.

**G901 Advanced Research (6 cr.)** For Ph.D. students who have at least 90 credit hours. May be taken for maximum of six semesters.