



**BISC 543**  
**Evolution & Adaptation in Marine Organisms**

**Units: 2**

**Spring 2024**

**Draft version 11.14.23**

**Location:** AHF 259

**Meeting time:** Tuesdays 2-3:50pm

**Instructors:**

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**Website:** <https://blackboard.usc.edu>

**Course Description**

This course covers fundamentals of evolutionary patterns and processes, with particular emphasis on adaptation to environmental change. It is primarily intended for beginning students in the Marine and Environmental Biology (MEB) Graduate Program.

**Learning Objectives**

After completing this course students will be able to:

- Describe the major biotic and abiotic forces governing organismal distributions
- Explain the primary mechanisms driving evolution including mutation, natural selection, genetic drift, and migration
- Outline current views on the origin of life on Earth and explain the universal tree of life
- Describe how basic central metabolism functions in model prokaryotes
- Explain how adaptation to temperature and CO<sub>2</sub> changes impact organisms
- Communicate how biodiversity, biogeography, and ecological principles explain ecosystem functioning
- Critique the current literature through discussions and written presentations.

**Prerequisite(s):** none

**Co-Requisite(s):** none

**Concurrent Enrollment:** none

**Required Readings and Supplementary Materials:** Course will use eBooks available from the USC library including:

1. Losos, J.B., Baum, D.A., Futuyma, D.J., Hoekstra, H.E., Lenski, R.E., Moore, A.E., Peichel, C.L., Schluter, D. & Whitlock, W.C., eds. (2013). *The Princeton Guide to Evolution*, Princeton University Press, Princeton, NJ, USA.
2. Bertrand, J.C., Caumette, P., Lebaron, P., Matheron, R., Normand, P. & Sime-Ngando, T. (2015). *Environmental Microbiology: Fundamentals and Applications*. Springer Science + Business Media, Dordrecht.
3. Kirchman, D.L. (2018). *Microbial Ecology*, 2<sup>nd</sup> ed. Oxford University Press.
4. Seckbach, J. & Stan-Lotter, H. (2020). *Extremophiles as Astrobiological Models*, Scrivener Publishing.
5. Ehrlich, H.L., Newman, D.K. & Kappler, A., eds. (2015). *Geomicrobiology*, CRC Press, Boca Raton, FL, USA.
6. Haug, R.T. (2019). *Lessons in environmental microbiology*, CRC Press, Boca Raton, FL, USA.
7. Salwan, R. & Sharma, V. (2020). *Physiological and Biotechnological Aspects of Extremophiles*, Academic Press, Cambridge, MA, USA.
8. MacKenzie, A., Ball, A. & Virdee, S. (2001). *Ecology*, 2<sup>nd</sup> ed. Taylor & Francis, U.K.

Other readings as assigned will be available via Blackboard.

**Description and Assessment of Assignments:** Each week, a randomly selected student will lead the discussion of a primary research paper, and all students are expected to participate in the discussion. Depending on class size, each student is expected to lead at least two presentations/discussions. Students will also write reviews of two of the papers discussed in class – one from each half of the course. A detailed rubric for presentations and writing assignments will be provided on Blackboard.

**Exams:** There will be two midterms (90 min each). The latter exam will take place during the finals time, but it will not be cumulative. Exams will be completed in person and will not be open book. All content from lectures and papers will be allowable for the exams. However, we will not be asking highly detailed questions from the papers but will expect understanding of concepts and key findings.

**Grading Breakdown:**

Assignment	Points	% of Grade
Paper presentations/discussions	200	20
Manuscript review 1	150	15
Manuscript review 2	150	15
Midterm 1	200	20
Midterm 2	200	20
Participation	100	10
<b>TOTAL</b>	<b>1000</b>	<b>100</b>

Field Code Changed

**Assignment Submission Policy:** Writing assignments will be submitted to the instructors by e-mail (deadline = midnight). Maximum credit will be reduced by 10% for every day the assignment is late unless the student has obtained prior approval from the instructor.

