جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Course Syllabus: Epigenetics and Chromatin - B 321

Division	Biological and Environmental Sciences & Engineering Division
Course Number	B 321
Course Title	Epigenetics and Chromatin
Academic Semester	Summer
Academic Year	2018/2019
Semester Start Date	06/16/2019
Semester End Date	08/08/2019
Class Schedule (Days & Time)	09:00 AM - 05:00 PM | Sun Mon Tue Wed Thu

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Valerio Orlando	Valerio.Orlando@KAUST.EDU.SA	+966128082674		Thursday, 9-10 am
Wolfgang Fischle	wolfgang.fischle@kaust.edu.sa	+966128082498	3334, 2, Ibn Al-Haytham (bldg. 2)	Thursday, 9-10 am

Teaching Assistant(s)

Name	Email

Course Information

Comprehensive Course Description	This course combines theoretical knowledge with state-of-the-art practical approaches. It was developed on the basis of advanced method courses for students held at the European Molecular Biology Organisation (EMBO) and International Max Planck Research Schools (IMPRS). Profs. Orlando and Fischle (including their laboratories' staff) will introduce up to date research questions and experimental technologies in current Epigenetics and Chromatin Research. Hands-on experiments with step-by-step instructions will be carried out in the KEEP laboratories involving laboratory staff. Topics include (not all at the same time): - Chromatin Architecture: fractionation of cells and nuclei for chromatin preparation, basic analysis of chromatin architecture (nucleosome positioning, and remodeling) - Histone Code: biochemistry of modifying enzymes, binding proteins and RNAs in chromatin regulation (protein-protein, protein-nucleic acids interactions, complex purification) - Epigenome Structure I: genome-wide mapping of histone modifications, chromatin factors, ncRNA (ChIP, ChIP-seq, ncRNA mapping, data analysis) - Cell Memory and Imprinting: DNA methylation and cellular imprinting (analysis of DNA methylation by different methods) - Epigenome Structure II: nuclear architecture, long-range chromatin interactions, chromosomal domains (chromosome paint, Hi-C) - The course is open to KAUST M.Sc. and Ph.D. Students (min. 6 and max. 12 participants in total). All students will have to complete reading assignments on basic and advanced topics in Epigenetics and the experimental approaches used in this field (to be provided by instructors ahead of the beginning of the course). Written reports summarizing and discussing the experiments in reflection of this theoretical background are part of the evaluation for all Students.

Course Description from Program Guide	The major aim of the three-week summer block course is to train participants (min. 6, max. 12) in experimental Cell Biology on the example of Chromatin Biochemistry, Epigenome Structure and Nuclear Organization. To improve students skills in designing, executing and analyzing experiments, the course combines two principles: theory and practice. Besides covering the fundamental background and theory of Epigenetics and Genome Regulation, participants will learn basal and cutting-edge experimental technologies that are currently used to answer key questions at the frontiers of Epigenetics research. The course is shaped according to international EMBL (European Molecular Biology Laboratories) and MPI (Max Planck Institutes) advanced method courses for M.Sc. and Ph.D. students. Profs. Orlando and Fischle (including their laboratories staff) will introduce Applied Epigenetics on the basis of dissection of classical and recent experiments. Student participants will carry out several hands-on experiments with step-by- step instructions.
Goals and Objectives	The course combines two major training objectives: - To provide the participants with fundamental theoretical understanding of basic and complex Epigenetic Phenomena - To give the participants hands-on training in the planning, execution and analysis of simple and advanced experiments in Cell Biology in general and with a focus on Epigenome Structure and Function, Chromatin Biology, Nuclear Organization, Noncoding RNA
Required Knowledge	- Basic experimental skills in Molecular and Cell Biology M.Sc. Students should have successfully completed the following courses: Molecular and Cellular Biology Lab (B241); Cell Biology I (B241) and II (B223). Successful Applicants will be notified by the Instructors by the end of Spring semester.
Reference Texts	- Epigenetics, CSHL press, 2nd edition - Epigenetics Protocols (Methods in Molecular Biology) 2nd edition - Detailed handouts provided by instructors
Method of evaluation	**33.00**% - Attendance and Participation **33.00**% - Written report **33.00**% - Presentation
Nature of the assignments	- Students will need to prepare the theoretical background of different scientific topics on the basis of individual and group reading assignments (primary and secondary literature) - Under supervision students will execute different experiments individually and in groups - On the basis of detailed assignments students will prepare and present seminars in front of the class to provide the background and scope of different experimental methods and in context of different scientific questions - Participants are required to prepare a scientific report covering the experiments executed in the form of a manuscript (introduction, rationale, results, discussion, literature)
Course Policies	Attendance of both theoretical and practical classes is mandatory.
Additional Information	Daily schedule: each day of the course is divided in theoretical and practical parts Theory: 9 – 10:00 lecture/seminar on the specified topics of Chromatin Biology and Epigenetics (classroom: lecturers, Ph.D. students) Practice: 10:00 – 11:00 theoretical introduction to specified experiment(s) of the day (classroom: instructors) 11:00 – 16:30 execution of specified experiments in small groups under supervision (KEEP laboratories: instructors); variable lunch break (1 hr) 16:30 – 17:30 discussion of results (classroom: instructors)

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Sun 06/16/2019 Mon 06/17/2019 Tue 06/18/2019 Wed 06/19/2019 Thu 06/20/2019	Day 1 Theory: Epigenome Structure and function Chromatin Immunoprecipitation (ChIP) and (RNA Chromatin associated RNA assays (ChIRP) Practice: ChIP and ChIRP assays Day 2 Theory: Epigenome Structure and function Practice: ChIP and ChIRP assays Day 3 Theory: Epigenome and Epigenetics Practice: ChIP and ChIRP assays Day 4 Theory: lncRNA and Epigenome Practice: analysis of ChIP and ChiRP Day 5 Theory: Epigenome and Environment Practice: analysis of ChIP and ChiRP
2	Sun 06/23/2019 Mon 06/24/2019 Tue 06/25/2019 Wed 06/26/2019 Thu 06/27/2019	Day 1 Theory: Nuclear Architecture Introduction to Fluorescence In Situ Hybridization (FISH) and Immuno -FISH Practice: RNA FISH and i-FISH Day 2 Theory: Chromatin by High Resolution Microscopy Practice: RNA FISH and i-FISH Day 3 Theory: Chromatin architecture by Chromosome Conformation Capture Practice: RNA FISH and i-FISH I Day 4 Theory: Image analysis Practice: RNA FISH and i-FISH I Image analysis Day 5 Practice: Student Seminars/Discussion groups
3	Sun 06/30/2019 Mon 07/01/2019 Tue 07/02/2019 Wed 07/03/2019 Thu 07/04/2019	Day 1 Theory: Bioinformatics practice: ChIP/ChIRP Seq Analysis Day 2 Theory: Bioinformatics Practice: ChIP/ChIRP Seq Analysis Day 3 Theory: Bioinformatic Practice: HiC analysis Day 4 Theory: Bioinformatic Practice: Data Integration/Discussion groups Day 5 WRAP UP

Note

The instructor reserves the right to make changes to this syllabus as necessary.