**GEORGE MASON UNIVERSITY**

**College of Science**

**BIOL666** (3 credits)

**Human Genetics Concepts for Health Care**

**Dr. Ancha Baranova**

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**Dr Mariaelena Pierobon** (office hours Monday 3:30-4:30 in IABR room 2016)

**mpierobo@gmu.edu**

Please write in advance to confirm appointment

**Prince William: SciTech (PW): K. Johnson Hall 249 MONDAYS 4:30 pm**

**IMPORTANT:**

**This course is offered jointly by**

**Dr. Baranova and Dr. Pierobon**

**Because of that, lecture slides may be updated right before each lecture**

**Please download “fresh” slides immediately before the lecture**

**Course Pre-requisites:** Students in BIOS/BIOL program will be able to count either this course, either BIOL572 Human Genetics, but not both of them.

**Course Title:** Human Genetic Concepts for Health Care

**Catalogue Description:** Principles of genetically-determined diseases with emphasis on clinical aspects of these diseases, genetic counseling, and laboratory methods used in human genetics. Extended Studies students preparing to enter Med- or Dental Schools are welcome.

***Pre-requisite:*** B.S. degree completed or enrollment in accelerated Masters program. At least one Cell or Molecular Biology undergraduate course. ***Not available to students who have taken BIOL 572.***

**Course Objectives:**

The course will integrate knowledge of genetic principles and framework of genetically-determined human diseases with a special emphasis on the pathophysiological aspects of monogenic and multifactorial diseases, and on genetic counseling. Students will learn to interpret the results obtained using research methods commonly used by human geneticists.

***Note:*** If you are a student with a disability and you need academic accommodations, please see instructor, and contact the Disability Resource Center (DRC) at 708-993-2474. All academic accommodations must be arranged through the DRC.

**Recommended Texts:**

Nussbaum, R.L., McInnes, R.R.& Willard, H.F. (2004). *Thompson & Thompson: Genetics in Medicine*, 6th ed. Philadelphia: Saunders.

Young, I.D. (2005). *Medical Genetics*. New York: Oxford University Press.

**Or any other, more recent editions of these two books**

**OTHER REQUIRED READING: (before 2nd exam)**

1. Seleman M, Hoyos-Bachiloglu R, Geha RS, Chou J. Uses of Next-Generation Sequencing Technologies for the Diagnosis of Primary Immunodeficiencies. Front Immunol. 2017 Jul 24;8:847. doi: 10.3389/fimmu.2017.00847. eCollection 2017. Review. PubMed PMID: 28791010; PubMed Central PMCID: PMC5522848.
2. Ramos E, Weissman SM. The dawn of consumer-directed testing. Am J Med Genet C Semin Med Genet. 2018 Mar;178(1):89-97. doi: 10.1002/ajmg.c.31603. Epub 2018 Mar 7. PubMed PMID: 29512889
3. Sawyer SL, Hartley T, Dyment DA, Beaulieu CL, Schwartzentruber J, Smith A,.. FORGE Canada Consortium; Care4Rare Canada Consortium, Majewski J, Boycott KM. Utility of whole-exome sequencing for those near the end of the diagnostic odyssey: time to address gaps in care. Clin Genet.2016 Mar;89(3):275-84. doi: 10.1111/cge.12654. Epub 2015 Sep 22. Review. PubMed PMID: 26283276; PubMed Central PMCID: PMC5053223.

**ADDITIONAL WORK FOR GRADE UPGRADE**

**(an exercise in scientific writing)**

 **It is expected that some students may not do so well in first or second exam. That is why I am offering (in advance), a mean to remedy insufficient grade. THIS IS ADDITIONAL (EXTRA) WORK WHICH IS NOT REQUIRED.**

 **It has to be, however, done in advance: please do not expect of yourself to be able to complete this work in a day before deadline**

 **Read the book: “The Goodness Paradox: The Strange Relationship Between Virtue and Violence in Human Evolution”** by Dr. Richard W. Wrangham

 **At the time of announcing grades of the 1st midterm exam, I will release the topic of Essay (3 pages, with references) which you may write and submit on April 6th.**

 **This essay will be graded either on “YES” or “Sorry, NO” scale, and will, to your best ability, respond to human diseases related scientific question posed by its topic. Criteria for grading would include: 1) it should clearly and correctly argument your point of view, with references, both from the book and from other scientific literature; 2) it should use proper scientific terminology; 3) it should be well-written; 3) it should be an interesting read!**

**If your Essay is graded “YES”, your grade for entire class will be upgraded by one grade (I.e. “A-“ upgraded to “A”, “B” upgraded to “B+”**

**If your Essay is graded “Sorry, NO”, your grade for entire class will not be chaged. That means “no fault” if essay wil l not be found sufficient for grade upgrade**