**Course Schedule: A Weekly Breakdown (Rev 1 – subject to change)**

Date	Discussion Topic	Readings	Deliverable/ Due Dates
<b>I. Ecological &amp; Evolutionary Processes</b>			
Jan 9	Ecology	#8 <i>Ecology</i> Ch A (Intro), H (Pop Ecol), I (Competition) & J (Predation)	
Jan 16	Biogeography	#8 <i>Ecology</i> Ch B (Adaptation), C (Climate) & E (Temperature) Paper: Sunday et al. 2011. Global analysis of thermal tolerance and latitude in ectotherms, <i>Proc Roy Soc B</i> 278(1713):1823-1830	Student presentation
Jan 23	Evolution I	#1 <i>Princeton Guide to Evolution</i> 1.1-1.4 Paper: Wang et al. 2015. Hypoxia causes transgenerational impairments in reproduction of fish. <i>Nature Comm</i> 7:12114	Student presentation
Jan 30	Evolution II	#1 <i>Princeton Guide to Evolution</i> 3.1-3.3 Paper: Faria et al 2019. Multiple chromosomal rearrangements in a hybrid zone between <i>Littorina saxatilis</i> ecotypes. <i>Molec Ecol</i> 28: 1375-1393.	Student presentation
Feb 6	Adaptation	#1 <i>Princeton Guide to Evolution</i> 3.13-3.15 Paper: Vianna et al. 2020. Genome-wide analyses reveal drivers of penguin diversification. <i>PNAS</i> 117(36):22303	Student presentation
Feb 13	Population Genetics I	#1 <i>Princeton Guide to Evolution</i> 4.0-4.4 Paper: Kuntz et al., 2022. Inheritance of somatic mutations by animal offspring. <i>Sci Adv</i> 8, eabn0707	Student presentation,
Feb 20	Population Genetics II	#1 <i>Princeton Guide to Evolution</i> 5.12-5.14 Paper: Kolora et al 2021. Origins and evolution of extreme life span in Pacific Ocean rockfishes. <i>Science</i> 374, 842-847.	Student presentation, <b>Review 1 due at midnight</b>
Feb 27	<b>Midterm 1</b>	Edmands portion of the class	
<b>II. Ecological &amp; Evolutionary Patterns</b>			
Mar 5	Origin life I	#5 Ehrlich Ch 2 and 3, #2 Bertrand Ch 4 Paper: Martin, W., J. et al. 2008. Hydrothermal vents and the origin of life. <i>Nat. Rev. Microbiol.</i> 6: 805–814. doi:10.1038/nrmicro1991	Student presentation
Mar 12	<b>Spring Break, no class</b>		
Mar 19	Tree of life I	#3 Kirchman Ch 1, 4 & 5, #2 Bertrand Ch5 Paper: Hug, L. A. et al. 2016. A new view of the tree of life. <i>Nat. Microbiol.</i> 1: 1–6. doi:10.1038/nmicrobiol.2016.48	Student presentation
Mar 26	Tree of life II	#4 Seckbach and Stan-Lotter Ch17 Paper: Parks, D. H., et al. 2017. Recovery of nearly 8,000 metagenome-assembled genomes substantially expands the tree of life. <i>Nat. Microbiol.</i> 2: 1533–1542. doi:10.1038/s41564-017-0012-7	Student presentation

<b>Apr 2</b>	Biomolecules - nucleic acids, proteins, carbohydrates, and lipids	#3 Kirchman Ch 2 Paper: Dworkin, J. 2023. Understanding the Stringent Response: Experimental Context Matters. mBio 14: e03404-22. doi:10.1128/mbio.03404-22	Student presentation
<b>Apr 9</b>	Metabolism and ATP production	#3 Kirchman Ch 8, #6 Haug Ch 4 Paper: Chen, J., and M. Strous. 2013. Denitrification and aerobic respiration, hybrid electron transport chains and co-evolution. Biochim. Biophys. Acta BBA - Bioenerg. 1827: 136–144. doi:10.1016/j.bbabi.2012.10.002	Student presentation
<b>Apr 16</b>	Symbiosis	#3 Kirchman Ch 14 Paper: Wein, T. et al. 2019. Currency, Exchange, and Inheritance in the Evolution of Symbiosis. Trends Microbiol. 27: 836–849. doi:10.1016/j.tim.2019.05.010	Student presentation,
<b>Apr 23</b>	Temperature, CO <sub>2</sub> and Adaptation	#3 Kirchman Ch 3, #7 Salwan Ch 2 and # 6 Haug Ch 5 Paper: Heinze, C., et al. 2021. The quiet crossing of ocean tipping points. Proc. Natl. Acad. Sci. 118: e2008478118. doi:10.1073/pnas.2008478118	Student presentation, <b>Review 2 due at midnight</b>
<b>Thurs May 2, 2-4pm</b>	<b>Midterm 2</b>	<u>Not</u> Cumulative – only on the Webb portion of the class	

### Statement on Academic Conduct and Support Systems

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one’s own academic work from misuse by others as well as to avoid using another’s work as one’s own.

#### Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, “Behavior Violating University Standards” [policy.usc.edu/scampus-part-b](http://policy.usc.edu/scampus-part-b). Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

#### Support Systems:

*Student Counseling Services (SCS)* – (213) 740-7711 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. [engemannshc.usc.edu/counseling](http://engemannshc.usc.edu/counseling)

*National Suicide Prevention Lifeline* – 1 (800) 273-8255

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. [www.suicidepreventionlifeline.org](http://www.suicidepreventionlifeline.org)

*Relationship and Sexual Violence Prevention Services (RSVP)* – (213) 740-4900 – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender-based harm. [engemannshc.usc.edu/rsvp](http://engemannshc.usc.edu/rsvp)

*Sexual Assault Resource Center*

For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: [sarc.usc.edu](http://sarc.usc.edu)

*Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086*

Works with faculty, staff, visitors, applicants, and students around issues of protected class. [equity.usc.edu](http://equity.usc.edu)

*Bias Assessment Response and Support*

Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. [studentaffairs.usc.edu/bias-assessment-response-support](http://studentaffairs.usc.edu/bias-assessment-response-support)

*The Office of Disability Services and Programs*

Provides certification for students with disabilities and helps arrange relevant accommodations. [dsp.usc.edu](http://dsp.usc.edu)

*Student Support and Advocacy – (213) 821-4710*

Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. [studentaffairs.usc.edu/ss](http://studentaffairs.usc.edu/ss)

*Diversity at USC*

Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. [diversity.usc.edu](http://diversity.usc.edu)

*USC Emergency Information*

Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible. [emergency.usc.edu](http://emergency.usc.edu)

*USC Department of Public Safety – UPC: (213) 740-4321 – HSC: (323) 442-1000 – 24-hour emergency or to report a crime.*

Provides overall safety to USC community. [dps.usc.edu](http://dps.usc.edu)

*Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)*

[ombuds.usc.edu](http://ombuds.usc.edu)

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.