Bi 464/564 Biological Clocks
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Syllabus Winter 2018

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The two great rhythms of the biosphere are the daily and seasonal variations in temperature, moisture, and resources. Plants and animals anticipate and prepare in advance for these environmental variations through the use of innate biological clocks. This course covers the phenomenon of biological time keeping at ecological, evolutionary, behavioral, physiological, neurological, and molecular, levels. The outcome of virtually every experiment from molecular to ecological in the lab or field with eukaryotes depends upon the time of day or year at which one runs those experiments. Likewise, the efficacy of therapeutics and surgery can depend upon the time of day or year at which they are administered.

Note: This course continues to undergo revisions due to (1) the text[1] becoming outdated, (2) unanimous opinion of previous classes that, after the first 2-3 weeks, readings from the original literature, in combination with lecture, were much more informative than the text and (3) continued advances reported in the primary literature. Consequently, portions of the text will be assigned only during Weeks 1-2; thereafter, all reading assignments will be from the original literature. Five copies of the text are on 4-hr reserve in the Science Library. Reading and lecture slides for each week will be available by midnight Saturday beforehand.

Three of the four hours each week will be devoted to lecture; the fourth hour will be used for discussion or exams. Discussion consists primarily the interpretation of data. I'll put data up on the screen, roll the dice, and if your number comes up, you have to discuss the data, why it is important, and what organism gave rise to those data. Past students have said this not-for-credit portion of the class is the most nerve-racking but also where they learned the most from discussion. Previously, there were undergraduate journal-club presentations of original papers from the literature, which proved beneficial to the presenter, but not to the class as a whole.

[1] *Chronobiology* by Dunlap et al. 2004. Sinauer Associates, Sunderland, MA. Do not buy this text as multiple copies are on 24-hour reserve in the Science Library.

Major topics and events.

Weeks 1-2: Layout of course and **Basic concepts**

Reading: *Biochronometray,* Chapters 1-4

Week 3. Monday 1st hr, 1-hour **Test** on Weeks 1-2..

Weeks 3-7. **Daily timing: circadian rhythmicity**

Prokaryotic clocks

Fungal clocks – Neurospora

Drosophila & some other insect clocks

Mammalian clocks

Week 8. Monday 1st hr, 2-hr **Test** on Weeks 3-7.

Week 8(Wednesday) – Week 10 (Monday). **Seasonal timing:**

Photoperiodism

Circannual rhythms

Week 9. Undergraduate reports due Wednesday by 1st class[2]

Week 10. Wednesday 1st hour, 1-hr **Test** on seasonal timing.

Week 10, Wednesday 2nd hour: Lecture, **Some human applications**

Final Exam: Graduate symposium[3]

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[2] Undergraduate reports will consist of a review paper based on literature over the last 10 years concerning the role of biological timing mechanisms on evolutionary (genetic) response to recent rapid climate change. The subject organisms of the paper will be determined by lot during the first week of class. Multiple students may draw the same organism and may work together, but would submit one report and all students would receive the same grade. To qualify for an "A" on this paper, students will have to write a sufficiently comprehensive report such that I can't find a relevant paper they have missed within ½ hour of my searching on the internet. Reviews are to be submitted to me in the form of a MS Word document (.doc or .docx) with tables and figures embedded in the text in the format of a *Journal of Biological Rhythms* review article. Submitted (ungraded) reviews will be forwarded to all members of the class.

[3] During the final exam, **Graduate students** will present a 35 minute talk (+ 5 min question-answer session) on applications of biological clocks to their dissertation research (worth **20% of the graduate grade**). The goal is to encourage active researchers not directly involved with biological timekeeping to think about how biological clocks affect their research; for students actually doing research in the area of biological clocks, their talk will provide the class with a vision of what is directly involved in using or exploring biological clocks and will enable them to present their research and answer questions before an entire audience cognizant of biological clocks. Undergraduates will fill out a check list of their reaction to the talk (worth **5% of the undergraduate grade**) and the check lists will be given to the speaker.

Power Point presentations are required.

Start out by presenting the broader question being approached

Introduce the organism and why it is appropriate for your research

List specific hypotheses to be or being tested

Describe potential outcomes and how these outcomes will change the direction of research or approach to the broader question.

GRADES ☹

Undergraduate:

Exams 1st hour exam = 15%; 2nd 2-hr exam = 40%; 3rd 1-hr exam = 20%
Climate change paper 20%; Symposium participation 5%

Graduate:

Exams 1st hour exam = 15%; 2nd 2-hr exam = 45%; 3rd 1-hr exam = 20%
Symposium talk = 20%.