Evolution and Marine Diversity (BIOSM 1780/MEFB 530)
27 June - 15 July 2019

Course Syllabus and Schedule
Version 1.5 6/10/19

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Prerequisites: none

Credit hours: 4

Course Objectives/Goals:

This course introduces major concepts of evolution using examples from marine environments, including: 1) phylogenetics and biogeography; 2) macroevolution and Earth history; 3) microevolution and population genetics; 4) speciation; 5) evolution and development; and 6) evolution and global change. We survey the diversity of life in marine and terrestrial habitats. We use a combination of lectures, discussions, field and laboratory exercises, and research/writing projects. **Students should leave the course with a basic understanding of: 1) the evidence for evolution; 2) the major mechanisms of evolution; 3) the centrality of evolution in modern biology; 4) the scope and nature of marine biodiversity; and 5) the scientific methods that allow for study of these topics.**
**Course Materials:**

We will make very few explicit reading assignments (see below). The Allmon book will be handed out. You will also receive a copy of the course lab manual for use in lab. The articles (and the Freeman & Herron chapters) will be distributed electronically. (You can also consult the Freeman and Herron book in Laighton Library or Palmer-Kinne Laboratory.)


**Drawing** is also an important part of this course. Each student will be provided with a small sketch book for use in lab and field.

**Assignments & Grading:**

**Quizzes and Examinations:** These quizzes are short-answer questions based on lecture, lab and field trips. There will also be one “midterm” exam and a practical exam. The final exam and final practical will be cumulative but concentrated on material from the latter half of the class.

**Field/Laboratory Work:** Field and laboratory sessions develop topics covered in lecture, and explore some topics in depth.

**Research Project:** This is a combined group and individual project researching questions developed from study of an intertidal transect on Appledore Island. As part of this project, you will be using your invertebrate and algae ID skills developed in the field/lab sessions.
Grading:

- **Quizzes** (three in-class short-answer) 90 points
- **Preliminary examination** with written (200 point) and practical (100 point) components 300 points
- **Final examination** with written (200 point) and practical (100 point) components 300 points
- **Research project** with group component (150 points) and individual component (150 points) 300 points
- **Participation** 10 points

Expectations and Conduct:

Students are responsible for understanding all of the information in this syllabus. If there are any questions regarding this information, it is the student’s responsibility to bring it to the instructors’ attention. Students are also responsible for attending all activities associated with this course and completing all assignments. **Students are responsible for asking questions if they need clarification (remember, there is no such thing as a bad question).**

Every student is responsible for their own behavior -- specifically, in being respectful and collegial to other students and with instructors. Students are responsible for fully understanding and adhering all of the information presented in the SML Appledore Handbook (see [http://www.sml.cornell.edu/sml_forms.html](http://www.sml.cornell.edu/sml_forms.html))

**Personal Technology.** Do not use cell phones, smart phones, iPads, mp3 players, headphones, or similar devices in the classroom or during course activities. If you take notes with your computer, disable wireless access during lecture.

There is a modest computer facility in Laighton Library; please treat this shared facility with respect. Printers are available, but please limit printing.

**Transmission of Course Materials.** Students are not authorized to replicate, reproduce, copy or transmit lectures and course materials presented, or derivative materials including class notes, for sale or free distribution to others without written consent of the instructors who are the original source of the materials. Lectures and other class sessions may not be recorded (neither video nor audio) without written consent of the instructors.

**Academic Integrity.** Any work submitted must be your own. Uncredited use of another person’s words, data or images is considered plagiarism, a serious violation of the Code, whether the material comes from another student, a web site, or a published paper. Students must adhere to Cornell’s and UNH’s policies for academic honesty/plagiarism and discrimination:

Cornell: [http://cuinfo.cornell.edu/aic.cfm](http://cuinfo.cornell.edu/aic.cfm)

UNH: [http://www.unh.edu/vpsas/handbook/welcome-university-new-hampshire](http://www.unh.edu/vpsas/handbook/welcome-university-new-hampshire)

Mental Health:

Everyone at Shoals Marine Laboratory cares about you and your well-being. **If you experience unusual personal or academic stress during the course or need to talk with someone about a personal problem, seek support from your instructors as soon as possible.** In addition, any SML staff are available for consultation 24/7. Find staff in the office in the Hamilton House between 8am – 7pm or knock on the door of Bartell House after hours.
Daily Schedule (version 1.5 – 6/9/19)

***Note: Everything subject to change based on weather, boat availability, visitors, tides, etc. Please refer to the daily schedule on the whiteboard in the dining room in Kiggins Commons.

