

ANTH 6407: Anthropological Genetics

Tuesdays 11.10- 1 pm,

Room 450 Monroe Hall

Spring 2018

Brief Summary: A detailed examination of molecular approaches to understanding human evolution and diversity. Emphasis will be on current research findings and new methodologies exploring topics such as: human origins and hominin evolution, population genomics, molecular adaptations, epigenetics and gene-culture interactions. We will also consider relevant social and ethical issues, including commercial DNA testing and ownership of biological samples.

Instructor: Brenda Bradley

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Office Hours: Tuesdays 1.30-3.30, or by appointment

Lab website: gwprimategenomicslab.org

Course website: via blackboard, though most correspondence/materials will be circulated via email

Human Evolutionary Genetics blog: <http://gwheg.blogspot.com>

Course Description:

This seminar course explores current research and methodologies in human genomics and evolutionary genetics. The first sequence and analysis of the human genome was announced in 2000. Our understanding of human genetic variation and molecular evolution has accelerated dramatically in the almost 20 years since. This course will examine, from an anthropological perspective, our current understanding of the structure and evolution of the human genome, transcriptome and microbiome. We will discuss how advancements in paleogenetics (e.g. sequencing of the Neanderthal and other hominin genomes) influence and confound our understanding of human origins and migrations. We will consider human genomic diversity within the context of local selective pressures related to biogeography, environment and culture (e.g. altitude, UV-exposure, diet). With the rapid advancement of genomic tools, particularly in medical genetics, have also come important ethical and social implications, and this course will consider some of these issues, such as personal genomics, sample ownership and privacy.

Readings:

Readings will be primary research papers and recent literature reviews. These will be posted on the course website.

Although we will read and discuss some 'classic' papers in the field (e.g. early work from Allan Wilson's lab; original human genome papers), focus will be on current research findings and their implications.

If you do not have a strong background in human genetics, a general textbook will be helpful.

Suggestions:

- *An Introduction to Molecular Anthropology by Stoneking 2017*
- *Human Evolutionary Genetics 2e* by Jobling et al. 2013
- *Genetics: Analysis of Genes and Genomes, 8e*, by Hartl & Ruvolo 2011

Additional readings relevant to specific topics will be chosen by students and either circulated via email or posted on blackboard.

Out-of-Class and Independent Learning:

Students will spend approximately two-three hours studying on their own for every hour spent in class. This will include time spent reading the material over before class and identifying and synthesizing additional relevant literature outside of class. Over the course of 15 weeks, students will spend 2 ½ hours (150 minutes) per week in lecture, so studying and other out-of-class work should be at least 300 minutes per week.

Academic Integrity

Following GWU's policies (<http://www.gwu.edu/~ntegrity/code.html>): All students must practice academic integrity. This means doing your own work, and when you use the words and ideas of others in any written work, you must: 1) identify direct quotations with quotation marks; and 2) indicate the source of ideas that are not your own by using social sciences notation and/or proper citations. If you have any questions about what this means, please speak to me. Plagiarism, and all breaches of academic integrity (for example, the sale of lecture-notes from this class, or the use of content from the internet as though it was your own, will be severely dealt with in accordance with the University's policies and procedures.

Support for Students Outside the Classroom

UNIVERSITY COUNSELING CENTER (UCC) [202-994-5300](tel:202-994-5300)

The University Counseling Center (UCC) offers 24/7 assistance and referral to address students' personal, social, career, and study skills problems. Services for students include:

- crisis and emergency mental health consultations
- confidential assessment, counseling services, and referrals

<http://gwired.gwu.edu/counsel/CounselingServices/AcademicSupportServices>

Class Policies

No extensions will be given for assignments or exams. If you are late with an assignment you will be penalized a letter grade (10% of total points) for each day it is late (e.g. go from an A to A- or A- to B+). If you fail to attend a class exam you will be assigned a failing grade for the exam. The only valid excuse for missing an exam or being late on assignments (including the project paper and in-class presentation) is a personal medical or family emergency. Students must

contact me and present an excuse in writing from a professional in order to be allowed to make up work and avoid penalties.

I reserve the right to not respond to email questions sent less than 36 hours before an assignment is due, or an exam is scheduled. Please send your questions ahead of time to ensure I have the time to respond to them appropriately. If you need an immediate response from me, please text/call my mobile (203.710.9698).

Student Projects:

Each student will design, implement, write-up, and present a small independent research project relevant to human genomics, diversity, evolution. These projects might entail analyzing on-line genomic data in genome browsers (e.g. ensembl.org) and/or Genbank. Alternatively, students might choose to write a *Trends in Genetics*-style review of a specific topic/issue (to be approved by instructor), or critically evaluate landmark evolutionary texts in light of modern genomics. Examples and ideas for possible projects will be provided.

