IMPORTANT: This syllabus form should be submitted to OAA (gsbs_academic_affairs@uth.tmc.edu) a week before the start of each semester.

NOTE to STUDENTS: If you need any accommodations related to attending/enrolling in this course, please contact one of the Graduate School's 504 Coordinators, Cheryl Spitzenberger or Natalie Sirisaengtaksin. We ask that you notify GSBS in advance (preferably at least 3 days before the start of the semester) so we can make appropriate arrangements.

Term and Year: **Spring 2024** Course Number and Course Title: **GS04 1253: Principles in Genetics & Epigenetics** Credit Hours**: 3** Meeting Location: **UT-MDACC/Basic Science Research Building (BSRB)** Building/Room#: **BSRB S3.8371 (GSBS Large Classroom)** and **BSRB S3. 8112 (Computer Lab)**	Program Required Course: **Yes** Approval Code: **No** **Audit Permitted: Yes** Classes Begin: **January 9, 2024** Classes End: **April 25** Final Exam Week: **April 29-May 3, 2024** **No final exam**

Class Meeting Schedule

Days	Times
Tuesday & Thursday (Regular Sessions)	**10:00-11:30 am**
Tuesday and & Thursday (Sessions with additional Application Workshops)	**10:00-12:00 pm**
Tuesday and & Thursday (for Applied Bioinformatics Worskshop Sessions @ Computer Lab)	**10:00-12:00 pm**

Course Director
Name and Degree: **Ralf Krahe, PhD**

Title: **Professor**

Department: **Genetics**

Institution: **MDACC**

Email Address: RKrahe@mdanderson.org

Contact Number: 713-834-6345

Course Co-Director/s:

Name and Degree: **Ashish Kapoor, PhD**

Title: **Assistant Professor**

Department: **IMM/Center for Human Genetics**

Institution: **UTH**

Instructor/s (See attached Class Schedule)

Email Address: Ashish.Kapoor@uth.tmc.edu

Contact Number: **713-500-2439**

Name and Degree: **Nidhi Sahni, PhD**

Title: **Assistant Professor**

Department: **Genetics & Molecular Carcinogenesis**

Institution: **MDACC**

Email Address: NSahni@mdanderson.org

Contact Number: 832-7500-7213

NOTE: Office hours are available by request. Please email me to arrange a time to meet.

Teaching Assistant(s): (if any)

TA#1 & TA#2 TBD
Name and Email Address

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, cancer, and experimental model systems. 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 trainees, including senior graduate students and 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, including an optional computing bootcamp if desired) sessions applied bioinformatics workshop is focused on RNA-seq, including bulk tissue and 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 instructors.*

Course Format

The class will be held two times a week, generally for one and a half hours each class:
Tuesday & Thursday, 10:00-11:30 am in BSRB S3.8371 Large Classroom. On days when an additional **Application Lecture (30 min; 10:00 am-12:00 pm)** is included, there will be a brief break (5-10 min) between the primary lecture and the application lecture by a senior trainee in the lab of the primary lecturer also **in BSRB S3.8371 Large Classroom**.

Sessions for the Applied Bioinformatics Workshop (#18-21) will be held Tuesday & Thursday, 10:00-12:00 pm in BSRB S3.8112 Computer Lab.

Textbook/Supplemental Reading Materials

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

Learning Objective/s:

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.

***Specific Learning Objectives*:**

1. Obtain foundational knowledge in experimental and human genetics, epigenetics and genomics, and understand how to address specific questions in these broad areas using suitable experimental desihns and techniques, and applying relevant bioinformatic tools.

2. Understand how to utilize, design, generate and use genetically engineered model organisms to answer specific research questions.

3. Gain a multifaceted understanding of advanced human genetics and genomics, including aspects of clinical genetics.

4. Learn to apply and utilize specific bioinformatics tools to analyze publicly available data and to generate new directions of investigation.

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 related to the week's topic.
3. Read 1-2 recommended primary research articles before and/or after each lecture.
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 in the Applied 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. *The use of AI-based resources (e.g., ChatGPT) is discouraged. However, if you elect to use them, you must clearly indicate when and where you used them and include references.* 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.

