Course Syllabus:
Stem Cell Techniques: Generate Genetically Modified ESC/iPSC Lines

Course Overview: This course provides an in-depth exploration of the CRISPR-Cas9 gene-editing technology and its applications in genetic modification. Through a combination of lectures, discussions, students will gain a comprehensive understanding of CRISPR technology, its underlying mechanisms, ethical considerations, and practical applications. Objectives include:

- Understanding theoretical concept of genomic modification
- Understanding theoretical concept of CRISPR molecular mechanism and guide design
- Identification of CRISPR applications

Course Duration: Three days spanning two weeks, 1:00 pm to 4:00 pm, including two hours of class time and a one-hour discussion

Note: Enrollment may be limited to a max of eight attendees per class to ensure individualized attention and optimal learning outcomes. The syllabus is designed to provide a comprehensive overview of the course content and may be adjusted based on participant needs and advancements in the field.

Prerequisites: Participants must complete the web-based Introduction to Stem Cell Laboratory Techniques. Participants should have a solid foundation in cell biology, molecular biology, and basic cell culture techniques. Familiarity with stem cell biology concepts is beneficial but not required.

Day 1: Introduction to CRISPR and Molecular Biology Basics

- Introduction to genetic modification and gene editing
- Molecular biology fundamentals: DNA, RNA, and protein structures
- DNA replication, transcription, and translation
- Overview of CRISPR-Cas systems: Types I, II, and III
- Detailed mechanism of CRISPR-Cas9 genome editing
- Components of CRISPR-Cas9: gRNA, Cas9 enzyme, PAM recognition
- Specificity and off-target effects

Day 2: CRISPR Application Design and Delivery

- Design principles for guide RNAs (gRNAs)
- Delivery methods: Plasmids, mRNA, ribonucleoproteins (RNPs)
- Optimization of CRISPR editing efficiency
- CRISPR screening techniques
- Knockout and knock-in strategies
- Gene activation and repression using dCas9
- Disease modeling and functional genomics
- Therapeutic applications: Gene therapy and personalized medicine
- Ethical implications of CRISPR technology

Day 3: Review of Assignments

- Hands-on laboratory exercises CRISPR design, cell culture, and editing assays
- Analysis of edited cells: PCR, sequencing, and functional assays

Assessment Methods:

- Class participation and discussions
- Performance on assignments