GENE REGULATION (6303)
(CRN # 20459)
Course Syllabus, Spring 2022
TTH: 9:00-10:20 am
Classroom Building C203

Manuel Miranda, Ph. D.
Office: Biosciences 2.166
e-mail: mmiranda3@utep.edu

Office Hours: Open door policy

TEXTBOOKS (Not requird)
Genes, IX, X or XI edition, Benjamin Lewin. Jones and Bartlet Publishers

Gene regulation, Fifth edition, Latchman, D. Taylor and Francis group.

You will not need to buy these books, we will review mostly papers

OBJECTIVES:
Upon completion of this class, students should be able to:

- Understand the basic structure of the chromatin
- Examining the different factors (genetic and environmental) that influence gene expression in eukaryotes and prokaryotes
- Design different expression systems in prokaryotes and eukaryotes

EXAMINATION PROCEDURE

- There will be two exams during the semester.
- Each student will prepare and discuss two research papers during the semester.
- Attendance is required

GRADING POLICY

A = 90-100
B = 80-89
C = 70-79
D = 60-69
F = Below 60

GRADE DISTRIBUTION

Exams (2) 50%

Student presentation 50%

This syllabus is tentative and may be changed during the semester

I. Introduction to DNA and RNA structure, the genetic code

Introduction to structure of DNA and RNA

Molecular structure of nucleic acids, Watson and Crick

The central dogma of Molecular Biology by F. Crick

A common periodic table of codons and amino acids

II. Transcriptional control

DNA sequence elements: short sequence elements located within or adjacent to the gene, promoter (short regulatory elements, enhancers, silencers)

What is a gene? Conserved cAMP responsive element and core promoter complex..

GT Box element

Enhancers

III. Transcriptional control

Book chapter, Chromatin structure: Euchromatin and heterochromatin, structure of the nucleosome, 30 nm, 300 nm and 700 nm fibers

Structure-function of the nucleosome-Roger Kornberg

Structure-function of the 300 and 700 nm fibers

Histone phosphorylation causes HP1 dissociation from heterochromatin

Histone sumoylation

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Histone ubiquitylation and chromatin dynamics

DNA oxidation

DNA methylation

DNA methyltransferase-Function

Structure of HP1 chromodomain bound to a lysine 9-methylated histone H3 tail

Bromodomain and histone acetylation

Take home exam

Protein-protein interaction modules: SH2 domain SH3 domain, **Pleckstrin homology domain** (PH domain), PHD domain

The PHD finger of NURF and chromatin remodeling

The TATA box binding protein (review)

Polycomb proteins and Xi chromosome

X-inactivation in female humans and epigenetic changes

IV. Transcriptional control

Genes Textbook -Chapter 28, Eukaryotic transcription regulation: Introduction, DNA binding by transcription factors.

The zinc finger motif

The leucine zipper

Helix-turn-helix motif

V. Introduction to gene expression - levels of gene regulation

RNA polymerase I, II and III, common features of transcription by the different RNA polymerases

Post transcriptional events: capping, polyadenylation, RNA splicing, RNA transport and translation

Catalytic RNA-paper

Alternative RNA splicing-paper

siRNA, technology

microRNA

VI. Genetic engineering

Prokaryotic expression systems, vectors and expression of recombinant proteins. The Gal operon. The Nobel Prize to Jacob and Monod

Eukaryotic expression systems, plasmids, vectors, lenti-, adeno-virus and gene targeting (mammals and yeast)

Transgenic mouse lines---CRE-LOX system, knockout, knock-in, Promoters and IRES, LacZ, Permisive loucs (ROSA)

Take home exam