

Biology 63 – RNA: The Real Secret of Life

Spring 2018

12 (MWF 12:50-1:55; X-hr Tues 1:21-2:10); Room 205 LSC

Instructor: Professor Kevin J Peterson

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Office Phone: 646-0215

Office Hours: By appointment

Course Description

See the ORC.

Course Goals & Learning Objectives

With the explosion of information about the nature of animal genomes it is clear that RNA might actually be the central molecule in life's central dogma, and when coupled with the realization that RNA is not only an older molecule than DNA and can serve both as an informational storage (genotype) and informational execution (phenotype), the "real" secret to life is not DNA, but RNA. Students will be exposed to much of the new exciting research currently being done in RNA biology and evolution, as they will be expected to read research papers, write a paper summarizing an area of RNA biology that they find particularly interesting, and present these findings to the class.

Pre-Requisites

One from among [BIOL 28](#), [BIOL 36](#), [BIOL 38](#), [BIOL 39](#) or [BIOL 45](#)

Text and Resources

All readings are posted on the Canvas site.

Course Expectations & Grading

There are four basic requirements for this class that need to be fulfilled:

First, working in pairs, students are expected to write a ~10-12 page paper (~15 or so with Figures and References at 1.5 line spacing) composed by both students on any aspect of RNA biology they find interesting. This paper is expected to summarize the relevant material, providing an abstract, giving the background, the current research efforts on the subject, and the likely future directions. A complete list of references must also be provided, and detailed figure legends must accompany the figures. The paper will be due at 5 PM (posted to Canvas) on the assigned Monday.

Second, this paper serves as a “first draft” if you will of a ~45 minute presentation to the class that will happen on the following Monday. This presentation can, but need not be, a standard powerpoint driven lecture. Students may (read “should”) meet with me during the term to discuss the paper/presentation, and to check for adequate progress and to address questions that they might have.

Third, during X hour, the rest of the class will critique both the paper (the first week) and the presentation (the second week). Each student will turn in to the two authors ~ 1 page review of the paper addressing everything from flow, tone, science, readability, grammar; essentially anything that the reviewer thinks would not only improve the paper, but would improve the subsequent presentation. The goal here is to help the students resolve any organizational, informational etc. problems that might be apparent within the written document *before* they give their presentation. Each student will email me their review by 12 PM on that Tuesday. The review to the authors should be anonymous and will be given to the students at the end of X hour. There is no written critique of the presentation. Then, based on the reviews and feedback from the class, the students will turn in a final version of their paper to me by the end of the day on that second Thursday. This will be emailed to me as a word document that I will then format. At the end of the term I will compile all of the papers and have them bound into a proper journal for everyone in the class.

So, the schedule is:

First Monday (5 PM): Paper posted to Canvas by the first group of students.

First Tuesday (Xhr, 1:20 PM): Critique of this Paper by the class

First Thursday (5 PM): Relevant literature posted to Canvas.

Second Monday (Class period 12:50 PM): Presentation; Paper posted to Canvas by the second group of students (5 PM)

Second Tuesday (Xhr, 1:20 PM): 1) Critique of the presentation the day before by the first group of students; 2) Critique of the paper that was due on the day before by the second pair of students.

Second Thursday: Revised paper from the first group due to Prof. Peterson by the end of the day; Second group posts their relevant literature to Canvas by 5 PM.

In order for this to work for everyone, all assignments must be done in a timely fashion. Thus, for each hour the paper is not posted to Canvas the students will be docked one letter grade increment (e.g., A- to B+). If reviews are not turned in to me by 12:00 and/or to the presenting students at X-hr, the student will be docked one letter-grade increment.

Finally, class participation is required, both attendance and contribution. Students are not allowed to miss other student's presentations and critiques; a student will be docked one letter-grade increment for any unexcused absences. Students are also expected to come to Discussion sessions having read the paper(s) beforehand; those that do not will be docked one letter-grade increment. Students will then be assessed in each of these capacities, their individual research paper, their presentation, their reviews and critiques of other student's papers and presentations, and their class participation. It is my expectation that all students will earn A's.

