

PHG 513: Basic Concepts in Pharmacogenetics and Toxicogenomics

Winter Quarter, 2015

Tuesday and Thursday 9:00 – 10:20 AM, RR-134

Course Coordinators:

Dave Eaton, Ph.D.
Professor, Environ. Occup. Health Sci.
Dean, Graduate School
Office: G1 Communications, Box 353770
Phone: 685-3785; Fax: 685-4696
e-mail: deaton@u.washington.edu

Ken Thummel, Ph.D.
Professor and Chair
Pharmaceutics, Box 357610
Office: H272N Magnuson HSB
Phone: 543-0819; Fax: 543-3204
e-mail: thummel@u.washington.edu

Office hours: by appointment

Teaching Assistant:

Corey Snelson
Public Health Genetics

Office hours: by appointment

e-mail: corey.snelson@gmail.com

Prerequisites: Biochem 442 or Genetics 372 or equivalent, or instructor permission.

Website: <https://canvas.uw.edu/courses/795564>

Course Description: This course will draw from multiple disciplines to provide a general understanding of molecular approaches to genotyping, as well as the understanding of genotype/phenotype relationships and gene-environment interactions as determinants of disease susceptibility. It will examine the molecular basis for interindividual differences in drug/xenobiotic disposition and application of that information for individualized drug treatment regimens and disease prevention strategies. It will also cover the application of array and sequencing technologies for the identification of disease susceptibility and drug response genes as well as potential environmental modifiers. Finally, it will explore ethics and policy issues relevant to testing for pharmacogenetic and toxicogenomic traits.

Learning Objectives: At the end of this course students should be able to:

1. explain the various technologies used to identify genetic polymorphisms, with particular emphasis on genes of pharmacological and environmental relevance.
2. be able to identify and understand the conceptual basis behind basic methodologies used to identify genetic variability in human DNA samples
3. explain the significance of genetic polymorphisms in the development, progression, and treatment of human disease.
4. appreciate the public health importance of genetic variability in specific multigene families of enzymes involved in metabolism of drugs and non-drug chemicals in the environment
5. understand the connection between environmental exposures, genetic polymorphisms, and risk for diseases of public health importance.
6. understand the role of genetic polymorphisms as determinants of adverse drug reactions and pharmacological efficacy.
7. read critically original scientific literature relating to ‘gene-environment interactions’
8. have the technical background necessary to appreciate the ethical, legal and social implications that arise out of pharmaco- and toxicogenomic research.
9. write professionally about one area of ‘gene-environment’ interaction with public health importance
10. integrate basic concepts of ethics into arguments for and against genotyping of populations for ‘environmental susceptibility’ genes.

Grading

The course will include 3 exams (multiple choice / short answer) over materials covered in class and assigned readings that will count for 75% of your grade (25% for each of 3 exams). The remaining 25% of your grade will be based on your class term paper. An average numeric score of 80 will be approximately equal to a grade point score of 3.0; a score of 90 will be a 3.5; and average scores of 95 and above will be 4.0.

Readings

Textbook: There is no textbook required for this class; class notes, the lectures and posted readings should be sufficient for comprehension of the material. However, if you would like additional background material, we recommend the textbook, “*Gene-Environment Interactions: Fundamentals of Ecogenetics* (LG Costa and DL Eaton, Editors, Wiley Press, 2006) and “*Pharmacogenetics: An Introduction and Clinical Perspective*” edited by Joseph S. Bertino, et al. 2013. For students who feel that their background in basic molecular biology and genetics requires updating, we recommend any basic textbook in molecular genetics or medical genetics. A good text is: Strachan and Read’s “*Human Molecular Genetics*,” 2003 (\$60 used paperback), or *Human Genetics and Society* (2008) by Ronnee Yashon and Michael Cummings.

Selected readings from the current literature will be posted on the course website. Again, these are intended primarily as an enrichment of the experience, although some parts of the readings may be discussed in class (e.g., Wylie Burke’s lectures).

Hard copies of lecture notes will generally not be provided on the day of the lecture in class. Powerpoint and pdf files of the lecture notes can be accessed on-line, through the course website. An exception will be made when the lecture is not available at least 24 hr prior to the start of class.

