Biology 590S. Origins of Cellular Life
Fall 2017

Meeting times and locations

Lectures: Wed, 3:05-5:30pm (BioSci 155)

Instructors

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Synopsis

The aim of this course is to investigate, explore, and evaulate the evidence for the orgin of life on earth and the possiblity of life on other planets. Students will read primary literature, understand and discuss competing hypotheses in the field, and write a final review paper on the state-of-the-art evidence for how life began and evolved.

Prerequisites

Molecular biology (Bio201 or equivalent) and inorganic chemistry. Microbiology and organic chemistry recommended but not required.

Course website

See the Biology 590S website at https://github.com/Bio590S-origins/Fall2017-Bio590S/wiki

Required reading

Please see the bibliography at the end of the syllabus for the required reading list. The papers are available for download at the course Wiki. Additional suggested background readings, videos, and lectures are also posted on the Wiki.

Office hours

Instructor is available by appointment. Please email, call, or meet after class to set up an appointment.

Due dates

1. Discussion topic leader choice: September 6 at end of class.
   - List three choices from the syllabus topic list in order of preference.
   - Email your choices to the instructor.
2. Discussion questions: 3-4 questions on the primary and review required readings, emailed each Monday at 8am to instructor and discussion leader for the day.
3. Paper draft: October 4 at end of class. Email your draft as PDF to instructor.
4. Final paper: December 6 at end of class. Email your draft as PDF to instructor.

Grading

Discussion leadership, 33%
Final Paper, 33%
Paper draft, 22%
Class participation, 11%

Format

The course is composed of reading, discussion, and writing a paper. Each week, we will read a few papers from the primary literature and a few from reviews or perspectives on the designated topic (see Bibliography at end of syllabus and the course wiki for papers). Each student will serve as discussion leader during one class period during the semester on a topic chosen from the syllabus topics list (see Topic List, below). Discussions will occasionally include a Skype call with the author of one of the discussed papers. Students will write a paper in a short review article format resembling that of Current Opinion journals. A graded draft of the paper will be due at mid-term, which will be edited by the instructor and fellow students. Edits will be used to revise for the final paper. Participation during discussions students do not lead will require contribution of discussion questions prior to the course meeting on that topic. Active participation in discussion is expected from each student each week.

Learning objectives

1. Learn and understand questions and concepts important to the field of the origin of life presented in the course.
2. Discuss and learn about methods and leading hypotheses in the field from field experts during Skype chats.
3. Become proficient in reading the relevant primary literature to evaluate competing hypotheses and discuss literature content in light of the history of the field.
4. Communicate your methods and findings to the scientific community (your peers, your instructors) in the form of discussion leadership and a term paper. Understand and apply the importance of peer review in the form of peer evaluations.

Expectations and policies

Students are expected to:

1. **Come to class on time.**
2. Submit discussion questions and papers by their due dates.
3. Read required readings before each class period.
4. Participate in discussions and skype chats.
5. Be good citizens of discussion: speak to each other with respect despite differing views on certain hypotheses.
6. Adhere to the Duke Community Standard (see "Academic Integrity" below). A zero tolerance policy is in effect: any assignments violating the Standard will receive a 0 grade.

Missed class time and late submissions

Students are expected to attend and participate in every class session. In the case of illness or extraordinary personal circumstance students should notify the instructors and their academic deans by means of a Short-Term Illness Notification Form (STINF) **before** the class session in which work is missed. Or, in the case of long-term medical or personal circumstances, students should request a letter from their academic dean. Homework assignments that are submitted late without a STINF or

instructor approval will receive half credit if submitted within 48 hours of the due date, or zero credit thereafter. If you are frequently ill, and submit more than two STINFs we will ask you to provide a doctor's or dean's letter explaining the circumstances.

