Biochemistry 2B03 (2007/08), Nucleic Acid Structure and Function

Instructors:
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Lectures:
Monday, Thursday 9:30 - 10:20 am
Tuesday 10:30-11:20 am

Location:
ITB/AB102

Course Textbook:
Biochemistry, Garrett & Grisham, updated 3rd Edition (optional).

Course objectives:
Nucleic acids are imperative to the storage and transmission of genetic information within cells. An accurate and detailed knowledge of their structure and function is of prime importance for molecular scientists of all description. Equally importantly, nucleic acids research has been a rich source of discovery and invention that is drastically enhancing our understanding of cells and diseases. In this course, we will examine the structure of nucleic acids, genes, the manner in which DNA is replicated and how its information content is utilized by cells. In addition to conveying the prevailing paradigms in this field, we will discuss how nucleic acids are studied experimentally and how we know what we know about them today. Finally, students will be given opportunities, through examination of very recent primary literature, to learn how our human creativity and imagination has led to numerous important scientific findings in nucleic acids research.

Evaluation:
Test 1: 25%
Thursday, Oct. 11, 2007. This test will be on the materials in unit 1 covered by Dr. Werstuck.
Test 2: 25%
Monday, Thursday, Nov. 8, 2007. This test will be on the materials covered in unit 2 taught by Dr. Li.
Group Project: 20%
5% will be on attendance and participation, 10% on your answers to the questions, and 5% on presentation. Additional 5% will be awarded for a group selected for class presentation for each topic upon successful completion of class presentation.
Final Exam: 30%
5% will be the materials covered by Drs. Li and Werstuck, 20% will be on the project assigned, 5% will be on other projects.

Detailed schedule:

Lecture 1, Thursday, September 6
Opening of class and general discussion. (Drs. Li & Werstuck).

Lecture 2, Monday, Sept. 10
Genes are made of DNA (Dr. Werstuck).

Lecture 3, Tuesday, Sept. 11
Structural details of DNA: Determination of the double-stranded DNA structure and the A, B, Z forms. Semi-conservative replication: Meselson-Stahl experiment. (Dr. Werstuck).

Lecture 4, Thursday, Sept. 13
DNA stability and superhelicity: chemical and thermal stability. (Dr. Werstuck).

Lecture 5, Monday, Sept. 17
DNA replication I: Overview of the enzymes required for DNA synthesis. (Dr. Werstuck).

Lecture 6, Tuesday, Sept. 18
DNA replication II: Current model for initiation at oriC. Leading strand, lagging strand and processivity. (Dr. Werstuck).

Lecture 7, Thursday, Sept. 20
Topological constraints introduced during replication: Topoisomerases. (Dr. Werstuck).

Lecture 8, Monday, Sept. 24
DNA repair: Overview of the common repair pathways. (Dr. Werstuck).

Lecture 9, Tuesday, Sept. 25
DNA recombination: Homologous recombination. Rec proteins. Holliday junction (Dr. Werstuck).

Lecture 10, Thursday, Sept. 27
Transposition: Types of transposons. (Dr. Werstuck).

Lecture 11, Monday, Oct. 1
DNA manipulation: restriction enzymes, PCR, DNA detection. (Dr. Werstuck).

Lecture 12, Tuesday, Oct. 2
Molecular cloning: Cloning of DNA and its applications. (Dr. Werstuck).

Lecture 13, Thursday, Oct. 4
Transcription I: central dogma; PaJaMo experiment; Jacob-Monod experiment; Brenner-Jacob-Meselson experiment; Spiegelman experiment. (Dr. Li).

Lecture 14, Tuesday, Oct. 9
Transcription II: chain initiation and elongation; promoter; RNA polymerase. (Dr. Li).

Lecture 15, Thursday, Oct. 11
TEST #1. (Dr. Werstuck).

Lecture 16, Monday, Oct. 15
Transcription III: Chain termination; eukaryotic gene transcription. (Dr. Li).

Lecture 17, Tuesday, Oct. 16
Transcription IV: Control of prokaryotic gene expression. (Dr. Li).

Lecture 18, Thursday, Oct. 18
Transcription V: Posttranscriptional modifications. (Dr. Li).

Lecture 19, Monday, Oct. 22
Translation I: genetic code (Dr. Li).

