CBE 517: Principles of Genome Engineering
Spring 2019 Syllabus

Lectures: TR 10:30 AM -12:00 PM (Towne 309)
Instructor: Dr. Bomyi Lim
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TA: Caroline Cameron (cvcam@seas.upenn.edu)

Office Hours: Tuesday 4-5 PM (Lim, 351 Towne)
Thursday 4-5 PM (Cameron, TBD)

Course Overview:
This course covers up-to-date techniques in genome engineering and its application in basic research and translational medicine. Genetic engineering techniques including site-directed DNA recombination (Cre-Lox, Phi31 integrase), genome editing (TALEN, CRISPR/Cas-9), next generation sequencing, and molecular imaging will be covered. Key concepts in genomics, epigenetics, gene regulation will be introduced, and application of genetic engineering techniques in the field of developmental biology, stem cell biology, and synthetic biology will be discussed.

Textbooks:
Textbook is not required in this course. We will use primary literature materials and power point slides. But, students are welcome to do some background reading using recommended textbooks below:

- Molecular Biology of the Gene, 7th edition. J.D. Watson et al. Pearson
- An Introduction to Genetic Engineering, 3rd edition. D.T. Nicholl. Cambridge University Press.
- Gene Cloning and DNA Analysis: An Introduction, 7th edition. T.A. Brown. Wiley.
- Principles of Gene Manipulation and Genomics, 7th edition. S.B. Primrose, R. Twyman. Wiley

Website: Announcements and homework assignments will be posted on **Canvas**.

Course Syllabus:

I. Introduction to genomics and gene regulation
   - organization and structure of genomes
   - gene regulation and diseases

II. Gene manipulation techniques

- Transgenesis and site-specific recombination: Cre-Lox, Phi31 integrase, etc.
- Genome editing: ZFNs, TALENs, CRISPR/Cas9
- Multi-gene assemblies and high-throughput DNA assembly techniques

III. Sequencing and mapping genomes
- Sanger sequencing
- Next Generation Sequencing
- Techniques utilizing NGS: Chip-seq, RNA-seq, single-cell transcriptomics
- Application to disease phenotyping

IV. Molecular imaging
- Fluorescent tagging of fixed and live cells
- CRISPR-based DNA tagging, rainbow imaging
- Quantitative and high-throughput single-cell image analysis

V. Application of genome engineering
- Application in synthetic and developmental biology
- Application in human genetics, disease phenotyping, etc.

Grading:

Homework	30%
In-class exam	35%
Final Project	35%

Homework:
- Homework assignments will be posted roughly every two weeks.
- Late homework will not be accepted.

Exam: April 2nd, Tuesday, in class.

Final Project: Presentations in the final week of the semester
- A group of 1-3 students will select a primary literature of interest, and present it to the entire class
- Each group will do ~15min presentation
- Please select primary research papers that discuss one or more of below:
  - i) New technique development in genome engineering
  - ii) Application of already developed techniques in understanding fundamental mechanism of interesting biological problems
  - iii) Application of already developed techniques for biomedical use
  - iv) Development of high-throughput genome engineering techniques