1. Thursday June 27 — Low tides are always listed here, each day, with time and tidal height: 1:04 am, 1.5 ft; 1:16 pm, 1.2 ft.

2:45 - 4:00 Portsmouth to Appledore
4:00 – 6:00 Unload and move-in; Island orientation (“Fire and Water”; SML staff)
6:00 - 7:00 Dinner
7:15 - 8:30 Island tour (EMD faculty); course introduction; Signals for Survival movie

2. Friday June 28 — 1:59 am, 1.2 ft; 2:06 pm, 1.2 ft

7:30 - 8:00 Breakfast
8:15 – 9:45 Lecture: Physical environment of the Gulf of Maine (Allmon)
10:00 – 11:00 Field exercise: “Why do these organisms look like this?” Part 1 (Allmon)
12:30 - 1:30 Lunch
1:30 – 2:45 Lecture: Origin of life (Allmon)
2:45 - 4:30 Field and Lab: Algae: Intertidal Field Trip #1 (Smith’s Cove, SW) (Factor)
4:30 – 6:00 Lecture: Daily Diversity 1: Algae & the origin of plants (Factor)
6:00 - 7:00 Dinner
7:15 - 8:45 Lab: Sea table exercise (Factor, Shin)

3. Saturday June 29 — 2:51 am, 0.8 ft; 2:55 pm, 1.1 ft

7:30 - 8:00 Breakfast
8:15 – 9:45 Lecture: Kingdoms, domains, protists, and the tree of life (Allmon)
10:00 – 11:00 “Why do these organisms look like this?” Part 2 (Allmon)
11:15 – 12:30 Lecture: Intro to invertebrate diversity (Factor)
12:30 - 1:30 Lunch
1:30 – 3:00 Lecture: Homology and common ancestry (Allmon)
3:15 - 5:45 Field: Intro to invertebrate diversity: Intertidal Field Trip #2 (Larus Ledge, NW) (Factor)
6:00 – 7:00 Dinner
7:15 - 8:45 Lab: Daily Diversity 2: Protists (Allmon/Factor)
4. Sunday June 30 — 3:40 am, 0.4 ft; 3:43 pm, 0.9 ft

8:15 – Quiz #1
8:30 – 9:45 Lecture: Daily Diversity 3: Plants (Allmon)
10:00 – 11:00 Brunch
11:15-12:30 Field: Plant walk (Allmon)
12:45-2:00 Lecture: Daily Diversity 4: Sponges (Factor)
2:00-3:00 Lab: Sea table evolutionary tree activity presentations
3:00-5:00 Field: Intertidal Field Trip #3 (Norwegian Cove, NE)
5:00 - 6:00 Dinner
6:15-7:45 Lecture: A brief history of evolutionary biology (Allmon) READING:

5. Monday July 1 — 4:28 am, -0.1 ft; 4:31 pm, 0.6 ft

7:30 - 8:00 Breakfast
8:15-9:45 Lecture: History of the Earth and life (Allmon) READING:
Freeman & Herron (2007) Ch. 18
10:00-11:15 Field: Geology walk (Allmon)
11:30 – 12:30 “Why do these organisms look like this?” Part 3
12:30-1:30 Lunch
1:45 – 3:00 Lecture: Daily Diversity 5: Non-coral Cnidarians (Factor)
3:15 – 5:30 Lab: Sponges and Cnidarians (Factor)
6:00 - 7:00 Dinner
7:15 – 8:45 Lecture: Microevolution, heritability, and Mendelian inheritance (Mittan)

6. Tuesday July 2 — 5:15 am, -0.5 ft; 5:19 pm, 0.4 ft

7:30 - 8:00 Breakfast
8:15 - Quiz #2
8:30 – 10:00 Lecture: Mendelian inheritance and population genetics (Mittan)
10:00 – 11:30 Lab: Nucella sorting (Mittan)
11:30 – 12:30 FREE TIME!
12:30-1:30 Lunch
1:45 – 3:00 Lecture: Daily Diversity 5 (continued): Corals and coral reefs (Factor)
3:00 – 4:00 Exercise: “The great clade race” (Shin)
4:00 – 6:00 FREE TIME!
6:00 - 7:00 Dinner
7:15 - 8:45 Lecture: Evolutionary mechanisms: selection, drift, migration, mutation (Mittan)

