

ANTH 6491: Anthropological Genetics
Wednesdays 6.10- 8 pm,
Purple Seminar Room, 6th floor Science & Engineering Hall
Fall 2015

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

Office: SEH 6820

Telephone: (203) 710.9698

Email: bradleyjbrenda@ gmail.com

Office Hours: Wednesdays 1-3, or by appointment

Lab website: gwprimategenomicslab.org

Course website: via blackboard

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 published in 2001. Our understanding of human genetic variation and molecular evolution has accelerated dramatically in the ~15 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:

- *Human Evolutionary Genetics 2e* by Jobling et al. 2013
 - *Introduction to Genetic Analysis* by Griffiths et al. 2011
 - *Genetics: Analysis of Genes and Genomes, 8e*, by Hartl & Ruvolo 2011
- Additional readings relevant to specific topics will be chosen by students and posted on the course website.

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://gwhieg.blogspot.com>
- **Student-led seminar** (20% of final grade)
 - Each student (or pairs of students, depending on class size), will select the topic and readings (to be approved by instructor) and lead the discussion for one seminar session.
- **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 9th of December.
- **Research project – presentation** (20%): students will give a 20 presentation to the class on their research project. All presentations will be on 2 December.
- **Final exam** (30%): there will be only one exam - a comprehensive final on the 9th December. This will cover 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 (2 September) Introduction: What is Molecular Anthropology?

Readings:

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

Week 2 (9 September) Structure and function of the human genome; General review of human genetics, genomics

Readings:

- Lewis (2010) *Human Genetics 9e*, Chapters: 1,4, 9,10.
- Jobling (2013) *Human Evolutionary Genetics*, Chapters: 2,3

Week 3 (16 September) The Human Genome at 15. 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 (23 September) The Supreme Court decision on genetic patenting: biological, social, and education issues.

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*
- Ratner, M. (2013). Myriad decision aftershocks ripple through biotech. *Nature biotechnology*, 31: 663-665.
- Marshall, E. (2013). In a Flurry of Metaphors, Justices Debate a Limit on Gene Patents. *Science*, 340:421-421.

Week 5 (30 September) 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 (7 October) History and memoir of anthropology genetics

Readings:

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

Week 7 (14 October) Ancient DNA; the Neanderthal & Denisovan genomes

Readings:

- 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 (21 October) Student selected topic and papers

EXAMPLE: 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 October 28th ***

Week 9 (28 October) *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 (4 November) *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 (11 November) *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 (18 November) *One-on-One Project Meetings*

November recess

Week 13 (2 December) ****Student presentations****

9th December

**** FINAL EXAM ****

**** Project papers due ****