**BIOL 434 Syllabus**

**Gene Expression Control Mechanisms**

**Spring 2019**

**TTh 11:00-12:15, 1374 Genome Sciences Building**

Professor: Dr. Lillie L. Searles, 508 Fordham Hall, lsearles@email.unc.edu

Office hours: Wed and Thur at 12:45-2:15 pm, or by appointment

Teaching Assistant: Aaron Crain, 3344 Genome Sciences Building (in the blue pod), acrain@unc.edu

Office hours: Mon 3:00-4:00 pm, or by appointment

Course Description: This course is designed for upper level undergraduate students who have completed BIOL 202 (or its equivalent) and want to explore further specific topics pertaining to gene expression control at a more advanced level. The main emphasis will be on eukaryotic gene expression control mechanisms as revealed through experimental analysis. You do not need to have prior research experience in order to be successful in this class.

Broad Objectives: This course is designed to give students an understanding of, not only what is known in the realm of molecular biology, but also how we know what we know and what we do not yet understand. In some instances, we will connect molecular processes to biological phenomena at other levels (e.g., cellular and developmental biology). An important objective is to provide a supportive environment for students to cultivate higher order thinking skills by synthesizing concepts and by analyzing and interpreting experiments. You will learn about classical molecular approaches as well as state-of-the-art techniques.

Textbook: *Molecular Biology of the Gene, 7th Edition, by Watson et al.*

Other Assignments: Guided reading questions (optional) will be provided for the textbook assignments.

In addition to the textbook, review articles and research papers will be used to explore topics in more depth and at a more complex level. During most class periods, we will discuss some of the experiments in a research paper. These papers will be more challenging to comprehend initially, and this will get easier over the course of the semester. The papers will be posted on Sakai, and the file name includes the number of the lecture for which the paper is assigned (e.g., paper L2 is assigned for the second lecture). You should expect to spend a total of about 6 hours per week on the reading assignments, and it is important that you read the assignments before each class.

Class Website: PowerPoint presentations, review articles, papers, and other lecture materials will be posted at <https://www.unc.edu/sakai/> in the Resources section. Review articles and papers will be posted at least one week prior to the assigned date.

Exams: The two mid-terms and the final exam each count 25% of the final grade (75% total). The exams will consist of open-note, essay or short answer questions. If you cannot be present for an exam, you must inform Dr. Searles in advance and make arrangements to take the exam at an alternate time.

Class Participation: Active student participation is expected throughout the semester and counts 15% of the final grade.

Student Presentations: Teams of students will make oral presentations based on a research paper at the end of the semester. This counts 10% of the grade.

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| **Date** | **Lecture #** | **Topic** | **Reading Assignment**  |
| 1/10 | 1 | Course Overview; Overview of the process of transcription; RNA polymerases; Transcription initiation in bacteria | **13:** 429-442 |
|  |  | **Transcription in bacteria** |  |
| 1/15 | 2 | Mechanism of initial transcription | Paper L2 |
| 1/17 | 3 | Transcription elongation  | **13:** 442-445, Paper L3 |
| 1/22 | 4 | Transcription termination | **13:** 445-447, Paper L4 |
| 1/24 | 5 | Transcriptional regulation | **18:** 615-633, Paper L5 |
| 1/29 | 6 | Bacteriophage lambda regulation: layers of regulation | **18:** 636-651, Paper L6 |
|  |  | **The basic transcription mechanism in eukaryotes** |  |
| 1/31 | 7 | Transcription initiation | **13:** 448-454, Paper L7 |
| 2/05 | 8 | Promoter-proximal pausing | Review article L8, Paper L8 |
| 2/07 | 9 | Dynamic association of factors with elongating RNA polymerase II | **13:** 455-460,Paper L9 |
| 2/12 | 10 | Polyadenylation and transcription termination | **13:** 458-462, Paper L10 |
| 2/14 |  | *Exam 1 (covers lectures 1-10)* |  |
|  |  | **Transcription and epigenetic regulation in eukaryotes** |  |
| 2/19 | 11 | The nucleosome structure and positioning | **8:** 220-222, Box 8-1, 236-237,240-241, Review L11, Paper L11 |
| 2/21 | 12 | Nucleosome remodeling  | **8:** 237-239; Snapshot L12, Paper L12 |
| 2/26 | 13 | Histone modification and transcriptional control | **8:** 241-245, 248-249, Paper L13 |
| 2/28 | 14 | Transcriptional activation: recruitment of proteins needed for initiation and elongation | **19:** 657-672 Paper L14 |
| 3/05 | 15 | Enhancers and insulators | **19:** 672-674; Paper L15 |
| 3/07 | 16 | Signal integration and combinatorial control | **19:** 675-686; Paper L16 |
| 3/12 |  | *Spring Break* |  |
| 3/14 |  | *Spring Break* |  |
| 3/19 | 17 | Gene silencing by modification of histones | **19:** 687-692; Paper L17 |
| 3/21 | 18 | DNA methylation and Epigenetic control of behavior | **19:** 692-698; Paper L18 |
| 3/26 | 19 | Xist and X-chromosome inactivation in mammals | **20:** 728-730; Paper L19 |
| 3/28 |  | *Exam 2 (covers lectures 11-19)* |  |
|  |  | **Other gene regulation mechanisms in eukaryotes** |  |
| 4/02 | 20 | Alternative splicing | **14:** 467-477, 480-482, 483-488, 491-496, Paper L20 |
| 4/04 | 21 | Translational control | **15:** 530-535, 556-557, Paper L21 |
|  |  | **Short Regulatory RNAs** |  |
| 4/09 | 22 | Short regulatory RNAs in eukaryotes: miRNAs | **20:** 711-727, Paper L22 |
| 4/11 | 23 | RNAs as defense agents in prokaryotes and archaea: CRISPR | **20:** 705-711, Paper L23 and Review Article L23  |
| 4/16 | 24 | CRISPR/Cas9 and genome engineering | Paper L24 and Highlight Article L24 |
|  |  | **Student presentations** |  |
| 4/18 | 25 | Student-selected topics |  |
| 4/23 | 26 | Student-selected topics |  |
| 4/25 | 27 | Student-selected topics |  |
| **4/29****12:00**  |  | *Final Exam (cumulative)* |  |