Genomics and Global Public Health (BIOL-GA 2015/GPH-GU 2015)
Syllabus and Schedule

INSTRUCTOR:
Professor Jane Carlton,
Room 506, Center for Genomics and Systems Biology, 12 Waverly Place
jane.carlton@nyu.edu

SESSIONS AND LOCATION:
14 sessions, Wednesday 4.55 – 7.35PM, Spring semester
Room 805, 8th Floor, Center for Genomics & Systems Biology, 12 Waverly Place
Discussion 4.55 – 6.25 (90 mins); Break – 10 mins; Lecture 6.35 – 7.35 (60 mins)
Office hours: 1 hour per week, by appointment

COURSE OVERVIEW
This course describes the developing relationship between genomics and genomic technologies with the health of populations in a global context. Topics covered include genomic technologies and their applications, genetic epidemiology, the human microbiome, infectious disease genomics, and the ethical, legal and social implications of genomics. The course consists of lectures, group discussions focused on current scientific papers, guest seminars, and a hands-on sequencing workshop. Students will leave the course with an increased awareness of how sequencing of microbes, parasites and human genomes helps develop better diagnostics and therapies and a greater understanding of human health globally.

PREREQUISITES
Students that are not Biology majors or who have not taken Biocore I (BIOL-GA.1001) should contact the Instructor prior to enrollment to discuss their academic background in biology.

COURSE DETAILS
The course consists of 14 sessions consisting of 13 lectures (including one optional basic molecular biology/genetics lecture), 11 discussion sessions, one sequencing workshop, one midterm exam and one final exam. Most sessions start with a discussion of the paper(s) given as a reading assignment in the previous week, followed by a lecture by the Instructor or a Guest Lecturer. The lecture provides the background for the papers assignments that are discussed the following week. The discussions are led by students, and this is organized during the first session. Depending upon the number of enrollees, the class will be divided into groups of 2-3 students, and different roles and responsibilities can be assigned to each team member as far as presentation of that group's paper. Each paper each week will be presented by a different group. The emphasis of the course is on the applications of genomics and genomic technologies to global public health, rather than on methods of computational or statistical analysis of genomic data.

EXPECTATIONS
This course is taught at a graduate level: therefore, students are asked to take responsibility for their learning. Students are expected to ask questions if anything is unclear, to read the paper(s) assigned each week, and to actively participate in ALL discussions and lectures. For paper discussions, the student presenters are expected to make a powerpoint presentation that summarizes the paper as follows: the position of the paper in its field, experimental approach used, analysis performed, and the major results and their implications. The students are also expected to critique the paper, *i.e.,* find any drawbacks and limitations of the approach or methods used, and identify alternative methods or experiments that could have improved the paper. Participation by all class members is expected and will be reflected in the class participation component of the final grade.

RECOMMENDED TEXT:
"Genomics Applications for the Developing World", Nelson & Jones-Nelson editors, Springer.

"Genomics Applications for the Developing World evolved from an observed need for information on genomics and other related "omics' technologies that are beginning to take hold in the developing world. It presents current research and perspectives from a wide range of respected scientists and world leaders in their fields in both developed and developing countries. Topics range from discussions on Tuberculosis, Malaria, emerging viruses and bacterial infectious agents to discussions on genomics of various crop species and the implications of studies on the human microbiome to aspects of developing world health. The global challenge of genomics education is also discussed. This book is a reference work for scientists at all levels, educators and students both at the graduate and undergraduate level who reside across the globe."

GRADING:

Assignments & discussion participation:	30%
Midterm:	35%
Final exam:	35%

Student Evaluation
This will be through three mechanisms:
(1) How the student performs during assigned discussion sessions that s/he is helping to present; and discussion participation during other presentations and lectures. A total of 30% of the total grade is assigned to this activity.
(2) How the student performs in the midterm exam. A total of 35% of the total grade is assigned to this activity.
(3) How the student performs in the final exam. A total of 35% of the total grade is assigned to this activity.

