GS04 1253 -- Principles in Genetics & Epigenetics (PIGE) (*last updated*: 2022-12-16, RK)

Syllabus – Spring 2023

In-person class
Tuesday & Thursday, 10:00 - 11:30 am / - 12:00 pm (application workshop sessions only) in BSRB S3.Large Classroom; except *Th, 02/12, 01/26, 02/02 & 04/13 in BSRB S5.8005ab.

2023 Date, Day	Class #	Wk	Lecture Topic	Lecturer
January 10, Tu	1	1	The structure of the genome	Sen
*January 12, Th	2		Chromosomes and aneuploidy	Cole
January 17, Tu	3	2	Molecular basis of disease phenotype-genotype	Hixson
January 19, Th	4		Genetic screens	Mattox
January 24, Tu	5	3	Genetic manipulation of mice	Behringer
*January 26, Th	6		Conditional genetic manipulations	Wang
January 31, Tu	7	4	RNA interference	Arur & Baek
*February 2, Th	8		Next generation DNA sequencing	Fornage & Krahe
February 7, Tu	9	5	Applications of genetic information to health outcomes in multifactorial disorders	Fornage
February 9, Th	10		Current human genetic approaches to gene discovery for multifactorial disorders	Kapoor
February 14, Tu	11	6	Medical genetics services & clinical risk assessment	Singletary
February 16, Th	12		Genetic basis of cancer	Krahe
February 21, Tu	13	7	Oncogenes, tumor suppressor genes and cancer pathways	Krahe
February 23, Th	14		Tumor Heterogeneity and scOmics Approaches	Casasent
February 28, Tu	15	8	Functional validation of Variants in Disease Candidate Genes	Karras & Gracia
March 2, Th	16		Bioinformatics Workshop: RNA-Seq	Liu
March 7, Tu	17	9	Bioinformatics Workshop: RNA-Seq	Liu
March 9, Th	18		Bioinformatics Workshop: RNA-Seq	Liu
March 13-17		**10**	Spring Break – **No class**	
March 21, Tu	19	11	Bioinformatics Workshop: scRNA-Seq	Liu & Casasent
March 23, Th	20		Gene precision therapies and stem cell therapeutics	McDonnell
March 28, Tu	21	12	DNA methylation	Huang
March 30, Th	22		Imprinting & X inactivation	Chen
April 4, Tu	23	13	Epigenetics techniques: bench skills	Jain
April 6, Th	24		Epigenetics & expression of the genome	Cheng
April 11, Tu	25	14	Histone code: Writers & Erasers	Lee
*April 13, Th	26		Histone code: Readers	Bedford & Wright
April 18, Tu	27	15	Histone variants	Bartholomew
April 20, Th	28		ATP-dependent chromatin remodelers	Bartholomew
April 25, Tu	29	16	Non-coding RNAs	Calin
April 28, Th	30		Epigenetics and cancer therapeutics	Santos
May 1-5			Final Exams Week – **No Final Exam**	

***Room change:** Th, 02/12, 01/26, 02/02 & 04/13 in BSRB S5.8005ab.

Course Description

Principles in Genetics and Epigenetics (PIGE) is designed for students who have a major interest in the aspects of experimental and human genetics, epigenetics, and genomics as they relate to human disease, including Mendelian disorders, complex diseases, and cancer. This class will provide in-depth instruction in four areas:

1) Experimental genetics
2) Human genetics and genomics
3) Epigenetics and epigenomics
4) Applied bioinformatics.

This course *fulfills a requirement of the Genetics & Epigenetics Graduate Program*.

Prerequisites: *Completion of the GSBS Core Course* or *equivalent* (***please contact one of the course directors to confirm prior equivalents***).

Didactic Lectures

Didactic lectures are divided into three thematic sections and follow a natural progression. In-depth instruction will be provided on topics related to (1) experimental genetics, (2) human genetics and genomics, and (3) epigenetics and epigenomics.

