01:694:492 Gene Regulation: Clocks to Cancer

Course Coordinator: Prof. Annika Barber
Course Instructors: Prof. Annika Barber (annika.barber@waksman.rutgers.edu)
Prof. Isaac Edery (edery@cabm.rutgers.edu)

Pre- or corequisite: *01:694:407-408 or 01:447:384-385 or 11:115:403-404 or 11:126:481.*
Class schedule: Mon. & Thurs. 10:20 - 11:40 AM
Class location: Room 1001 of the Waksman Building (190 Frelinghuysen Rd, Piscataway)
Office Hours: By Appointment.

Gene Regulation: Clocks to Cancer (01:694:492) is a course for advanced undergraduate students majoring in the Life Sciences. Humans have about 20-25,000 protein-coding genes that are regulated by complex regulatory pathways giving rise to approximately 80-100,000 different proteins. Proteins can be modified in a variety of ways, such as phosphorylation and proteolysis, further expanding the coding repertoire of the genome to millions of different protein isoforms. In addition, there are at least 1,000 non-coding RNAs that intertwine with gene expression. In this course we will discuss different levels of eukaryotic gene expression, focusing on integrated regulatory circuits that underlie development and the timing mechanisms of "cellular clocks" that drive daily rhythms. We will take a closer look at the role of diet and sleep, including the emerging role of the microbiome in health and disease. Cancer will be used as an example of a major disease that is influenced by mis-regulation of gene circuits during development, cell growth, clock function and the microbiome. Advances in stem cell and gene therapy will be discussed. Ever wonder why you might be a late-night owl or early bird? Why elephants and blind mole rats hardly get cancer? There are no textbooks. Material taught in this course is based on providing general background information in conjunction with reading and in-depth analysis of selected primary research articles. Thus, a goal of this course is to enhance understanding of scientific literature as a means of gaining critical thinking skills.

Syllabus for Spring 2023 (subject to revision):

Jan 19 T	Intro	**Intro-Annika/Isaac**
Jan 23 M	Lecture 1	**Genome and gene organization in eukaryotes**
Jan 26 T	Lecture 2	**Transcriptional control of gene expression**
Jan 30 M	Lecture 3	**Posttranscriptional control of gene expression**
Feb 2 T	Lecture 4	**Epigenetics, chromatin, 3D genome organization**
Feb 6 M	Lecture 5	**Gene regulatory circuits**
Feb 9 T	Lecture 6	**Cell fate specification**
Feb 13 M	Lecture 7	**Morphogen gradients and patterning**
Feb 16 T	Lecture 8	**Stem cells and stem cell reprogramming**
Feb 20 M	Test 1	**Lectures 1-8**
Feb 23 T	Lecture 9	**Circadian rhythms: overview and principles**
Feb 27 M	Lecture 10	**Clock mechanisms I**
Mar 2 T	Lecture 11	**Clock mechanisms II**
Mar 6 M	Lecture 12	**Circadian rhythms and connection to cancer and other diseases I**

Mar 9 T	Lecture 13	**Circadian rhythms and connection to cancer and other diseases II**
SPRING BREAK (no class 13th or 16th)		
Mar 20 M	Lecture 14	**Signaling to the clock**
Mar 23 T	Lecture 15	**Clock, feeding, microbiome, disease**
Mar 27 M	Lecture 16	**Clock, cancer, metabolism**
Mar 30 M	**EXAM 2**	**Lectures 8 - 16**
Apr 3 M	Lecture 17	**Gene regulation in cancer metastasis**
Apr 6 T	Lecture 18	**Gene therapy**
Apr 10 M	NO CLASS	**No class**
Apr 13 T	NO CLASS	**No class**
Apr 17 M	Lecture 19	**Clock, codon usage, protein folding**
Apr 20 T	Lecture 20	**Clocks, immunity, lungs and COVID vaccines**
Apr 24 M	Lecture 21	**Cancer, elephants and mole rats: Do all animals get cancer?**
Apr 27 T	Lecture 22	**Follow the science?**
May 1 M	EXAM 3	**Lectures 17 - 22**

Course Satisfies Learning Goals

1. Students should demonstrate an understanding of the knowledge that is needed to begin biomedical research and that is required for post-graduate exams and studies.

2. Students should demonstrate the ability to find and evaluate information about specific biological systems or problems.

Exams, Assignments, and Grading Policy

PowerPoint lecture material and readings for each class will be posted on the relevant Canvas site for this course. There will be three (possibly 4) exams over the semester that will cover the material presented in class; there will not be a cumulative final exam. Each exam will count for 25% of the grade (or 20% if 4 tests are given). In addition, there will be problem sets, in class quizzes, critiques, and/or other assignments that together will count for the remaining 20 or 25% of the grade. Absence from exams will be excused only in the case of serious illness or family emergency, and only when backed up by appropriate documentation. Requests for regrades must be submitted within 72 hours of return of the exam.

Course Materials

Because we are focusing on current topics, there is no textbook, but there will be assigned readings and literature research from the primary literature, and where appropriate, background reference material will be recommended by the instructors. All material will be available on the Canvas site for this course.

Course Closed?

If this course is closed, please contact Dr. Isaac Edery concerning special permission numbers.

Faculty

The course will be taught by two faculty members from the Department of Molecular Biology and Biochemistry, Annika Barber and Isaac Edery.

Course Coordinator: Annika Barber

** All information is subject to change at the discretion of the course coordinator.