Requirements and grading:

Discussion, 'journal club', and blog participation (10% of final grade)

- Students will be expected to participate in discussions on assigned readings, and contribute additional examples, case studies, etc. on each topic ("pot-luck").
- Students will be asked to monitor new publications in assigned journals (*American Journal of Human Genetics*, *Nature Genetics*, *Trends in Genetics*, etc) and post links and comments for relevant articles on the GW Human Evolutionary Genetic blog: <http://gwheg.blogspot.com>

Student-led seminar (20% of final grade)

- In pairs, students will select a topic and readings (to be approved by instructor), prepare and circulate discussion questions before class, and lead the discussion for one seminar topic.

Research project – written (20%): each student will develop a small independent research project (see above) and will write a 10-20 page project report. Due via email 30th of April.

Research project – presentation (20%): students will give a 20 presentation to the class on their research project. Presentations will be on April 17th & 24th.

Final exam (30%): there will be only one exam - a comprehensive final at a date/time set by the university (TBD). The format of the exam will entail 4-6 short essays covering material presented and discussed in seminar, readings, and on the course blog.

Seminar Topics and Reading Schedule

NOTE: this is a tentative schedule, subject to change

Week 1 (16 January – via email) Introduction

Readings:

- Jobling (2013) *Human Evolutionary Genetics*, Chapter 1: An Introduction to Human Evolutionary Genetics

Week 2 (23 January) Structure and function of the human genome; General review of human genetics, genomics

Readings:

- Stoneking (2017) *An Introduction to Molecular Anthropology* Chapters 1,2,4,5, 7, 9 – skim these chapters as a review
- Peruse “Learn.Genetics”: <http://learn.genetics.utah.edu> especially the sections under “Basic Genetics” <http://learn.genetics.utah.edu/content/basics/>
- Review any unfamiliar terms on the vocabulary list using preferred online or textbook resources (e.g. Scitable www.nature.com/scitable; DNA from the Beginning www.dnafb.org)

Week 3 (30 January) The Human Genome two decades on. What have we learned? *Readings:*

- International Human Genome Sequencing Consortium (2001) Initial sequencing and analysis of the human genome. *Nature* 409:860–921.
- Venter, J. C. et al. (2001) The sequence of the human genome. *Science* 291, 1304– 1351.
- Lander ES (2011) Initial impact of the sequencing of the human genome. *Nature* 470, 187–197
- Jasny BR, Zahn LM (2011) Genome-sequencing anniversary. A celebration of the genome. *Science* 331:546.
- Zarrei, M., MacDonald, J. R., Merico, D., & Scherer, S. W. (2015). A copy number variation map of the human genome. *Nature Reviews Genetics*.
+ student pot-luck contributions

Week 4 (6 February) Ethical Legal and Social Issues (ELSI) in human genome research; The Supreme Court decision on genetic patenting

Readings:

- Supreme Court of the United States: Association for Molecular Pathology et al. v. Myriad Genetics, Inc., et al. Retrieve from: http://www.supremecourt.gov/opinions/12pdf/12-398_1b7d.pdf
- Kesselheim AS, et al. (2013). Gene Patenting—The Supreme Court Finally Speaks. *New England Journal of Medicine*
- Marshall, E. (2013). In a Flurry of Metaphors, Justices Debate a Limit on Gene Patents. *Science*, 340:421-421.
- Additional readings on CRISPR, GMOs, DTC personal genomics, or other ELSI debate topics to be decided collectively
+ student pot-luck contributions

Week 5 (13 February) Evolutionary relationships among humans and other apes; “Classic” papers in molecular anthropology

Readings:

- Sarich V, Wilson AC (1967) Immunological time scale for hominid evolution. *Science* 158, 1200–1203.
 - King M-C, Wilson AC (1975) Evolution at two levels in humans and chimpanzees. *Science* 188, 107–116
 - Cann RL, Stoneking M, Wilson AC (1987) Mitochondrial DNA and human evolution. *Nature* 325, 31–36
 - Ruvolo, M. (1997). Molecular phylogeny of the hominoids: inferences from multiple independent DNA sequence data sets. *Molecular Biology and Evolution*, 14: 248-265.
- + student pot-luck contributions

Week 6 (20 February) History and memoir of anthropology genetics

Readings:

- Svante Paabo (2014) *Neanderthal Man: In Search of Lost Genomes*

Week 7 (27 February) Ancient DNA; Archaic human genomes

- Krings M, Stone A, Schmitz RW, et al. (1997) Neandertal DNA sequences and the origin of modern humans. *Cell* 90, 19–30.
 - Green R, et al. (2010) A draft sequence of the Neandertal genome. *Science*. 710-722.
 - Meyer M et al. (2012). A high-coverage genome sequence from an archaic Denisovan individual. *Science*, 338(6104), 222-226.
 - Disotell TR (2012). Archaic human genomics. *AJPA*, 149: 24-39.
 - Racimo, F. et al. (2015). Evidence for archaic adaptive introgression in humans. *Nature Rev. Genet.* 16: 359–371
- + student pot-luck contributions