Course Schedule

Presentation Schedule

Group 1

Paper Due Monday April 2nd 5:00 PM

Paper Critique Tuesday April 3rd

Literature posted Thursday April 5th 5:00 PM

Presentation Monday April 9th

Presentation Critique Tuesday April 10th

Final Paper Due Thursday April 12th

Group 2

Paper Due Monday April 9th 5:00 PM

Paper Critique Tuesday April 10th

Literature posted Thursday April 12th 5:00 PM

Presentation Monday April 16th

Presentation Critique Tuesday April 17th

Final Paper Due Thursday April 19th

Group 3

Paper Due Monday April 16th 5:00 PM

Paper Critique Tuesday April 17th

Literature posted Thursday April 19th 5:00 PM

Presentation Monday April 23rd

Presentation Critique Tuesday April 24th

Final Paper Due Thursday April 26th

Group 4

Paper Due Monday April 23rd 5:00 PM

Paper Critique Tuesday April 24th

Literature posted Thursday April 26th 5:00 PM

Presentation Monday April 30th

Presentation Critique Tuesday May 1st

Final Paper Due Thursday May 3rd

Group 5

Paper Due Monday April 30th 5:00 PM

Paper Critique Tuesday May 1st

Literature posted Thursday May 3rd 5:00 PM

Presentation Monday May 7th

Presentation Critique May 8th

Final Paper Due Thursday May 10th

Group 6

Paper Due Monday May 7th 5:00 PM

Paper Critique Tuesday May 8th

Literature posted Thursday May 10th 5:00 PM

Presentation Monday May 14th

Presentation Critique Tuesday May 15th

Final Paper Due Thursday May 17th

Group 7

Paper Due Monday May 14th 5:00 PM

Paper Critique Tuesday May 15th

Literature posted Thursday May 17th 5:00 PM

Presentation Monday May 21st

Presentation Critique Tuesday May 22nd

Final Paper Due Thursday May 24th

Group 8

Paper Due Monday May 21st 5:00 PM

Paper Critique Tuesday May 22nd

Literature posted and Final Paper Due Thursday May 17th 5:00 PM

Presentation Monday May 28th

Presentation Critique Tuesday May 29th

Lecture Schedule

Meeting _____ Topic _____

The Ancient RNA World

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| 3/26 | Lecture 1: Molecular Fossils of the Ancient RNA World |
| 3/27 | X-hr: Meet to discuss presentations and to assign topics |
| 3/28 | Lecture 1 continued: Peptidyl Transferase & the Invention of Protein Synthesis |
| 3/30 | Lecture 1 continued: The RNA Biology of our Last Universal Common Ancestor |
| 4/02 | Discussion 1: Writing and Presenting Scientific Papers |
| 4/03 | X-hr Critique |

The Discovery and Fundamental Biology of Small RNAs

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| 4/04 | Lecture 2: The discovery of microRNAs and the Modern RNA world |
| 4/06 | Lecture 2 continued |
| 4/09 | Student Presentation |

- 4/10 X-hr Critique
- 4/11 Discussion 2: The discovery of siRNAs
- 4/13 Discussion 3: Writing and Reviewing Scientific Papers
- 4/16 Student Presentation
- 4/17 X-hr Critique
- 4/18 Lecture 3: siRNA and miRNA Biogenesis Pathways
- 4/20 Lecture 3 continued

Small RNAs in Development, Evolution & Disease

- 4/23 Student Presentation
- 4/24 X-hr Critique
- 4/25 Lecture 4: miRNA Target Recognition and Developmental Robustness
- 4/27 Lecture 4 continued
- 4/30 Student Presentation
- 5/01 X-hr Critique
- 5/02 Lecture 5: miRNAs and Cancer (Guest lecture by Dr. Arti Gaur, Dartmouth Medical School)
- 5/04 Discussion 4: miRNAs and Cancer

Non-Coding RNAs and the Modern RNA World

- 5/07 Student Presentation

5/08 X-hr Critique

5/09 Lecture 6: 3'UTR Evolution & Expression

5/11 Lecture 7: lncRNAs

5/14 Student Presentation

5/15 X-hr Critique

5/16 Lecture 7 continued

5/18 Discussion 5: lncRNAs and Imprinting

5/21 Student Presentation

5/22 X-hr Critique

5/23 Lecture 8: circular RNAs and the ceRNA Hypothesis

5/25 Lecture 8 continued

5/28 Student Presentation (Optional)

5/29 X-hr Critique

5/30 Discussion 6: miRNAs and Morphological Complexity