7. Wednesday July 3 — 6:03 am, -0.9 ft; 6:09 pm, 0.1 ft (@ Portsmouth: 6:23 am, -0.8 ft)

7:30 - 8:00 Breakfast
8:15-9:15 Nucella sorting recap (Mittan)
9:30-11:00 Lecture: Daily Diversity 6: Lophotrochozoa (Factor)
11:00-12:30 FREE TIME
12:30 - 1:30 Lunch
1:45 – 3:15 Lab: Lophotrochozoa (Factor)
3:15 – 4:00 Lecture: Evolutionary mechanisms, continued (Mittan)
4:00 – food run: help unload at dock
5:00 – 6:00 Lecture: Evolutionary mechanisms, continued (Mittan)
6:00 – 7:00 Dinner
7:15 – 8:30 Systematics, part 1 (Allmon) READING: Freeman & Herron (2007) Ch. 4

8. Thursday July 4 — 6:52 am, -1.1 ft; 7:00 pm, 0.0 ft (@ Portsmouth: 7:12 am, -1.0 ft)

6:30-8:30 Field: Intertidal time! Intertidal Field Trip #4 (Halftide Ledges, SW)
8:30 Late breakfast on our own
10:00 – 12:30 FREE TIME!
12:30 - 1:30 Lunch
1:45 - Quiz #3
2:00 - 3:30 Lecture: Daily Diversity 7: Mollusks etc. (Factor)
4:00 – 6:00 FREE TIME!
6:00-7:00 Dinner
7:15 – 8:45 Lecture: Genetics wrap-up (Mittan)

9. Friday July 5 — 7:42 am, -1.2 ft; 7:53 pm, -0.1 ft (@ Portsmouth: 8:02 am, -1.1 ft)

7:30 - 8:00 Breakfast
8:15 – 9:45 Lecture: Systematics, part 2 (Allmon)
10:00 – 12:15 Lab: Mollusk Madness! (Factor, Allmon, Shin)
12:30 - 1:30 Lunch
1:45 – 3:15 Lecture: Systematics, part 3 – Phylogenetic reconstruction (Allmon)
3:30 – 4:30 Genetics review (Mittan)
4:30-6:00 Study time
6:00 - 7:00 Dinner
7:15 – Review for Lab Practical (all faculty), then study time

10. Saturday July 6 — 8:33 am, -1.2 ft; 8:49 pm, 0.0 ft (@ Portsmouth: 8:53 am, -1.1 ft)

7:30-8:00 breakfast
8:15 - 11:15 Preliminary Written Exam & Practical Exam
11:15 – 12:30 FREE TIME!
12:30-1:30 Lunch
1:30 – 2:30 FREE TIME!
2:30 – 4:00 Lecture: Daily Diversity 8: Ecdysozoa (Factor)
4:15-5:45 Field: Bioblitz activity
6:00 - 7:00 Dinner
7:15 – 8:45 Lecture: Natural selection and adaptation, part 1 (Allmon)
11. Sunday July 7 — 9:27 am, -1.0 ft; 9:48 pm, 0.0 ft

**Field Trip to Creek Farm (mainland) MUD FLAT HABITAT!**
7:30 - 8:00 Breakfast on our own
8:30 - Depart Appledore
9:30 - 12:00 Fieldwork & collecting
12:15 Depart Portsmouth
1:00 - Arrive Appledore – grab late meal, rinse off equipment, unpack organisms in lab
2:30 - 5:00 **Group project**: Intro and methods for field transects (**Allmon**, **Factor**)
5:00 - 6:00 Dinner
6:15 – 7:45 **Lecture**: Natural selection and adaptation, part 2 (**Allmon**) **READING**:
   Gould & Lewontin (1979); Kricher (1988)

12. Monday July 8 — 10:22 am, -0.7 ft; 10:50 pm, 0.1 ft

7:30 - 8:00 Breakfast
8:15 – 10:30 **Lab**: Lobsterfest! (**Factor**)
10:30 – 12:30 **Project field time**
12:30 - 1:30 Lunch
1:45 – 3:15 **Lecture**: Daily Diversity 9: Deuterostomia: Echinodermata and nonvertebrate chordates (**Factor**)
3:30 – 5:45 **Lab**: Echinoderms (**Factor**)
6:00 - 7:00 Dinner
7:15 – 8:30 **Lecture**: Biogeography and evolution (**Allmon**)

