COURSE: Evolutionary genetics of humans and other primates (070:420 or 447:420)

LOCATION/TIME: HLL-009-B Mon, Thurs 8:40-10:00 A.M.

INSTRUCTOR: Chi-hua Chiu, Depts. of Genetics and of Anthropology

Office Hours: Monday 3:00-4:00 p.m. or by appointment (one week in advance)

Location: Dept. of Genetics, Life Sciences Building Rm. 222

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DESCRIPTION: We have entered an exciting time of research, the so-called 'postgenomic era' where a major challenge is to discover the genetic basis of being human. In this class, we will identify meaningful patterns of genetic change in genomes and investigate molecular processes that shape genomes within the context of primate phylogeny. We will also investigate mechanisms by which genetic makeup becomes realized in the phenotype of humans and other primates.

DOWNLOADS: PDFs (required reading) and class lecture notes can be downloaded at this website.
ftp://lifesci.rutgers.edu/chiu-review (username: chiuftp; password: NelTMP604).

TEXTS: Assigned PDFs, required.
Human Evolutionary Genetics by M.A. Jobling *et al*., optional
Genes IX by Benjamin Lewin, optional
Molecular Evolution by Wen-Hsiung Li, optional

GRADING: Exam 1 (30%), Exam 2 (30%). Not cumulative.
2 Homework assignments, (10% each; 20% total). Oral presentation (20%). 100 points total.

SYLLABUS:

Part I: Principles of evolutionary genetics

Sept. 6: Introduction to evolutionary genetics.

a. A review of the basics: DNA, RNA, proteins, mutations. [Kimchi-Sarfaty et al. 2007, **required pdf**]. Suggested reading, *Human Evolutionary Genetics: Origins, Peoples, & Disease*, Chapter 2 pp. 22-30.

b. What is a 'gene'? How do we define it and how many 'genes' do humans have? How does this compare to other taxa? [Pennisi, 2005**, required pdf**].

Sept. 10 Evolutionary genetics of humans.

a. Homology at the genetic level. Reading: *Human Evolutionary Genetics: Origins, Peoples, & Disease*, Chapter 6, pp. 153-157.

b. Phylogenetic tree thinking exercise [Baum et al. 2005, **required pdf].**

c. Humankind's place in nature. An overview of primate phylogeny. Suggested reading, *Human Evolutionary Genetics: Origins, Peoples, & Disease*, Chapter 7, pp. 201-207; 211-223. [Goodman et al. 2005, **suggested reading**].

Sept. 13:
a. What are the principles of evolution?
b. Variation, genetic drift, and fixation.
c. Neutral evolution as a null hypothesis. The molecular clock.
d. Selection.

Sept. 17:
a. Predictions of the neutral theory of evolution and it's applications in biology.
b. Detecting sequence signatures of selection and it's applications in biology. Case studies of molecular adaptations. Reading: *Human Evolutionary Genetics: Origins, Peoples, & Disease*, Chapter 13, pp. 407-421. [Messier and Stewart, 1997, **required pdf**].

Sept. 20: Are humans still evolving? Reading: *Human Evolutionary Genetics: Origins, Peoples, & Disease*, Chapter 13, pp. 423-433.

Part II: Evolution of genes and genomes

Sept. 27:
a. The structural components of the "gene" and its context within the genome.
b. Comparative genomics of vertebrate taxa. Phylogenetic footprinting and differential phylogenetic footprinting. [Bofelli et al. 2003, **suggested reading**].

Oct. 1: Patterns and functional significance of differences in genomes across different primate taxa.

Oct. 4 Evolution by gene duplication 1: Major pathways.

Oct. 8: Evolution by gene duplication 2: How gene duplication affects coding and non-coding DNA evolution. [Zhang, 2006, **required pdf**].

Oct. 11: **EXAM 1- IN CLASS**

Oct. 15: Recombination based drivers of genome evolution.

Oct. 18: Evolution by exon shuffling and alternative splicing.

Part III: Linking evolution of genes and genomes to evolution of phenotypes.

Oct. 22: Evolution and development (evo-devo 1): Guiding principles and morphological differences *between* species.

Oct. 25: Evo-devo 2: Limb evolution in primates and other chordates.

Oct. 29:
a. Evo-devo and morphological differences *within* species [Abzhanov et al. 2004, **required pdf**].
b. Eco-devo-devo (interactions with the environment).

Nov. 1: Molecular evolution of brain-expressed genes. Detecting sequence signatures of selection. Detecting evolutionary changes in gene regulation.

Nov. 5: Neanderthal genomics and the uniqueness of humans. [Noonan et al. 2006, **required pdf**; Evans et al. 2006, **suggested reading**].

Nov. 8: NO CLASS- Professor is out of town

Nov. 12: Variation and selection within humans. [Tishkoff et al. 2007, **required pdf**; Levy et al. 2007**, required pdf].**

Nov. 15: Pharmacogenomics: Treating human disease by making use of variation among different human populations.

Nov. 19: **EXAM 2- IN CLASS**
Nov. 22: Happy Thanksgiving! NO CLASS TODAY
Nov. 26: Oral Presentations
Nov. 29: Oral Presentations
Dec. 3: Oral presentations
Dec. 6: Oral Presentations
Dec. 10: Last Day of Class