Biology 63 – RNA: The Real Secret of Life

12 (MWF 12:50-1:55; X-hr Tues 1:20-2:10)

Zoom (god forbid...): https://dartmouth.zoom.us/j/92604080442

(passcode is "Bio63")

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Office Hours: By appointment

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 as the eukaryotic cell can be described as an "RNA machine." Further, given that RNA is not only an older molecule than DNA that 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 in the form of our class journal "RNA - The Real Secret of Life."

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 groups of 3, students are expected to write a ~15 page paper (~20 or so with Figures and References at 1.5 line spacing) 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 Sunday.

Second, this paper serves as a "first draft" that during X hour the rest of the class will critique. Each student will turn in to the authors (via email to me by 10 AM Tuesday morning) a ~ 1 page review of the paper addressing everything from flow, tone, science, readability, grammar - essentially anything that the reviewer thinks would improve the paper. The goal here is to help the students resolve any organizational, informational etc. problems that might be apparent within the written document so that they can rewrite it to present to the class as a second and near final draft on that second Wednesday (see below). A subset of the class will again review the paper, and one group of three will return to the authors a "track changes" document to help them finalize the paper for submission. At that point the students will then email to me as a word document their final draft, and I will finalize the formatting. 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 Sunday (5 PM): First draft posted to Canvas.

First Tuesday (Xhr, 1:20 PM): Critique of the first draft (reviews due to me over email by 10 AM)

Second Wednesday (8 PM): Second draft posted to Canvas.

Second Friday (5 PM): Critique of the second draft and the track changes returned to the authors.

Third Friday (5:00 PM): Submission of final draft to me.

In order for this to work for everyone, all assignments must be done in a timely fashion. I will dock a student an increment in their letter grade for every late assignment.

Finally, class participation is required, both attendance and contribution. In particular, students are not allowed to miss other student's critiques (barring sickness etc). Students are also expected to come to Discussion sessions having read the paper(s) beforehand. Classes, critiques and discussions will not be recorded.

Let me know if you have any questions or if I forgot to address anything.

Course Schedule:

Monday March 28th Lecture 1: Discovery

Background Reading: Chapter 1_Figures_v2.pdf

Tuesday March 29th Xhr: Assigning groups, dates and topics for papers.

Wednesday March 30th Lecture 1 continued

Friday April 1st Lecture 1 continued

Sunday March 3rd Group 1 paper due to class (all papers are due to the class by 5:00 PM Sunday evenings - everything will just be sent via email to the class over Canvas)

Monday March 4th Journal Discussion 1: Papers and reviews

First Draft.pdf

Reviews.pdf

Tuesday March 5th Xhr: Group 1 review (all reviews are due to me by 10:00 AM Tuesday mornings)

Wednesday March 6th Journal Discussion 2: Second and final drafts

Second Draft.pdf

Final Draft.pdf

Template.docx

Friday March 8th Discussion 1: RNAi

Nature 1998 Fire.pdf

Nature 1997 Voinnet.pdf

Nature 2006 Bots.pdf

Sunday April 10th Group 2 paper due

Monday March 11th Lecture 2: Biogenesis

Background Reading: Chapter 2_Figures_v2.docx

Tuesday April 12th Group 2 paper review

Wednesday April 13th Lecture 2 continued; Group 1 second draft due (all second draft papers are due to the class by 5:00 PM Wednesday evenings)

Friday April 15th Discussion 2: microRNA processing. Group 1 second review due by Groups 4-6; review + track changes by Group 7

Proceedings of the National Academy of Sciences 2016 Kim.pdf

Sunday April 17th Group 3 paper due

Monday April 18th Lecture 3: Targeting

Lecture 3_Targeting_2022_v2.pptx

Background reading: Cell 2012 Ebert.pdf

Tuesday April 19th Group 3 review

Wednesday April 20th Lecture 3 continued. Group 2 second draft due; Group 1 final draft due to me

Friday April 22nd Discussion 3: Noise Reduction. Group 2 second review due by Groups 5-7; review + track changes by Group 1

Science 2015 Schmiedel.pdf

Science 2015 Hoffman.pdf

Sunday April 24th Group 4 paper due

Monday April 25th Lecture 3 continued

Tuesday April 26th Group 4 review

Wednesday April 27th Lecture 3 continued; Group 3 second draft due; Group 2 final draft due to me

Friday April 29th Discussion 4: Non-canonical microRNA binding. Group 3 second review due by Groups 6-1; review + track changes by Group 2

Nature 2008 Tay.pdf

Sunday May 1st Group 5 paper due

Monday May 2nd Lecture 4: Evolution

Background Reading: Chapter 4_Figures_v2.docx

Tuesday May 3rd Group 5 review

Wednesday May 4th Lecture 4 continued; Group 4 second draft due; Group 3 final draft due to me

Friday May 6th Discussion 5: oops.... Group 4 second review due by Groups 7-2; review + track changes by Group 3

Biol Letters 2012 Lyson.pdf

Evol Dev 2014 Field.pdf

Sunday May 8th Group 6 paper due

Monday May 9th Lecture 5: Circuitry

Background readings:

Bioessays 2013 Wang.pdf

Bioessays 2017 Fiszbein.pdf

Science 2008 Makeyev.pdf

Science 2013 Wilusz.pdf

Tuesday May 10th Group 6 review

Wednesday May 11th Lecture 5 continued; Group 5 final draft due; Group 4 final draft due to me

Friday May 13th Discussion 6: mir-721; Group 5 paper second review due by Groups 1-3; review + track changes by Group 4

N Engl J Med 2021 Blanco-Domínguez.pdf

Sunday May 15th Group 7 paper due

Monday May 16th Lecture 5 continued.

Tuesday May 17th Group 7 Review

Wednesday May 18th Lecture 5 continued; Group 6 second draft due; Group 5 final draft due to me

Friday May 20th NO CLASS (Green Key!). Group 6 paper second review due by Groups 2-4; review + track changes by Group 5

Monday May 23rd Lecture 6. Complexity

Background Reading: Bioessays 2009 Peterson.pdf

Tuesday May 24th Group photo on green; Review/Discussion of octopus paper

Octopus.pdf

6_GZ_KJP_Suppl.docx

Wednesday May 25th Lecture 6 continued; Group 7 second draft due; Group 6 final draft due to me

Friday May 27th Discussion 7: mir-1182. Group 7 paper second review due by Groups 3-5; review + track changes by Group 6

Biochemical and Biophysical Research Communications 2016 Zhou.pdf

Monday May 30th No Class

Tuesday May 31st Actual review for Gigascience

GIGA-D-22-00075.pdf

Wednesday June 1st No class