Term Paper

You will be asked to choose a particular disease that has both a genetic and an environmental component to it, and write a brief paper (12-15 pages, double spaced) describing what is known about the etiology of the disease. In the paper, you should cover:

1. the fundamental biology of the disease, including which genes are involved
2. identify candidate genes that might act as susceptibility genes, and discuss their function
3. review the basic epidemiology of the disease that has led to discoveries that genetic factors are involved
4. identify and discuss any environmental factors that have been implicated in the etiology of the disease; environmental factors are defined in their broadest terms, and include diet, viruses and other microbiological factors, occupation, lifestyle factors, etc.
5. identify and discuss at least one “ELSI” problem – real or potential, that has surfaced in your study of the disease.
6. include all appropriate references

Possible diseases for discussion include, but are not limited to:

Parkinson’s Disease	Diabetes
Amyotrophic Lateral Sclerosis (ALS: Lou Gehrig’s Disease)	Alcoholism, Smoking dependence
Alzheimer’s Disease	Certain birth defects that may have a genetic component
Cancer, any kind, especially:	Heart disease
Colon, breast and brain cancer, leukemia	Lung diseases (e.g, COPD, asthma)

LECTURE SCHEDULE, WINTER QUARTER, 2014

Date	Topic	Lecturer	Textbook
Jan. 6	Introduction: genes, environment and disease	Eaton	^{A, B} Ch. 1 & 2
Jan. 8	Technological approaches to understanding genotype-phenotype relationships I – DNA analysis	Kelly	^{A, B} Ch. 3
Jan. 13	Technological approaches to understanding genotype-phenotype relationships II – RNA analysis	Kelly	^A Ch. 3
Jan. 15	Technological approaches to understanding genotype-phenotype relationships III – Proteomics and metabolomics analyses	Thummel	Handout only
Jan. 20	Applications of GWAS and Next Generation sequencing technologies	Thummel	^B Ch. 3
Jan. 22	Polymorphisms, Enzyme Kinetics and Pharmacokinetics/Toxicokinetics	Thummel	Handout only
Jan. 27	Epigenetics	Eaton	Handout only
Jan. 29	EXAM 1 (from Jan 6 – Jan 22)	Eaton	
Feb. 3	Pharmacogenetics and individualized therapies - I (CYPs 2D6, 2C9, CYP3A5, 2C19)	Thummel	^B Ch. 6A
Feb. 5	Toxicogenomics -1 (CYPs 1A1, 1B1, 2E1, FMO3, ALDH2)	Eaton	^A Ch. 7
Feb 10	Pharmacogenetics and individualized therapies – II (VKORC1, HLA, G-protein coupled receptors)	Thummel	^B Ch. 15, pgs 135-136
Feb. 12	Toxicogenomics - 2 (NATs, SULTs, GSTs, mEH, NQO1)	Eaton	^A Ch. 8, 9
Feb. 17	Pharmacogenetics and individualized therapies – III (UGT1A1, TPMT, OATP1B1, OCT1)	Thummel	^B Ch. 6B, 13, 7
Feb. 19	Pgx/Tgx Review and Discussion	Eaton	
Feb. 24	EXAM 2 (from Jan 27 – Feb. 19)	Thummel	
Feb. 26	Mechanisms of DNA Damage and Polymorphisms in DNA repair	Eaton	^A Ch. 10
March 3	ELSI related to Pharmaco- and Toxicogenomics	Wylie Burke	^A Ch. 21-23
March 5	ELSI related to Pharmaco- and Toxicogenomics	Wylie Burke	^A Ch. 21-23
March 10	Pharmacogenomics and Drug Development	Thummel	Handout only
March 12	Rare Diseases – Genetic Discovery and Treatment	Thummel	Handout only
Final Week	EXAM 3 (TBA; material from Mar 3 – Mar 12); Term paper – due 4 PM, Friday March 20		

^A Textbook: Costa, LG and Eaton DL. *Gene-Environment Interactions: Fundamentals of Ecogenetics*, Wiley Press, 2006.

^B Textbook: *Pharmacogenetics: An Introduction and Clinical Perspective* edited by Joseph S. Bertino, et al. 2013.

NOTE: Lecture notes will be on the web page at least 24 hours before class if available. If they are not posted by that time, hard copies will be provided on the day of the lecture in class. Any additional readings will be listed on the website if links are available.

Guest Lecturers:

Wylie Burke, Professor and Chair, Department of Bioethics & Humanities, UW;
wburke@u.washington.edu

Ed Kelly, Associate Professor, Department of Pharmaceutics, UW;
edkelly@u.washington.edu

Students with disabilities: To request academic accommodations due to a disability, please contact Disability Resources for Students, 448 Schmitz Hall, 206-543-8924 (V/TTY). If you have a letter from Disability Resources for Students indicating that you have a disability that requires academic accommodations, please present the letter to me so we can discuss the accommodations you might need in this class.