Application Lectures

Short application lectures (3-4; 30 min each) by senior graduate students or post-doctoral fellows in laboratories of participating faculty will follow selected lectures to highlight specific techniques and applications to the material covered in the primary lecture.

Applied Bioinformatics Workshop

This hands-on four (five) sessions bioinformatics workshop is focused on RNA-seq, including single-cell RNA-seq. Students will learn how to process and analyze RNA-seq data, and how RNA-seq is being applied as a method to answer biological and experimental questions related to all three sections of the course.

Sequence datasets will be provided by the instructor. However, students can also use their own sequence data or datasets available through public repositories.

Learning Objectives

As a *foundational course*, this course is designed to *introduce students to the basic principles in genetics and epigenetics* and *prepare the student to generate novel hypothesis-driven projects* as part of their own research in the areas of genetics and epigenetics inside and outside of G&E laboratories. The course emphasizes active learning through a combination of didactic lectures, selected application lectures and a bioinformatics workshop.

Learning Resources

Lectures will draw from recommended and suggested readings, including landmark historic and contemporary papers, as well as review articles. *No textbook is required.*

Student Responsibilities and Expectations

Students enrolled in this course will be expected to perform the following activities each week:

1. Participate in and contribute to course discussions during the didactic lectures and review sessions
2. Process and review material from each lecture, and read 1 or 2 recommended seminal reviews relating to the week's topic
3. Read 1-2 recommended primary research articles
4. Attend and participate at the Application lectures
5. Prepare for and complete weekly homework assignment based on course lectures and readings
6. Attend and participate at the Applies Bioinformatics workshop sessions and review sessions
7. Prepare for and complete applied bioinformatics assignment based on course lectures

Students are expected to complete all assigned reading material (reviews and research literature). While you may work and discuss all course materials and assignments in groups, all writing assignments must be your own. Plagiarism and failure to properly cite scientific literature and other sources will not be tolerated and are grounds for dismissal from the course and further GSBS disciplinary action. Cheating or engaging in unethical behavior for any assignments will be grounds for dismissal from the course without credit and further GSBS disciplinary action.

Grades & Grading

Letter grade (A-F). Students are expected to actively participate in the course by initiating discussions, asking questions, and providing constructive comments.

There will be weekly (every Friday) open-book homework assignments based on the material covered in each lecture, to be completed within 1 week (following Friday) of assignment. *There is no final exam.*

Students will be evaluated on attendance and participation (15%), bioinformatics workshop participation and completion of assigned exercises (15%), and overall performance on the assigned homework (70%).

Course Format

The class will be held two times a week for one and a half hours each class:
Tuesday & Thursday, 10:00 am – 11:30 am in BSRB S3.Large Classroom; except Th, 02/12, 01/26, 02/02 & 04/13 in BSRB S5.8005ab. On days when an additional **Application Lecture (30 min; 10:00 am – 12:00/noon)** is included, there will be a 15 min break between the primary lecture and the application lecture by a senior trainee in the lab of the primary lecturer.

In-person learning is a central part of graduate education and offers our students important opportunities to interact and with both peers and faculty. However, COVID continues to be a major public health concern. Please observe the following:

- All in-person classes should follow the host institutions COVID safety policies. This includes policies on social distancing, masking, and eating in class. Please take into account classroom capacities in determining the number of students who may be enrolled.
- Course directors should be ready to make accommodations for virtual participation upon request by students who cannot attend class safely for significant health reasons. Students should not be given such accommodations for reasons of convenience alone. Any situations in which a student feels they have been unfairly denied an accommodation should be referred immediately to the Office of Academic Affairs at the GSBS.

- **Students in all classes should be cautioned <u>not to attend in-person if they are displaying any potential COVID symptoms (whether they have been tested or not)</u> and accommodations should be provided to these student to attend online or view a recording of the class.**

Course Directors

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