MCB143 Evolution of genomes, cells, and development

Instructor:

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This course is intended for upper-division undergraduates seeking an interactive course based on modern concepts in evolution and comparative genomics. The course will emphasize the contribution of molecular evolution to a series of seminal events in life's history:

- Origin of life
- Origin of cells
- Origin of eukaryotes
- Origin of multicellularity
- Evolution of animal development

Success in the course will require the development of critical thinking skills, the ability to understand and synthesize challenging material, and the ability to communicate complex scientific topics clearly, both in writing and speech.

PREREQUISITES:

Bio 1A, Bio 1B and MCB C100A or MCB 102; MCB 104 or MCB 140 recommended

READINGS

selected from the primary literature, review articles, and sections from trade books (e.g. *Evolution of Individuality* by Leo Buss, *Life on a Young Planet* by Andrew Knoll, *Selfish Gene* by Richard Dawkins, and *From DNA to Diversity* by Carroll *et al*.)

STRUCTURE OF COURSE:

- Two lectures and in-class exercises (Tuesday/Thursday), plus one discussion session per week (Friday)
- Field trips
- Practicals (including bioinformatics and literature searches)

GRADING:

- Active, informed, and thoughtful participation in class discussion (30%)
- Two in-class midterms (20% total)
- Short written assignments, presentations, and a final paper/project (50%)

Lectures will not be recorded. *Please do not register for the course if you are not able to attend lectures and discussion sections (e.g. have another class or other obligations scheduled at the same time).*

FAQs:

Q: How does grading work in this class?

A: My goal with grading is to give you feedback about how well you are performing relative to expectations. Therefore, I will use the following evaluation key for most assignments:

4 = Advanced mastery - exceeds expectations

3 = Meets expectations

2 = Approaching expectations

1 = Below expectations

These evaluation scores will be scaled up to calculate the final grade. If you generally meet expectations (i.e. average >3), that will translate into an A/A- grade.

Q: What if I need to miss lecture or a discussion section?

A: Please get notes from your classmates so that you don't fall behind. Lecture slides will be posted just before class and they will often have links to the primary sources of the data, so you can follow those links to learn more.

Q: What if I need to miss a field trip or practical?

A: These will be harder to make up. In some cases, you may be able to go on your own or with another organized tour, but in most cases that won't be possible. For practicals, you may be able to follow the course notes to replicate the training experience. Please reach out to discuss options.

Q: I'm feeling a little sick, but I don't want to miss class. What should I do?

A: If you have a fever, are coughing, have been exposed to someone with COVID, or have tested positive for COVID yourself, please stay home. Even if you are only a little sick and none of the above applies to you, you are encouraged to stay home and rest up. However, if you really want to come to class, you are COVID-negative and your symptoms are mild, please exercise all available precautions. Wear an N95 or KN95 mask, wash your hands, and sit far away from others to maintain space. Thanks for your cooperation with this!

Q: When will you post lecture slides?

A: Probably right before class starts.

Q: What are some keys to success in this course?

A: Come to class, stay engaged, stay curious. Start working on writing projects and presentations far enough in advance to get feedback from classmates and Prof. King. Use your critical thinking skills to evaluate the information you find in the primary literature. Ask yourselves, do the data support the claims made by the authors? Is there a better way to address these scientific questions?

Weekly Schedule

August 24	**Intro to stratification and the fossil record**
August 25	**No discussion section**
August 29	**The molecular bases of heritability and evolution**
August 31	**Biodiversity and phylogenetics**
September 1	**"I wonder..." activity (meet outside Faculty Club)**
September 5	**Abiogenesis**
September 7	**RNA world and origin of the protocell**
September 8	**How to conduct a literature search (meet at Biosciences Library)**
September 12	**LUCA and the tree of life**
September 14	**Evolution of genes**
September 15	**Presentation of research questions**
September 19	**Presentation of research questions/Evolution of genes**
September 21	n/a
September 22	**Evolution of genomes**
September 26	**Evolution of genomes II**
September 28	**Evolution of bacteria I**
September 29	***Optional* review**
October 3	**Evolution of bacteria II**
October 5	**Evolution of archaea**
October 6	**Midterm 1**
October 10	**Rapid evolution: experimental evolution in bacteria**
October 12	**Rapid evolution: ecological experiments with mice**

October 13	**Exam re-cap and intro to final projects**
October 17	**Independent origins of multicellularity**
October 19	**Aggregative vs. clonal multicellularity: evolutionary implications**
October 20	**Optional**
October 24	**Origin of multicellularity in animals**
October 26	**Establishment of a new model organism**
October 27	**Optional**
October 31	**Evolution of animal cell adhesion and signaling**
November 2	**Evolution of animal transcriptional regulation**
November 3	**TBD**
November 7	**Evolution of sex and recombination**
November 9	**Evolution of sex and recombination**
November 10	**Veteran's Day -- no class**
November 14	**Bacterial influences on animals and their evolution**
November 16	**Evolution of cilia**
November 17	**Botanical Garden**
November 21	**UCMP**
November 23	**THANKSGIVING**
November 24	**THANKSGIVING**
November 28	**Midterm 2**
November 30	**Student presentations, course evaluation, pizza party**
December 1	**Student presentations**