Midterm and final exams: Both exams will consist of multiple choice and short answer/essay questions to test the student's understanding of basic concepts in genomics and global public health, and how genomics and genomic technologies are being used in global public health.

POLICIES:
Missed exams
Exams will be excused only for medical or family emergencies, and notification needs to occur by email before the exam. A make-up test will be made available. An **unexcused** absence from an exam will be calculated as 0% for that particular test.

COURSE SCHEDULE
Detailed topics are subject to minor changes.

SESSION 1: Lecture: Introduction to genomics and global public health. World-wide improvement in health, reduction of disparities, protection against global threats. Power of genomics as a technology and discipline to improve human health.
Background lecture: Basic concepts in molecular biology and genetics. DNA, RNA, protein; transcription, translation; the genetic code; genotype, phenotype; types of genetic mutations.
Assignment: genomics and global public health overview.

SESSION 2: Paper discussion: genomics and global public health overviews.

Lecture: Next generation sequencing and its applications, large data analysis, manipulation and storage. NGS data analysis, GenBank and organism-specific sequence databases, analysis of sequence data.
Sequencing workshop: visit to genomics core, library preparation, sequencing run.
Assignment: next generation sequencing and data analysis papers.

SESSION 3: Paper discussion & sequencing workshop: next generation sequencing data analysis papers, analysis of sequence data generated from previous week.
Lecture: Genetic epidemiology and population genomics. Concept of genetic variation, basic population genetics, use of GIS/GPS & Google Earth to map spread of disease.
Assignment: genetic epidemiology and population genomics papers.

SESSION 4: Paper discussion: genetic epidemiology and population genomics papers.
Guest lecturer: Metagenomics: the human microbiome in health and disease in global populations, and global environmental genomics.
Assignment: human microbiome and environmental metagenomics papers.

SESSION 5: Paper discussion: human microbiome and environmental metagenomics papers.
Lecture: Global health burden, life-cycle, methods of control, comparative genomics of medically-important parasites, with particular emphasis on arthropod-borne parasites such as malaria and trypanosomes.
Assignment: parasite genetics and genomics papers.

SESSION 6: Paper discussion: parasite genetics and genomics papers.
Lecture: Global health burden, life-cycle, methods of control, comparative genomics of enteric pathogens, with particular emphasis on diarrheal diseases caused by *Giardia, Entamoeba, Cryptosporidium*, *Shigella* and cholera.
Assignment: diarrheal disease genomics papers:

SESSION 7: MIDTERM EXAM

SPRING RECESS

SESSION 8: Paper discussion: diarrheal disease genomics papers.
Lecture: : Human genetic susceptibility to disease. International HapMap Project, 1000 human genomes project, GWAS, linkage disequilibrium, genetic crosses, selective sweeps.
Assignment: GWAS and genetic crossing papers.

SESSION 9: Paper discussion: GWAS and genetic crossing papers.
Guest lecture: Non-communicable diseases and public health.
Assignment: non-communicable disease genomics papers and reviews.

SESSION 10: Paper discussion: non-communicable disease genomics.
Lecture: Genomics of DNA and RNA viruses, with a focus on influenza and its variants, HIV, hemorrhagic fever viruses, and viral zoonoses/emerging viruses.
Assignment: Viral genomics papers and movie “Contagion”.

SESSION 11: Paper discussion: Viral genomics papers and movie “Contagion”
Lecture: Genomics of pathogens causing sexually transmitted infections. *Chlamydia*, trich, gonorrhea, syphilis, candidiasis. Tracking sexual networks using genomics.

Assignment: sexually transmitted infection genomics papers.

SESSION 12: Paper discussion: sexually transmitted infection genomics papers.
Guest Lecture: Using genomics to increase food production and produce biofuels.
Assignment: food production and alternative energy genomics papers.

SESSION 13: Paper discussion: food production and alternative energy genomics papers.
Lecture: The ethical, legal and social implications of genomics and global public health. Sharing genomic sequence data, beliefs, practices and policies regarding genomic information and technologies, and the legal, regulatory and public policy issues.
Review of course: Questions, clarifications, wrap-up.

SESSION 14: FINAL EXAM