BIOL 338: Introduction to Genomics: W2017 draft syllabus

Prerequisite: BIOL 233 or 234, or FRST 302

Instructors:

Dr. Jincan Chen

Meeting times:

- Lectures: 10:00 – 10:50 on Monday, Wednesday, and Friday

Course overview:

This course will provide students with an introduction to the relatively new and cutting-edge discipline of genomics. It will be organized into five sections: Contents, organization, and dynamics of genomes; genome sequencing and annotation; genomics approaches to studying gene expression; genome analysis and comparative genomics; research in genomics. Applications of genomics to human health and disease, crop plant improvement, and other applied situations will be included. Tutorials will consist of computer labs to introduce students to web resources in genomics, along with group discussions of genomics research papers and timely topics in genomics.

Course learning outcomes:

NO.1	Achieve a working knowledge of concepts and recent discoveries in genomics
No. 2	Explain how technological advances have led to conceptual advances in genomics
No. 3	Relate concepts and discoveries in genomics to human disease, crop plant improvement, and other applied situations
No. 4	Utilize major web resources in genomics
No. 5	Identify the main results from a genomics research study and interpret figures from a primary research paper

Evaluation:

Midterm exam 1	18%
Midterm exam 2	18%
Final exam - cumulative	35%
Tutorial exercises	18% (1.5% per tutorial)
Pre reading quizzes	6%
Clicker questions/attendance	5%

Reading:

No textbook. Readings will consist of literature review articles from journals and other materials to give an introduction to the lecture topics. Readings for tutorials will consist of primary research papers and other materials.

Readings will be posted on the course Connect site. There will be a pre-reading quiz approximately once per week.

Required materials:

A laptop computer or tablet is needed for computer exercises in certain tutorials. Clickers are needed for all lectures.

Lecture schedule

Section 1: Contents, organization, and dynamics of genomes (Adams)

January 4	Course introduction, introduction to genomics
January 6	Chromatin structure and methylation
January 9	Transposable elements: types and their abundance in genomes
January 13	Repetitive DNA: satellites and microsatellites
January 18	Centromeres and telomeres
January 23	Sex chromosomes
January 30	Midterm exam #1

Section 2: Resource building - Genome sequencing and annotation (Lee)

February 1	Promises and advances in genomics
February 3	Research questions in genomics
February 6	Next generation sequencing - enabled research applications

February 8	Basics and practice of genome assembly (focused on Human genome assembly by CVI)
February 13	Family day, no class
February 15	Genome annotation: Chromosome mapping, gene structure, and gene content

Section 3: Genomics approaches to studying gene expression (Adams)

February 27	Transcriptomics
March 3	Proteomics
March 8	Uses of NGS in evolution studies
March 10	Midterm exam #2

Section 4: Genomics-enabled biology: mutation profiling and comparative genomics (Lee)

March 13	System genomics as an integrated research tool
March 15	Targeted sequencing: Exome sequencing for mutational profiling and functional genomics approaches
March 20	Population-level genomics: 1000 genome projects and genome wide association studies (GWAS)
March 24	Personalized genomics: survey, introduction, and discussion
March 27	Comparative genomes (focused on Human Evolution and Macroevolution)

Section 5: Research in genomics (Adams and Lee)

March 31	Current topics in genomics: CRISPR system, genomics to

	combat infectious diseases
April 3	Research presentation (Adams Lab)
April 5	Research presentation (Lee Lab)

Tutorials, indicated by weeks

January 9	Research paper discussion: transposable elements
January 16	Computer exercise: GenBank gene and chromosome records, BLAST searching
January 23	Research paper discussion: sex chromosomes
January 30	Peer teaching and discussion: pros and cons of various NGS platforms (interactive)
February 6	Research paper discussion: NGS-based genome assembly (Klebsormidium genome, as a review of the key concepts in genome assembly) - The need for long-reads?
February13	Computer exercise: Annotation of a protein-encoding gene (Computer algorithms and public databases)
February 27	Computer exercise: Gene expression and human genomics databases
March 6	Research paper discussion: Proteomics
March 13	Research paper discussion: exome sequencing (Mendelian genetic disorder, as a review of the key concepts in the exome study) - The statistical power of exome-reads?
March 20	Survey on public views about personalized medicine

	(Briefing of their homework in class -no tutorial sessions per se)
March 27	Research paper discussion: comparative genomics study (Human specific traits, focused on comparative techniques)
April 3	Paper discussion: CRISPR system