Grading System: **Letter Grade (A-F)**

Student Assessment and Grading Criteria : *(May include the following:)*

Percentage	Description
Homework (70%)	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.*
Lab Workshop (15 %)	Bioinformatics workshop participation and completion of assigned exercises
Participation and/or Attendance (15 %)	Attendance, punctuality, and participation. Students are expected to actively participate in the course by initiating discussions, asking questions, and providing constructive comments.

CLASS SCHEDULE – Spring 2024

NOTE: I will attached the lis of faculty leturers here. I need to convert it to pdf file so the alignment will not mess up.

2024 Date, Day	Class #	Wk	Lecture Topic	Lecturer
January 9, Tu	1	1	Introduction: What is genetics & epigenetics?	Krahe & Kapoor
January 11, Th	2		Chromosomes – Cytogenetics & its implications in biomedical research	Multani
January 16, Tu	3	2	Chromosomes and aneuploidy	Cole
January 18, Th	4		Gene structure & expression	Lee
January 23, Tu	5	3	Molecular basis of disease phenotype-genotype	Hixson
January 25, Th	6		Medical genetics services & clinical risk assessment	Singletary
January 30, Tu	7	4	Next generation DNA sequencing	Kapoor & Krahe
February 1, Th	8		Current human genetic approaches to gene discovery for multifactorial disorders	Fornage
February 6, Tu	9	5	Applications of genetic information to health outcomes in multifactorial disorders	Fornage
February 8, Th	10		Genetic basis of cancer	Krahe
February 13, Tu	11	6	Oncogenes, tumor suppressor genes and cancer pathways	Krahe
February 15, Th	12		Tumor Heterogeneity and scOmics Approaches	Casasent
February 20, Tu	13	7	Non-coding genome variation	Kapoor
February 22, Th	14		Connecting genetic variation to gene networks	Sahni
February 27, Tu	15	8	Functional validation of variants in disease candidate genes	Karras & Gracia
February 29, Th	16		Model systems: genetic manipulation of mice	Behringer
March 5, Tu	17	9	Model systems: conditional genetic manipulations of mice	Wang
March 7, Th	18		Applied Bioinformatics Workshop: RNA-Seq	Liu
March 12, Tu	19	10	Applied Bioinformatics Workshop: RNA-Seq	Liu
March 14, Th	20		Applied Bioinformatics Workshop: RNA-Seq	Liu
March 18-22		**11**	Spring Break – **No class**	
March 26, Tu	21	12	Applied Bioinformatics Workshop: scRNA-Seq	Casasent
March 28, Th	22		Epigenetics & expression of the genome	Cheng
April 2, Tu	23	13	Enhancer RNAs and genome organization in the regulation of gene expression	Li
April 4, Th	24		DNA methylation	Ting
April 9, Tu	25	14	Imprinting & X inactivation	Chen
April 11, Th	26		Epigenetics techniques: bench skills	Jain
April 16, Tu	27	15	Chromatin ATP-dependent remodelers & histone variants	Bartholomew
April 18, Th	28		Histone code: Writers & Erasers	Lee
April 23, Tu	29	16	Non-coding RNAs	Calin
April 25, Th	30		Histone code: Readers	Bedford
April 29-May 3			Final Exams Week – **No Final Exam**	

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GS04 1253: Principles of Genetics and Epigenetics

Course Directors

Krahe, Ralf – Class #1, 7, 10-11
Lead Director
Dept. of Genetics
UTMDACC
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Kapoor, Ashish – Class #1, 13
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Sahni, Nidhi – Class #15
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Teaching Assistant (TA)

TBD – All classes #1-30
Graduate Research Assistant
Genetics & Epigenetics Program
???
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Lecturers (Alphabetical Order)

Bartholomew, Blaine – Class #27
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Bedford, Mark – Class #29
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Behringer, Richard & Mullen, Rachel – Class #16
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Calin, George – Class #30
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Casasent, Anna – Class #12, 21
Dept. of Genetics
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Chen, Taiping – Class #25
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Cheng, Xiaodong – Class #23
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Cole, Francesca – Class #3
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Fornage, Myriam – Class #7-8-9
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Jain, Abhinav – Class #26
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Karras, Georgios & Gracia, Brant – Class #14
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Lee, Min-Gyu – Class #28
Dept. of Molecular and Cellular Oncology
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Lee, Shih-Han "Peggy" – Class #4
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Li, Wenbo – Class #22
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Liu, Bin – Class #18-19-20
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Multani, Asha – Class #2
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Singletary, Claire – Class #6
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