

The Ancient and Modern RNA Worlds

Prof. Laura Landweber

Laura.Landweber@columbia.edu

Wednesdays, 2:10-4:00 PM Fairchild 1000

Spring, 2023

Course description, overview, and goals:

RNA has recently taken center stage with the discovery that RNA molecules sculpt the landscape and information contained within our genomes. Furthermore, some ancient RNA molecules combine the roles of both genotype and phenotype into a single molecule. These multi-tasking RNAs offering a possible solution to the paradox of which came first: DNA or proteins. This seminar explores the link between modern RNA, metabolism, and insights into a prebiotic RNA world that existed some 3.8 billion years ago. Topics include the origin of life, replication, and the origin of the genetic code; conventional, new, and bizarre forms of RNA processing; structure, function and evolution of key RNA molecules, including the ribosome, and RNA therapeutics including vaccines. The format will be weekly seminar discussions with presentations. Readings will be taken from the primary literature, emphasizing foundational and recent literature. Requirements will be student presentations, class participation, and a final paper.

Prerequisite: BIOC GU4512 or equivalent

Week

1. January 18 – RNA and the setting for the origin of life
2. January 25 – Ribozymes: Towards an RNA replicase and therapeutics
3. February 1 – Ribosomal RNA and the tree of life
4. February 8 – Deoxyribozymes and biotechnology (guest, [Edward CurtisLinks to an external site.](#))
5. February 15 – The ribosome
6. February 22 – RNA viruses (guest, [Lena SteckelbergLinks to an external site.](#))
7. March 1 – Riboswitches
8. March 8 – Origin of the genetic code

March 15 – spring break – no class

9. March 22 – CRISPR (guest, [Sam SternbergLinks to an external site.](#))

- 10. March 29 – The tiny RNA world
- 11. April 5 – Intron evolution
- 12. April 12 – RNA-mediated epigenetic inheritance
- 13. April 19 – student presentations
- 14. April 26 – student presentations

Course requirements and grading:

- *Participation*: 30%, broken down as 15% at midterm evaluation; 15% second half. Students are expected to have done the assigned readings before class and come prepared for and fully engage in lively in-class discussions and critique of the readings. Sitting back and letting others do the talking, or contributing at a minimum, will lead to a participation grade of C- with regular attendance.
- *Presentations*: 40% (20% on leading a discussion of the readings for a selected week and 20% on presenting your final project to the class).
- *Weekly readings*: See email log for weekly readings. Come prepared to present **any figure** in the assigned reading and write down at least 3 questions or comments as you read the papers to foster class participation.
- *Written work*: There will be a substantive final paper (25% of grade) due May 1, 2018 and a *graded outline due approximately two weeks before the paper deadline* (5% of grade).
- *Late policy*: one point deducted per day late (without an approved extension)

e.g. the outline would up to 3 points max instead of 5 if two days late; the final paper would be out of 22 points max instead of 25 if three days late without an extension.

Class and university policies: Students are responsible for contributing positively to an inclusive environment that is hospitable to learning, for appropriately acknowledging and citing the work of others, for ensuring that all work they submit is their own, unless specifically permitted to work in groups, which should be named as such, and for upholding Columbia's standards of Academic Integrity as described on the website below. In addition, the instructor will work the DS as needed, per the faculty policies below.

- *Faculty Statement on Academic Integrity:*
<http://www.college.columbia.edu/academics/integrity-statement>
- *Faculty Statement on Disability Accommodation:*
<http://www.college.columbia.edu/rightsandresponsibilities>