**Lecture 20**, Tuesday, Oct. 23
Translation II: tRNAs and their aminoacylation. (Dr. Li).

**Lecture 21**, Thursday, Oct. 25
Translation III: ribosomes. (Dr. Li).

**Lecture 22**, Monday, Oct. 29
Translation IV: Polypeptide synthesis I (Dr. Li).

**Lecture 23**, Tuesday, Oct. 30
Translation V: Polypeptide synthesis II. (Dr. Li).

**Lecture 24**, Thursday, Nov. 1
Translation VI: Posttranslational modification and protein degradation. (Dr. Werstuck).

**Lecture 25**, Monday, Nov. 5.
Group project time.

**Lecture 26**, Tuesday, Nov. 6.
Group project time.

**Lecture 27**: Thursday, Nov. 8, 2007.
TEST #2. (Dr. Li).

**Lecture 28**, Monday, Nov. 12.
Group project time.

**Lecture 29**, Tuesday, Nov. 13.
Group project time.

**Lecture 30**: Thursday, Nov. 15 (10 groups, whole day)
Individual group presentation.

**Lecture 31**: Friday, Nov. 16 (10 groups, whole day)
Individual group presentation.
It is possible that some of you may have scheduling conflicts with other courses. It may mean that you may have to skip the other class in order to give your presentation.

**Lecture 32**, Monday, Nov. 19
Student lecture 1

**Lecture 33**, Tuesday, Nov. 20
Student lecture 2

**Lecture 34**, Thursday, Nov. 22
Student lecture 3

**Lecture 35**: Monday, Nov. 26
Student lecture 4

**Group project--Self-directed learning:**

1. **Papers:** We have selected four recent research articles that cover a broad range of nucleic acids related topics and techniques as the basis for our group projects. The topics are:

Paper 2. Mayr C, Hemann MT, Bartel DP. Disrupting the pairing between let-7 and Hmga2 enhances oncogenic transformation. Science. 2007 Mar 16;315(5818):1576-9. Five groups (2A through 2E) will be selected for this paper.


2. Responsibilities of students

Each student should sign up for one of the 20 groups. Each student should sign up in Learnlink on Sept. 14 at 10 pm Learnlink time (sign-ups before that time will not be considered). You must sign up by Sept. 18 at 10 pm or you will be assessed a 5% penalty. You can sign up for a group according to your interest; however, only five groups can select a given paper and each group can only have maximal 8 students. Therefore, you should be prepared to have a second or third choice (please list the 20 groups in order of preference, such as 1A, 2C, 2D, etc., when signing in Learnlink).

Each group must select a group leader who will be in charge of group activities, otherwise the instructors will arbitrarily select a group leader. Please e-mail the name and contact information of the group leader to the course coordinator liying@mcmaster.ca by Sept 21. A teaching assistant is available to work with students on a given paper and the TA will function as a resource person for guidance.

Each group needs to work together to answer some questions related to the paper. Some of the questions are technique oriented and others are problem solving directed. The answer to many of these questions can only be found from inquiry. Be aware that your written answers will be screened for plagiarism using Turn-it on software. Each group should e-mail the course coordinator the written answers to the questions given by Monday, Nov. 26 at 4 pm. Late submissions will be assessed a 5% penalty.

Each group also needs to put together a 30-minute (± 5 minutes) PowerPoint presentation and present to the TAs and the instructors on Nov. 15/16 at a specific time to be provided later. The presentation will be followed by a short question and answer period to all the members of the group. Each group must hand in a PowerPoint presentation file by 5PM Tuesday, Nov. 13 (Electronic files please). Please note that the presentation time to the instructors and TAs cannot be changed, so when you sign up for a particular group consider any conflicts with your own schedule. Absolutely no re-scheduling will be given once the groups are set and all members of the groups must attend their presentations.
Each group must contact their TA to set up two mandatory meetings, one in October and one in November. These two meetings are required as part of 5% marks on attendance and participation.

Each presentation will be evaluated by two TAs and one instructor on the basis of clarity, creativity, accuracy and quality of the presentation. One group will be selected to present each topic to the entire class. The winning group will receive an extra 5% to their final mark. However, each group has to be prepared to give a presentation in a relevant class during which the competition results will be announced. Everybody must attend all the presentations to the class, even if they are not the presenters. Attendance will be randomly checked, please bring your ID to class.

A significant portion of your final marks (45%) relates to the group project, speaking to its importance. The group project needs a term-long effort and each group should start to work on its project as early as possible. It is everyone’s responsibility to be an active member of your group and to make sure that YOU ABSOLUTELY UNDERSTAND THE PAPER ASSIGNED AND KNOWS CRUCIAL DETAILS, in order to do well in the final exam.