13. Tuesday July 9 — 11:19 am, -0.4 ft; 11:54 pm, 0.2 ft

7:30 - 8:00 Breakfast
8:15– 9:45 **Lecture**: Species and speciation (**Allmon**)
11:30-12:30 **Project field time**
12:30 - 1:30 Lunch
1:45 – 3:00 **Lecture**: Daily Diversity 10: Vertebrates 1 – Fishes (**Allmon**)
3:15 – 5:30 **Lab**: Fishes (**Allmon**)
6:00 - 7:00 Dinner
7:15 – 8:45 **Lecture**: Origin of tetrapods (**Allmon**)

14. Wednesday July 10 —12:17 pm, 0.0 ft

7:30 - 8:00 Breakfast
8:15– 9:45 **Lecture**: Daily Diversity 11: Vertebrates 2 – Reptiles & Birds (**Allmon**)
10:00 – 11:30 **Lab**: Reptiles & Birds (**Allmon**)
11:30 – 12:30 Project field time
12:30 - 1:30 Lunch
1:45 – 3:15 Lecture: Macroevolution (Allmon)
4:00 – 5:00 Help unload food run at the dock
5:00 – 6:00 Lecture: Evolution of behavior (Allmon)
6:00 - 7:00 Dinner
7:15 – 8:45 Lecture: Sexual selection (Allmon)

15. Thursday July 11 — 1:00 am, 0.2 ft; 1:18 pm, 0.3 ft

7:30 - 8:00 Breakfast
8:30 – 10:00 Lecture: Daily Diversity 12: Vertebrates 3 -- Mammals (Allmon)
10:15 – 12:15 Lab: Mammals (Allmon)
12:30 - 1:30 Lunch
1:45 – 2:45 Lecture: Evolution and development (Allmon) READING: Alberch (1986)
2:45 – 4:45 Project field time
4:45 – 5:45 Lecture: Life history evolution (Allmon)
6:00 - 7:00 Dinner
7:15 – 8:45 Lecture: Humanity as an evolutionary force (Allmon) READING: Steffen et al. (2007)

TBD:
● Trip to Duck Island to see seals
● Star Island trip

16. Friday July 12 — 2:06 am, 0.2 ft; 2:18 pm, 0.6 ft

7:30 - 8:00 Breakfast
8:15 - 12:30 Project: Writing workshop (group and individual feedback) (Allmon, Factor, Shin)
12:30 - 1:30 Lunch
1:45 - 5:45 Project/study time
6:00 - 7:00 Dinner
7:00 - Project/study time

17. Saturday July 13 — 3:07 am, 0.0 ft; 3:16 pm, 0.7 ft

7:30 - 8:00 Breakfast
8:15 Research Project paper due
8:15-12:30 Study/free time
12:30 - 1:30 Lunch
1:45 – 2:45 Course assessment (Shin)
2:45 - 6:00 Study/free time
6:00 - 7:00 Dinner
7:00 - 8:30 Study/free time
18. Sunday July 14 — 4:03 am, -0.1 ft; 4:08 pm, 0.8 ft

10:00 - 11:00 Brunch
11:00 - 12:00 Study time
12:00 - 3:30 Final Written Exam & Practical Exam
3:45 - 5:00 Lab cleanup
5:00 - 6:00 Dinner
6:00 final celebration

19. Monday July 15 — 4:53 am, -0.2 ft; 4:56 pm, 0.8 ft

7:30 - 8:00 Breakfast
9:45 - 10:30 Boat from Appledore to Portsmouth
“It is interesting to contemplate an entangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent on each other in so complex a manner, have all been produced by laws acting around us. These laws, taken in the largest sense, being Growth with Reproduction; Inheritance which is almost implied by reproduction; Variability from the indirect and direct action of the external conditions of life, and from use and disuse; a Ratio of Increase so high as to lead to a Struggle for Life, and as a consequence to Natural Selection, entailing Divergence of Character and the Extinction of less-improved forms. Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved.”


“The value of universities to a capitalist society depends on their ability to resist capitalism, to carve out space for intellectual endeavors that don’t have obvious metrics or market value. Consider that holy grail of learning outcomes, critical thinking — what the philosopher John Dewey called the ability “to maintain the state of doubt and to carry on systematic and protracted inquiry.” Teaching it is not a cheap or efficient process. It does not come from trying to educate the most students at the lowest possible cost or from emphasizing short, quantifiable, standardized assignments at the expense of meandering, creative and difficult investigation. Producing thoughtful, talented graduates is not a matter of focusing on market-ready skills. It’s about giving students an opportunity that most of them will never have again in their lives: the chance for serious exploration of complicated intellectual problems, the gift of time in an institution where curiosity and discovery are the source of meaning. That’s how we produce the critical thinkers American employers want to hire. And there’s just no app for that.”