Week 8 (6 March) Student selected topic and papers

EXAMPLE: Human evolution and the microbiome

Readings:

- Ley et al. (2006). Ecological and evolutionary forces shaping microbial diversity in the human intestine. *Cell*, 124(4),
- Degnan et al. (2012). Factors associated with the diversification of the gut microbial communities within chimpanzees from Gombe National Park. *Proceedings of the National Academy of Sciences of the United States of America*, 109(32), 13034-9.
- Fierer et al. (2010). Forensic identification using skin bacterial communities. *Proceedings of the National Academy of Sciences of the United States of America*, 107(14), 6477-81.
- De Filippo, et al. (2010). Impact of diet in shaping gut microbiota revealed by a comparative study in children from Europe and rural Africa. *Proceedings of the*

National Academy of Sciences of the United States of America, 107: 14691-6.
+ student pot-luck contributions

**** Deadline to confirm project topic March 6th ****

**** Spring break over March 13th, no class****

Week 9 (20 March) Student selected topic and papers

EXAMPLE: Integrating genetics and archaeology

Readings:

- Paabo, et al. (2004) Genetic Analyses from Ancient DNA. Annual Review of Genetics. 38: 645-679.
 - Reich et al. (2012) Reconstructing Native American Population History. Nature. 7411: 370
 - Kirsten et al. (2011) A draft genome of Yersinia pestis from victims of the Black Death. Nature. 478: 506- 510.
 - Adler, et al. (2013). Sequencing ancient calcified dental plaque shows changes in oral microbiota with dietary shifts of the neolithic and industrial revolutions. Nature Genetics, 45: 450-5.
- + student pot-luck contributions

Week 10 (27 March) Student selected topic and papers

EXAMPLE: Evolutionary medicine

Readings:

- Stearns SC (2012). Evolutionary Medicine: its scope, interest, and potential. Proc Biol Sci. 279(1746): 4305-21.
 - Profet, M. (1988) The Evolution of Pregnancy Sickness as Protection to the Embryo Against Pleistocene Teratogens. Evolutionary Theory. 8:177-190.
 - Emera D; Romero R; Wagner G. (2012) The Evolution of menstruation: a new model for genetic assimilation: explaining molecular origins of maternal responses for fetal invasiveness. Bioessays. Jan; 34(1): 26-35.
 - Gilbert & Epel (2009). Ecological developmental biology: integrating epigenetics, medicine, and evolution.
 - Nesse RM. How is Darwinian medicine useful? (2001) J Med. 174(5): 358- 60.
- + student pot-luck contributions

Week 11 (3 April) Student selected topic and papers

EXAMPLE: Genetics of human adaptation

Readings:

- Xin Yi, et al, (2010) Sequencing of 50 Human Exomes Reveals Adaptation to High Altitude Science 329, 75
- Williamson et al. (2007) Localizing Recent Adaptive Evolution in the Human Genome. PLoS Genet3(6): e90.
- Friedlander et al. (2013) ACTN3 Allele Frequency in Humans Covaries with Global Latitudinal Gradient. PLoS ONE 8(1): e52282.
doi:10.1371/journal.pone.0052282

- Sabeti PC et al. (2005) The Case for Selection at CCR5-Δ32. PLoS Biol 3(11):
- + student pot-luck contributions

Week 12 (10 April) *Student selected topic and papers*

EXAMPLE: Human evolution and epigenetics

Readings:

- Heijmans BT, et al. (2008) Persistent epigenetic differences associated with prenatal exposure to famine in humans. PNAS 105:17046-17049.
- Weaver IC, Cervoni N, Champagne FA, D'Alessio AC, Sharma S, Seckl JR, Dymov S, Szyf M, Meaney MJ. Epigenetic programming by maternal behavior. Nature neuroscience. 2004 Aug 1;7(8):847-54.
- Fraga MF, Ballestar E, Paz MF, Ropero S, Setien F, Ballestar ML, Heine-Suñer D, Cigudosa JC, Urioste M, Benitez J, Boix-Chornet M. Epigenetic differences arise during the lifetime of monozygotic twins. Proceedings of the National Academy of Sciences of the United States of America. 2005 Jul 26;102(30):10604-9.
- Lea AJ, Altmann J, Alberts SC, Tung J. Resource base influences genome-wide DNA methylation levels in wild baboons (*Papio cynocephalus*). Molecular ecology. 2016 Apr 1;25(8):1681-96.

+ student pot-luck contributions

Weeks 13 & 14 (17 & 24 April) *Student presentations*****

**** FINAL EXAM in early May, date & time set by University****

**** Project papers due April 30th****