**Please note: this is ADDITONAL work, which is NOT REQUIRED.**

**I will gladly discuss your Essay with you, and will explain why I had not given “YES” grade, but I WILL NOT CHANGE “Sorry, NO” grade to “YES” grade.**

**Please note: it is advisable to read the book in advance (i.e. in the beginning of the semester). The answer for the essay IS NOT in the book. Book is a “food for thought” and scientific framework for an essay. No more, no less.**

**ESSAY is submitted on April 6th, as a printout (not as emailed attachment)**

**Course Grading :**

**Evaluation will be based upon:**

Closed Book Exams 100% (25% 1st Mid-term, 25% 2nd Mid-term, 50% Final exam) PLUS possible grade upgrade described above

The website for the GMU honor code: http://www.gmu.edu/facstaff/handbook/aD.html

**Course Schedule**

| **Week** | **Activity** |
| --- | --- |
| **WEEK 1, January 27th** | **Lecture 1. Acute and chronic diseases: blurry borders. EBV infection as an example. Genetic classification of human diseases. Family studies, twin studies, adoption studies. Polygenic inheritance. Heritability. Genes and Environment. “Liability-Threshold model”. Susceptibility genes. Common disease-common variant (CDCV) hypothesis. Linkage and association. (BARANOVA)** |
| **February 3rd**  | **Lecture 2. Examples of multifactorial diseases: detailed analysis. 1. Alzheimer disease 2. Coronary Artery disease 3. Diabetes Type I (childhood onset) 4. Diabetes type II (adult onset) 5.Hirschprung disease 6. Neural tube defects 7. Schizophrenia (BARANOVA)** |
| **February 10th** | **Lecture 3. Mutations and their consequences to expression of the gene or function of its product. Functional types of mutations, loss and gain of function. Spontaneous and induced mutations. Mutagens. Instability of the human genome. Paternal gain of mutations. Common types of mutations in DNA. Rate of mutations in humans. (BARANOVA)** |
| **February 17th** | **Lecture 3 continued. Mutations vs. Aneuploidy. Truncation selection in human populations. Forced gain of mutations. HPRT Assay. Comet assay. Environmental carcinogens.DNA repair and DNA checkpoints. Ataxia-Telangioectasia.Direct-to-Consumer (DTC) genetic testing.(BARANOVA)** |
| **February 24th** | **Lecture 4.** **Genetics of human development. Human reproduction as an inefficient process. Critical periods for developmental defects. Classification of birth defects. Teratogenesis. Hox and Pax genes. FGF pathway. Sonic hedgehog pathway. Neural crest cell migration network. Sex determination pathway.** (**BARANOVA)** |
| **March 2th**  | **EXAM1 Lecture 5 Chromosome instability syndromes. Telomeric instability. (BARANOVA)** |
| **March 16th** | **Lecture 5. Mendelian diseases. Important definitions of classic genetics. Expressivity. Penetrance. Consanguinity.** |
| **March 23th** |  **Lecture 6. X-chromosome inactivation. Anticipation. Mosaicism. Mitochondrial inheritance. (BARANOVA)** |
| **March 30th** | **Lecture 7. NextGen sequencing to find out gene defects. Exome sequencing for rare diseases. Recent advances. READ ASSIGNED MS before lecture and another time before exam****Lecture 8. Human Polymorphisms. Types of Variations in Human Genome. Types of SNPs. Life cycles of SNPs and mutations. (BARANOVA/ PIEROBON)** |
| **April 6th**  | **EXAM 2. Lecture 8 CONTINUED Disease risk and treatment response associated types of variation. ApoE4.TP53 Arg/Pro. Human Polymorphisms. Isoniazide, methotrexate, tamoximen response and its genetic modifiers. INDEL polymorphisms. ACE Alu-based indel. CCR5 indel. Copy Number Variations. CCL3L1. CNVs and autism. Allelic associations. Ankylosing spondylitis and B27 allele. Genome-wide association studies. HapMap project. Biomedical differences between chimps and human. (BARANOVA/ PIEROBON)** |
| **April 13th** | **Lecture 9. Obesity as an example of complex disease. (backed up as VIDEO RECORDED LECTURE). (PIEROBON) – other disease examples (cell signaling)** |
| **April 20st** | **Lecture 11. Tumor genetics (backed up as VIDEO RECORDED LECTURE) (PIEROBON)** |
| **April 27th**  | **Lecture 10. REACTIVE OXIGEN SPECIES AS CONTRIBUTORS TO HUMAN DISEASES/ (PIEROBON) Lecture 12Epigenetics contributions to human disorders(PIEROBON)** |
| **May 4th** | **Reading Day**  |
| **May 11th** | **FINAL EXAM MAY 13th** |