

Biochemistry 410, 2012, Advanced Topics in Nucleic Acids

Course Coordinator: Dr. Eric Jan

Lecturers: Dr. LeAnn Howe, Dr. Eric Jan, Dr. Ivan Sadowski

*(Important: subject to change!)*

## **Section A: DNA Replication – Sadowski (Sept. 5 – Sept. 21)**

### **1. Introduction and review of chromosome structure**

- a) Introduction and Themes
- b) Properties of DNA and RNA
- c) Chromosomes and genomes

### **2. Introduction to the Eukaryotic Cell Cycle**

- a) Review of the eukaryotic cell division cycle.
- b) CDC's and CDK's.

### **3. DNA Replication Introduction**

- a) DNA polymerases.
- b) Origins of replication.

### **4. Replication of Eukaryotic Chromosomes**

- a) Genetic identification of replication origins.
- b) Biochemical analysis of replication origins (ARS).
- c) The origin of replication complex (ORC).
- d) Licensing and the pre-replicative complex (CDC6 and MCM).
- e) Regulation of DNA replication at the start of S phase.
- f) ChIP - Seq. - a better way for global identification of DNA binding sites.

## **Monday Sept. 24, MID TERM 1 (10% of Final Grade)**

## **Section B: Transcription and Regulation of Chromatin Structure (Sept. 26-Oct 26)**

### **5. Introduction to Eukaryotic Transcription**

- a) Eukaryotic RNA polymerases.
- b) Genes and promoters in eukaryotes.

### **6. The General Initiation Factors for RNA Polymerase II**

- a). Properties and functions of the TFIIs.

### **7. Regulation of Transcriptional Initiation**

- a) The eukaryotic RNA polymerase II holoenzyme/ mediator complex.
- b) Function and structure of the mediator (transcription control panel).

### **8. Eukaryotic Transcription cycle**

- a) Complexes involved in eukaryotic transcription.
- b) The C-terminal domain (CTD) of RNA Polymerase II.

### **9. Eukaryotic Gene Regulation**

- a) Gene regulatory proteins.
- b) Signal-responsive regulation of transcription - gene regulatory networks.
- d) Control of HIV-1 repression and transcription by T-cell signaling.

#### 10. Chromatin and Transcriptional Regulation

- a) Transcription initiation on a chromatin template
- b) Transcription elongation through nucleosomes
- c) Role of chromatin in transcriptional repression and silencing

### **Mon. Oct. 29 - MID TERM 2 (15% of Final Grade)**

#### **Section C: RNA Structure and Function – Jan (Oct. 31 – Nov. 30)**

#### 11. RNA Properties and Structure

- a) Purification of RNAs.
- b) Secondary structure.
- c) Tertiary structure
- d) Catalytic RNA, the ribosome as a ribozyme

#### 12. Nuclear Processing of RNAs

- a) Nuclear pores and trafficking of RNA
- b) RNA splicing
- c) Regulation of RNA degradation.

#### 13. Regulation of mRNA Translation

- a) Mechanisms for regulation of translation by RNA structure
- b) Regulatory features in 5'- and 3'-untranslated regions
- c) Internal ribosome entry segments (IRESs)

#### 14. Regulation of Gene Expression by RNAs

- a) miRNAs and regulation of gene expression
- b) RNA interference

### **Other Important Dates**

**Fri. Nov. 30 - Term Paper Assignment Due (20% of Final Grade)**

**Sometime in December - Final Exam**

### **Grade Distribution**

**Mid Term 1 - 10%**

**Mid Term 2 - 15%**

**Term Paper - 20%**

**Final Exam - 40% (cumulative - 70% Jan, 30% Sadowski/ Howe)**

**Group Assignment – 10%**

**1.5% for each assignment (total 7.5%)    2.5% for peer-evaluation**