Students who will miss a class session due to religious observance should submit a Religious Observance Notification Form *no later than one week prior to the date of the holiday.*

Students who are members of a varsity athletic team, and who may be required to miss some class time, should provide the instructors with a copy of their spring semester travel schedule during the first week of classes. Students should also complete an online "Notification of Varsity Athletic Participation (NOVAP)" form *no later than one week prior to each absence.*

Students who will be travelling should notify the instructor *at least one week in advance about missed class time.*

If you miss submission of discussion questions or other assignments due to illness *you must submit the work within 36 hours for half credit. A zero score will be assigned after 1 week late.*

Students with excused absences (religious observance, athletic participation, etc.) are still expected to complete and submit homework assignments on time.

Academic Integrity

All students are expected to adhere to, and have an obligation to act, in accordance with the Duke Community Standard. For more information about the community standard please refer to the documents available at: https://studentaffairs.duke.edu/conduct/about-us/duke-community-standard. Any violations of the community standard will be referred to the undergraduate judicial board.

Especially as it applies to written assignments and group posters, a strict adherence to the plagiarism policy described in the Community Standard will be observed. We have a zero tolerance policy. Any assignments suspected of plagiarism will receive a zero.

Topic List, Fall 2017

Please refer to the course wiki for detailed bibliography and downloadable PDFs of the readings

- **August 30. Defining life**
  - Sagan chapter from the Nature of Life; Koshland, 2002.
- **September 6. The early Earth**
  - *Primary:* Dodd et al., 2017
  - *Review:* PBS NOVA: "Origins: Earth is Born"
  - *Supplementary:* Nutman et al., 2016; Allwood, 2016; PBS NOVA: "Life's Rocky Start"
  - Discussion leader choices due
- **September 13. No class.**
- **September 20. Prebiotic chemistry: Experimental synthesis**
  - *Primary:* Miller, 1953
  - *Review:* Hazen's Genesis, chapter 2, part 6; NOVA:"Origins: how life began"
- **September 27. Prebiotic chemistry: metabolism first hypothesis**
  - *Primary:* Kelley et al., 2001.
  - *Review:* Lane and Martin, 2012; Lane online lecture; Arndt and Nisbet, 2012.
  - Discussion leader: Thabit Pulak
- **October 4. RNA world and protocells**
  - *Primary:* Prywes et al., 2016; Mansy et al., 2008.
  - *Review:* Gilbert, 1986; Joyce et al., 2002.
  - Paper drafts due
  - Discussion leader: Kieth Keenan
- **October 11. LUCA**
  - *Primary:* Weiss et al., 2016a
  - *Review:* Martin et al., 2016, Gogarten and Deamer, 2016; Weiss et al., 2016b.
  - Discussion leader: Jenny Bai
  - Peer reviews on paper drafts due.
- **October 18. The Great Oxygenation Event**
  - *Primary:* Zerkle et al., 2017.
  - Discussion leader: Hannah Devens
- **October 25. Discovery of the *Archaea***
  - *Primary:* Woese and Fox, 1977; Woese et al., 1990.
  - *Review:* Woese, 1987.
  - Discussion leader: Jackie Vahey
- **November 1. Rooting the tree of life**
  - *Primary:* Raymann et al., 2015; Zaremba-Niedzwiedzka et al., 2017
  - *Review:* Williams et al., 2013.
  - Skype: Simonetta Gibralado
  - Discussion leader: Ivana Premansinghe
- **November 8. Universal molecular characters? The example of transcription**
  - *Primary:* Smollett et al., 2017
  - *Review:* Werner and Grohmann, 2011.
  - Discussion leader: Mera Liccione
- **November 15. Eukaryogenesis**
  - *Primary:* Sagan, 1967.
  - *Review:* Gray, 2017; Poole and Gibraldo, 2014.
  - Discussion leader: Aikya Sone
- **November 22. Thanksgiving break**
- **November 29. Extremophiles**
  - *Primary:* Kashefi and Lovely, 2003.
  - *Review:* Rothschild and Mancinelli, 2001.
  - Discussion leader: Alice Chen
  - Skype: Carlos Mariscal

- **December 6. Astrobiology**
  - *Primary:* Vreeland et al., 2007; Goordial et al., 2016.
  - *Review:* Webb and DiRuggiero chapter, Polyextremophiles (eBook); NOVA: "Finding life beyond Earth."
  - Final papers due
  - Discussion leader: Charles Huang